Junos® OS

BGP Feature Guide

Modified: 2019-06-27

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- Using the Examples in This Manual on page xxvii
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Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at https://www.juniper.net/documentation/.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at https://www.juniper.net/books.

Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

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Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   system {
     scripts {
       commit {
         file ex-script.xsl;
       }
     }
   }
   interfaces {
     fxp0 {
       disable;
       unit 0 {
         family inet {
           address 10.0.0.1/24;
         }
       }
     }
   }
   ```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

   ```
   [edit]
   user@host# load merge /var/tmp/ex-script.conf
   load complete
   ```

Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   commit {
     file ex-script-snippet.xsl; }
   ```


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2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see CLI Explorer.

Documentation Conventions

Table 1 on page xxix defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.
	Tip	Indicates helpful information.
	Best practice	Alerts you to a recommended use or implementation.

Table 2 on page xxx defines the text and syntax conventions used in this guide.

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Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the **configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`
Italic text like this	• Introduces or emphasizes important new terms. • Identifies guide names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS CLI User Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: [edit] root@# **set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Encloses optional keywords or variables.	**stub <default-metric** *metric***>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(***string1* **|** *string2* **|** *string3***)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Encloses a variable for which you can substitute one or more values.	**community name members [** *community-ids* **]**

Indention and braces ({ })	Identifies a level in the configuration hierarchy.	[edit]
		routing-options {
		  static {
		  route default {
		  nexthop *address*;
		  retain;
		  }
		  }
		}

; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	

GUI Conventions

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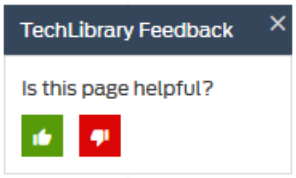
Table 2: Text and Syntax Conventions (continued)

Convention	Description	Examples
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

We encourage you to provide feedback so that we can improve our documentation. You can use either of the following methods:

- Online feedback system—Click TechLibrary Feedback, on the lower right of any page on the Juniper Networks TechLibrary site, and do one of the following:



  - Click the thumbs-up icon if the information on the page was helpful to you.
  - Click the thumbs-down icon if the information on the page was not helpful to you or if you have suggestions for improvement, and use the pop-up form to provide feedback.

- E-mail—Send your comments to **techpubs-comments@juniper.net**. Include the document or topic name, URL or page number, and software version (if applicable).

Requesting Technical Support

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- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at https://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf.
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Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: https://www.juniper.net/customers/support/
- Search for known bugs: https://prsearch.juniper.net/
- Find product documentation: https://www.juniper.net/documentation/
- Find solutions and answer questions using our Knowledge Base: https://kb.juniper.net/
- Download the latest versions of software and review release notes: https://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://kb.juniper.net/InfoCenter/
- Join and participate in the Juniper Networks Community Forum: https://www.juniper.net/company/communities/
- Create a service request online: https://myjuniper.juniper.net

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: https://entitlementsearch.juniper.net/entitlementsearch/

Creating a Service Request with JTAC

You can create a service request with JTAC on the Web or by telephone.

- Visit https://myjuniper.juniper.net.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see https://support.juniper.net/support/requesting-support/.

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PART 1

Overview

- Introduction to BGP on page 3

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CHAPTER 1

Introduction to BGP

- Understanding BGP on page 4
- Supported Standards for BGP on page 6
- BGP Routes Overview on page 9
- BGP Route Resolution Overview on page 10
- BGP Messages Overview on page 11
- BGP Configuration Overview on page 13
- Understanding BGP Path Selection on page 14

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Understanding BGP

BGP is an exterior gateway protocol (EGP) that is used to exchange routing information among routers in different autonomous systems (ASs). BGP routing information includes the complete route to each destination. BGP uses the routing information to maintain a database of network reachability information, which it exchanges with other BGP systems. BGP uses the network reachability information to construct a graph of AS connectivity, which enables BGP to remove routing loops and enforce policy decisions at the AS level.

Multiprotocol BGP (MBGP) extensions enable BGP to support IP version 6 (IPv6). MBGP defines the attributes MP_REACH_NLRI and MP_UNREACH_NLRI, which are used to carry IPv6 reachability information. Network layer reachability information (NLRI) update messages carry IPv6 address prefixes of feasible routes.

BGP allows for policy-based routing. You can use routing policies to choose among multiple paths to a destination and to control the redistribution of routing information.

BGP uses TCP as its transport protocol, using port 179 for establishing connections. Running over a reliable transport protocol eliminates the need for BGP to implement update fragmentation, retransmission, acknowledgment, and sequencing.

The Junos OS routing protocol software supports BGP version 4. This version of BGP adds support for Classless Interdomain Routing (CIDR), which eliminates the concept of network classes. Instead of assuming which bits of an address represent the network by looking at the first octet, CIDR allows you to explicitly specify the number of bits in the network address, thus providing a means to decrease the size of the routing tables. BGP version 4 also supports aggregation of routes, including the aggregation of AS paths.

This section discusses the following topics:

- Autonomous Systems on page 4
- AS Paths and Attributes on page 4
- External and Internal BGP on page 5
- Multiple Instances of BGP on page 5

Autonomous Systems

An *autonomous system* (AS) is a set of routers that are under a single technical administration and normally use a single interior gateway protocol and a common set of metrics to propagate routing information within the set of routers. To other ASs, an AS appears to have a single, coherent interior routing plan and presents a consistent picture of what destinations are reachable through it.

AS Paths and Attributes

The routing information that BGP systems exchange includes the complete route to each destination, as well as additional information about the route. The route to each destination is called the *AS path*, and the additional route information is included in *path attributes*. BGP uses the AS path and the path attributes to completely determine the network topology. Once BGP understands the topology, it can detect and eliminate

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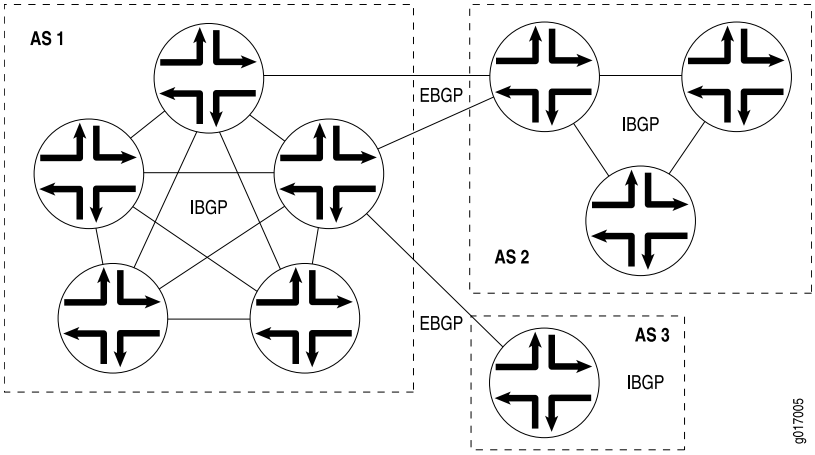
routing loops and select among groups of routes to enforce administrative preferences and routing policy decisions.

External and Internal BGP

BGP supports two types of exchanges of routing information: exchanges among different ASs and exchanges within a single AS. When used among ASs, BGP is called *external BGP* (EBGP) and BGP sessions perform *inter-AS routing*. When used within an AS, BGP is called *internal BGP* (IBGP) and BGP sessions perform *intra-AS routing*. Figure 1 on page 5 illustrates ASs, IBGP, and EBGP.

Figure 1: ASs, EBGP, and IBGP



A BGP system shares network reachability information with adjacent BGP systems, which are referred to as *neighbors* or *peers*.

BGP systems are arranged into *groups*. In an IBGP group, all peers in the group—called *internal peers*—are in the same AS. Internal peers can be anywhere in the local AS and do not have to be directly connected to one another. Internal groups use routes from an IGP to resolve forwarding addresses. They also propagate external routes among all other internal routers running IBGP, computing the next hop by taking the BGP next hop received with the route and resolving it using information from one of the interior gateway protocols.

In an EBGP group, the peers in the group—called *external peers*—are in different ASs and normally share a subnet. In an external group, the next hop is computed with respect to the interface that is shared between the external peer and the local router.

Multiple Instances of BGP

You can configure multiple instances of BGP at the following hierarchy levels:

- **[edit routing-instances *routing-instance-name* protocols]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols]**

Multiple instances of BGP are primarily used for Layer 3 VPN support.

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IGP peers and external BGP (EBGP) peers (both nonmultihop and multihop) are all supported for routing instances. BGP peering is established over one of the interfaces configured under the **routing-instances** hierarchy.

NOTE: When a BGP neighbor sends BGP messages to the local routing device, the incoming interface on which these messages are received must be configured in the same routing instance that the BGP neighbor configuration exists in. This is true for neighbors that are a single hop away or multiple hops away.

Routes learned from the BGP peer are added to the **instance-name.inet.0** table by default. You can configure import and export policies to control the flow of information into and out of the instance routing table.

For Layer 3 VPN support, configure BGP on the provider edge (PE) router to receive routes from the customer edge (CE) router and to send the instances' routes to the CE router if necessary. You can use multiple instances of BGP to maintain separate per-site forwarding tables for keeping VPN traffic separate on the PE router.

You can configure import and export policies that allow the service provider to control and rate-limit traffic to and from the customer.

You can configure an EBGP multihop session for a VRF routing instance. Also, you can set up the EBGP peer between the PE and CE routers by using the loopback address of the CE router instead of the interface addresses.

Related Documentation

- BGP Routes Overview on page 9
- BGP Messages Overview on page 11

Supported Standards for BGP

Junos OS substantially supports the following RFCs and Internet drafts, which define standards for IP version 4 (IPv4) BGP.

For a list of supported IP version 6 (IPv6) BGP standards, see *Supported IPv6 Standards*.

Junos OS BGP supports authentication for protocol exchanges (MD5 authentication).

- RFC 1745, *BGP4/IDRP for IP—OSPF Interaction*
- RFC 1772, *Application of the Border Gateway Protocol in the Internet*
- RFC 1997, *BGP Communities Attribute*
- RFC 2283, *Multiprotocol Extensions for BGP-4*
- RFC 2385, *Protection of BGP Sessions via the TCP MD5 Signature Option*
- RFC 2439, *BGP Route Flap Damping*
- RFC 2545, *Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing*

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- RFC 2796, *BGP Route Reflection – An Alternative to Full Mesh IBGP*
- RFC 2858, *Multiprotocol Extensions for BGP-4*
- RFC 2918, *Route Refresh Capability for BGP-4*
- RFC 3065, *Autonomous System Confederations for BGP*
- RFC 3107, *Carrying Label Information in BGP-4*
- RFC 3345, *Border Gateway Protocol (BGP) Persistent Route Oscillation Condition*
- RFC 3392, *Capabilities Advertisement with BGP-4*
- RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*
- RFC 4273, *Definitions of Managed Objects for BGP-4*
- RFC 4360, *BGP Extended Communities Attribute*
- RFC 4364, *BGP/MPLS IP Virtual Private Networks (VPNs)*
- RFC 4456, *BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP)*
- RFC 4486, *Subcodes for BGP Cease Notification Message*
- RFC 4659, *BGP-MPLS IP Virtual Private Network (VPN) Extension for IPv6 VPN*
- RFC 4632, *Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan*
- RFC 4684, *Constrained Route Distribution for Border Gateway Protocol/MultiProtocol Label Switching (BGP/MPLS) Internet Protocol (IP) Virtual Private Networks (VPNs)*
- RFC 4724, *Graceful Restart Mechanism for BGP*
- RFC 4760, *Multiprotocol Extensions for BGP-4*
- RFC 4781, *Graceful Restart Mechanism for BGP with MPLS*
- RFC 4798, *Connecting IPv6 Islands over IPv4 MPLS Using IPv6 Provider Edge Routers (6PE)*

  Option 4b (eBGP redistribution of labeled IPv6 routes from AS to neighboring AS) is not supported.
- RFC 4893, *BGP Support for Four-octet AS Number Space*
- RFC 5004, *Avoid BGP Best Path Transitions from One External to Another*
- RFC 5065, *Autonomous System Confederations for BGP*
- RFC 5082, *The Generalized TTL Security Mechanism (GTSM)*
- RFC 5291, *Outbound Route Filtering Capability for BGP-4 (partial support)*
- RFC 5292, *Address-Prefix-Based Outbound Route Filter for BGP-4 (partial support)*

  Devices running Junos OS can receive prefix-based ORF messages.
- RFC 5396, *Textual Representation of Autonomous System (AS) Numbers*
- RFC 5492, *Capabilities Advertisement with BGP-4*

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- RFC 5512, *The BGP Encapsulation Subsequent Address Family Identifier (SAFI) and the BGP Tunnel Encapsulation Attribute*
- RFC 5549, *Advertising IPv4 Network Layer Reachability Information with an IPv6 Next Hop*
- RFC 5575, *Dissemination of flow specification rules*
- RFC 5668, *4-Octet AS Specific BGP Extended Community*
- RFC 6368, *Internal BGP as the Provider/Customer Edge Protocol for BGP/MPLS IP Virtual Private Networks (VPNs)*
- RFC 6810, *The Resource Public Key Infrastructure (RPKI) to Router Protocol*
- RFC 6811, *BGP Prefix Origin Validation*
- RFC 6996, *Autonomous System (AS) Reservation for Private Use*
- RFC 7300, *Reservation of Last Autonomous System (AS) Numbers*
- RFC 7752, *North-Bound Distribution of Link-State and Traffic Engineering (TE) Information Using BGP*
- RFC 7854, *BGP Monitoring Protocol (BMP)*
- RFC 7911, *Advertisement of Multiple Paths in BGP*
- RFC 8326, *Graceful BGP session Shutdown*
- Internet draft draft-idr-rfc8203bis-00, *BGP Administrative Shutdown Communication* (expires October 2018)
- Internet draft draft-ietf-grow-bmp-adj-rib-out-01, *Support for Adj-RIB-Out in BGP Monitoring Protocol (BMP)* (expires September 3, 2018)
- Internet draft draft-ietf-idr-aigp-06, *The Accumulated IGP Metric Attribute for BGP* (expires December 2011)
- Internet draft draft-ietf-idr-as0-06, *Codification of AS 0 processing* (expires February 2013)
- Internet draft draft-ietf-idr-link-bandwidth-06.txt, *BGP Link Bandwidth Extended Community* (expires July 2013)
- Internet draft draft-ietf-sidr-origin-validation-signaling-00, *BGP Prefix Origin Validation State Extended Community (partial support)* (expires May 2011)

  The extended community (origin validation state) is supported in Junos OS routing policy. The specified change in the route selection procedure is not supported.
- Internet draft draft-kato-bgp-ipv6-link-local-00.txt, *BGP4+ Peering Using IPv6 Link-local Address*

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The following RFCs and Internet draft do not define standards, but provide information about BGP and related technologies. The IETF classifies them variously as "Experimental" or "Informational."

- RFC 1965, *Autonomous System Confederations for BGP*
- RFC 1966, *BGP Route Reflection—An alternative to full mesh IBGP*
- RFC 2270, *Using a Dedicated AS for Sites Homed to a Single Provider*
- Internet draft draft-ietf-ngtrans-bgp-tunnel-04.txt, *Connecting IPv6 Islands across IPv4 Clouds with BGP* (expires July 2002)

Related Documentation

- *Supported IPv6 Standards*
- *Accessing Standards Documents on the Internet*

BGP Routes Overview

A BGP route is a destination, described as an IP address prefix, and information that describes the path to the destination.

The following information describes the path:

- AS path, which is a list of numbers of the ASs that a route passes through to reach the local router. The first number in the path is that of the last AS in the path—the AS closest to the local router. The last number in the path is the AS farthest from the local router, which is generally the origin of the path.
- Path attributes, which contain additional information about the AS path that is used in routing policy.

BGP peers advertise routes to each other in update messages.

BGP stores its routes in the Junos OS routing table (**inet.0**). The routing table stores the following information about BGP routes:

- Routing information learned from update messages received from peers
- Local routing information that BGP applies to routes because of local policies
- Information that BGP advertises to BGP peers in update messages

For each prefix in the routing table, the routing protocol process selects a single best path, called the active path. Unless you configure BGP to advertise multiple paths to the same destination, BGP advertises only the active path.

The BGP router that first advertises a route assigns it one of the following values to identify its origin. During route selection, the lowest origin value is preferred.

- **0**—The router originally learned the route through an IGP (OSPF, IS-IS, or a static route).
- **1**—The router originally learned the route through an EGP (most likely BGP).

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- **2**—The route's origin is unknown.

Related Documentation

- Understanding BGP Path Selection on page 14
- Example: Advertising Multiple Paths in BGP on page 470

BGP Route Resolution Overview

An internal BGP (IBGP) route with a next-hop address to a remote BGP neighbor (protocol next hop) must have its next hop resolved using some other route. BGP adds this route to the rpd resolver module for next-hop resolution. If RSVP is used in the network, then the BGP next hop is resolved using the RSVP ingress route. This results in the BGP route pointing to an indirect next hop, and the indirect next hop pointing to a forwarding next hop. The forwarding next hop is derived from the RSVP route next hop. There is often a large set of internal BGP routes that have the same protocol next hop, and in such cases, the set of BGP routes would reference the same indirect next hop.

Prior to Junos OS Release 17.2R1, the resolver module of the routing protocol process (rpd) resolved routes within the IBGP received routes in the following ways:

1. Partial route resolution—The protocol next hop is resolved based on helper routes, such as RSVP or IGP routes. The metric values are derived from the helper routes, and the next hop is referred to as the resolver forwarding next hop inherited from helper routes. These metric values are used for selecting routes in the routing information base (RIB), also known as the routing table.

2. Complete route resolution—The final next hop is derived and is referred to as the kernel routing table (KRT) forwarding next hop based on the forwarding export policy.

Starting in Junos OS Release 17.2R1, the resolver module of rpd is optimized to increase the throughput of inbound processing flow, accelerating the learning rate of RIB and FIB. With this enhancement, the route resolution is affected as follows:

- The partial and complete route resolution methods are triggered for each IBGP route, although each route might inherit the same resolved forwarding next hop or KRT forwarding next hops.
- The BGP path selection is deferred until complete route resolution is performed for network layer reachability information (NLRI) received from a BGP neighbor, which might not be the best route in the RIB after route selection.

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The benefits of the rpd resolver optimization include:

- Lower RIB resolution lookup cost—The output of the resolved path is saved in a resolver cache, so that the same derived next hop and metric values can be inherited to another set of routes sharing the same path behavior instead of performing both partial and complete route resolution flow. This reduces the route resolution lookup cost by maintaining only the most frequent resolver state in a cache with limited depth.
- BGP route selection optimization—The BGP route selection algorithm is triggered twice for every IBGP route received—first, while adding the route in the RIB with the next hop as unusable, and second, while adding the route with a resolved next hop in the RIB (after route resolution). This results in selecting the best route twice. With the resolver optimization, the route selection process is triggered in the receive flow only after getting the next-hop information from the resolver module.
- Internal caching to avoid frequent lookup—The resolver cache maintains the most frequent resolver state, and as a result, the lookup functionality, such as next-hop lookup and route lookup is done from the local cache.
- Path equivalence group—When different paths share the same forwarding state, or are received from the same protocol next hop, the paths can belong to one path equivalence group. This approach avoids the need to perform of complete route resolution for such paths. When a new path requires complete route resolution, it is first looked up in the path equivalence group database, which contains the resolved path output, such as indirect next hop and forwarding next hop.

Release History Table

Release	Description
17.2R1	Starting in Junos OS Release 17.2R1, the resolver module of rpd is optimized to increase the throughput of inbound processing flow, accelerating the learning rate of RIB and FIB.

Related Documentation

- BGP Routes Overview on page 9
- Examine BGP Routes on page 983
- Examine BGP Routes and Route Selection on page 1013

BGP Messages Overview

All BGP messages have the same fixed-size header, which contains a marker field that is used for both synchronization and authentication, a length field that indicates the length of the packet, and a type field that indicates the message type (for example, open, update, notification, keepalive, and so on).

This section discusses the following topics:

- Open Messages on page 12
- Update Messages on page 12

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- Keepalive Messages on page 13
- Notification Messages on page 13
- Route-Refresh Messages on page 13

Open Messages

After a TCP connection is established between two BGP systems, they exchange BGP open messages to create a BGP connection between them. Once the connection is established, the two systems can exchange BGP messages and data traffic.

Open messages consist of the BGP header plus the following fields:

- Version—The current BGP version number is 4.
- Local AS number—You configure this by including the **autonomous-system** statement at the **[edit routing-options]** or **[edit logical-systems *logical-system-name* routing-options]** hierarchy level.
- Hold time—Proposed hold-time value. You configure the local hold time with the BGP **hold-time** statement.
- BGP identifier—IP address of the BGP system. This address is determined when the system starts and is the same for every local interface and every BGP peer. You can configure the BGP identifier by including the **router-id** statement at the **[edit routing-options]** or **[edit logical-systems *logical-system-name* routing-options]** hierarchy level. By default, BGP uses the IP address of the first interface it finds in the router.
- Parameter field length and the parameter itself—These are optional fields.

Update Messages

BGP systems send update messages to exchange network reachability information. BGP systems use this information to construct a graph that describes the relationships among all known ASs.

Update messages consist of the BGP header plus the following optional fields:

- Unfeasible routes length—Length of the withdrawn routes field
- Withdrawn routes—IP address prefixes for the routes being withdrawn from service because they are no longer deemed reachable
- Total path attribute length—Length of the path attributes field; it lists the path attributes for a feasible route to a destination
- Path attributes—Properties of the routes, including the path origin, the multiple exit discriminator (MED), the originating system's preference for the route, and information about aggregation, communities, confederations, and route reflection
- Network layer reachability information (NLRI)—IP address prefixes of feasible routes being advertised in the update message

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Keepalive Messages

BGP systems exchange keepalive messages to determine whether a link or host has failed or is no longer available. Keepalive messages are exchanged often enough so that the hold timer does not expire. These messages consist only of the BGP header.

Notification Messages

BGP systems send notification messages when an error condition is detected. After the message is sent, the BGP session and the TCP connection between the BGP systems are closed. Notification messages consist of the BGP header plus the error code and subcode, and data that describes the error.

Route-Refresh Messages

BGP systems send route-refresh messages to a peer only if they have received the route refresh capability advertisement from the peer. A BGP system must advertise the route refresh capability to its peers using BGP capabilities advertisement if it wants to receive route-refresh messages. This optional message is sent to request dynamic, inbound, BGP route updates from BGP peers or to send outbound route updates to a BGP peer.

Route-refresh messages consist of the following fields:

- AFI—Address Family Identifier (16-bit).
- Res—Reserved (8-bit) field, which must be set to 0 by the sender and ignored by the receiver.
- SAFI—Subsequent Address Family Identifier (8-bit).

If a peer without the route-refresh capability receives a route-refresh request message from a remote peer, the receiver ignores the message.

Related Documentation

- Understanding BGP on page 4
- BGP Routes Overview on page 9

BGP Configuration Overview

To configure the device as a node in a BGP network:

1. Configure network interfaces. See the *Junos OS Interfaces Configuration Guide for Security Devices*.
2. Configure point-to-point peering sessions. See "Example: Configuring External BGP Point-to-Point Peer Sessions" on page 24.
3. Configure IBGP sessions between peers. See "Example: Configuring Internal BGP Peer Sessions" on page 51.

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4. Configure a routing policy to advertise the BGP routes.

5. (Optional) Configure route reflector clusters. See "Example: Configuring a Route Reflector" on page 732.

6. (Optional) Subdivide autonomous systems (ASs). See "Example: Configuring BGP Confederations" on page 755.

7. (Optional) Assign a router ID to each routing device running BGP.

8. (Optional) Configure a local preference to direct all outbound AS traffic to a specific peer. See "Example: Configuring the Local Preference Value for BGP Routes" on page 220 in the *Junos OS Routing Protocols Library*.

9. (Optional) Configure routing table path selection options that define different ways to compare multiple exit discriminators (MEDs). See "Understanding BGP Path Selection" on page 14 in the *Junos OS Routing Protocols Library*.

Related Documentation

- Understanding BGP on page 4

Understanding BGP Path Selection

For each prefix in the routing table, the routing protocol process selects a single best path. After the best path is selected, the route is installed in the routing table. The best path becomes the active route if the same prefix is not learned by a protocol with a lower (more preferred) global preference value, also known as the administrative distance. The algorithm for determining the active route is as follows:

1. Verify that the next hop can be resolved.

2. Choose the path with the lowest preference value (routing protocol process preference).

   Routes that are not eligible to be used for forwarding (for example, because they were rejected by routing policy or because a next hop is inaccessible) have a preference of –1 and are never chosen.

3. Prefer the path with higher local preference.

   For non-BGP paths, choose the path with the lowest **preference2** value.

4. If the accumulated interior gateway protocol (AIGP) attribute is enabled, prefer the path with the lower AIGP attribute.

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5. Prefer the path with the shortest autonomous system (AS) path value (skipped if the **as-path-ignore** statement is configured).

   A confederation segment (sequence or set) has a path length of 0. An AS set has a path length of 1.

6. Prefer the route with the lower origin code.

   Routes learned from an IGP have a lower origin code than those learned from an exterior gateway protocol (EGP), and both have lower origin codes than incomplete routes (routes whose origin is unknown).

7. Prefer the path with the lowest multiple exit discriminator (MED) metric.

   Depending on whether nondeterministic routing table path selection behavior is configured, there are two possible cases:

   - If nondeterministic routing table path selection behavior is not configured (that is, if the **path-selection cisco-nondeterministic** statement is not included in the BGP configuration), for paths with the same neighboring AS numbers at the front of the AS path, prefer the path with the lowest MED metric. To always compare MEDs whether or not the peer ASs of the compared routes are the same, include the **path-selection always-compare-med** statement.
   - If nondeterministic routing table path selection behavior is configured (that is, the **path-selection cisco-nondeterministic** statement is included in the BGP configuration), prefer the path with the lowest MED metric.

   Confederations are not considered when determining neighboring ASs. A missing MED metric is treated as if a MED were present but zero.

   NOTE: MED comparison works for single path selection within an AS (when the route does not include an AS path), though this usage Is uncommon.

   By default, only the MEDs of routes that have the same peer autonomous systems (ASs) are compared. You can configure routing table path selection options to obtain different behaviors.

8. Prefer strictly internal paths, which include IGP routes and locally generated routes (static, direct, local, and so forth).

9. Prefer strictly external BGP (EBGP) paths over external paths learned through internal BGP (IBGP) sessions.

10. Prefer the path whose next hop is resolved through the IGP route with the lowest metric.

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NOTE: A path is considered a BGP equal-cost path (and will be used for forwarding) if a tie-break is performed after the previous step. All paths with the same neighboring AS, learned by a multipath-enabled BGP neighbor, are considered.

BGP multipath does not apply to paths that share the same MED-plus-IGP cost yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

BGP compares the type of IGP metric before comparing the metric value itself in **rt_metric2_cmp**. For example, BGP routes that are resolved through IGP are preferred over discarded or rejected next-hops that are of type **RTM_TYPE_UNREACH**. Such routes are declared **inactive** because of their **metric-type**.

11. If both paths are external, prefer the currently active path to minimize route-flapping. This rule is not used if any one of the following conditions is true:
    - **path-selection external-router-id** is configured.
    - Both peers have the same router ID.
    - Either peer is a confederation peer.
    - Neither path is the current active path.
12. Prefer a primary route over a secondary route. A primary route is one that belongs to the routing table. A secondary route is one that is added to the routing table through an export policy.
13. Prefer the path from the peer with the lowest router ID. For any path with an originator ID attribute, substitute the originator ID for the router ID during router ID comparison.
14. Prefer the path with the shortest cluster list length. The length is 0 for no list.
15. Prefer the path from the peer with the lowest peer IP address.

Routing Table Path Selection

The shortest AS path step of the algorithm, by default, evaluates the length of the AS path and determines the active path. You can configure an option that enables Junos OS to skip this step of the algorithm by including the **as-path-ignore** option.

NOTE: Starting with Junos OS Release 14.1R8, 14.2R7, 15.1R4, 15.1F6, and 16.1R1, the **as-path-ignore** option is supported for routing instances.

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The routing process path selection takes place before BGP hands off the path to the routing table to makes its decision. To configure routing table path selection behavior, include the **path-selection** statement:

```
path-selection {
  (always-compare-med | cisco-non-deterministic | external-router-id);
  as-path-ignore;
  med-plus-igp {
    igp-multiplier number;
    med-multiplier number;
  }
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Routing table path selection can be configured in one of the following ways:

- Emulate the Cisco IOS default behavior (**cisco-non-deterministic**). This mode evaluates routes in the order that they are received and does not group them according to their neighboring AS. With **cisco-non-deterministic** mode, the active path is always first. All inactive, but eligible, paths follow the active path and are maintained in the order in which they were received, with the most recent path first. Ineligible paths remain at the end of the list.

  As an example, suppose you have three path advertisements for the 192.168.1.0 /24 route:

  - Path 1—learned through EBGP; AS Path of 65010; MED of 200
  - Path 2—learned through IBGP; AS Path of 65020; MED of 150; IGP cost of 5
  - Path 3—learned through IBGP; AS Path of 65010; MED of 100; IGP cost of 10

  These advertisements are received in quick succession, within a second, in the order listed. Path 3 is received most recently, so the routing device compares it against path 2, the next most recent advertisement. The cost to the IBGP peer is better for path 2, so the routing device eliminates path 3 from contention. When comparing paths 1 and 2, the routing device prefers path 1 because it is received from an EBGP peer. This allows the routing device to install path 1 as the active path for the route.

  NOTE: We do not recommend using this configuration option in your network. It is provided solely for interoperability to allow all routing devices in the network to make consistent route selections.

- Always comparing MEDs whether or not the peer ASs of the compared routes are the same (**always-compare-med**).
- Override the rule that If both paths are external, the currently active path is preferred (**external-router-id**). Continue with the next step (Step 12) in the path-selection process.

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- Adding the IGP cost to the next-hop destination to the MED value before comparing MED values for path selection (**med-plus-igp**).

  BGP multipath does not apply to paths that share the same MED-plus-IGP cost, yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

BGP Table path selection

The following parameters are followed for BGP's path selection:

1. Prefer the highest local-preference value.
2. Prefer the shortest AS-path length.
3. Prefer the lowest origin value.
4. Prefer the lowest MED value.
5. Prefer routes learned from an EBGP peer over an IBGP peer.
6. Prefer best exit from AS.
7. For EBGP-received routes, prefer the current active route.
8. Prefer routes from the peer with the lowest Router ID.
9. Prefer paths with the shortest cluster length.
10. Prefer routes from the peer with the lowest peer IP address. Steps 2, 6 and 12 are the RPD criteria.

Effects of Advertising Multiple Paths to a Destination

BGP advertises only the active path, unless you configure BGP to advertise multiple paths to a destination.

Suppose a routing device has in its routing table four paths to a destination and is configured to advertise up to three paths (**add-path send path-count 3**). The three paths are chosen based on path selection criteria. That is, the three best paths are chosen in path-selection order. The best path is the active path. This path is removed from consideration and a new best path is chosen. This process is repeated until the specified number of paths is reached.

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Release History Table

Release	Description
14.1R8	Starting with Junos OS Release 14.1R8, 14.2R7, 15.1R4, 15.1F6, and 16.1R1, the **as-path-ignore** option is supported for routing instances.

Related Documentation

- Example: Ignoring the AS Path Attribute When Selecting the Best Path on page 180
- *Examples: Configuring BGP MED*
- *Example: Advertising Multiple BGP Paths to a Destination*

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PART 2

Configuring a Basic BGP Peering Session

- Configuring External BGP Peering on page 23
- Configuring Internal BGP Peering on page 49

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CHAPTER 2

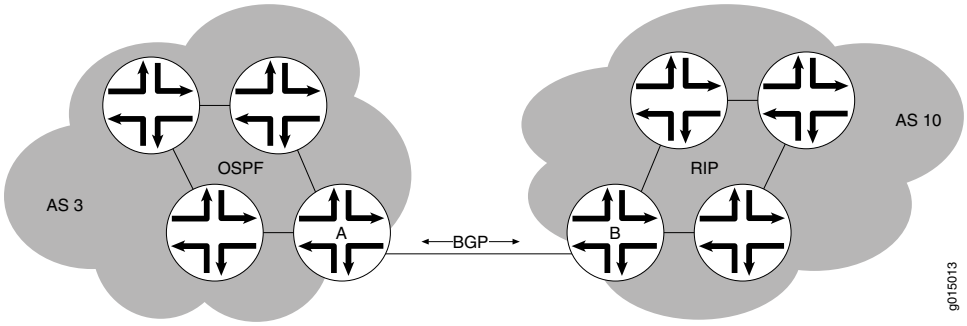
Configuring External BGP Peering

- Understanding External BGP Peering Sessions on page 23
- Example: Configuring External BGP Point-to-Point Peer Sessions on page 24
- Example: Configuring External BGP on Logical Systems with IPv6 Interfaces on page 31

Understanding External BGP Peering Sessions

To establish point-to-point connections between peer autonomous systems (ASs), you configure a BGP session on each interface of a point-to-point link. Generally, such sessions are made at network exit points with neighboring hosts outside the AS. Figure 2 on page 23 shows an example of a BGP peering session.

Figure 2: BGP Peering Session



In Figure 2 on page 23, Router A is a gateway router for AS 3, and Router B is a gateway router for AS 10. For traffic internal to either AS, an interior gateway protocol (IGP) is used (OSPF, for instance). To route traffic between peer ASs, a BGP session is used.

You arrange BGP routing devices into groups of peers. Different peer groups can have different group types, AS numbers, and route reflector cluster identifiers.

To define a BGP group that recognizes only the specified BGP systems as peers, statically configure all the system's peers by including one or more **neighbor** statements. The peer neighbor's address can be either an IPv6 or IPv4 address.

As the number of external BGP (EBGP) groups increases, the ability to support a large number of BGP sessions might become a scaling issue. The preferred way to configure a large number of BGP neighbors is to configure a few groups consisting of multiple neighbors per group. Supporting fewer EBGP groups generally scales better than

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supporting a large number of EBGP groups. This becomes more evident in the case of hundreds of EBGP groups when compared with a few EBGP groups with multiple peers in each group.

After the BGP peers are established, non-BGP routes are not automatically advertised by the BGP peers. At each BGP-enabled device, policy configuration is required to export the local, static, or IGP-learned routes into the BGP RIB and then advertise them as BGP routes to the other peers. BGP's advertisement policy, by default, does not advertise any non-BGP routes (such as local routes) to peers.

Related Documentation

- Understanding BGP on page 4
- Example: Configuring External BGP Point-to-Point Peer Sessions on page 24
- Example: Configuring Internal BGP Peer Sessions on page 51
- *forwarding-options (Security)*

Example: Configuring External BGP Point-to-Point Peer Sessions

This example shows how to configure BGP point-to-point peer sessions.

- Requirements on page 24
- Overview on page 24
- Configuration on page 25
- Verification on page 28

Requirements

Before you begin, if the default BGP policy is not adequate for your network, configure routing policies to filter incoming BGP routes and to advertise BGP routes.

Overview

Figure 3 on page 25 shows a network with BGP peer sessions. In the sample network, Device E in AS 17 has BGP peer sessions to a group of peers called **external-peers**. Peers A, B, and C reside in AS 22 and have IP addresses 10.10.10.2, 10.10.10.6, and 10.10.10.10. Peer D resides in AS 79, at IP address 10.21.7.2. This example shows the configuration on Device E.

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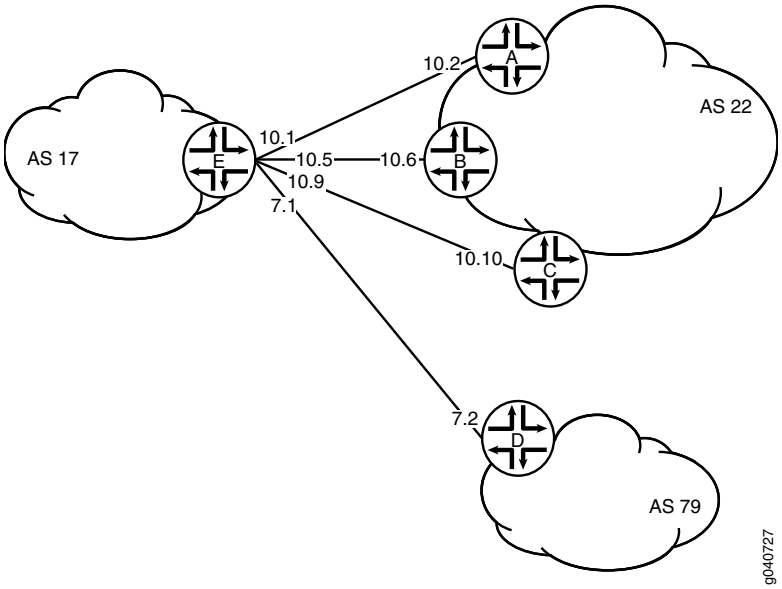
Figure 3: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set interfaces ge-1/2/0 unit 0 description to-A
set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30
set interfaces ge-0/0/1 unit 5 description to-B
set interfaces ge-0/0/1 unit 5 family inet address 10.10.10.5/30
set interfaces ge-0/1/0 unit 9 description to-C
set interfaces ge-0/1/0 unit 9 family inet address 10.10.10.9/30
set interfaces ge-1/2/1 unit 21 description to-D
set interfaces ge-1/2/1 unit 21 family inet address 10.21.7.1/30
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 22
set protocols bgp group external-peers neighbor 10.10.10.2
set protocols bgp group external-peers neighbor 10.10.10.6
set protocols bgp group external-peers neighbor 10.10.10.10
set protocols bgp group external-peers neighbor 10.21.7.2 peer-as 79
set routing-options autonomous-system 17
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the interfaces to Peers A, B, C, and D.

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```
[edit interfaces]
user@E# set ge-1/2/0 unit 0 description to-A
user@E# set ge-1/2/0 unit 0 family inet address 10.10.10.1/30
user@E# set ge-0/0/1 unit 5 description to-B
user@E# set ge-0/0/1 unit 5 family inet address 10.10.10.5/30
user@E# set ge-0/1/0 unit 9 description to-C
user@E# set ge-0/1/0 unit 9 family inet address 10.10.10.9/30
user@E# set ge-1/2/1 unit 21 description to-D
user@E# set ge-1/2/1 unit 21 family inet address 10.21.7.1/30
```

2. Set the autonomous system (AS) number.

```
[edit routing-options]
user@E# set autonomous-system 17
```

3. Create the BGP group, and add the external neighbor addresses.

```
[edit protocols bgp group external-peers]
user@E# set neighbor 10.10.10.2
user@E# set neighbor 10.10.10.6
user@E# set neighbor 10.10.10.10
```

4. Specify the autonomous system (AS) number of the external AS.

```
[edit protocols bgp group external-peers]
user@E# set peer-as 22
```

5. Add Peer D, and set the AS number at the individual neighbor level.

   The neighbor configuration overrides the group configuration. So, while **peer-as 22** is set for all the other neighbors in the group, **peer-as 79** is set for neighbor 10.21.7.2.

```
[edit protocols bgp group external-peers]
user@E# set neighbor 10.21.7.2 peer-as 79
```

6. Set the peer type to external BGP (EBGP).

```
[edit protocols bgp group external-peers]
user@E# set type external
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@E# show interfaces
```


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```
ge-1/2/0 {
   unit 0 {
      description to-A;
      family inet {
         address 10.10.10.1/30;
      }
   }
}
ge-0/0/1 {
   unit 5 {
      description to-B;
      family inet {
         address 10.10.10.5/30;
      }
   }
}
ge-0/1/0 {
   unit 9 {
      description to-C;
      family inet {
         address 10.10.10.9/30;
      }
   }
}
ge-1/2/1 {
   unit 21 {
      description to-D;
      family inet {
         address 10.21.7.1/30;
      }
   }
}
```

```
[edit]
user@E# show protocols
bgp {
   group external-peers {
      type external;
      peer-as 22;
      neighbor 10.10.10.2;
      neighbor 10.10.10.6;
      neighbor 10.10.10.10;
      neighbor 10.21.7.2 {
         peer-as 79;
      }
   }
}
```

```
[edit]
user@E# show routing-options
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 28
- Verifying BGP Groups on page 30
- Verifying BGP Summary Information on page 31

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp neighbor** command.

```
user@E> show bgp neighbor
Peer: 10.10.10.2+179 AS 22     Local: 10.10.10.1+65406 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.2       Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: ge-1/2/0.0
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 10   Sent 6    Checked 1
  Input messages:  Total 8522   Updates 1       Refreshes 0     Octets 161922
  Output messages: Total 8433   Updates 0       Refreshes 0     Octets 160290
  Output Queue[0]: 0

Peer: 10.10.10.6+54781 AS 22   Local: 10.10.10.5+179 AS 17
  Type: External    State: Established    Flags: <Sync>
```


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```
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.6       Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: ge-0/0/1.5
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 12   Sent 6    Checked 33
  Input messages:  Total 8527   Updates 1       Refreshes 0     Octets 162057
  Output messages: Total 8430   Updates 0       Refreshes 0     Octets 160233
  Output Queue[0]: 0

Peer: 10.10.10.10+55012 AS 22  Local: 10.10.10.9+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.10      Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 2
  BFD: disabled, down
  Local Interface: fe-0/1/0.9
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
```

```
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 15   Sent 6    Checked 37
  Input messages:  Total 8527   Updates 1       Refreshes 0     Octets 162057
  Output messages: Total 8429   Updates 0       Refreshes 0     Octets 160214
  Output Queue[0]: 0

Peer: 10.21.7.2+61867 AS 79    Local: 10.21.7.1+179 AS 17
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.21.7.2        Local ID: 10.10.10.1       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 3
  BFD: disabled, down
  Local Interface: ge-1/2/1.21
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 79)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 28   Sent 24   Checked 47
  Input messages:  Total 8521   Updates 1       Refreshes 0     Octets 161943
  Output messages: Total 8427   Updates 0       Refreshes 0     Octets 160176
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, run the **show bgp group** command.

```
user@E> show bgp group
```


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```
Group Type: External                                Local AS: 17
  Name: external-peers  Index: 0                    Flags: <>
  Holdtime: 0
  Total peers: 4        Established: 4
  10.10.10.2+179
  10.10.10.6+54781
  10.10.10.10+55012
  10.21.7.2+61867
  inet.0: 0/0/0/0

Groups: 1  Peers: 4    External: 4    Internal: 0    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 0          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From operational mode, run the **show bgp summary** command.

```
user@E> show bgp summary
```

```
Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.10.10.2               22       8559       8470       0       0 2d 16:12:56
0/0/0/0              0/0/0/0
10.10.10.6               22       8566       8468       0       0 2d 16:12:12
0/0/0/0              0/0/0/0
10.10.10.10              22       8565       8466       0       0 2d 16:11:31
0/0/0/0              0/0/0/0
10.21.7.2                79       8560       8465       0       0 2d 16:10:58
0/0/0/0              0/0/0/0
```

Related Documentation

- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- Understanding External BGP Peering Sessions on page 23
- Example: Configuring Internal BGP Peer Sessions on page 51
- BGP Configuration Overview on page 13

Example: Configuring External BGP on Logical Systems with IPv6 Interfaces

This example shows how to configure external BGP (EBGP) point-to-point peer sessions on logical systems with IPv6 interfaces.

- Requirements on page 32
- Overview on page 32

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- Configuration on page 33
- Verification on page 42

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

Junos OS supports EBGP peer sessions by means of IPv6 addresses. An IPv6 peer session can be configured when an IPv6 address is specified in the **neighbor** statement. This example uses EUI-64 to generate IPv6 addresses that are automatically applied to the interfaces. An EUI-64 address is an IPv6 address that uses the IEEE EUI-64 format for the interface identifier portion of the address (the last 64 bits).

NOTE: Alternatively, you can configure EBGP sessions using manually assigned 128-bit IPv6 addresses.

If you use 128-bit link-local addresses for the interfaces, you must include the **local-interface** statement. This statement is valid only for 128-bit IPv6 link-local addresses and is mandatory for configuring an IPv6 EBGP link-local peer session.

Configuring EBGP peering using link-local addresses is only applicable for directly connected interfaces. There is no support for multihop peering.

After your interfaces are up, you can use the **show interfaces terse** command to view the EUI-64-generated IPv6 addresses on the interfaces. You must use these generated addresses in the BGP **neighbor** statements. This example demonstrates the full end-to-end procedure.

In this example, Frame Relay interface encapsulation is applied to the logical tunnel (**lt**) interfaces. This is a requirement because only Frame Relay encapsulation is supported when IPv6 addresses are configured on the **lt** interfaces.

Figure 4 on page 33 shows a network with BGP peer sessions. In the sample network, Router R1 has five logical systems configured. Device E in autonomous system (AS) 17 has BGP peer sessions to a group of peers called **external-peers**. Peers A, B, and C reside in AS 22. This example shows the step-by-step configuration on Logical System A and Logical System E.

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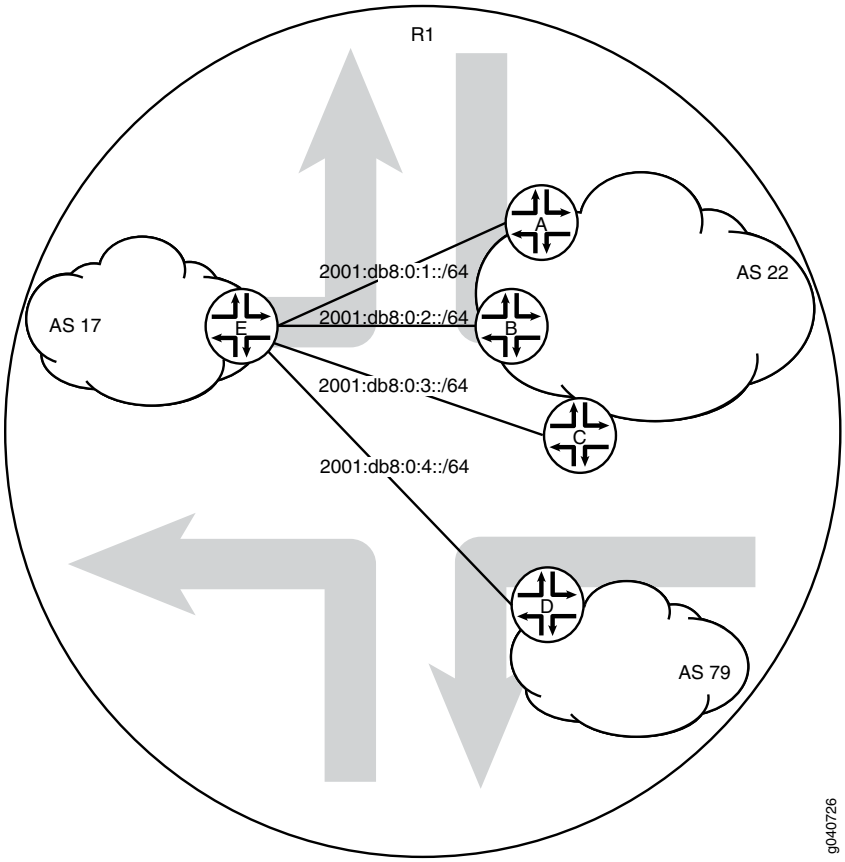
Figure 4: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Device A

```
set logical-systems A interfaces lt-0/1/0 unit 1 description to-E
set logical-systems A interfaces lt-0/1/0 unit 1 encapsulation frame-relay
set logical-systems A interfaces lt-0/1/0 unit 1 dlci 1
set logical-systems A interfaces lt-0/1/0 unit 1 peer-unit 25
set logical-systems A interfaces lt-0/1/0 unit 1 family inet6 address 2001:db8:0:1::/64
    eui-64
set logical-systems A interfaces lo0 unit 1 family inet6 address 2001:db8::1/128
set logical-systems A protocols bgp group external-peers type external
set logical-systems A protocols bgp group external-peers peer-as 17
set logical-systems A protocols bgp group external-peers neighbor
    2001:db8:0:1:2a0:a502:0:19da
set logical-systems A routing-options router-id 172.16.1.1
set logical-systems A routing-options autonomous-system 22
```

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Device B

```
set logical-systems B interfaces lt-0/1/0 unit 6 description to-E
set logical-systems B interfaces lt-0/1/0 unit 6 encapsulation frame-relay
set logical-systems B interfaces lt-0/1/0 unit 6 dlci 6
set logical-systems B interfaces lt-0/1/0 unit 6 peer-unit 5
set logical-systems B interfaces lt-0/1/0 unit 6 family inet6 address 2001:db8:0:2::/64
  eui-64
set logical-systems B interfaces lo0 unit 2 family inet6 address 2001:db8::2/128
set logical-systems B protocols bgp group external-peers type external
set logical-systems B protocols bgp group external-peers peer-as 17
set logical-systems B protocols bgp group external-peers neighbor
  2001:db8:0:2:2a0:a502:0:5da
set logical-systems B routing-options router-id 172.16.2.2
set logical-systems B routing-options autonomous-system 22
```

Device C

```
set logical-systems C interfaces lt-0/1/0 unit 10 description to-E
set logical-systems C interfaces lt-0/1/0 unit 10 encapsulation frame-relay
set logical-systems C interfaces lt-0/1/0 unit 10 dlci 10
set logical-systems C interfaces lt-0/1/0 unit 10 peer-unit 9
set logical-systems C interfaces lt-0/1/0 unit 10 family inet6 address 2001:db8:0:3::/64
  eui-64
set logical-systems C interfaces lo0 unit 3 family inet6 address 2001:db8::3/128
set logical-systems C protocols bgp group external-peers type external
set logical-systems C protocols bgp group external-peers peer-as 17
set logical-systems C protocols bgp group external-peers neighbor
  2001:db8:0:3:2a0:a502:0:9da
set logical-systems C routing-options router-id 172.16.3.3
set logical-systems C routing-options autonomous-system 22
```

Device D

```
set logical-systems D interfaces lt-0/1/0 unit 7 description to-E
set logical-systems D interfaces lt-0/1/0 unit 7 encapsulation frame-relay
set logical-systems D interfaces lt-0/1/0 unit 7 dlci 7
set logical-systems D interfaces lt-0/1/0 unit 7 peer-unit 21
set logical-systems D interfaces lt-0/1/0 unit 7 family inet6 address 2001:db8:0:4::/64
  eui-64
set logical-systems D interfaces lo0 unit 4 family inet6 address 2001:db8::4/128
set logical-systems D protocols bgp group external-peers type external
set logical-systems D protocols bgp group external-peers peer-as 17
set logical-systems D protocols bgp group external-peers neighbor
  2001:db8:0:4:2a0:a502:0:15da
set logical-systems D routing-options router-id 172.16.4.4
set logical-systems D routing-options autonomous-system 79
```

Device E

```
set logical-systems E interfaces lt-0/1/0 unit 5 description to-B
set logical-systems E interfaces lt-0/1/0 unit 5 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 5 dlci 6
set logical-systems E interfaces lt-0/1/0 unit 5 peer-unit 6
set logical-systems E interfaces lt-0/1/0 unit 5 family inet6 address 2001:db8:0:2::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 9 description to-C
set logical-systems E interfaces lt-0/1/0 unit 9 encapsulation frame-relay
```


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```
set logical-systems E interfaces lt-0/1/0 unit 9 dlci 10
set logical-systems E interfaces lt-0/1/0 unit 9 peer-unit 10
set logical-systems E interfaces lt-0/1/0 unit 9 family inet6 address 2001:db8:0:3::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 21 description to-D
set logical-systems E interfaces lt-0/1/0 unit 21 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 21 dlci 7
set logical-systems E interfaces lt-0/1/0 unit 21 peer-unit 7
set logical-systems E interfaces lt-0/1/0 unit 21 family inet6 address 2001:db8:0:4::/64
  eui-64
set logical-systems E interfaces lt-0/1/0 unit 25 description to-A
set logical-systems E interfaces lt-0/1/0 unit 25 encapsulation frame-relay
set logical-systems E interfaces lt-0/1/0 unit 25 dlci 1
set logical-systems E interfaces lt-0/1/0 unit 25 peer-unit 1
set logical-systems E interfaces lt-0/1/0 unit 25 family inet6 address 2001:db8:0:1::/64
  eui-64
set logical-systems E interfaces lo0 unit 5 family inet6 address 2001:db8::5/128
set logical-systems E protocols bgp group external-peers type external
set logical-systems E protocols bgp group external-peers peer-as 22
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:1:2a0:a502:0:1da
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:2:2a0:a502:0:6da
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:3:2a0:a502:0:ada
set logical-systems E protocols bgp group external-peers neighbor
  2001:db8:0:4:2a0:a502:0:7da peer-as 79
set logical-systems E routing-options router-id 172.16.5.5
set logical-systems E routing-options autonomous-system 17
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Run the **show interfaces terse** command to verify that the physical router has a logical tunnel (**lt**) interface.

   ```
   user@R1> show interfaces terse
   Interface               Admin Link Proto    Local                 Remote
   ...
   lt-0/1/0                up    up
   ...
   ```

2. On Logical System A, configure the interface encapsulation, peer-unit number, and DLCI to reach Logical System E.

   ```
   user@R1> set cli logical-system A
   Logical system: A
   [edit]
   user@R1:A> edit
   ```

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```
Entering configuration mode
[edit]
user@R1:A# edit interfaces
[edit interfaces]
user@R1:A# set lt-0/1/0 unit 1 encapsulation frame-relay
user@R1:A# set lt-0/1/0 unit 1 dlci 1
user@R1:A# set lt-0/1/0 unit 1 peer-unit 25
```

3. On Logical System A, configure the network address for the link to Peer E, and configure a loopback interface.

```
[edit interfaces]
user@R1:A# set lt-0/1/0 unit 1 description to-E
user@R1:A# set lt-0/1/0 unit 1 family inet6 address 2001:db8:0:1::/64 eui-64
user@R1:A# set lo0 unit 1 family inet6 address 2001:db8::1/128
```

4. On Logical System E, configure the interface encapsulation, peer-unit number, and DLCI to reach Logical System A.

```
user@R1> set cli logical-system E
Logical system: E
[edit]
user@R1:E> edit
Entering configuration mode
[edit]
user@R1:E# edit interfaces
[edit interfaces]
user@R1:E# set lt-0/1/0 unit 25 encapsulation frame-relay
user@R1:E# set lt-0/1/0 unit 25 dlci 1
user@R1:E# set lt-0/1/0 unit 25 peer-unit 1
```

5. On Logical System E, configure the network address for the link to Peer A, and configure a loopback interface.

```
[edit interfaces]
user@R1:E# set lt-0/1/0 unit 25 description to-A
user@R1:E# set lt-0/1/0 unit 25 family inet6 address 2001:db8:0:1::/64 eui-64
user@R1:E# set lo0 unit 5 family inet6 address 2001:db8::5/128
```

6. Run the **show interfaces terse** command to see the IPv6 addresses that are generated by EUI-64.

   The 2001 addresses are used in this example in the BGP **neighbor** statements.

NOTE: The fe80 addresses are link-local addresses and are not used in this example.

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```
user@R1:A> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
Logical system: A

betsy@tp8:A> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
lt-0/1/0
lt-0/1/0.1              up    up   inet6    2001:db8:0:1:2a0:a502:0:1da/64
                                            fe80::2a0:a502:0:1da/64
lo0
lo0.1                   up    up   inet6    2001:db8::1
                                            fe80::2a0:a50f:fc56:1da
```

```
user@R1:E> show interfaces terse
Interface               Admin Link Proto    Local                 Remote
lt-0/1/0
lt-0/1/0.25             up    up   inet6    2001:db8:0:1:2a0:a502:0:19da/64

                                            fe80::2a0:a502:0:19da/64
lo0
lo0.5                   up    up   inet6    2001:db8::5
                                            fe80::2a0:a50f:fc56:1da
```

7. Repeat the interface configuration on the other logical systems.

Configuring the External BGP Sessions

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. On Logical System A, create the BGP group, and add the external neighbor address.

```
[edit protocols bgp group external-peers]
user@R1:A# set neighbor 2001:db8:0:1:2a0:a502:0:19da
```

2. On Logical System E, create the BGP group, and add the external neighbor address.

```
[edit protocols bgp group external-peers]
user@R1:E# set neighbor 2001:db8:0:1:2a0:a502:0:1da
```

3. On Logical System A, specify the autonomous system (AS) number of the external AS.

```
[edit protocols bgp group external-peers]
user@R1:A# set peer-as 17
```

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4. On Logical System E, specify the autonomous system (AS) number of the external AS.

```
[edit protocols bgp group external-peers]
user@R1:E# set peer-as 22
```

5. On Logical System A, set the peer type to EBGP.

```
[edit protocols bgp group external-peers]
user@R1:A# set type external
```

6. On Logical System E, set the peer type to EBGP.

```
[edit protocols bgp group external-peers]
user@R1:E# set type external
```

7. On Logical System A, set the autonomous system (AS) number and router ID.

```
[edit routing-options]
user@R1:A# set router-id 172.16.1.1
user@R1:A# set autonomous-system 22
```

8. On Logical System E, set the AS number and router ID.

```
[edit routing-options]
user@R1:E# set router-id 172.16.5.5
user@R1:E# set autonomous-system 17
```

9. Repeat these steps for Peers A, B, C, and D.

Results From configuration mode, confirm your configuration by entering the **show logical-systems** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show logical-systems
A {
   interfaces {
      lt-0/1/0 {
         unit 1 {
            description to-E;
            encapsulation frame-relay;
            dlci 1;
            peer-unit 25;
            family inet6 {
               address 2001:db8:0:1::/64 {
                  eui-64;
```


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```
            }
          }
        }
      }
      lo0 {
        unit 1 {
          family inet6 {
            address 2001:db8::1/128;
          }
        }
      }
    }
    protocols {
      bgp {
        group external-peers {
          type external;
          peer-as 17;
          neighbor 2001:db8:0:1:2a0:a502:0:19da;
        }
      }
      routing-options {
        router-id 172.16.1.1;
        autonomous-system 22;
      }
    }
    B {
      interfaces {
        lt-0/1/0 {
          unit 6 {
            description to-E;
            encapsulation frame-relay;
            dlci 6;
            peer-unit 5;
            family inet6 {
              address 2001:db8:0:2::/64 {
                eui-64;
              }
            }
          }
        }
        lo0 {
          unit 2 {
            family inet6 {
              address 2001:db8::2/128;
            }
          }
        }
      }
      protocols {
        bgp {
          group external-peers {
            type external;
            peer-as 17;
            neighbor 2001:db8:0:2:2a0:a502:0:5da;
          }
```

```
    }
    routing-options {
      router-id 172.16.2.2;
      autonomous-system 22;
    }
  }
  C {
    interfaces {
      lt-0/1/0 {
        unit 10 {
          description to-E;
          encapsulation frame-relay;
          dlci 10;
          peer-unit 9;
          family inet6 {
            address 2001:db8:0:3::/64 {
              eui-64;
            }
          }
        }
      }
      lo0 {
        unit 3 {
          family inet6 {
            address 2001:db8::3/128;
          }
        }
      }
    }
    protocols {
      bgp {
        group external-peers {
          type external;
          peer-as 17;
          neighbor 2001:db8:0:3:2a0:a502:0:9da;
        }
      }
    }
    routing-options {
      router-id 172.16.3.3;
      autonomous-system 22;
    }
  }
  D {
    interfaces {
      lt-0/1/0 {
        unit 7 {
          description to-E;
          encapsulation frame-relay;
          dlci 7;
          peer-unit 21;
          family inet6 {
            address 2001:db8:0:4::/64 {
              eui-64;
            }
```


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```
        }
      }
    }
    lo0 {
      unit 4 {
        family inet6 {
          address 2001:db8::4/128;
        }
      }
    }
  }
  protocols {
    bgp {
      group external-peers {
        type external;
        peer-as 17;
        neighbor 2001:db8:0:4:2a0:a502:0:15da;
      }
    }
    routing-options {
      router-id 172.16.4.4;
      autonomous-system 79;
    }
  }
  E {
    interfaces {
      lt-0/1/0 {
        unit 5 {
          description to-B;
          encapsulation frame-relay;
          dlci 6;
          peer-unit 6;
          family inet6 {
            address 2001:db8:0:2::/64 {
              eui-64;
            }
          }
        }
        unit 9 {
          description to-C;
          encapsulation frame-relay;
          dlci 10;
          peer-unit 10;
          family inet6 {
            address 2001:db8:0:3::/64 {
              eui-64;
            }
          }
        }
        unit 21 {
          description to-D;
          encapsulation frame-relay;
          dlci 7;
          peer-unit 7;
          family inet6 {
```

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```
                address 2001:db8:0:4::/64 {
                  eui-64;
                }
              }
            }
            unit 25 {
              description to-A;
              encapsulation frame-relay;
              dlci 1;
              peer-unit 1;
              family inet6 {
                address 2001:db8:0:1::/64 {
                  eui-64;
                }
              }
            }
          }
          lo0 {
            unit 5 {
              family inet6 {
                address 2001:db8::5/128;
              }
            }
          }
        }
        protocols {
          bgp {
            group external-peers {
              type external;
              peer-as 22;
              neighbor 2001:db8:0:1:2a0:a502:0:1da;
              neighbor 2001:db8:0:2:2a0:a502:0:6da;
              neighbor 2001:db8:0:3:2a0:a502:0:ada;
              neighbor 2001:db8:0:4:2a0:a502:0:7da {
                peer-as 79;
              }
            }
          }
        }
        routing-options {
          router-id 172.16.5.5;
          autonomous-system 17;
        }
      }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 43
- Verifying BGP Groups on page 45

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- Verifying BGP Summary Information on page 46
- Checking the Routing Table on page 46

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp neighbor** command.

```
user@R1:E> show bgp neighbor
Peer: 2001:db8:0:1:2a0:a502:0:1da+54987 AS 22 Local:
2001:db8:0:1:2a0:a502:0:19da+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Open Message Error
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Error: 'Open Message Error' Sent: 20 Recv: 0
  Peer ID: 172.16.1.1         Local ID: 172.16.5.5           Active Holdtime: 90

  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: lt-0/1/0.25
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 7    Sent 18   Checked 81
  Input messages:  Total 1611   Updates 1       Refreshes 0     Octets 30660
  Output messages: Total 1594   Updates 0       Refreshes 0     Octets 30356
  Output Queue[0]: 0

Peer: 2001:db8:0:2:2a0:a502:0:6da+179 AS 22 Local:
2001:db8:0:2:2a0:a502:0:5da+55502 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Open Message Error
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
```

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```
  Error: 'Open Message Error' Sent: 26 Recv: 0
  Peer ID: 172.16.2.2         Local ID: 172.16.5.5           Active Holdtime: 90

  Keepalive Interval: 30         Peer index: 2
  BFD: disabled, down
  Local Interface: lt-0/1/0.5
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 15   Sent 8    Checked 8
  Input messages:  Total 1610   Updates 1       Refreshes 0     Octets 30601
  Output messages: Total 1645   Updates 0       Refreshes 0     Octets 32417
  Output Queue[0]: 0

Peer: 2001:db8:0:3:2a0:a502:0:ada+55983 AS 22 Local:
2001:db8:0:3:2a0:a502:0:9da+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 172.16.3.3         Local ID: 172.16.5.5           Active Holdtime: 90

  Keepalive Interval: 30         Peer index: 3
  BFD: disabled, down
  Local Interface: lt-0/1/0.9
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 22)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
```


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```
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 21   Sent 21   Checked 67
  Input messages:  Total 1610   Updates 1       Refreshes 0     Octets 30641
  Output messages: Total 1587   Updates 0       Refreshes 0     Octets 30223
  Output Queue[0]: 0

Peer: 2001:db8:0:4:2a0:a502:0:7da+49255 AS 79 Local:
2001:db8:0:4:2a0:a502:0:15da+179 AS 17
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 172.16.4.4         Local ID: 172.16.5.5           Active Holdtime: 90

  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: lt-0/1/0.21
  NLRI for restart configured on peer: inet6-unicast
  NLRI advertised by peer: inet6-unicast
  NLRI for this session: inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet6-unicast
  NLRI of received end-of-rib markers: inet6-unicast
  NLRI of all end-of-rib markers sent: inet6-unicast
  Peer supports 4 byte AS extension (peer-as 79)
  Peer does not support Addpath
  Table inet6.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          0
  Last traffic (seconds): Received 6    Sent 17   Checked 25
  Input messages:  Total 1615   Updates 1       Refreshes 0     Octets 30736
  Output messages: Total 1593   Updates 0       Refreshes 0     Octets 30337
  Output Queue[0]: 0
```

Meaning IPv6 unicast network layer reachability information (NLRI) is being exchanged between the neighbors.

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, run the **show bgp group** command.

```
user@R1:E> show bgp group
```

```
Group Type: External                                Local AS: 17
  Name: external-peers  Index: 0                    Flags: <>
  Holdtime: 0
  Total peers: 4        Established: 4
  2001:db8:0:1:2a0:a502:0:1da+54987
  2001:db8:0:2:2a0:a502:0:6da+179
  2001:db8:0:3:2a0:a502:0:ada+55983
  2001:db8:0:4:2a0:a502:0:7da+49255
  inet6.0: 0/0/0/0

Groups: 1  Peers: 4    External: 4    Internal: 0    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0                0          0          0          0          0          0
inet6.2                0          0          0          0          0          0
```

Meaning The group type is external, and the group has four peers.

Verifying BGP Summary Information

Purpose Verify that the BGP that the peer relationships are established.

Action From operational mode, run the **show bgp summary** command.

```
user@R1:E> show bgp summary
```

```
Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0                0          0          0          0          0          0
inet6.2                0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
2001:db8:0:1:2a0:a502:0:1da          22       1617       1600       0       0
 12:07:00 Establ
  inet6.0: 0/0/0/0
2001:db8:0:2:2a0:a502:0:6da          22       1616       1651       0       0
 12:06:56 Establ
  inet6.0: 0/0/0/0
2001:db8:0:3:2a0:a502:0:ada          22       1617       1594       0       0
 12:04:32 Establ
  inet6.0: 0/0/0/0
2001:db8:0:4:2a0:a502:0:7da          79       1621       1599       0       0
 12:07:00 Establ
  inet6.0: 0/0/0/0
```

Meaning The Down peers: 0 output shows that the BGP peers are in the established state.

Checking the Routing Table

Purpose Verify that the inet6.0 routing table is populated with local and direct routes.

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Action From operational mode, run the **show route** command.

```
user@R1:E> show route
inet6.0: 15 destinations, 18 routes (15 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2001:db8::5/128    *[Direct/0] 12:41:18
                    > via lo0.5
2001:db8:0:1::/64  *[Direct/0] 14:40:01
                    > via lt-0/1/0.25
2001:db8:0:1:2a0:a502:0:19da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.25
2001:db8:0:2::/64  *[Direct/0] 14:40:02
                    > via lt-0/1/0.5
2001:db8:0:2:2a0:a502:0:5da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.5
2001:db8:0:3::/64  *[Direct/0] 14:40:02
                    > via lt-0/1/0.9
2001:db8:0:3:2a0:a502:0:9da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.9
2001:db8:0:4::/64  *[Direct/0] 14:40:01
                    > via lt-0/1/0.21
2001:db8:0:4:2a0:a502:0:15da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.21
fe80::/64          *[Direct/0] 14:40:02
                    > via lt-0/1/0.5
                    [Direct/0] 14:40:02
                    > via lt-0/1/0.9
                    [Direct/0] 14:40:01
                    > via lt-0/1/0.21
                    [Direct/0] 14:40:01
                    > via lt-0/1/0.25
fe80::2a0:a502:0:5da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.5
fe80::2a0:a502:0:9da/128
                   *[Local/0] 14:40:02
                      Local via lt-0/1/0.9
fe80::2a0:a502:0:15da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.21
fe80::2a0:a502:0:19da/128
                   *[Local/0] 14:40:01
                      Local via lt-0/1/0.25
fe80::2a0:a50f:fc56:1da/128
                   *[Direct/0] 12:41:18
                    > via lo0.5
```

Meaning The inet6.0 routing table contains local and direct routes. To populate the routing table with other types of routes, you must configure routing policies.

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Related Documentation

- Understanding External BGP Peering Sessions on page 23

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CHAPTER 3

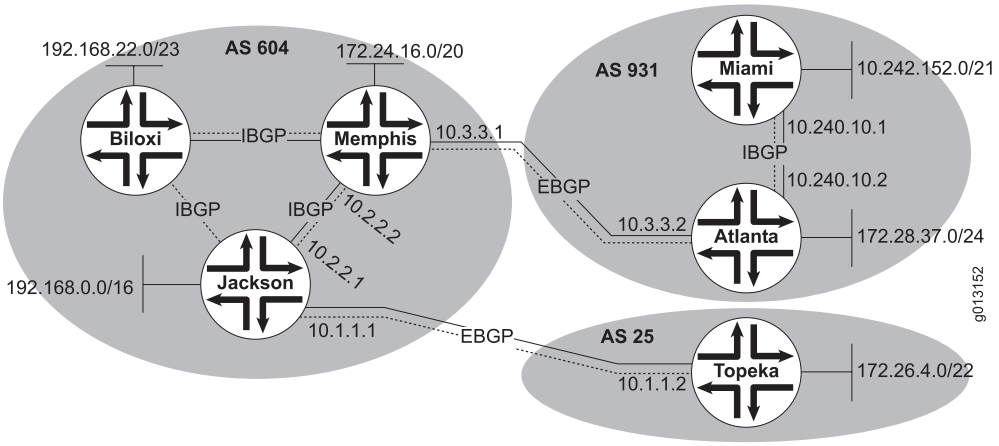
Configuring Internal BGP Peering

- Understanding Internal BGP Peering Sessions on page 49
- Example: Configuring Internal BGP Peer Sessions on page 51
- Example: Configuring Internal BGP Peering Sessions on Logical Systems on page 63

Understanding Internal BGP Peering Sessions

When two BGP-enabled devices are in the same autonomous system (AS), the BGP session is called an *internal* BGP session, or IBGP session. BGP uses the same message types on IBGP and external BGP (EBGP) sessions, but the rules for when to send each message and how to interpret each message differ slightly. For this reason, some people refer to IBGP and EBGP as two separate protocols.

Figure 5: Internal and External BGP



In Figure 5 on page 49, Device Jackson, Device Memphis, and Device Biloxi have IBGP peer sessions with each other. Likewise, Device Miami and Device Atlanta have IBGP peer sessions between each other.

The purpose of IBGP is to provide a means by which EBGP route advertisements can be forwarded throughout the network. In theory, to accomplish this task you could redistribute all of your EBGP routes into an interior gateway protocol (IGP), such as OSPF or IS-IS. This, however, is not recommended in a production environment because of the large

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number of EBGP routes in the Internet and because of the way that IGPs operate. In short, with that many routes the IGP churns or crashes.

Generally, the loopback interface (lo0) is used to establish connections between IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peering session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peering session also goes up and down. Thus the loopback interface provides fault tolerance in case the physical interface or the link goes down, if the device has link redundancy.

While IBGP neighbors do not need to be directly connected, they do need to be fully meshed. In this case, fully meshed means that each device is logically connected to every other device through neighbor peer relationships. The **neighbor** statement creates the mesh. Because of the full mesh requirement of IBGP, you must configure individual peering sessions between all IBGP devices in the AS. The full mesh need not be physical links. Rather, the configuration on each routing device must create a full mesh of peer sessions (using multiple **neighbor** statements).

NOTE: **The requirement for a full mesh is waived if you configure a confederation or route reflection.**

To understand the full-mesh requirement, consider that an IBGP-learned route cannot be readvertised to another IBGP peer. The reason for preventing the readvertisement of IBGP routes and requiring the full mesh is to avoid routing loops within an AS. The AS path attribute is the means by which BGP routing devices avoid loops. The path information is examined for the local AS number only when the route is received from an EBGP peer. Because the attribute is only modified across AS boundaries, this system works well. However, the fact that the attribute is only modified across AS boundaries presents an issue inside the AS. For example, suppose that routing devices A, B, and C are all in the same AS. Device A receives a route from an EBGP peer and sends the route to Device B, which installs it as the active route. The route is then sent to Device C, which installs it locally and sends it back to Device A. If Device A installs the route, a loop is formed within the AS. The routing devices are not able to detect the loop because the AS path attribute is not modified during these advertisements. Therefore, the BGP protocol designers decided that the only assurance of never forming a routing loop was to prevent an IBGP peer from advertising an IBGP-learned route within the AS. For route reachability, the IBGP peers are fully meshed.

IBGP supports multihop connections, so IBGP neighbors can be located anywhere within the AS and often do not share a link. A recursive route lookup resolves the loopback peering address to an IP forwarding next hop. The lookup service is provided by static routes or an IGP such as OSPF, or BGP routes.

Related Documentation

- Example: Configuring Internal BGP Peer Sessions on page 51
- Example: Configuring Internal BGP Peering Sessions on Logical Systems on page 63

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Example: Configuring Internal BGP Peer Sessions

This example shows how to configure internal BGP peer sessions.

- Requirements on page 51
- Overview on page 51
- Configuration on page 52
- Verification on page 60

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

In this example, you configure internal BGP (IBGP) peer sessions. The loopback interface (lo0) is used to establish connections between IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peer session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peer session also goes up and down. Thus, if the device has link redundancy, the loopback interface provides fault tolerance in case the physical interface or one of the links goes down.

When a device peers with a remote device's loopback interface address, the local device expects BGP update messages to come from (be sourced by) the remote device's loopback interface address. The **local-address** statement enables you to specify the source information in BGP update messages. If you omit the **local-address** statement, the expected source of BGP update messages is based on the device's source address selection rules, which normally results in the egress interface address being the expected source of update messages. When this happens, the peer session is not established because a mismatch exists between the expected source address (the egress interface of the peer) and the actual source (the loopback interface of the peer). To make sure that the expected source address matches the actual source address, specify the loopback interface address in the **local-address** statement.

Because IBGP supports multihop connections, IBGP neighbors can be located anywhere within the autonomous system (AS) and often do not share a link. A recursive route lookup resolves the loopback peer address to an IP forwarding next hop. In this example, this service is provided by OSPF. Although interior gateway protocol (IGP) neighbors do not need to be directly connected, they do need to be fully meshed. In this case, fully meshed means that each device is logically connected to every other device through neighbor peer relationships. The **neighbor** statement creates the mesh.

NOTE: The requirement for a full mesh is waived if you configure a confederation or route reflection.

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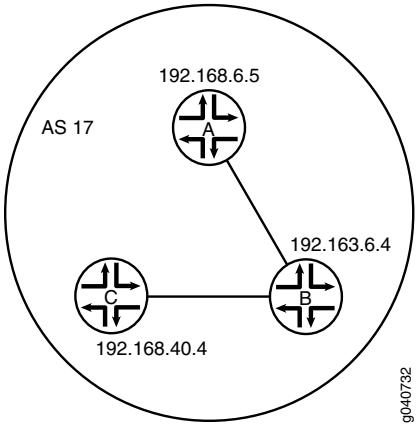
After the BGP peers are established, local routes are not automatically advertised by the BGP peers. At each BGP-enabled device, policy configuration is required to export the local, static, or IGP-learned routes into the BGP routing information base (RIB) and then advertise them as BGP routes to the other peers. BGP's advertisement policy, by default, does not advertise any non-BGP routes (such as local routes) to peers.

In the sample network, the devices in AS 17 are fully meshed in the group **internal-peers**. The devices have loopback addresses 192.168.6.5, 192.163.6.4, and 192.168.40.4.

Figure 6 on page 52 shows a typical network with internal peer sessions.

Figure 6: Typical Network with IBGP Sessions



Configuration

- Configuring Device A on page 53
- Configuring Device B on page 56
- Configuring Device C on page 58

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set interfaces ge-0/1/0 unit 1 description to-B
set interfaces ge-0/1/0 unit 1 family inet address 10.10.10.1/30
set interfaces lo0 unit 1 family inet address 192.168.6.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description “connections to B and C”
set protocols bgp group internal-peers local-address 192.168.6.5
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.1
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
```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```
set routing-options router-id 192.168.6.5
set routing-options autonomous-system 17
```

Device B

```
set interfaces ge-0/1/0 unit 2 description to-A
set interfaces ge-0/1/0 unit 2 family inet address 10.10.10.2/30
set interfaces ge-0/1/1 unit 5 description to-C
set interfaces ge-0/1/1 unit 5 family inet address 10.10.10.5/30
set interfaces lo0 unit 2 family inet address 192.163.6.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description “connections to A and C”
set protocols bgp group internal-peers local-address 192.163.6.4
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.2
set protocols ospf area 0.0.0.0 interface ge-0/1/1.5
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
set routing-options router-id 192.163.6.4
set routing-options autonomous-system 17
```

Device C

```
set interfaces ge-0/1/0 unit 6 description to-B
set interfaces ge-0/1/0 unit 6 family inet address 10.10.10.6/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers description “connections to A and B”
set protocols bgp group internal-peers local-address 192.168.40.4
set protocols bgp group internal-peers export send-direct
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface ge-0/1/0.6
set policy-options policy-statement send-direct term 2 from protocol direct
set policy-options policy-statement send-direct term 2 then accept
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Configuring Device A

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device A:

1. Configure the interfaces.

```
[edit interfaces ge-0/1/0 unit 1]
user@A# set description to-B
```

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```
user@A# set family inet address 10.10.10.1/30
[edit interfaces]
user@A# set lo0 unit 1 family inet address 192.168.6.5/32
```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

```
[edit protocols bgp group internal-peers]
user@A# set type internal
user@A# set description "connections to B and C"
user@A# set local-address 192.168.6.5
user@A# set export send-direct
user@A# set neighbor 192.163.6.4
user@A# set neighbor 192.168.40.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@A# set interface lo0.1 passive
user@A# set interface ge-0/1/0.1
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 2]
user@A# set from protocol direct
user@A# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@A# set router-id 192.168.6.5
user@A# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@A# show interfaces
ge-0/1/0 {
   unit 1 {
      description to-B;
      family inet {
```


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```
        address 10.10.10.1/30;
      }
    }
}
lo0 {
    unit 1 {
      family inet {
        address 192.168.6.5/32;
      }
    }
}
```

```
user@A# show policy-options
policy-statement send-direct {
    term 2 {
      from protocol direct;
      then accept;
    }
}
```

```
user@A# show protocols
bgp {
    group internal-peers {
      type internal;
      description “connections to B and C”;
      local-address 192.168.6.5;
      export send-direct;
      neighbor 192.163.6.4;
      neighbor 192.168.40.4;
    }
}
ospf {
    area 0.0.0.0 {
      interface lo0.1 {
        passive;
      }
      interface ge-0/1/0.1;
    }
}
```

```
user@A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Configuring Device B

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

To configure internal BGP peer sessions on Device B:

1. Configure the interfaces.

```
[edit interfaces ge-0/1/0 unit 2]
user@B# set description to-A
user@B# set family inet address 10.10.10.2/30
[edit interfaces ge-0/1/1]
user@B# set unit 5 description to-C
user@B# set unit 5 family inet address 10.10.10.5/30
[edit interfaces]
user@B# set lo0 unit 2 family inet address 192.163.6.4/32
```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

```
[edit protocols bgp group internal-peers]
user@B# set type internal
user@B# set description "connections to A and C"
user@B# set local-address 192.163.6.4
user@B# set export send-direct
user@B# set neighbor 192.168.40.4
user@B# set neighbor 192.168.6.5
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@B# set interface lo0.2 passive
user@B# set interface ge-0/1/0.2
user@B# set interface ge-0/1/1.5
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 2]
user@B# set from protocol direct
user@B# set then accept
```

5. Configure the router ID and the AS number.

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```
[edit routing-options]
user@B# set router-id 192.163.6.4
user@B# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@B# show interfaces
ge-0/1/0 {
   unit 2 {
      description to-A;
      family inet {
         address 10.10.10.2/30;
      }
   }
}
ge-0/1/1 {
   unit 5 {
      description to-C;
      family inet {
         address 10.10.10.5/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.163.6.4/32;
      }
   }
}
```

```
user@B# show policy-options
policy-statement send-direct {
   term 2 {
      from protocol direct;
      then accept;
   }
}
```

```
user@B# show protocols
bgp {
   group internal-peers {
      type internal;
      description “connections to A and C”;
      local-address 192.163.6.4;
      export send-direct;
      neighbor 192.168.40.4;
      neighbor 192.168.6.5;
```

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```
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.2 {
            passive;
        }
        interface ge-0/1/0.2;
        interface ge-0/1/1.5;
    }
}
```

```
user@B# show routing-options
router-id 192.163.6.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device C

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device C:

1. Configure the interfaces.

```
[edit interfaces ge-0/1/0 unit 6]
user@C# set description to-B
user@C# set family inet address 10.10.10.6/30
[edit interfaces]
user@C# set lo0 unit 3 family inet address 192.168.40.4/32
```

2. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

```
[edit protocols bgp group internal-peers]
user@C# set type internal
user@C# set description "connections to A and B"
user@C# set local-address 192.168.40.4
user@C# set export send-direct
user@C# set neighbor 192.163.6.4
user@C# set neighbor 192.168.6.5
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@C# set interface lo0.3 passive
```


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```
user@C# set interface ge-0/1/0.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 2]
user@C# set from protocol direct
user@C# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@C# set router-id 192.168.40.4
user@C# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@C# show interfaces
ge-0/1/0 {
    unit 6 {
        description to-B;
        family inet {
            address 10.10.10.6/30;
        }
    }
}
lo0 {
    unit 3 {
        family inet {
            address 192.168.40.4/32;
        }
    }
}
```

```
user@C# show policy-options
policy-statement send-direct {
    term 2 {
        from protocol direct;
        then accept;
    }
}
```

```
user@C# show protocols
bgp {
```

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```
    group internal-peers {
      type internal;
      description “connections to A and B”;
      local-address 192.168.40.4;
      export send-direct;
      neighbor 192.163.6.4;
      neighbor 192.168.6.5;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.3 {
        passive;
      }
      interface ge-0/1/0.6;
    }
  }
```

```
user@C# show routing-options
router-id 192.168.40.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 60
- Verifying BGP Groups on page 62
- Verifying BGP Summary Information on page 62
- Verifying That BGP Routes Are Installed in the Routing Table on page 62

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@A> show bgp neighbor
```

```
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+58852 AS 17
  Type: Internal    State: Established    Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: Preference LocalAddress Refresh
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
```


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```
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            3
    Accepted prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 25   Sent 19   Checked 67
  Input messages:  Total 2420   Updates 4       Refreshes 0     Octets 46055
  Output messages: Total 2411   Updates 2       Refreshes 0     Octets 45921
  Output Queue[0]: 0

Peer: 192.168.40.4+179 AS 17   Local: 192.168.6.5+56466 AS 17
  Type: Internal    State: Established    Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: Preference LocalAddress Refresh
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            2
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 7    Sent 21   Checked 24
```

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```
  Input messages:  Total 2412   Updates 2       Refreshes 0     Octets 45867
  Output messages: Total 2409   Updates 2       Refreshes 0     Octets 45883
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, enter the **show bgp group** command.

```
user@A> show bgp group
```

```
Group Type: Internal    AS: 17                     Local AS: 17
  Name: internal-peers  Index: 0                   Flags: <Export Eval>
  Export: [ send-direct ]
  Holdtime: 0
  Total peers: 2        Established: 2
  192.163.6.4+179
  192.168.40.4+179
  inet.0: 0/5/5/0

Groups: 1  Peers: 2    External: 0    Internal: 2    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary
```

```
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17       2441       2432       0       0    18:18:52
0/3/3/0              0/0/0/0
192.168.40.4             17       2432       2430       0       0    18:18:48
0/2/2/0              0/0/0/0
```

Verifying That BGP Routes Are Installed in the Routing Table

Purpose Verify that the export policy configuration is causing the BGP routes to be installed in the routing tables of the peers.

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Action From operational mode, enter the **show route protocol bgp** command.

```
user@A> show route protocol bgp
inet.0: 7 destinations, 12 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30       [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
10.10.10.4/30       [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
                    [BGP/170] 07:07:12, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
192.163.6.4/32      [BGP/170] 07:09:57, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
192.168.40.4/32     [BGP/170] 07:07:12, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via ge-0/1/0.1
```

Related Documentation

- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- Understanding Internal BGP Peering Sessions on page 49
- BGP Configuration Overview on page 13

Example: Configuring Internal BGP Peering Sessions on Logical Systems

This example shows how to configure internal BGP peer sessions on logical systems.

- Requirements on page 63
- Overview on page 63
- Configuration on page 64
- Verification on page 70

Requirements

In this example, no special configuration beyond device initialization is required.

Overview

In this example, you configure internal BGP (IBGP) peering sessions.

In the sample network, the devices in AS 17 are fully meshed in the group **internal-peers**. The devices have loopback addresses 192.168.6.5, 192.163.6.4, and 192.168.40.4.

Figure 7 on page 64 shows a typical network with internal peer sessions.

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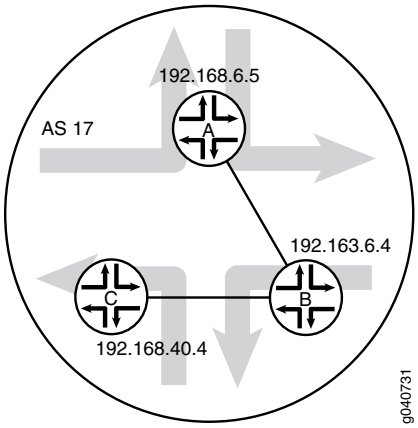
Figure 7: Typical Network with IBGP Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set logical-systems A interfaces lt-0/1/0 unit 1 description to-B
set logical-systems A interfaces lt-0/1/0 unit 1 encapsulation ethernet
set logical-systems A interfaces lt-0/1/0 unit 1 peer-unit 2
set logical-systems A interfaces lt-0/1/0 unit 1 family inet address 10.10.10.1/30
set logical-systems A interfaces lo0 unit 1 family inet address 192.168.6.5/32
set logical-systems A protocols bgp group internal-peers type internal
set logical-systems A protocols bgp group internal-peers local-address 192.168.6.5
set logical-systems A protocols bgp group internal-peers export send-direct
set logical-systems A protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems A protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems A protocols ospf area 0.0.0.0 interface lo0.1 passive
set logical-systems A protocols ospf area 0.0.0.0 interface lt-0/1/0.1
set logical-systems A policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems A policy-options policy-statement send-direct term 2 then accept
set logical-systems A routing-options router-id 192.168.6.5
set logical-systems A routing-options autonomous-system 17
set logical-systems B interfaces lt-0/1/0 unit 2 description to-A
set logical-systems B interfaces lt-0/1/0 unit 2 encapsulation ethernet
set logical-systems B interfaces lt-0/1/0 unit 2 peer-unit 1
set logical-systems B interfaces lt-0/1/0 unit 2 family inet address 10.10.10.2/30
set logical-systems B interfaces lt-0/1/0 unit 5 description to-C
set logical-systems B interfaces lt-0/1/0 unit 5 encapsulation ethernet
set logical-systems B interfaces lt-0/1/0 unit 5 peer-unit 6
set logical-systems B interfaces lt-0/1/0 unit 5 family inet address 10.10.10.5/30
set logical-systems B interfaces lo0 unit 2 family inet address 192.163.6.4/32
set logical-systems B protocols bgp group internal-peers type internal
set logical-systems B protocols bgp group internal-peers local-address 192.163.6.4
set logical-systems B protocols bgp group internal-peers export send-direct
set logical-systems B protocols bgp group internal-peers neighbor 192.168.40.4
```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```
set logical-systems B protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems B protocols ospf area 0.0.0.0 interface lo0.2 passive
set logical-systems B protocols ospf area 0.0.0.0 interface lt-0/1/0.2
set logical-systems B protocols ospf area 0.0.0.0 interface lt-0/1/0.5
set logical-systems B policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems B policy-options policy-statement send-direct term 2 then accept
set logical-systems B routing-options router-id 192.163.6.4
set logical-systems B routing-options autonomous-system 17
set logical-systems C interfaces lt-0/1/0 unit 6 description to-B
set logical-systems C interfaces lt-0/1/0 unit 6 encapsulation ethernet
set logical-systems C interfaces lt-0/1/0 unit 6 peer-unit 5
set logical-systems C interfaces lt-0/1/0 unit 6 family inet address 10.10.10.6/30
set logical-systems C interfaces lo0 unit 3 family inet address 192.168.40.4/32
set logical-systems C protocols bgp group internal-peers type internal
set logical-systems C protocols bgp group internal-peers local-address 192.168.40.4
set logical-systems C protocols bgp group internal-peers export send-direct
set logical-systems C protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems C protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems C protocols ospf area 0.0.0.0 interface lo0.3 passive
set logical-systems C protocols ospf area 0.0.0.0 interface lt-0/1/0.6
set logical-systems C policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems C policy-options policy-statement send-direct term 2 then accept
set logical-systems C routing-options router-id 192.168.40.4
set logical-systems C routing-options autonomous-system 17
```

Device A

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure internal BGP peer sessions on Device A:

1. Configure the interfaces.

```
[edit logical-systems A interfaces lt-0/1/0 unit 1]
user@R1# set description to-B
user@R1# set encapsulation ethernet
user@R1# set peer-unit 2
user@R1# set family inet address 10.10.10.1/30
user@R1# set family inet address 192.168.6.5/32
user@R1# up
user@R1# up
[edit logical-systems A interfaces]
user@R1# set lo0 unit 1 family inet address 192.168.6.5/32
user@R1# exit
[edit]
user@R1# edit logical-systems B interfaces lt-0/1/0
[edit logical-systems B interfaces lt-0/1/0]
user@R1# set unit 2 description to-A
user@R1# set unit 2 encapsulation ethernet
```

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```
user@R1# set unit 2 peer-unit 1
user@R1# set unit 2 family inet address 10.10.10.2/30
user@R1# set unit 5 description to-C
user@R1# set unit 5 encapsulation ethernet
user@R1# set unit 5 peer-unit 6
user@R1# set family inet address 10.10.10.5/30
user@R1# up
[edit logical-systems B interfaces]
user@R1# set lo0 unit 2 family inet address 192.163.6.4/32
user@R1# exit
[edit]
user@R1# edit logical-systems C interfaces lt-0/1/0 unit 6
[edit logical-systems C interfaces lt-0/1/0 unit 6]
set description to-B
set encapsulation ethernet
set peer-unit 5
set family inet address 10.10.10.6/30
user@R1# up
user@R1# up
[edit logical-systems C interfaces]
set lo0 unit 3 family inet address 192.168.40.4/32
```

2. Configure BGP.

   On Logical System A, the **neighbor** statements are included for both Device B and Device C, even though Logical System A is not directly connected to Device C.

```
[edit logical-systems A protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.168.6.5
user@R1# set export send-direct
user@R1# set neighbor 192.163.6.4
user@R1# set neighbor 192.168.40.4
[edit logical-systems B protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.163.6.4
user@R1# set export send-direct
user@R1# set neighbor 192.168.40.4
user@R1# set neighbor 192.168.6.5
[edit logical-systems C protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.168.40.4
user@R1# set export send-direct
user@R1# set neighbor 192.163.6.4
user@R1# set neighbor 192.168.6.5
```

3. Configure OSPF.

```
[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface lt-0/1/0.1
[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.2 passive
```


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```
user@R1# set interface lt-0/1/0.2
user@R1# set interface lt-0/1/0.5
[edit logical-systems A protocols ospf area 0.0.0.0]
user@R1# set interface lo0.3 passive
user@R1# set interface lt-0/1/0.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit logical-systems A policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept
[edit logical-systems B policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept
[edit logical-systems C policy-options policy-statement send-direct term 2]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and the autonomous system (AS) number.

```
[edit logical-systems A routing-options]
user@R1# set router-id 192.168.6.5
user@R1# set autonomous-system 17
[edit logical-systems B routing-options]
user@R1# set router-id 192.163.6.4
user@R1# set autonomous-system 17
[edit logical-systems C routing-options]
user@R1# set router-id 192.168.40.4
user@R1# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show logical-systems** command. If the output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@R1# show logical-systems
A {
   interfaces {
      lt-0/1/0 {
         unit 1 {
            description to-B;
            encapsulation ethernet;
            peer-unit 2;
            family inet {
               address 10.10.10.1/30;
            }
         }
      }
```

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```
    lo0 {
      unit 1 {
        family inet {
          address 192.168.6.5/32;
        }
      }
    }
  }
  protocols {
    bgp {
      group internal-peers {
        type internal;
        local-address 192.168.6.5;
        export send-direct;
        neighbor 192.163.6.4;
        neighbor 192.168.40.4;
      }
    }
    ospf {
      area 0.0.0.0 {
        interface lo0.1 {
          passive;
        }
        interface lt-0/1/0.1;
      }
    }
  }
  policy-options {
    policy-statement send-direct {
      term 2 {
        from protocol direct;
        then accept;
      }
    }
  }
  routing-options {
    router-id 192.168.6.5;
    autonomous-system 17;
  }
}
B {
  interfaces {
    lt-0/1/0 {
      unit 2 {
        description to-A;
        encapsulation ethernet;
        peer-unit 1;
        family inet {
          address 10.10.10.2/30;
        }
      }
      unit 5 {
        description to-C;
        encapsulation ethernet;
        peer-unit 6;
```


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```
            family inet {
              address 10.10.10.5/30;
            }
          }
        }
        lo0 {
          unit 2 {
            family inet {
              address 192.163.6.4/32;
            }
          }
        }
      }
      protocols {
        bgp {
          group internal-peers {
            type internal;
            local-address 192.163.6.4;
            export send-direct;
            neighbor 192.168.40.4;
            neighbor 192.168.6.5;
          }
        }
        ospf {
          area 0.0.0.0 {
            interface lo0.2 {
              passive;
            }
            interface lt-0/1/0.2;
            interface lt-0/1/0.5;
          }
        }
      }
      policy-options {
        policy-statement send-direct {
          term 2 {
            from protocol direct;
            then accept;
          }
        }
      }
      routing-options {
        router-id 192.163.6.4;
        autonomous-system 17;
      }
    }
    C {
      interfaces {
        lt-0/1/0 {
          unit 6 {
            description to-B;
            encapsulation ethernet;
            peer-unit 5;
            family inet {
              address 10.10.10.6/30;
```

```
            }
          }
        }
        lo0 {
          unit 3 {
            family inet {
              address 192.168.40.4/32;
            }
          }
        }
      }
      protocols {
        bgp {
          group internal-peers {
            type internal;
            local-address 192.168.40.4;
            export send-direct;
            neighbor 192.163.6.4;
            neighbor 192.168.6.5;
          }
        }
        ospf {
          area 0.0.0.0 {
            interface lo0.3 {
              passive;
            }
            interface lt-0/1/0.6;
          }
        }
      }
      policy-options {
        policy-statement send-direct {
          term 2 {
            from protocol direct;
            then accept;
          }
        }
      }
      routing-options {
        router-id 192.168.40.4;
        autonomous-system 17;
      }
    }
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 71
- Verifying BGP Groups on page 72

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- Verifying BGP Summary Information on page 72
- Verifying That BGP Routes Are Installed in the Routing Table on page 73

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

Action From the operational mode, enter the **show bgp neighbor** command.

```
user@R1> show bgp neighbor logical-system A
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+58852 AS 17
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: <Preference LocalAddress Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            3
    Accepted prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 16   Sent 1    Checked 63
  Input messages:  Total 15713  Updates 4       Refreshes 0     Octets 298622
  Output messages: Total 15690  Updates 2       Refreshes 0     Octets 298222
  Output Queue[0]: 0

Peer: 192.168.40.4+179 AS 17   Local: 192.168.6.5+56466 AS 17
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct ]
  Options: <Preference LocalAddress Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
```

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```
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            2
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 15   Sent 22   Checked 68
  Input messages:  Total 15688  Updates 2       Refreshes 0     Octets 298111
  Output messages: Total 15688  Updates 2       Refreshes 0     Octets 298184
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From the operational mode, enter the **show bgp group** command.

```
user@A> show bgp group logical-system A
```

```
Group Type: Internal    AS: 17                     Local AS: 17
  Name: internal-peers  Index: 0                   Flags: <Export Eval>
  Export: [ send-direct ]
  Holdtime: 0
  Total peers: 2        Established: 2
  192.163.6.4+179
  192.168.40.4+179
  inet.0: 0/5/5/0

Groups: 1  Peers: 2    External: 0    Internal: 2    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

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Action From the operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary logical-system A
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 5          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17      15723      15700       0       0 4d 22:13:15
0/3/3/0              0/0/0/0
192.168.40.4             17      15698      15699       0       0 4d 22:13:11
0/2/2/0              0/0/0/0
```

Verifying That BGP Routes Are Installed in the Routing Table

Purpose Verify that the export policy configuration is working.

Action From the operational mode, enter the **show route protocol bgp** command.

```
user@A> show route protocol bgp logical-system A
inet.0: 7 destinations, 12 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30       [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
10.10.10.4/30       [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
                    [BGP/170] 4d 11:03:10, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
192.163.6.4/32      [BGP/170] 4d 11:05:55, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
192.168.40.4/32     [BGP/170] 4d 11:03:10, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via lt-0/1/0.1
```

Related Documentation

- Understanding Internal BGP Peering Sessions on page 49
- BGP Configuration Overview on page 13

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PART 3

Configuring BGP Route Prioritization

- Configuring BGP Route Prioritization on page 77

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CHAPTER 4

Configuring BGP Route Prioritization

- Understanding BGP Route Prioritization on page 77
- Example: Configuring the BGP Output Priority Scheduler and Global Address Family Priority on page 81
- Example: Controlling Routing Table Convergence Using BGP Route Prioritization on page 87

Understanding BGP Route Prioritization

While BGP is one of the most widely deployed routing protocols in use today, carrying not only network layer reachability information (NLRI) but also many types of VPN reachability information, it is notable that the protocol does not specify how the information is ordered in BGP update messages. This decision is left to the implementation.

In large-scale systems, BGP might take a significant amount of time to exchange its routing information between systems. This is especially true during BGP startup, route refresh operations, and when assisting with *graceful restart.* In order to handle the large amount of information that needs to be processed, BGP route processing is accomplished with the use of queues. Outbound routes are placed in output queues for processing. BGP route prioritization is introduced in Junos OS Release 16.1 as a means to allow the user to deterministically prioritize BGP update messages. BGP route prioritization is a process that operates strictly on the output queues., helping to order the information that is being sent to BGP peer routers.

In the default configuration, that is, when no **output-queue-priority** configuration or policy that overrides priority exists, the routing protocol process (rpd) enqueues BGP routes into the output queue per routing information base (RIB). A RIB, which is also known as a routing table, corresponds to both a specific address family, such as inet.0, and to routing instance tables such as vrf.inet.0. While processing output queues, the BGP update code flushes the output queue for the current RIB before moving on to the next RIB that has a non-empty output queue.

Because of the default behavior, any specific RIB that continues to grow while being processed can lead to starvation (lack of route update processing) in other RIBs. It also means that specific NLRI that is more important than other NLRI might be queued behind a long list of other route processing work in a nondeterministic manner.

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NOTE: There is no attempt to automatically prioritize routes even if there is a theoretical possibility of doing so. Prioritizing individual routes is, therefore, left completely to the user.

Use Cases for BGP Route Prioritization

Table 3 on page 78 shows the types of routes that would benefit from route prioritization and some notes about why they would benefit from it. Examples of those types of routes are also included. Prioritizing these routes within a given large-scale environment can help routers to react more quickly to important route changes.

Table 3: Use Cases for BGP Route Prioritization

Route or Update Type	Notes	Example
Prefixes used for resolving BGP next hops to an immediate forwarding next hop	Changes to these prefixes should be made as soon as possible.	• Host routes • Prefixes that are part of recursive resolution requirements
Routes used for tunnel endpoints	Tunnel endpoints such as GRE or MPLS are often used as BGP next hops.	BGP labeled unicast routes
Route types that are critical for the operation of a protocol feature	For some VPN protocols, certain route types are used to trigger time sensitive changes within the protocol. Changes to these routes must be made as soon as possible.	• MVPN Source Active Autodiscovery (Type 5) • Multihomed VPLS sites
Service provider infrastructure routes	These routes are critical to a service provider's ability to conduct business. Without accurate and up-to-date routes, the service provider might not be able to provide some of its service offerings.	• Internal management networks • Network operations prefixes • DNS resources
Network topology changes	These should be prioritized ahead of simple route refreshes.	• New router added to the network • Routers removed from the network
Address family prioritization	Some service providers simply have different preferences than others in regard to address family priority.	You might prefer to have Layer 3 VPNs converge prior to the Internet RIB. Another service provider might prefer that the Internet RIB converge first.

Properties of BGP Route Prioritization

BGP route prioritization in Junos OS is implemented using a set of 17 prioritized (numbered) output queues that are serviced by a user-configurable token mechanism. This section describes the prioritized output queues, the operation of the token system, and assignment of routes to queues.

Prioritized Output Queues

Table 4 on page 79 shows the available output queues and their function within the prioritization system. The prioritization system functions on a traditional low, medium, and high priority scale with 1 being the lowest priority and 16 being the highest priority.

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Table 4: Prioritized Output Queues

Queue	Function
expedited	This is the highest priority output queue. Routes in this class are guaranteed some portion of the output queue processing while flushing the output queue. This queue has no number and is referred to in the configuration by its name.
1 (lowest priority)	This is the lowest priority output queue. This is the default priority queue, meaning that routes with no explicit queue assignment from either automatic protocol determination or user policy are placed in this queue by default. Route refresh messages are placed in this queue by default.
2 - 16 (low - high priority)	These output queues range in priority from lowest priority (2) to highest priority (16). They are assigned routes based on user policy or BGP peer configuration. Routes in a higher priority output queue can preempt the routes in lower priority queues.

Assignment of Routes to Queues

Assigning routes to the various queues can be accomplished by setting and assigning BGP export policies. This means that route priority can vary in each BGP peer group as well as in specific neighbor configurations within the BGP peer groups. You can also assign routes to queues using the action portion of a policy statement. Assignment of routes to queues by the action of a policy statement will override assignments made by BGP configuration.

Work Token Mechanism

Tokens correspond to the work to create a BGP update message. All the queues are assigned tokens that are stored in buckets. The number of tokens in a given bucket is user-configurable. In this way, users can craft policies that permit their routes to be served in the proportions they prefer. The configuration of the priority scheduler is accomplished globally within BGP at the **[edit protocols bgp]** hierarchy level. By default, all priority queues have at least 1 token in their bucket to ensure that misconfigured priorities do not starve.

Understanding Queue Priority and Fairness

The scheme used by BGP route prioritization focuses on two elements: fairness and priority:

- Fairness means that when there is work to do in any given queue, other queues are guaranteed to get some work done at some point. How much work each queue is permitted to get done is determined by the number of tokens assigned to each priority.
- Priority means that when there is competing work and fairness has been ensured, to always choose the more important work.

For example, presume three classes of priority: low, medium, and high. These could be assigned to queues 1, 2, and 3, respectively. Alternatively, they could be assigned to queues 3, 6, and 9. For fairness, if the decision is that high priority gets 50% of the available work, medium gets 35%, and low gets the remaining 15%, tokens can be assigned as 50 to high, 35 to medium, and 15 to low. Alternatively, tokens can be assigned as 5 to high, 4 to medium, and 2 to low. You can assign any of the 17 queues any value between 1 and

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100. The ratio of the number of tokens in a single queue to the total number of tokens in all queues gives the percentage of work that will be done in each queue.

Priority is most important when work appears in a queue while tokens are in the process of being spent in another queue by the work scheduler. Table 5 on page 80 shows the starting point for an example of this.

Table 5: Queues and Tokens

Priority Queue (Queue Number)	Number of Tokens Assigned to Queue	Number of Tokens Left in Queue	Number of Entries in Queue
High (9)	50	50	0
Medium (6)	35	15	5000
Low (3)	15	15	10000

If we assume that the work scheduler is processing the medium queue (queue number 6) and has spent 20 tokens, then there are 15 tokens left to be spent on the remaining entries in the medium queue and 15 tokens left to be spent in the low priority queue. If 5 entries arrive in the expedited queue prior to the next run of the work scheduler, those 5 entries will be sent first because there are still 50 tokens left in the expedited queue.

Queue Servicing Procedure

The queue servicing procedure operates per-BGP peer group with each group maintaining its own token buckets.

- Token buckets for each priority start full either at the configured number of tokens or at the default of 1.
- Each time a route entry is pulled from a queue to start a BGP update, a token is subtracted from that queue.
- While the expedited queue has tokens, every other queue entry is drawn from the expedited queue, subject to the route packing rules.
- Entries are taken from the queue that has the highest priority. This means that if entries are added to a higher priority queue between runs of the queue servicing mechanism, and there are tokens available in that higher priority queue, the new entries in the higher priority queue are sent first, thus preempting entries in lower priority queues. If the higher priority queue has no work tokens available when the new entries arrive, the new entries are not sent until after the next token refresh.
- Tokens are refreshed after all priority queues have been serviced (there are no entries remaining in any queue) or when all tokens are exhausted.

Address Family Prioritization

By default, there is no preferential treatment of NLRI for any given address family. Additionally, route refresh and topology change updates are, by default, treated as the lowest priority (1). You can configure individual address families to be output, refreshed,

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or withdrawn at higher priority levels by assigning them to specific output queues in their respective configuration hierarchies. Address family prioritization is configured at the **[edit protocols bgp** In this way, certain address families can receive higher priorities than others.

Related Documentation

- Example: Controlling Routing Table Convergence Using BGP Route Prioritization on page 87
- Example: Configuring the BGP Output Priority Scheduler and Global Address Family Priority on page 81

Example: Configuring the BGP Output Priority Scheduler and Global Address Family Priority

This example shows how to configure and test the system-wide BGP route priority scheduler.

- Requirements on page 81
- Overview on page 81
- Configuration on page 82
- Configure Global Output Priorities for a Route Family on page 84
- Configure a BGP Group Named test1 on page 84
- Verification on page 84

Requirements

This example uses the following hardware and software components:

- An MX Series router (R1) running Junos OS Release 16.1 or later

Before you configure the BGP route prioritization scheduler, be sure that the BGP protocol is running on the router.

Overview

The BGP route priority scheduler is used to control the amount of work done within the 17 output queues of the route prioritization system. The system uses a set of 17 prioritized output queues, per routing instance to which work tokens are assigned. All 17 prioritized output queues (1-16 and expedited) have 1 token assigned by default. Any number of tokens between 1 and 100 can be assigned to each of the 17 queues. Assigning tokens to the queues allows you to balance the amount of work performed on the routes within the queues. In addition, default settings for high, medium, and low priority queuing can be configured by assigning each keyword to a specific numbered output queue. In this example, we will configure each of the 17 priority queues with distinct numbers of work tokens and we also configure global output priorities for inet unicast routes and demonstrate inheritance by setting up some BGP groups to override global priority settings.

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Configuration

- Assign **update-tokens** to each of the 17 output queues.
- Specify which numbered queues will be used as the default **high**, **medium**, and **low** priority queues.
- Configure global output priorities for **inet unicast** routes.
- Configure a BGP group named test1 that will show group override capabilities.
- Configure a BGP group named test2 that will show global inheritance.

- Configuring the Individual Output Priority Queues on page 83
- Configure Default Queues to Use for High, Medium, and Low Priority Route Updates on page 83
- Results on page 83

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp output-queue-priority expedited update-tokens 100
set protocols bgp output-queue-priority priority 1 update-tokens 1
set protocols bgp output-queue-priority priority 2 update-tokens 10
set protocols bgp output-queue-priority priority 3 update-tokens 15
set protocols bgp output-queue-priority priority 4 update-tokens 20
set protocols bgp output-queue-priority priority 5 update-tokens 25
set protocols bgp output-queue-priority priority 6 update-tokens 30
set protocols bgp output-queue-priority priority 7 update-tokens 35
set protocols bgp output-queue-priority priority 8 update-tokens 40
set protocols bgp output-queue-priority priority 9 update-tokens 45
set protocols bgp output-queue-priority priority 10 update-tokens 50
set protocols bgp output-queue-priority priority 11 update-tokens 55
set protocols bgp output-queue-priority priority 12 update-tokens 60
set protocols bgp output-queue-priority priority 13 update-tokens 65
set protocols bgp output-queue-priority priority 14 update-tokens 70
set protocols bgp output-queue-priority priority 15 update-tokens 75
set protocols bgp output-queue-priority priority 16 update-tokens 80
set protocols bgp output-queue-priority defaults low priority 1
set protocols bgp output-queue-priority defaults medium priority 10
set protocols bgp output-queue-priority defaults high expedited
set protocols bgp group reflector local-address 198.51.100.140
set protocols bgp family inet unicast output-queue-priority priority 1
set protocols bgp family inet unicast route-refresh-priority priority 2
set protocols bgp family inet unicast withdraw-priority priority 3
set protocols bgp group test1 family inet unicast output-queue-priority priority 4
set protocols bgp group test1 family inet unicast route-refresh-priority priority 6
set protocols bgp group test1 peer-as 64511 set protocols bgp group test1 local-as 64511
set protocols bgp group test1 neighbor 224.223.1.1
set protocols bgp group test1 neighbor 224.223.2.2 family inet unicast output-queue-priority
  priority 7
```


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```
set protocols bgp group test1 neighbor 224.223.2.2 family inet unicast route-refresh-priority
    priority 8
set protocols bgp group test1 neighbor 224.223.2.2 family inet unicast withdraw-priority
    expedited
set protocols bgp group test2 peer-as 64513
set protocols bgp group test2 local-as 64511
set protocols bgp group test2 neighbor 224.223.3.3
```

Configuring the Individual Output Priority Queues

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Assign update tokens to each of the 17 prioritized output queues

```
[edit protocols bgp output-queue-priority]
user@R1# set expedited update-tokens 100
user@R1# set priority 1 update-tokens 1
user@R1# set priority 2 update-tokens 10
user@R1# set priority 3 update-tokens 15
user@R1# set priority 4 update-tokens 20
user@R1# set priority 5 update-tokens 25
user@R1# set priority 6 update-tokens 30
user@R1# set priority 7 update-tokens 35
user@R1# set priority 8 update-tokens 40
user@R1# set priority 9 update-tokens 45
user@R1# set priority 10 update-tokens 50
user@R1# set priority 11 update-tokens 55
user@R1# set priority 12 update-tokens 60
user@R1# set priority 13 update-tokens 65
user@R1# set priority 14 update-tokens 70
user@R1# set priority 15 update-tokens 75
user@R1# set priority 16 update-tokens 80
```

Configure Default Queues to Use for High, Medium, and Low Priority Route Updates

Step-by-Step Procedure

1.
```
[edit protocols bgp output-queue-priority]
user@R1# set defaults low priority 1
user@R1# set defaults medium priority 10
user@R1# set defaults high expedited
```

Results

To confirm the configuration, issue the **show bgp output-scheduler** command from operational mode:

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Configure Global Output Priorities for a Route Family

Step-by-Step Procedure

1. Configure the global **output-queue-priority** for **inet unicast** routes:

```
[edit bgp family inet unicast]
user@R1# set output-queue-priority priority 1
user@R1# set route-refresh-priority priority 2
user@R1# set withdraw-priority priority 3
```

Configure a BGP Group Named test1

Step-by-Step Procedure

1. Configure the group **test1** to override global output priorities and include one neighbor that overrides the group and one neighbor that does not.

```
[edit protocols bgp group test1]
user@R1# set family inet unicast output-queue-priority priority 4
user@R1# set family inet unicast route-refresh-priority priority 6
user@R1# set peer-as 64511
user@R1# set local-as 64511
user@R1# set neighbor 224.223.1.1
user@R1# set neighbor 224.223.2.2 family inet unicast output-queue-priority priority
  7
user@R1# set neighbor 224.223.2.2 family inet unicast route-refresh-priority priority
  8
user@R1# set neighbor 224.223.2.2 family inet unicast withdraw-priority expedited
```

Configure a BGP Group Named test2

Step-by-Step Procedure

1. Configure the BGP group **test2** to accept global defaults.

```
[edit protocols bgp group test2]
user@R1# set peer-as 64513
user@R1# set local-as 64511
user@R1# set neighbor 224.223.3.3
```

Verification

Verifying the BGP Output Scheduler Configuration

Purpose To verify the configuration of the BGP output scheduler, issue the **show bgp output-scheduler** command from operational mode.

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Action `user@R1>` **show bgp output-scheduler**

```
user@R1> show bgp output-scheduler
Instance: master
  Class         Tokens
  ------------  ------
  Priority  1        1
  Priority  2       10
  Priority  3       15
  Priority  4       20
  Priority  5       25
  Priority  6       30
  Priority  7       35
  Priority  8       40
  Priority  9       45
  Priority 10       50
  Priority 11       55
  Priority 12       60
  Priority 13       65
  Priority 14       70
  Priority 15       75
  Priority 16       80
  Expedited        100

  Priority  Class
  --------  ------------
  low       Priority  1
  medium    Priority 10
  high      Expedited
```

Meaning The output shows that the output scheduler configuration was successful in applying the proper number of tokens to each output queue and that the high, medium, and low priority keywords were assigned to the proper output queues.

Verify Group Configuration, Group Override, and Neighbor Override

Purpose To verify that the configured groups demonstrate group override, neighbor override and inheritance, issue the **show bgp group *group-name*** command from operational mode.

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Action

```
user@R1> show bgp group test1
Group Type: Internal    AS: 64511                 Local AS: 64511
  Name: test1           Index: 2                  Flags: <>
  Options: <LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
 OutQ: priority 7 RRQ: priority 8 WDQ: expedited
  Local AS: 64511 Local System AS: 64511
  Total peers: 1        Established: 0
  224.223.2.2

Group Type: Internal    AS: 64511                 Local AS: 64511
  Name: test1           Index: 1                  Flags: <Export Eval>
  Options: <LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
 OutQ: priority 4 RRQ: priority 6 WDQ: priority 3
  Local AS: 64511 Local System AS: 64511
  Total peers: 1        Established: 0
  224.223.1.1
```

Meaning The output shows that the output queue priority for peer 224.223.2.2 is 7, the route refresh priority is 8, and the withdraw priority is expedited. While the output queue priority for neighbor 224.223.1.1 is 4, the route refresh priority is 6, and the withdraw priority is the default setting for the family **inet unicast**, or 3.

Verify Inheritance from Global Priority Settings

Purpose To verify that groups that are not configured to override the global BGP route prioritization settings, issue the **show bgp group *group-name*** command at the operational level.

Action

```
user@R1> show bgp group test2
Group Type: External                              Local AS: 64511
  Name: test2           Index: 3                  Flags: <Export Eval>
  Options: <LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
 OutQ: priority 1 RRQ: priority 2 WDQ: priority 3
  Local AS: 64511 Local System AS: 64511
  Total peers: 1        Established: 0
  224.223.3.3
```

Meaning The output shows that the default route priorities for **inet unicast** routes in the **test2** group match the global configuration.

Related Documentation

- Example: Controlling Routing Table Convergence Using BGP Route Prioritization on page 87

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Example: Controlling Routing Table Convergence Using BGP Route Prioritization

The following example configures BGP route prioritization in order to allow **inet labeled-unicast** routes to converge before **inet unicast** routes.

- Requirements on page 87
- Overview on page 87
- Configure BGP Route Prioritization on page 87
- Verification on page 90

Requirements

This example uses the following hardware and software components:

- An MX-Series router (R1) running Junos OS Release 16.1 or later that will be the focus of the example.
- A second router (R2) configured as an internal BGP peer with R1.
- A BGP route reflector (RR) that will be used to populate the routing tables of R1. In this example, we will not configure the route reflector.

Overview

The BGP route prioritization feature is designed to allow the prioritization of outbound BGP update messages in a router. Using BGP route prioritization enables the user to ensure that more important BGP route updates, such as GRE or MPLS tunnel endpoint changes, are sent out before less important BGP route updates, such as route refresh updates.

In this example, we will configure R1 to treat **inet labeled-unicast** route updates to R2 as higher priority than **inet unicast** route updates. To do this, we will configure the R2 router to accept both **inet unicast** and **inet labeled-unicast** routes from its peer router, R1. Then we will populate the **inet.0** routing table on R1 from a route reflector and import a portion of that table into the **labeled-unicast** table, **inet.3** using **rib-group** import. As the routes are queued on R1, we can validate the operation by observing whether the routes in the **inet.3** RIB are flushed before the remainder of the routes in the **inet.0** RIB.

Configure BGP Route Prioritization

Configure R2 as a BGP peer of R1.

On R1:

- Configure the router R2 as a peer of router R1.
- Create a BGP group named reflector that will be used to obtain Internet routes from a route reflector.
- Create a BGP group named internal that will be used for assigning the labeled-unicast traffic to a higher priority output-queue.

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- Create a RIB group into which the routes received from the reflector are imported.
- Create the policy that determines what portion of the **inet.0** RIB is imported into the RIB group.
- [xref target has no title]

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router R2

```
set protocols bgp group internal type internal
set protocols bgp group internal family inet unicast
set protocols bgp group internal family inet labeled-unicast rib inet.3
set protocols bgp group internal peer-as 64511
set protocols bgp group internal local-as 64511
set protocols bgp group internal neighbor 192.0.2.1
```

Router R1

```
set protocols bgp group internal type internal
set protocols bgp group internal hold-time 900
set protocols bgp group internal family inet unicast withdraw-priority expedited
set protocols bgp group internal family inet labeled-unicast output-queue-priority priority
  2
set protocols bgp group internal family inet labeled-unicast rib inet.3
set protocols bgp group internal family inet-vpn unicast
set protocols bgp group internal local-as 64511
set protocols bgp group internal neighbor 192.0.2.2 local-address 192.0.2.1
set protocols bgp group reflector local-address 203.0.113.225
set protocols bgp group reflector family inet unicast rib-group into3
set protocols bgp group reflector peer-as 64500
set protocols bgp group reflector local-as 64496
set protocols bgp group reflector neighbor 192.51.100.71 multihop
set policy-options policy-statement match-all then accept
set routing-options rib-groups into3 import-rib inet.0
set routing-options rib-groups into3 import-rib inet.3
set routing-options rib-groups into3 import-policy match-long
set policy-options policy-statement match-long term a from route-filter 192.0.0.0/8
  prefix-length-range /20-/24
set policy-options policy-statement match-long term a then accept
set policy-options policy-statement match-long then reject
set policy-options policy-statement match-all then accept
```


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Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure R2:

1. Configure a BGP group named internal.

```
[edit protocols bgp group internal]
user@R2# set type internal
user@R2# set family inet unicast
user@R2# set family inet labeled-unicast rib inet.3
user@R2# set peer-as 64511
user@R2# set local-as 64511
user@R2# set neighbor 192.0.2.1
```

Step-by-Step Procedure

To configure R1:

1. Configure a BGP group named reflector that receives routes from the RR.

```
[edit protocols bgp group reflector]
user@R1# set local-address 203.0.113.225
user@R1# set family inet unicast rib-group into3
user@R1# set peer-as 64500
user@R1# set local-as 64496
user@R1# set neighbor 192.51.100.71 multihop
```

2. Configure a BGP group named internal

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set hold-time 900
user@R1# set family inet unicast withdraw-priority expedited
user@R1# set family inet labeled-unicast output-queue-priority priority 2
user@R1# set family inet labeled-unicast rib inet.3
user@R1# set family inet-vpn unicast
user@R1# set local-as 64511
user@R1# set neighbor 192.0.2.2 local-address 192.0.2.1
```

3. Configure a RIB group named into3

```
[edit routing-options rib-groups into3]
user@R1# set import-rib inet.0
user@R1# set import-rib inet.3
user@R1# set import-policy match-long
```

4. Configure a routing policy named match-long

```
[edit policy-options policy-statement match-long]
```

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```
user@R1# set term a from route-filter 192.0.0.0/8 prefix-length-range /20-/24
user@R1# set term a then accept
user@R1# set then reject
```

5. Configure a routing policy named match-all

```
[edit policy-options policy-statement match-all]
user@R1# set then accept
```

Verification

Verifying that Neighbor Updates are Properly Prioritized

Purpose To confirm that route updates are being placed in the proper queues and that the queues are updating.

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Action To see the route updates that are queued for the BGP neighbor 192.0.2.2, issue the **show bgp neighbor output-queue 192.0.2.2** command from operational mode

```
user@R1> show bgp neighbor output-queue 192.0.2.2
Peer: 192.0.2.2+179 AS 64511 Local: 192.0.2.1+63704 AS 64511
Output Queue[0]: 502701 (inet.0, inet-unicast)
Priority 1 : 502701
Priority 2 : 0
Priority 3 : 0
Priority 4 : 0
Priority 5 : 0
Priority 6 : 0
Priority 7 : 0
Priority 8 : 0
Priority 9 : 0
Priority 10: 0
Priority 11: 0
Priority 12: 0
Priority 13: 0
Priority 14: 0
Priority 15: 0
Priority 16: 0
Expedited : 0
```

```
user@R1> show bgp neighbor output-queue 192.0.2.2
Peer: 192.0.2.2+179 AS 64511 Local: 192.0.2.1+63704 AS 64511
Output Queue[1]: 6687 (inet.3, inet-labeled-unicast)
Priority 1 : 0
Priority 2 : 6687
Priority 3 : 0
Priority 4 : 0
Priority 5 : 0
Priority 6 : 0
Priority 7 : 0
Priority 8 : 0
Priority 9 : 0
Priority 10: 0
Priority 11: 0
Priority 12: 0
Priority 13: 0
Priority 14: 0
Priority 15: 0
Priority 16: 0
Expedited : 0
```

```
user@R1> show bgp neighbor output-queue 192.0.2.2
Peer: 192.0.2.2+179 AS 64511 Local: 192.0.2.1+63704 AS 64511
Output Queue[0]: 491187 (inet.0, inet-unicast)
Priority 1 : 491187
Priority 2 : 0
Priority 3 : 0
Priority 4 : 0
Priority 5 : 0
Priority 6 : 0
Priority 7 : 0
Priority 8 : 0
```

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```
Priority 9 : 0
Priority 10: 0
Priority 11: 0
Priority 12: 0
Priority 13: 0
Priority 14: 0
Priority 15: 0
Priority 16: 0
Expedited : 0
```

```
user@R1> show bgp neighbor output-queue 192.0.2.2
```

```
Peer: 192.0.2.2+179 AS 64511 Local: 192.0.2.1+63704 AS 64511
Output Queue[1]: 0 (inet.3, inet-labeled-unicast)
Priority 1 : 0
Priority 2 : 0
Priority 3 : 0
Priority 4 : 0
Priority 5 : 0
Priority 6 : 0
Priority 7 : 0
Priority 8 : 0
Priority 9 : 0
Priority 10: 0
Priority 11: 0
Priority 12: 0
Priority 13: 0
Priority 14: 0
Priority 15: 0
Priority 16: 0
Expedited : 0
```

Meaning The output from **show bgp neighbor output-queue 192.0.2.2** shows that the labeled unicast route updates are placed in the priority 2 output queue and that the priority 2 output queue is emptied before the unicast route updates that are in the priority 1 output queue.

Related Documentation

- Example: Configuring the BGP Output Priority Scheduler and Global Address Family Priority on page 81
- Understanding BGP Route Prioritization on page 77

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PART 4

Configuring BGP Session Attributes

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- Connecting to Autonomous Systems on page 197
- Configuring the Local Preference for BGP Routes on page 219
- Configuring the MED Attribute for BGP on page 255
- Configuring BGP Multihop Sessions on page 299

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CHAPTER 5

Configuring Autonomous Systems for BGP Sessions

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- Example: Configuring a Local AS for EBGP Sessions on page 100
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- Understanding AS Override on page 160
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- Understanding Private AS Number Removal from AS Paths on page 188
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Understanding the BGP Local AS Attribute

When an Internet service provider (ISP) acquires a network that belongs to a different autonomous system (AS), there is no seamless method for moving the BGP peers of the acquired network to the AS of the acquiring ISP. The process of configuring the BGP peers with the new AS number can be time-consuming and cumbersome. Sometimes customers do not want to or are not immediately able to modify their peer arrangements or configuration. During this kind of transition period, it can be useful to configure BGP-enabled devices in the new AS to use the former AS number in BGP updates. This former AS number is called a *local AS*.

Using a local AS number permits the routing devices in an acquired network to appear to belong to the former AS.

For example, ISP A, with an AS of 200, acquires ISP B, with an AS of 250. ISP B has a customer, ISP C, that does not want to change its configuration. After ISP B becomes part of ISP A, a local AS number of 250 is configured for use in EBGP peer sessions with ISP C. Consequently, the local AS number of 250 is either prepended before or used

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instead of the global AS number of 200 in the AS path used to export routes to direct external peers in ISP C.

If the route is received from an internal BGP (IBGP) peer, the AS path includes the local AS number prepended before the global AS number.

The local AS number is used instead of the global AS number if the route is an external route, such as a static route or an interior gateway protocol (IGP) route that is imported into BGP. If the route is external and you want the global AS number to be included in the AS path, you can apply a routing policy that uses **as-path-expand** or **as-path-prepend**. Use the **as-path-expand** policy action to place the global AS number behind the local AS number. Use the **as-path-prepend** policy action to place the global AS number in front of the local AS number.

For example:

```
user@R2# show policy-options
policy-statement prepend-global {
   term 1 {
      from protocol static;
      then {
         as-path-prepend 200; # or use as-path-expand
         accept;
      }
   }
}
```

```
user@R2# show protocols bgp
group ext {
   export prepend-global;
   type external;
   local-as 250;
   neighbor 10.0.0.1 {
      peer-as 100;
   }
   neighbor 10.1.0.2 {
      peer-as 300;
   }
}
```

```
user@R2# show routing-options
static {
   route 1.1.1.1/32 next-hop 10.0.0.1;
}
autonomous-system 200;
```

```
user@R3#  run show route 1.1.1.1 protocol bgp
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.1/32         *[BGP/170] 00:05:11, localpref 100
                      AS path: 200 250 I, validation-state: unverified
                    > to 10.1.0.1 via lt-1/2/0.4
```


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In a Layer 3 VPN scenario, in which a provider edge (PE) device uses external BGP (EBGP) to peer with a customer edge (CE) device, the **local-as** statement behaves differently than in the non-VPN scenario. In the VPN scenario, the global AS number defined in the master instance is prepended to the AS path by default. To override this behavior, you can configure the **no-prepend-global-as** in the routing-instance BGP configuration on the PE device, as shown here:

```
user@R2# show routing-instances
red {
   instance-type vrf;
   interface fe-1/2/0.2;
   route-distinguisher 2:1;
   vrf-target target:2:1;
   protocols {
      bgp {
         group toR1 {
            type external;
            peer-as 1;
            local-as 200 no-prepend-global-as;
            neighbor 10.1.1.1;
         }
      }
   }
}
```

The Junos operating system (Junos OS) implementation of the local AS attribute supports the following options:

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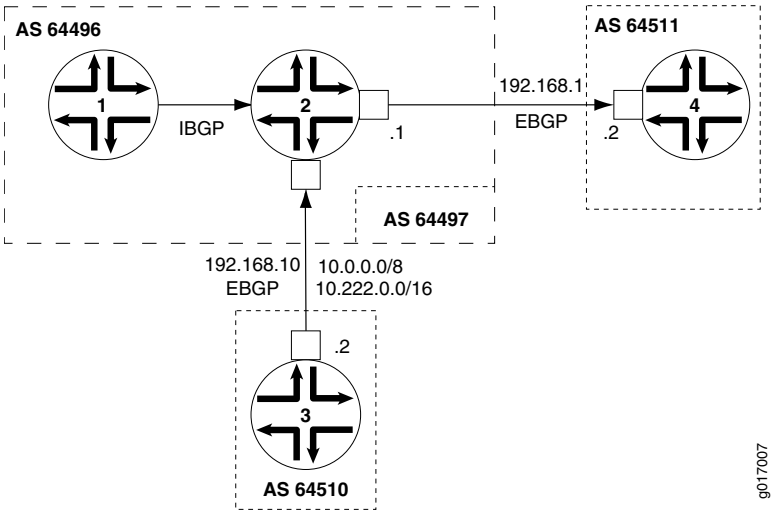
- **Local AS with private option**—When you use the **private** option, the local AS is used during the establishment of the BGP session with an EBGP neighbor but is hidden in the AS path sent to other EBGP peers. Only the global AS is included in the AS path sent to external peers.

  The **private** option is useful for establishing local peering with routing devices that remain configured with their former AS or with a specific customer that has not yet modified its peer arrangements. The local AS is used to establish the BGP session with the EBGP neighbor but is hidden in the AS path sent to external peers in another AS.

  Include the **private** option so that the local AS is not prepended before the global AS in the AS path sent to external peers. When you specify the **private** option, the local AS is prepended only in the AS path sent to the EBGP neighbor.

  For example, in Figure 8 on page 98, Router 1 and Router 2 are in AS 64496, Router 4 is in AS 64511, and Router 3 is in AS 64510. Router 2 formerly belonged to AS 64497, which has merged with another network and now belongs to AS 64496. Because Router 3 still peers with Router 2 using its former AS (64497), Router 2 needs to be configured with a local AS of 64497 in order to maintain peering with Router 3. Configuring a local AS of 64497 permits Router 2 to add AS 64497 when advertising routes to Router 3. Router 3 sees an AS path of 64497 64496 for the prefix 10/8.

Figure 8: Local AS Configuration



  To prevent Router 2 from adding the local AS number in its announcements to other peers, use the **local-as 64497 private** statement. This statement configures Router 2 to not include local AS 64497 when announcing routes to Router 1 and to Router 4. In this case, Router 4 sees an AS path of 64496 64510 for the prefix 10.222/16.

- **Local AS with alias option**—In Junos OS Release 9.5 and later, you can configure a local AS as an alias. During the establishment of the BGP open session, the AS used in the open message alternates between the local AS and the global AS. If the local AS is used to connect with the EBGP neighbor, then only the local AS is prepended to the AS path when the BGP peer session is established. If the global AS is used to connect with the EBGP neighbor, then only the global AS is prepended to the AS path when the BGP peer session is established. The use of the **alias** option also means that

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the local AS is not prepended to the AS path for any routes learned from that EBGP neighbor. Therefore, the local AS remains hidden from other external peers.

Configuring a local AS with the **alias** option is especially useful when you are migrating the routing devices in an acquired network to the new AS. During the migration process, some routing devices might be configured with the new AS while others remain configured with the former AS. For example, it is good practice to start by first migrating to the new AS any routing devices that function as route reflectors. However, as you migrate the route reflector clients incrementally, each route reflector has to peer with routing devices configured with the former AS, as well as peer with routing devices configured with the new AS. To establish local peer sessions, it can be useful for the BGP peers in the network to use both the local AS and the global AS. At the same time, you want to hide this local AS from external peers and use only the global AS in the AS path when exporting routes to another AS. In this kind of situation, configure the **alias** option.

Include the **alias** option to configure the local AS as an alias to the global AS configured at the **[edit routing-options]** hierarchy level. When you configure a local AS as an alias, during the establishment of the BGP open session, the AS used in the open message alternates between the local AS and the global AS. The local AS is prepended to the AS path only when the peer session with an EBGP neighbor is established using that local AS. The local AS is hidden in the AS path sent to any other external peers. Only the global AS is prepended to the AS path when the BGP session is established using the global AS.

NOTE: The private and alias options are mutually exclusive. You cannot configure both options with the same local-as statement.

- **Local AS with option not to prepend the global AS**—In Junos OS Release 9.6 and later, you can configure a local AS with the option not to prepend the global AS. Only the local AS is included in the AS path sent to external peers.

  Use the **no-prepend-global-as** option when you want to strip the global AS number from outbound BGP updates in a virtual private network (VPN) scenario. This option is useful in aVPN scenario in which you want to hide the global AS from the VPN.

  Include the **no-prepend-global-as** option to have the global AS configured at the **[edit routing-options]** hierarchy level removed from the AS path sent to external peers. When you use this option, only the local AS is included in the AS path for the routes sent to a customer edge (CE) device.

- **Number of loops option**—The local AS feature also supports specifying the number of times that detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

  For the **loops *number*** statement, you can configure 1 through 10.

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NOTE: If you configure the local AS values for any BGP group, the detection of routing loops is performed using both the AS and the local AS values for all BGP groups.

If the local AS for the EBGP or IBGP peer is the same as the current AS, do not use the **local-as** statement to specify the local AS number.

When you configure the local AS within a VRF, this impacts the AS path loop-detection mechanism. All of the **local-as** statements configured on the device are part of a single AS domain. The AS path loop-detection mechanism is based on looking for a matching AS present in the domain.

Related Documentation

- Example: Configuring a Local AS for EBGP Sessions on page 100
- Example: Configuring a Private Local AS for EBGP Sessions on page 111

Example: Configuring a Local AS for EBGP Sessions

This example shows how to configure a local autonomous system (AS) for a BGP peer so that both the global AS and the local AS are used in BGP inbound and outbound updates.

- Requirements on page 100
- Overview on page 100
- Configuration on page 101
- Verification on page 108

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Use the **local-as** statement when ISPs merge and want to preserve a customer's configuration, particularly the AS with which the customer is configured to establish a peer relationship. The **local-as** statement simulates the AS number already in place in customer routers, even if the ISP's router has moved to a different AS.

This example shows how to use the **local-as** statement to configure a local AS. The **local-as** statement is supported for BGP at the global, group, and neighbor hierarchy levels.

When you configure the **local-as** statement, you must specify an AS number. You can specify a number from 1 through 4,294,967,295 in plain-number format. In Junos OS Release 9.1 and later, the range for AS numbers is extended to provide BGP support for 4-byte AS numbers as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*.

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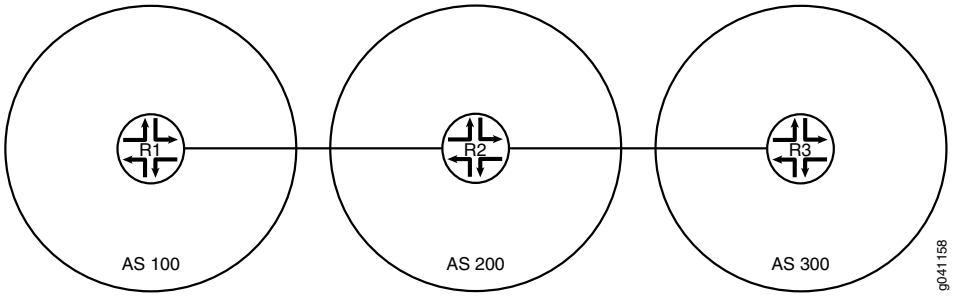
In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>.<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format. You can specify a value from 0.0 through 65535.65535 in AS-dot notation format. Junos OS continues to support 2-byte AS numbers. The 2-byte AS number range is 1 through 65,535 (this is a subset of the 4-byte range).

Figure 9 on page 101 shows the sample topology.

Figure 9: Topology for Configuring the Local AS



In this example, Device R2 formerly belonged to AS 250 and now is in AS 200. Device R1 and Device R3 are configured to peer with AS 250 instead of with the new AS number (AS 200). Device R2 has the new AS number configured with the **autonomous-system 200** statement. To enable the peering sessions to work, the **local-as 250** statement is added in the BGP configuration. Because **local-as 250** is configured, Device R2 includes both the global AS (200) and the local AS (250) in its BGP inbound and outbound updates.

Configuration

- Configuring Device R1 on page 102
- Configuring Device R2 on page 104
- Configuring Device R3 on page 106

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 1 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 250
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
```

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```
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.1.0.0/30 next-hop 10.0.0.2
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 3 family inet address 10.1.0.1/30
set interfaces lo0 unit 2 family inet address 192.168.0.2/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext local-as 250
set protocols bgp group ext neighbor 10.0.0.1 peer-as 100
set protocols bgp group ext neighbor 10.1.0.2 peer-as 300
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 10.1.0.2/30
set interfaces lo0 unit 3 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 250
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.0.0.0/30 next-hop 10.1.0.1
set routing-options autonomous-system 300
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 1 family inet address 10.0.0.1/30
user@R1# set lo0 unit 1 family inet address 192.168.0.1/32
```

2. Configure external BGP (EBGP).

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```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set export send-direct
user@R1# set export send-static
user@R1# set peer-as 250
user@R1# set neighbor 10.0.0.2
```

3. Configure the routing policy.

```
[edit policy-options]
user@R1# set policy-statement send-direct term 1 from protocol direct
user@R1# set policy-statement send-direct term 1 then accept
user@R1# set policy-statement send-static term 1 from protocol static
user@R1# set policy-statement send-static term 1 then accept
```

4. Configure a static route to the remote network between Device R2 and Device R3.

```
[edit routing-options]
user@R1# set static route 10.1.0.0/30 next-hop 10.0.0.2
```

5. Configure the global AS number.

```
[edit routing-options]
user@R1# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
```

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```
    term 1 {
      from protocol direct;
      then accept;
    }
}
policy-statement send-static {
    term 1 {
      from protocol static;
      then accept;
    }
}
```

```
user@R1# show protocols
bgp {
    group ext {
      type external;
      export [ send-direct send-static ];
      peer-as 250;
      neighbor 10.0.0.2;
    }
}
```

```
user@R1# show routing-options
static {
    route 10.1.0.0/30 next-hop 10.0.0.2;
}
autonomous-system 100;
```

When you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 2 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 3 family inet address 10.1.0.1/30
user@R2# set lo0 unit 2 family inet address 192.168.0.2/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@R2# set type external
user@R2# set export send-direct
user@R2# set export send-static
```


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```
user@R2# set neighbor 10.0.0.1 peer-as 100
user@R2# set neighbor 10.1.0.2 peer-as 300
```

3. Configure the local autonomous system (AS) number.

```
[edit protocols bgp group ext]
user@R2# set local-as 250
```

4. Configure the global AS number.

```
[edit routing-options]
user@R2# set autonomous-system 200
```

5. Configure the routing policy.

```
[edit policy-options]
user@R2# set policy-statement send-direct term 1 from protocol direct
user@R2# set policy-statement send-direct term 1 then accept
user@R2# set policy-statement send-static term 1 from protocol static
user@R2# set policy-statement send-static term 1 then accept
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 2 {
      family inet {
         address 10.0.0.2/30;
      }
   }
}
fe-1/2/1 {
   unit 3 {
      family inet {
         address 10.1.0.1/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.168.0.2/32;
      }
   }
}
```

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```
user@R2# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
policy-statement send-static {
   term 1 {
      from protocol static;
      then accept;
   }
}
```

```
user@R2# show protocols
bgp {
   group ext {
      type external;
      export [ send-direct send-static ];
      local-as 250;
      neighbor 10.0.0.1 {
         peer-as 100;
      }
      neighbor 10.1.0.2 {
         peer-as 300;
      }
   }
}
```

```
user@R2# show routing-options
autonomous-system 200;
```

When you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

```
[edit interfaces]
user@R3# set fe-1/2/0 unit 4 family inet address 10.1.0.2/30
user@R3# set lo0 unit 3 family inet address 192.168.0.3/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
```


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```
user@R3# set type external
user@R3# set export send-direct
user@R3# set export send-static
user@R3# set peer-as 250
user@R3# set neighbor 10.1.0.1
```

3. Configure the global autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 300
```

4. Configure a static route to the remote network between Device R1 and Device R2.

```
[edit routing-options]
user@R3# set static route 10.0.0.0/30 next-hop 10.1.0.1
```

5. Configure the routing policy.

```
[edit policy-options]
user@R3# set policy-statement send-direct term 1 from protocol direct
user@R3# set policy-statement send-direct term 1 then accept
user@R3# set policy-statement send-static term 1 from protocol static
user@R3# set policy-statement send-static term 1 then accept
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
   unit 4 {
      family inet {
         address 10.1.0.2/30;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.0.3/32;
      }
   }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
   term 1 {
```

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```
      from protocol direct;
      then accept;
    }
}
policy-statement send-static {
    term 1 {
      from protocol static;
      then accept;
    }
}
```

```
user@R3# show protocols
bgp {
    group ext {
      type external;
      export [ send-direct send-static ];
      peer-as 250;
      neighbor 10.1.0.1;
    }
}
```

```
user@R3# show routing-options
static {
    route 10.0.0.0/30 next-hop 10.1.0.1;
}
autonomous-system 300;
```

When you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Local and Global AS Settings on page 108
- Checking the BGP Peering Sessions on page 110
- Verifying the BGP AS Paths on page 110

Checking the Local and Global AS Settings

Purpose Make sure that Device R2 has the local and global AS settings configured.

Action From operational mode, enter the **show bgp neighbors** command.

```
user@R2> show bgp neighbors
```

```
Peer: 10.0.0.1+179 AS 100      Local: 10.0.0.2+61036 AS 250
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct send-static ]
  Options: <Preference PeerAS LocalAS Refresh>
  Holdtime: 90 Preference: 170 Local AS: 250 Local System AS: 200
```


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```
  Number of flaps: 0
  Peer ID: 192.168.0.1     Local ID: 192.168.0.2       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: fe-1/2/0.2
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 100)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          4
  Last traffic (seconds): Received 6    Sent 14   Checked 47
  Input messages:  Total 258    Updates 3       Refreshes 0     Octets 4969
  Output messages: Total 258    Updates 2       Refreshes 0     Octets 5037
  Output Queue[0]: 0

Peer: 10.1.0.2+179 AS 300      Local: 10.1.0.1+52296 AS 250
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct send-static ]
  Options: <Preference PeerAS LocalAS Refresh>
  Holdtime: 90 Preference: 170 Local AS: 250 Local System AS: 200
  Number of flaps: 0
  Peer ID: 192.168.0.3     Local ID: 192.168.0.2       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: fe-1/2/1.3
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 300)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          4
```

```
Last traffic (seconds): Received 19   Sent 26   Checked 9
Input messages:  Total 256    Updates 3       Refreshes 0     Octets 4931
Output messages: Total 256    Updates 2       Refreshes 0     Octets 4999
Output Queue[0]: 0
```

Meaning The Local AS: 250 and Local System AS: 200 output shows that Device R2 has the expected settings. Additionally, the output shows that the options list includes LocalAS.

Checking the BGP Peering Sessions

Purpose Ensure that the sessions are established and that the local AS number 250 is displayed.

Action From operational mode, enter the **show bgp summary** command.

```
user@R1> show bgp summary
```

```
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 4          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.2                250        232        233       0       4     1:42:37
2/4/4/0              0/0/0/0
```

```
user@R3> show bgp summary
```

```
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 4          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.1.0.1                250        235        236       0       4     1:44:25
2/4/4/0              0/0/0/0
```

Meaning Device R1 and Device R3 appear to be peering with a device in AS 250, even though Device R2 is actually in AS 200.

Verifying the BGP AS Paths

Purpose Make sure that the routes are in the routing tables and that the AS paths show the local AS number 250.

Action From configuration mode, enter the **set route protocol bgp** command.

```
user@R1> show route protocol bgp
```

```
inet.0: 6 destinations, 8 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
10.0.0.0/30         [BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                    > to 10.0.0.2 via fe-1/2/0.1
10.1.0.0/30         [BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                    > to 10.0.0.2 via fe-1/2/0.1
192.168.0.2/32     *[BGP/170] 01:46:44, localpref 100
                      AS path: 250 I
                     > to 10.0.0.2 via fe-1/2/0.1
192.168.0.3/32     *[BGP/170] 01:46:40, localpref 100
                      AS path: 250 300 I
                     > to 10.0.0.2 via fe-1/2/0.1
```

```
user@R3> show route protocol bgp

inet.0: 6 destinations, 8 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/30         [BGP/170] 01:47:10, localpref 100
                      AS path: 250 I
                    > to 10.1.0.1 via fe-1/2/0.4
10.1.0.0/30         [BGP/170] 01:47:10, localpref 100
                      AS path: 250 I
                     > to 10.1.0.1 via fe-1/2/0.4
192.168.0.1/32     *[BGP/170] 01:47:10, localpref 100
                      AS path: 250 100 I
                     > to 10.1.0.1 via fe-1/2/0.4
192.168.0.2/32     *[BGP/170] 01:47:10, localpref 100
                      AS path: 250 I
                     > to 10.1.0.1 via fe-1/2/0.4
```

Meaning The output shows that Device R1 and Device R3 appear to have routes with AS paths that include AS 250, even though Device R2 is actually in AS 200.

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Example: Configuring a Private Local AS for EBGP Sessions

This example shows how to configure a private local autonomous system (AS) number. The local AS is considered to be private because it is advertised to peers that use the local AS number for peering, but is hidden in the announcements to peers that can use the global AS number for peering.

- Requirements on page 112
- Overview on page 112
- Configuration on page 113
- Verification on page 116

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Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Use the **local-as** statement when ISPs merge and want to preserve a customer's configuration, particularly the AS with which the customer is configured to establish a peer relationship. The **local-as** statement simulates the AS number already in place in customer routers, even if the ISP's router has moved to a different AS.

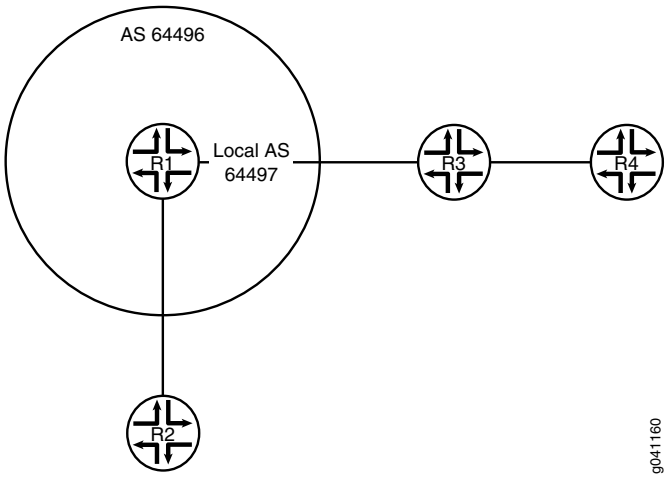
When you use the **private** option, the local AS is used during the establishment of the BGP session with an external BGP (EBGP) neighbor, but is hidden in the AS path sent to other EBGP peers. Only the global AS is included in the AS path sent to external peers.

The **private** option is useful for establishing local peering with routing devices that remain configured with their former AS or with a specific customer that has not yet modified its peer arrangements. The local AS is used to establish the BGP session with the EBGP neighbor, but is hidden in the AS path sent to external peers in another AS.

Include the **private** option so that the local AS is not prepended before the global AS in the AS path sent to external peers. When you specify the **private** option, the local AS is prepended only in the AS path sent to the EBGP neighbor.

Figure 10 on page 112 shows the sample topology.

Figure 10: Topology for Configuring a Private Local AS



Device R1 is in AS 64496. Device R2 is in AS 64510. Device R3 is in AS 64511. Device R4 is in AS 64512. Device R1 formerly belonged to AS 64497, which has merged with another network and now belongs to AS 64496. Because Device R3 still peers with Device R1, using its former AS, 64497, Device R1 needs to be configured with a local AS of 64497 in order to maintain peering with Device R3. Configuring a local AS of 64497 permits Device R1 to add AS 64497 when advertising routes to Device R3. Device R3 sees an AS path of 64497 64496 for the prefix 10.1.1.2/32, which is Device R2's loopback interface.

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Device R4, which is behind Device R3, sees an AS path of 64511 64497 64496 64510 to Device R2's loopback interface. To prevent Device R1 from adding the local AS number in its announcements to other peers, this example includes the **local-as 64497 private** statement. The **private** option configures Device R1 to not include the local AS 64497 when announcing routes to Device R2. Device R2 sees an AS path of 64496 64511 to Device R3 and an AS path of 64496 64511 64512 to Device R4. The **private** option in Device R1's configuration causes the AS number 64497 to be missing from the AS paths that Device R1 readvertises to Device R2.

Device R1 is hiding the private local AS from all the routers, except Device R3. The **private** option applies to the routes that Device R1 receives (learns) from Device R3 and that Device R1, in turn, readvertises to other routers. When these routes learned from Device R3 are readavertised by Device R1 to Device R2, the private local AS is missing from the AS path advertised to Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 3 family inet address 192.168.1.1/24
set interfaces fe-1/2/1 unit 5 family inet address 192.168.10.1/24
set interfaces lo0 unit 2 family inet address 10.1.1.1/32
set protocols bgp group external-AS64511 type external
set protocols bgp group external-AS64511 peer-as 64511
set protocols bgp group external-AS64511 local-as 64497
set protocols bgp group external-AS64511 local-as private
set protocols bgp group external-AS64511 neighbor 192.168.1.2
set protocols bgp group external-AS64510 type external
set protocols bgp group external-AS64510 peer-as 64510
set protocols bgp group external-AS64510 neighbor 192.168.10.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64496
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 192.168.10.2/24
set interfaces lo0 unit 3 family inet address 10.1.1.2/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 64496
set protocols bgp group external neighbor 192.168.10.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64510
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.1.2/24
set interfaces fe-1/2/1 unit 7 family inet address 192.168.5.1/24
set interfaces lo0 unit 4 family inet address 10.1.1.3/32
```

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```
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 192.168.1.1 peer-as 64497
set protocols bgp group external neighbor 192.168.5.2 peer-as 64512
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64511
```

Device R4

```
set interfaces fe-1/2/0 unit 8 family inet address 192.168.5.2/24
set interfaces lo0 unit 5 family inet address 10.1.1.4/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 64511
set protocols bgp group external neighbor 192.168.5.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64512
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 3]
user@R1# set family inet address 192.168.1.1/24
[edit interfaces fe-1/2/1 unit 5]
user@R1# set family inet address 192.168.10.1/24
[edit interfaces lo0 unit 2]
user@R1# set family inet address 10.1.1.1/32
```

2. Configure the EBGP peering session with Device R2.

```
[edit protocols bgp group external-AS64510]
user@R1# set type external
user@R1# set peer-as 64510
user@R1# set neighbor 192.168.10.2
```

3. Configure the EBGP peering session with Device R3.

```
[edit protocols bgp group external-AS64511]
user@R1# set type external
user@R1# set peer-as 64511
user@R1# set local-as 64497
user@R1# set local-as private
user@R1# set neighbor 192.168.1.2
```


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4. Configure the routing policy.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the global autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 64496
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 3 {
      family inet {
         address 192.168.1.1/24;
      }
   }
}
fe-1/2/1 {
   unit 5 {
      family inet {
         address 192.168.10.1/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 10.1.1.1/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
bgp {
   group external-AS64511 {
```

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```
    type external;
    peer-as 64511;
    local-as 64497 private;
    neighbor 192.168.1.2;
  }
  group external-AS64510 {
    type external;
    peer-as 64510;
    neighbor 192.168.10.2;
  }
}
```

```
user@R1# show routing-options
autonomous-system 64496;
```

If you are done configuring the device, enter **commit** from configuration mode.

Repeat the configuration as needed for the other devices in the topology.

Verification

Confirm that the configuration is working properly.

- Checking Device R2's AS Paths on page 116
- Checking Device R3's AS Paths on page 117

Checking Device R2's AS Paths

Purpose Make sure that Device R2 does not have AS 64497 in its AS paths to Device R3 and Device R4.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R2> show route protocol bgp
inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.3/32        *[BGP/170] 01:33:11, localpref 100
                      AS path: 64496 64511 I
                    > to 192.168.10.1 via fe-1/2/0.6
10.1.1.4/32        *[BGP/170] 01:33:11, localpref 100
                      AS path: 64496 64511 64512 I
                    > to 192.168.10.1 via fe-1/2/0.6
192.168.5.0/24     *[BGP/170] 01:49:15, localpref 100
                      AS path: 64496 64511 I
                    > to 192.168.10.1 via fe-1/2/0.6
```

Meaning Device R2's AS paths do not include AS 64497.

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Checking Device R3's AS Paths

Purpose Make sure that the local AS 64497 is prepended only in the AS path sent to the EBGP neighbor R3 . Device R3 sees an AS path of 64497 64496 for the prefix 10.1.1.2/32, which is Device R2's loopback interface.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R3> show route protocol bgp
inet.0: 7 destinations, 8 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.2/32        *[BGP/170] 01:35:11, localpref 100
                      AS path: 64497 64496 64510 I
                    > to 192.168.1.1 via fe-1/2/0.4
10.1.1.4/32        *[BGP/170] 01:35:11, localpref 100
                      AS path: 64512 I
                    > to 192.168.5.2 via fe-1/2/1.7
192.168.5.0/24      [BGP/170] 01:51:15, localpref 100
                      AS path: 64512 I
                    > to 192.168.5.2 via fe-1/2/1.7
```

Meaning Device R3's route to Device R2 (prefix 10.1.1.2) includes both the local and the global AS configured on Device R1 (64497 and 64496, respectively).

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Understanding the Accumulated IGP Attribute for BGP

The interior gateway protocols (IGPs) are designed to handle routing within a single domain or an autonomous system (AS). Each link is assigned a particular value called a metric. The distance between the two nodes is calculated as a sum of all the metric values of links along the path. The IGP selects the shortest path between two nodes based on distance.

BGP is designed to provide routing over a large number of independent ASs with limited or no coordination among respective administrations. BGP does not use metrics in the path selection decisions.

The accumulated IGP (AIGP) metric attribute for BGP enables deployment in which a single administration can run several contiguous BGP ASs. Such deployments allow BGP to make routing decisions based on the IGP metric. In such networks, it is possible for BGP to select paths based on metrics as is done by IGPs. In this case, BGP chooses the shortest path between two nodes, even though the nodes might be in two different ASs.

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The AIGP attribute is particularly useful in networks that use tunneling to deliver a packet to its BGP next hop. The Juniper Networks® Junos® operating system (Junos OS) currently supports the AIGP attribute for two BGP address families, **family inet labeled-unicast** and **family inet6 labeled-unicast**.

AIGP impacts the BGP best-route decision process. The AIGP attribute preference rule is applied after the local-preference rule. The AIGP distance is compared to break a tie. The BGP best-route decision process also impacts the way the interior cost rule is applied if the resolving next hop has an AIGP attribute. Without AIGP enabled, the interior cost of a route is based on the calculation of the metric to the next hop for the route. With AIGP enabled, the resolving AIGP distance is added to the interior cost.

The AIGP attribute is an optional non-transitive BGP path attribute and is specified in Internet draft draft-ietf-idr-aigp-06, *The Accumulated IGP Metric Attribute for BGP*.

Related Documentation

- Example: Configuring the Accumulated IGP Attribute for BGP on page 118
- Configuring the Accumulated IGP Attribute for BGP

Example: Configuring the Accumulated IGP Attribute for BGP

This example shows how to configure the accumulated IGP (AIGP) metric attribute for BGP.

- Requirements on page 118
- Overview on page 118
- Configuration on page 120
- Verification on page 153

Requirements

This example uses the following hardware and software components:

- Seven BGP-speaking devices.
- Junos OS Release 12.1 or later.

Overview

The AIGP attribute enables deployments in which a single administration can run several contiguous BGP autonomous systems (ASs). Such deployments allow BGP to make routing decisions based on the IGP metric. With AIGP enabled, BGP can select paths based on IGP metrics. This enables BGP to choose the shortest path between two nodes, even though the nodes might be in different ASs. The AIGP attribute is particularly useful in networks that use tunneling to deliver a packet to its BGP next hop. This example shows AIGP configured with MPLS label-switched paths.

To enable AIGP, you include the aigp statement in the BGP configuration on a protocol family basis. Configuring AIGP on a particular family enables sending and receiving of

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the AIGP attribute on that family. By default, AIGP is disabled. An AIGP-disabled neighbor does not send an AIGP attribute and silently discards a received AIGP attribute.

Junos OS supports AIGP for **family inet labeled-unicast** and **family inet6 labeled-unicast**. The **aigp** statement can be configured for a given family at the global BGP, group, or neighbor level.

By default, the value of the AIGP attribute for a local prefix is zero. An AIGP-enabled neighbor can originate an AIGP attribute for a given prefix by export policy, using the aigp-originate policy action. The value of the AIGP attribute reflects the IGP distance to the prefix. Alternatively, you can specify a value, by using the **aigp-originate distance *distance*** policy action. The configurable range is 0 through 4,294,967,295. Only one node needs to originate an AIGP attribute. The AIGP attribute is retained and readvertised if the neighbors are AIGP enabled with the **aigp** statement in the BGP configuration.

The policy action to originate the AIGP attribute has the following requirements:

- Neighbor must be AIGP enabled.
- Policy must be applied as an export policy.
- Prefix must have no current AIGP attribute.
- Prefix must export with next-hop self.
- Prefix must reside within the AIGP domain. Typically, a loopback IP address is the prefix to originate.

The policy is ignored if these requirements are not met.

Topology Diagram

Figure 11 on page 120 shows the topology used in this example. OSPF is used as the interior gateway protocol (IGP). Internal BGP (IBGP) is configured between Device PE1 and Device PE4. External BGP (EBGP) is configured between Device PE7 and Device PE1, between Device PE4 and Device PE3, and between Device PE4 and Device PE2. Devices PE4, PE2, and PE3 are configured for multihop. Device PE4 selects a path based on the AIGP value and then readvertises the AIGP value based on the AIGP and policy configuration. Device PE1 readvertises the AIGP value to Device PE7, which is in another administrative domain. Every device has two loopback interface addresses: 10.9.9.x is used for BGP peering and the router ID, and 10.100.1.x is used for the BGP next hop.

The network between Device PE1 and PE3 has IBGP peering and multiple OSPF areas. The external link to Device PE7 is configured to show that the AIGP attribute is readvertised to a neighbor outside of the administrative domain, if that neighbor is AIGP enabled.

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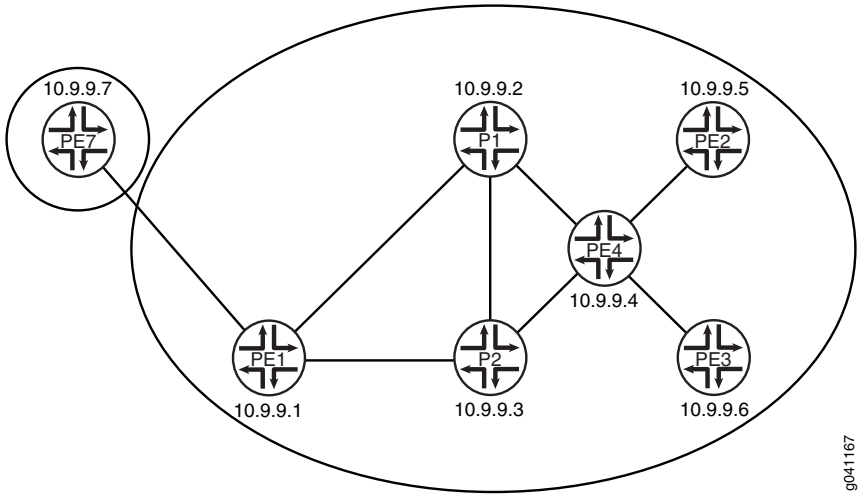
Figure 11: Advertisement of Multiple Paths in BGP



For origination of an AIGP attribute, the BGP next hop is required to be itself. If the BGP next hop remains unchanged, the received AIGP attribute is readvertised, as is, to another AIGP neighbor. If the next hop changes, the received AIGP attribute is readvertised with an increased value to another AIGP neighbor. The increase in value reflects the IGP distance to the previous BGP next hop. To demonstrate, this example uses loopback interface addresses for Device PE4's EBGP peering sessions with Device PE2 and Device PE3. Multihop is enabled on these sessions so that a recursive lookup is performed to determine the point-to-point interface. Because the next hop changes, the IGP distance is added to the AIGP distance.

Configuration

- Configuring Device P1 on page 126
- Configuring Device P2 on page 130
- Configuring Device PE4 on page 133
- Configuring Device PE1 on page 139
- Configuring Device PE2 on page 143
- Configuring Device PE3 on page 147
- Configuring Device PE7 on page 151

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device P1

```
set interfaces fe-1/2/0 unit 1 description P1-to-PE1
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.2/30
set interfaces fe-1/2/0 unit 1 family mpls
set interfaces fe-1/2/1 unit 4 description P1-to-P2
set interfaces fe-1/2/1 unit 4 family inet address 10.0.0.29/30
set interfaces fe-1/2/1 unit 4 family mpls
```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```
set interfaces fe-1/2/2 unit 8 description P1-to-PE4
set interfaces fe-1/2/2 unit 8 family inet address 10.0.0.17/30
set interfaces fe-1/2/2 unit 8 family mpls
set interfaces lo0 unit 3 family inet address 10.9.9.2/32
set interfaces lo0 unit 3 family inet address 10.100.1.2/32
set protocols rsvp interface fe-1/2/0.1
set protocols rsvp interface fe-1/2/2.8
set protocols rsvp interface fe-1/2/1.4
set protocols mpls label-switched-path P1-to-P2 to 10.9.9.3
set protocols mpls label-switched-path P1-to-PE1 to 10.9.9.1
set protocols mpls label-switched-path P1-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.1
set protocols mpls interface fe-1/2/2.8
set protocols mpls interface fe-1/2/1.4
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.2
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal neighbor 10.9.9.1
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group internal neighbor 10.9.9.4
set protocols ospf area 0.0.0.1 interface fe-1/2/0.1 metric 1
set protocols ospf area 0.0.0.1 interface fe-1/2/1.4 metric 1
set protocols ospf area 0.0.0.0 interface fe-1/2/2.8 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.2 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.2 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.2 passive
set protocols ospf area 0.0.0.0 interface 10.100.1.2 metric 1
set routing-options router-id 10.9.9.2
set routing-options autonomous-system 13979
```

Device P2

```
set interfaces fe-1/2/0 unit 3 description P2-to-PE1
set interfaces fe-1/2/0 unit 3 family inet address 10.0.0.6/30
set interfaces fe-1/2/0 unit 3 family mpls
set interfaces fe-1/2/1 unit 5 description P2-to-P1
set interfaces fe-1/2/1 unit 5 family inet address 10.0.0.30/30
set interfaces fe-1/2/1 unit 5 family mpls
set interfaces fe-1/2/2 unit 6 description P2-to-PE4
set interfaces fe-1/2/2 unit 6 family inet address 10.0.0.13/30
set interfaces fe-1/2/2 unit 6 family mpls
set interfaces lo0 unit 5 family inet address 10.9.9.3/32
set interfaces lo0 unit 5 family inet address 10.100.1.3/32
set protocols rsvp interface fe-1/2/1.5
set protocols rsvp interface fe-1/2/2.6
set protocols rsvp interface fe-1/2/0.3
set protocols mpls label-switched-path P2-to-PE1 to 10.9.9.1
set protocols mpls label-switched-path P2-to-P1 to 10.9.9.2
set protocols mpls label-switched-path P2-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/1.5
set protocols mpls interface fe-1/2/2.6
set protocols mpls interface fe-1/2/0.3
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.3
set protocols bgp group internal family inet labeled-unicast aigp
```

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```
set protocols bgp group internal neighbor 10.9.9.1
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group internal neighbor 10.9.9.4
set protocols ospf area 0.0.0.0 interface fe-1/2/2.6 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.3 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.3 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.3 passive
set protocols ospf area 0.0.0.0 interface 10.100.1.3 metric 1
set routing-options router-id 10.9.9.3
set routing-options autonomous-system 13979
```

Device PE4

```
set interfaces fe-1/2/0 unit 7 description PE4-to-P2
set interfaces fe-1/2/0 unit 7 family inet address 10.0.0.14/30
set interfaces fe-1/2/0 unit 7 family mpls
set interfaces fe-1/2/1 unit 9 description PE4-to-P1
set interfaces fe-1/2/1 unit 9 family inet address 10.0.0.18/30
set interfaces fe-1/2/1 unit 9 family mpls
set interfaces fe-1/2/2 unit 10 description PE4-to-PE2
set interfaces fe-1/2/2 unit 10 family inet address 10.0.0.21/30
set interfaces fe-1/2/2 unit 10 family mpls
set interfaces fe-1/0/2 unit 12 description PE4-to-PE3
set interfaces fe-1/0/2 unit 12 family inet address 10.0.0.25/30
set interfaces fe-1/0/2 unit 12 family mpls
set interfaces lo0 unit 7 family inet address 10.9.9.4/32
set interfaces lo0 unit 7 family inet address 10.100.1.4/32
set protocols rsvp interface fe-1/2/0.7
set protocols rsvp interface fe-1/2/1.9
set protocols rsvp interface fe-1/2/2.10
set protocols rsvp interface fe-1/0/2.12
set protocols mpls label-switched-path PE4-to-PE2 to 10.9.9.5
set protocols mpls label-switched-path PE4-to-PE3 to 10.9.9.6
set protocols mpls label-switched-path PE4-to-P1 to 10.9.9.2
set protocols mpls label-switched-path PE4-to-P2 to 10.9.9.3
set protocols mpls interface fe-1/2/0.7
set protocols mpls interface fe-1/2/1.9
set protocols mpls interface fe-1/2/2.10
set protocols mpls interface fe-1/0/2.12
set protocols bgp export next-hop
set protocols bgp export aigp
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.4
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal neighbor 10.9.9.1
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.4
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external peer-as 7018
set protocols bgp group external neighbor 10.9.9.5
set protocols bgp group external neighbor 10.9.9.6
set protocols ospf area 0.0.0.0 interface fe-1/2/1.9 metric 1
```


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```
set protocols ospf area 0.0.0.0 interface fe-1/2/0.7 metric 1
set protocols ospf area 0.0.0.0 interface 10.9.9.4 passive
set protocols ospf area 0.0.0.0 interface 10.9.9.4 metric 1
set protocols ospf area 0.0.0.0 interface 10.100.1.4 passive
set protocols ospf area 0.0.0.0 interface 10.100.1.4 metric 1
set protocols ospf area 0.0.0.2 interface fe-1/2/2.10 metric 1
set protocols ospf area 0.0.0.3 interface fe-1/0/2.12 metric 1
set policy-options policy-statement aigp term 10 from protocol static
set policy-options policy-statement aigp term 10 from route-filter 44.0.0.0/24 exact
set policy-options policy-statement aigp term 10 then aigp-originate distance 200
set policy-options policy-statement aigp term 10 then next-hop 10.100.1.4
set policy-options policy-statement aigp term 10 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.4
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.4/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.4/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.4
set policy-options policy-statement next-hop term 20 then accept
set routing-options static route 44.0.0.0/24 discard
set routing-options router-id 10.9.9.4
set routing-options autonomous-system 13979
```

Device PE1

```
set interfaces fe-1/2/0 unit 0 description PE1-to-P1
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces fe-1/2/0 unit 0 family mpls
set interfaces fe-1/2/1 unit 2 description PE1-to-P2
set interfaces fe-1/2/1 unit 2 family inet address 10.0.0.5/30
set interfaces fe-1/2/1 unit 2 family mpls
set interfaces fe-1/2/2 unit 14 description PE1-to-PE7
set interfaces fe-1/2/2 unit 14 family inet address 10.0.0.9/30
set interfaces lo0 unit 1 family inet address 10.9.9.1/32
set interfaces lo0 unit 1 family inet address 10.100.1.1/32
set protocols rsvp interface fe-1/2/0.0
set protocols rsvp interface fe-1/2/1.2
set protocols rsvp interface fe-1/2/2.14
set protocols mpls label-switched-path PE1-to-P1 to 10.9.9.2
set protocols mpls label-switched-path PE1-to-P2 to 10.9.9.3
set protocols mpls interface fe-1/2/0.0
set protocols mpls interface fe-1/2/1.2
set protocols mpls interface fe-1/2/2.14
set protocols bgp group internal type internal
set protocols bgp group internal local-address 10.9.9.1
set protocols bgp group internal family inet labeled-unicast aigp
set protocols bgp group internal export SET_EXPORT_ROUTES
set protocols bgp group internal vpn-apply-export
set protocols bgp group internal neighbor 10.9.9.4
set protocols bgp group internal neighbor 10.9.9.2
set protocols bgp group internal neighbor 10.9.9.3
set protocols bgp group external type external
set protocols bgp group external family inet labeled-unicast aigp
```

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```
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external peer-as 7019
set protocols bgp group external neighbor 10.0.0.10
set protocols ospf area 0.0.0.1 interface fe-1/2/0.0 metric 1
set protocols ospf area 0.0.0.1 interface fe-1/2/1.2 metric 1
set protocols ospf area 0.0.0.1 interface 10.9.9.1 passive
set protocols ospf area 0.0.0.1 interface 10.9.9.1 metric 1
set protocols ospf area 0.0.0.1 interface 10.100.1.1 passive
set protocols ospf area 0.0.0.1 interface 10.100.1.1 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set routing-options router-id 10.9.9.1
set routing-options autonomous-system 13979
```

Device PE2

```
set interfaces fe-1/2/0 unit 11 description PE2-to-PE4
set interfaces fe-1/2/0 unit 11 family inet address 10.0.0.22/30
set interfaces fe-1/2/0 unit 11 family mpls
set interfaces lo0 unit 9 family inet address 10.9.9.5/32 primary
set interfaces lo0 unit 9 family inet address 10.100.1.5/32
set protocols rsvp interface fe-1/2/0.11
set protocols mpls label-switched-path PE2-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.11
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.5
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export next-hop
set protocols bgp group external export aigp
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external vpn-apply-export
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.9.9.4
set protocols ospf area 0.0.0.2 interface 10.9.9.5 passive
set protocols ospf area 0.0.0.2 interface 10.9.9.5 metric 1
set protocols ospf area 0.0.0.2 interface 10.100.1.5 passive
set protocols ospf area 0.0.0.2 interface 10.100.1.5 metric 1
set protocols ospf area 0.0.0.2 interface fe-1/2/0.11 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol static
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.5
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set policy-options policy-statement aigp term 10 from route-filter 55.0.0.0/24 exact
set policy-options policy-statement aigp term 10 then aigp-originate distance 20
set policy-options policy-statement aigp term 10 then next-hop 10.100.1.5
set policy-options policy-statement aigp term 10 then accept
set policy-options policy-statement aigp term 20 from route-filter 99.0.0.0/24 exact
set policy-options policy-statement aigp term 20 then aigp-originate distance 30
set policy-options policy-statement aigp term 20 then next-hop 10.100.1.5
```


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```
set policy-options policy-statement aigp term 20 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.5
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.5/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.5/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.5
set policy-options policy-statement next-hop term 20 then accept
set routing-options static route 99.0.0.0/24 discard
set routing-options static route 55.0.0.0/24 discard
set routing-options router-id 10.9.9.5
set routing-options autonomous-system 7018
```

Device PE3

```
set interfaces fe-1/2/0 unit 13 description PE3-to-PE4
set interfaces fe-1/2/0 unit 13 family inet address 10.0.0.26/30
set interfaces fe-1/2/0 unit 13 family mpls
set interfaces lo0 unit 11 family inet address 10.9.9.6/32
set interfaces lo0 unit 11 family inet address 10.100.1.6/32
set protocols rsvp interface fe-1/2/0.13
set protocols mpls label-switched-path PE3-to-PE4 to 10.9.9.4
set protocols mpls interface fe-1/2/0.13
set protocols bgp group external type external
set protocols bgp group external multihop ttl 2
set protocols bgp group external local-address 10.9.9.6
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export next-hop
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external vpn-apply-export
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.9.9.4
set protocols ospf area 0.0.0.3 interface 10.9.9.6 passive
set protocols ospf area 0.0.0.3 interface 10.9.9.6 metric 1
set protocols ospf area 0.0.0.3 interface 10.100.1.6 passive
set protocols ospf area 0.0.0.3 interface 10.100.1.6 metric 1
set protocols ospf area 0.0.0.3 interface fe-1/2/0.13 metric 1
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol static
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.6
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set policy-options policy-statement next-hop term 10 from protocol bgp
set policy-options policy-statement next-hop term 10 then next-hop 10.100.1.6
set policy-options policy-statement next-hop term 10 then accept
set policy-options policy-statement next-hop term 20 from protocol direct
set policy-options policy-statement next-hop term 20 from route-filter 10.9.9.6/32 exact
set policy-options policy-statement next-hop term 20 from route-filter 10.100.1.6/32
  exact
set policy-options policy-statement next-hop term 20 then next-hop 10.100.1.6
set policy-options policy-statement next-hop term 20 then accept
set routing-options router-id 10.9.9.6
```

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```
set routing-options autonomous-system 7018
```

Device PE7

```
set interfaces fe-1/2/0 unit 15 description PE7-to-PE1
set interfaces fe-1/2/0 unit 15 family inet address 10.0.0.10/30
set interfaces lo0 unit 13 family inet address 10.9.9.7/32
set interfaces lo0 unit 13 family inet address 10.100.1.7/32
set protocols bgp group external type external
set protocols bgp group external family inet labeled-unicast aigp
set protocols bgp group external export SET_EXPORT_ROUTES
set protocols bgp group external peer-as 13979
set protocols bgp group external neighbor 10.0.0.9
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol direct
set policy-options policy-statement SET_EXPORT_ROUTES term 10 from protocol bgp
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.7
set policy-options policy-statement SET_EXPORT_ROUTES term 10 then accept
set routing-options router-id 10.9.9.7
set routing-options autonomous-system 7019
```

Configuring Device P1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device P1:

1. Configure the interfaces.

```
[edit interfaces]
user@P1# set fe-1/2/0 unit 1 description P1-to-PE1
user@P1# set fe-1/2/0 unit 1 family inet address 10.0.0.2/30
user@P1# set fe-1/2/0 unit 1 family mpls
user@P1# set fe-1/2/1 unit 4 description P1-to-P2
user@P1# set fe-1/2/1 unit 4 family inet address 10.0.0.29/30
user@P1# set fe-1/2/1 unit 4 family mpls
user@P1# set fe-1/2/2 unit 8 description P1-to-PE4
user@P1# set fe-1/2/2 unit 8 family inet address 10.0.0.17/30
user@P1# set fe-1/2/2 unit 8 family mpls
user@P1# set lo0 unit 3 family inet address 10.9.9.2/32
user@P1# set lo0 unit 3 family inet address 10.100.1.2/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@P1# set rsvp interface fe-1/2/0.1
user@P1# set rsvp interface fe-1/2/2.8
user@P1# set rsvp interface fe-1/2/1.4
user@P1# set mpls label-switched-path P1-to-P2 to 10.9.9.3
user@P1# set mpls label-switched-path P1-to-PE1 to 10.9.9.1
```


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```
user@P1# set mpls label-switched-path P1-to-PE4 to 10.9.9.4
user@P1# set mpls interface fe-1/2/0.1
user@P1# set mpls interface fe-1/2/2.8
user@P1# set mpls interface fe-1/2/1.4
```

3. Configure BGP.

```
[edit protocols bgp group internal]
user@P1# set type internal
user@P1# set local-address 10.9.9.2
user@P1# set neighbor 10.9.9.1
user@P1# set neighbor 10.9.9.3
user@P1# set neighbor 10.9.9.4
```

4. Enable AIGP.

```
[edit protocols bgp group internal]
user@P1# set family inet labeled-unicast aigp
```

5. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@P1# set area 0.0.0.1 interface fe-1/2/0.1 metric 1
user@P1# set area 0.0.0.1 interface fe-1/2/1.4 metric 1
user@P1# set area 0.0.0.0 interface fe-1/2/2.8 metric 1
user@P1# set area 0.0.0.0 interface 10.9.9.2 passive
user@P1# set area 0.0.0.0 interface 10.9.9.2 metric 1
user@P1# set area 0.0.0.0 interface 10.100.1.2 passive
user@P1# set area 0.0.0.0 interface 10.100.1.2 metric 1
```

6. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@P1# set router-id 10.9.9.2
user@P1# set autonomous-system 13979
```

7. If you are done configuring the device, commit the configuration.

```
user@P1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@P1# show interfaces
```

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```
fe-1/2/0 {
    unit 1 {
        description P1-to-PE1;
        family inet {
            address 10.0.0.2/30;
        }
        family mpls;
    }
}
fe-1/2/1 {
    unit 4 {
        description P1-to-P2;
        family inet {
            address 10.0.0.29/30;
        }
        family mpls;
    }
}
fe-1/2/2 {
    unit 8 {
        description P1-to-PE4;
        family inet {
            address 10.0.0.17/30;
        }
        family mpls;
    }
}
lo0 {
    unit 3 {
        family inet {
            address 10.9.9.2/32;
            address 10.100.1.2/32;
        }
    }
}
```

```
user@P1# show protocols
rsvp {
    interface fe-1/2/0.1;
    interface fe-1/2/2.8;
    interface fe-1/2/1.4;
}
mpls {
    label-switched-path P1-to-P2 {
        to 10.9.9.3;
    }
    label-switched-path P1-to-PE1 {
        to 10.9.9.1;
    }
    label-switched-path P1-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/0.1;
    interface fe-1/2/2.8;
```


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```
    interface fe-1/2/1.4;
}
bgp {
    group internal {
        type internal;
        local-address 10.9.9.2;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        neighbor 10.9.9.1;
        neighbor 10.9.9.3;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.1 {
        interface fe-1/2/0.1 {
            metric 1;
        }
        interface fe-1/2/1.4 {
            metric 1;
        }
    }
    area 0.0.0.0 {
        interface fe-1/2/2.8 {
            metric 1;
        }
        interface 10.9.9.2 {
            passive;
            metric 1;
        }
        interface 10.100.1.2 {
            passive;
            metric 1;
        }
    }
}
```

```
user@P1# show routing-options
router-id 10.9.9.2;
autonomous-system 13979;
```

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Configuring Device P2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device P2:

1. Configure the interfaces.

```
[edit interfaces]
user@P2# set fe-1/2/0 unit 3 description P2-to-PE1
user@P2# set fe-1/2/0 unit 3 family inet address 10.0.0.6/30
user@P2# set fe-1/2/0 unit 3 family mpls
user@P2# set fe-1/2/1 unit 5 description P2-to-P1
user@P2# set fe-1/2/1 unit 5 family inet address 10.0.0.30/30
user@P2# set fe-1/2/1 unit 5 family mpls
user@P2# set fe-1/2/2 unit 6 description P2-to-PE4
user@P2# set fe-1/2/2 unit 6 family inet address 10.0.0.13/30
user@P2# set fe-1/2/2 unit 6 family mpls
user@P2# set lo0 unit 5 family inet address 10.9.9.3/32
user@P2# set lo0 unit 5 family inet address 10.100.1.3/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@P2# set rsvp interface fe-1/2/1.5
user@P2# set rsvp interface fe-1/2/2.6
user@P2# set rsvp interface fe-1/2/0.3
user@P2# set mpls label-switched-path P2-to-PE1 to 10.9.9.1
user@P2# set mpls label-switched-path P2-to-P1 to 10.9.9.2
user@P2# set mpls label-switched-path P2-to-PE4 to 10.9.9.4
user@P2# set mpls interface fe-1/2/1.5
user@P2# set mpls interface fe-1/2/2.6
user@P2# set mpls interface fe-1/2/0.3
```

3. Configure BGP.

```
[edit protocols bgp group internal]
user@P2# set type internal
user@P2# set local-address 10.9.9.3
user@P2# set neighbor 10.9.9.1
user@P2# set neighbor 10.9.9.2
user@P2# set neighbor 10.9.9.4
```

4. Enable AIGP.

```
[edit protocols bgp group internal]
user@P2# set family inet labeled-unicast aigp
```


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5. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@P2# set area 0.0.0.0 interface fe-1/2/2.6 metric 1
user@P2# set area 0.0.0.0 interface 10.9.9.3 passive
user@P2# set area 0.0.0.0 interface 10.9.9.3 metric 1
user@P2# set area 0.0.0.0 interface 10.100.1.3 passive
user@P2# set area 0.0.0.0 interface 10.100.1.3 metric 1
```

6. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@P2# set router-id 10.9.9.3
user@P2# set autonomous-system 13979
```

7. If you are done configuring the device, commit the configuration.

```
user@P2# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@P2# show interfaces
fe-1/2/0 {
   unit 3 {
      description P2-to-PE1;
      family inet {
         address 10.0.0.6/30;
      }
      family mpls;
   }
}
fe-1/2/1 {
   unit 5 {
      description P2-to-P1;
      family inet {
         address 10.0.0.30/30;
      }
      family mpls;
   }
}
fe-1/2/2 {
   unit 6 {
      description P2-to-PE4;
      family inet {
         address 10.0.0.13/30;
      }
      family mpls;
```

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```
    }
}
lo0 {
    unit 5 {
        family inet {
            address 10.9.9.3/32;
            address 10.100.1.3/32;
        }
    }
}
```

```
user@P2# show protocols
rsvp {
    interface fe-1/2/1.5;
    interface fe-1/2/2.6;
    interface fe-1/2/0.3;
}
mpls {
    label-switched-path P2-to-PE1 {
        to 10.9.9.1;
    }
    label-switched-path P2-to-P1 {
        to 10.9.9.2;
    }
    label-switched-path P2-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/1.5;
    interface fe-1/2/2.6;
    interface fe-1/2/0.3;
}
bgp {
    group internal {
        type internal;
        local-address 10.9.9.3;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        neighbor 10.9.9.1;
        neighbor 10.9.9.2;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.0 {
        interface fe-1/2/2.6 {
            metric 1;
        }
        interface 10.9.9.3 {
            passive;
            metric 1;
        }
```


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```
    interface 10.100.1.3 {
      passive;
      metric 1;
    }
  }
}
```

```
user@P2# show routing-options
router-id 10.9.9.3;
autonomous-system 13979;
```

Configuring Device PE4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE4:

1. Configure the interfaces.

```
[edit interfaces]
user@PE4# set fe-1/2/0 unit 7 description PE4-to-P2
user@PE4# set fe-1/2/0 unit 7 family inet address 10.0.0.14/30
user@PE4# set fe-1/2/0 unit 7 family mpls
user@PE4# set fe-1/2/1 unit 9 description PE4-to-P1
user@PE4# set fe-1/2/1 unit 9 family inet address 10.0.0.18/30
user@PE4# set fe-1/2/1 unit 9 family mpls
user@PE4# set fe-1/2/2 unit 10 description PE4-to-PE2
user@PE4# set fe-1/2/2 unit 10 family inet address 10.0.0.21/30
user@PE4# set fe-1/2/2 unit 10 family mpls
user@PE4# set fe-1/0/2 unit 12 description PE4-to-PE3
user@PE4# set fe-1/0/2 unit 12 family inet address 10.0.0.25/30
user@PE4# set fe-1/0/2 unit 12 family mpls
user@PE4# set lo0 unit 7 family inet address 10.9.9.4/32
user@PE4# set lo0 unit 7 family inet address 10.100.1.4/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE4# set rsvp interface fe-1/2/0.7
user@PE4# set rsvp interface fe-1/2/1.9
user@PE4# set rsvp interface fe-1/2/2.10
user@PE4# set rsvp interface fe-1/0/2.12
user@PE4# set mpls label-switched-path PE4-to-PE2 to 10.9.9.5
user@PE4# set mpls label-switched-path PE4-to-PE3 to 10.9.9.6
user@PE4# set mpls label-switched-path PE4-to-P1 to 10.9.9.2
user@PE4# set mpls label-switched-path PE4-to-P2 to 10.9.9.3
user@PE4# set mpls interface fe-1/2/0.7
user@PE4# set mpls interface fe-1/2/1.9
user@PE4# set mpls interface fe-1/2/2.10
```

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```
user@PE4# set mpls interface fe-1/0/2.12
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE4# set export next-hop
user@PE4# set export aigp
user@PE4# set group internal type internal
user@PE4# set group internal local-address 10.9.9.4
user@PE4# set group internal neighbor 10.9.9.1
user@PE4# set group internal neighbor 10.9.9.3
user@PE4# set group internal neighbor 10.9.9.2
user@PE4# set group external type external
user@PE4# set group external multihop ttl 2
user@PE4# set group external local-address 10.9.9.4
user@PE4# set group external peer-as 7018
user@PE4# set group external neighbor 10.9.9.5
user@PE4# set group external neighbor 10.9.9.6
```

4. Enable AIGP.

```
[edit protocols bgp]
user@PE4# set group external family inet labeled-unicast aigp
user@PE4# set group internal family inet labeled-unicast aigp
```

5. Originate a prefix, and configure an AIGP distance.

   By default, a prefix is originated using the current IGP distance. Optionally, you can configure a distance for the AIGP attribute, using the **distance** option, as shown here.

```
[edit policy-options policy-statement aigp term 10]
user@PE4# set from protocol static
user@PE4# set from route-filter 44.0.0.0/24 exact
user@PE4# set then aigp-originate distance 200
user@PE4# set then next-hop 10.100.1.4
user@PE4# set then accept
```

6. Enable the policies.

```
[edit policy-options policy-statement next-hop]
user@PE4# set term 10 from protocol bgp
user@PE4# set term 10 then next-hop 10.100.1.4
user@PE4# set term 10 then accept
user@PE4# set term 20 from protocol direct
user@PE4# set term 20 from route-filter 10.9.9.4/32 exact
user@PE4# set term 20 from route-filter 10.100.1.4/32 exact
user@PE4# set term 20 then next-hop 10.100.1.4
user@PE4# set term 20 then accept
```


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7. Configure a static route.

```
[edit routing-options]
user@PE4# set static route 44.0.0.0/24 discard
```

8. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf]
user@PE4# set area 0.0.0.0 interface fe-1/2/1.9 metric 1
user@PE4# set area 0.0.0.0 interface fe-1/2/0.7 metric 1
user@PE4# set area 0.0.0.0 interface 10.9.9.4 passive
user@PE4# set area 0.0.0.0 interface 10.9.9.4 metric 1
user@PE4# set area 0.0.0.0 interface 10.100.1.4 passive
user@PE4# set area 0.0.0.0 interface 10.100.1.4 metric 1
user@PE4# set area 0.0.0.2 interface fe-1/2/2.10 metric 1
user@PE4# set area 0.0.0.3 interface fe-1/0/2.12 metric 1
```

9. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE4# set router-id 10.9.9.4
user@PE4# set autonomous-system 13979
```

10. If you are done configuring the device, commit the configuration.

```
user@PE4# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE4# show interfaces
fe-1/0/2 {
   unit 12 {
      description PE4-to-PE3;
      family inet {
         address 10.0.0.25/30;
      }
      family mpls;
   }
}
fe-1/2/0 {
   unit 7 {
      description PE4-to-P2;
      family inet {
         address 10.0.0.14/30;
      }
```

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```
      family mpls;
    }
}
fe-1/2/1 {
    unit 9 {
      description PE4-to-P1;
      family inet {
        address 10.0.0.18/30;
      }
      family mpls;
    }
}
fe-1/2/2 {
    unit 10 {
      description PE4-to-PE2;
      family inet {
        address 10.0.0.21/30;
      }
      family mpls;
    }
}
lo0 {
    unit 7 {
      family inet {
        address 10.9.9.4/32;
        address 10.100.1.4/32;
      }
    }
}
```

```
user@PE4# show policy-options
policy-statement aigp {
    term 10 {
      from {
        protocol static;
        route-filter 44.0.0.0/24 exact;
      }
      then {
        aigp-originate distance 200;
        next-hop 10.100.1.4;
        accept;
      }
    }
}
policy-statement next-hop {
    term 10 {
      from protocol bgp;
      then {
        next-hop 10.100.1.4;
        accept;
      }
    }
    term 20 {
      from {
```


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```
        protocol direct;
        route-filter 10.9.9.4/32 exact;
        route-filter 10.100.1.4/32 exact;
      }
      then {
        next-hop 10.100.1.4;
        accept;
      }
    }
}
```

```
user@PE4# show protocols
rsvp {
  interface fe-1/2/0.7;
  interface fe-1/2/1.9;
  interface fe-1/2/2.10;
  interface fe-1/0/2.12;
}
mpls {
  label-switched-path PE4-to-PE2 {
    to 10.9.9.5;
  }
  label-switched-path PE4-to-PE3 {
    to 10.9.9.6;
  }
  label-switched-path PE4-to-P1 {
    to 10.9.9.2;
  }
  label-switched-path PE4-to-P2 {
    to 10.9.9.3;
  }
  interface fe-1/2/0.7;
  interface fe-1/2/1.9;
  interface fe-1/2/2.10;
  interface fe-1/0/2.12;
}
bgp {
  export [ next-hop aigp ];
  group internal {
    type internal;
    local-address 10.9.9.4;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    neighbor 10.9.9.1;
    neighbor 10.9.9.3;
    neighbor 10.9.9.2;
  }
  group external {
    type external;
    multihop {
      ttl 2;
```

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```
    }
    local-address 10.9.9.4;
    family inet {
      labeled-unicast {
        aigp;
      }
    }
    peer-as 7018;
    neighbor 10.9.9.5;
    neighbor 10.9.9.6;
  }
}
ospf {
  area 0.0.0.0 {
    interface fe-1/2/1.9 {
      metric 1;
    }
    interface fe-1/2/0.7 {
      metric 1;
    }
    interface 10.9.9.4 {
      passive;
      metric 1;
    }
    interface 10.100.1.4 {
      passive;
      metric 1;
    }
  }
  area 0.0.0.2 {
    interface fe-1/2/2.10 {
      metric 1;
    }
  }
  area 0.0.0.3 {
    interface fe-1/0/2.12 {
      metric 1;
    }
  }
}
```

```
user@PE4# show routing-options
static {
  route 44.0.0.0/24 discard;
}
router-id 10.9.9.4;
autonomous-system 13979;
```


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Configuring Device PE1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE1:

1. Configure the interfaces.

```
[edit interfaces]
user@PE1# set fe-1/2/0 unit 0 description PE1-to-P1
user@PE1# set fe-1/2/0 unit 0 family inet address 10.0.0.1/30
user@PE1# set fe-1/2/0 unit 0 family mpls
user@PE1# set fe-1/2/1 unit 2 description PE1-to-P2
user@PE1# set fe-1/2/1 unit 2 family inet address 10.0.0.5/30
user@PE1# set fe-1/2/1 unit 2 family mpls
user@PE1# set fe-1/2/2 unit 14 description PE1-to-PE7
user@PE1# set fe-1/2/2 unit 14 family inet address 10.0.0.9/30
user@PE1# set lo0 unit 1 family inet address 10.9.9.1/32
user@PE1# set lo0 unit 1 family inet address 10.100.1.1/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE1# set rsvp interface fe-1/2/0.0
user@PE1# set rsvp interface fe-1/2/1.2
user@PE1# set rsvp interface fe-1/2/2.14
user@PE1# set mpls label-switched-path PE1-to-P1 to 10.9.9.2
user@PE1# set mpls label-switched-path PE1-to-P2 to 10.9.9.3
user@PE1# set mpls interface fe-1/2/0.0
user@PE1# set mpls interface fe-1/2/1.2
user@PE1# set mpls interface fe-1/2/2.14
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE1# set group internal type internal
user@PE1# set group internal local-address 10.9.9.1
user@PE1# set group internal export SET_EXPORT_ROUTES
user@PE1# set group internal vpn-apply-export
user@PE1# set group internal neighbor 10.9.9.4
user@PE1# set group internal neighbor 10.9.9.2
user@PE1# set group internal neighbor 10.9.9.3
user@PE1# set group external type external
user@PE1# set group external export SET_EXPORT_ROUTES
user@PE1# set group external peer-as 7019
user@PE1# set group external neighbor 10.0.0.10
```

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4. Enable AIGP.

```
[edit protocols bgp]
user@PE1# set group internal family inet labeled-unicast aigp
user@PE1# set group external family inet labeled-unicast aigp
```

5. Enable the policies.

```
[edit policy-options policy-statement SET_EXPORT_ROUTES term 10]
user@PE1# set from protocol direct
user@PE1# set from protocol bgp
user@PE1# set then next-hop 10.100.1.1
user@PE1# set then accept
```

6. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf area 0.0.0.1]
user@PE1# set interface fe-1/2/0.0 metric 1
user@PE1# set interface fe-1/2/1.2 metric 1
user@PE1# set interface 10.9.9.1 passive
user@PE1# set interface 10.9.9.1 metric 1
user@PE1# set interface 10.100.1.1 passive
user@PE1# set interface 10.100.1.1 metric 1
```

7. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE1# set router-id 10.9.9.1
user@PE1# set autonomous-system 13979
```

8. If you are done configuring the device, commit the configuration.

```
user@PE1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show interfaces
fe-1/2/0 {
   unit 0 {
      description PE1-to-P1;
      family inet {
         address 10.0.0.1/30;
      }
      family mpls;
```


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```
    }
}
fe-1/2/1 {
    unit 2 {
        description PE1-to-P2;
        family inet {
            address 10.0.0.5/30;
        }
        family mpls;
    }
}
fe-1/2/2 {
    unit 14 {
        description PE1-to-PE7;
        family inet {
            address 10.0.0.9/30;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 10.9.9.1/32;
            address 10.100.1.1/32;
        }
    }
}
```

```
user@PE1# show policy-options
policy-statement SET_EXPORT_ROUTES {
    term 10 {
        from protocol [ direct bgp ];
        then {
            next-hop 10.100.1.1;
            accept;
        }
    }
}
```

```
user@PE1# show protocols
rsvp {
    interface fe-1/2/0.0;
    interface fe-1/2/1.2;
    interface fe-1/2/2.14;
}
mpls {
    label-switched-path PE1-to-P1 {
        to 10.9.9.2;
    }
    label-switched-path PE1-to-P2 {
        to 10.9.9.3;
    }
    interface fe-1/2/0.0;
    interface fe-1/2/1.2;
```

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```
    interface fe-1/2/2.14;
}
bgp {
    group internal {
        type internal;
        local-address 10.9.9.1;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        export SET_EXPORT_ROUTES;
        vpn-apply-export;
        neighbor 10.9.9.4;
        neighbor 10.9.9.2;
        neighbor 10.9.9.3;
    }
    group external {
        type external;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        export SET_EXPORT_ROUTES;
        peer-as 7019;
        neighbor 10.0.0.10;
    }
}
ospf {
    area 0.0.0.1 {
        interface fe-1/2/0.0 {
            metric 1;
        }
        interface fe-1/2/1.2 {
            metric 1;
        }
        interface 10.9.9.1 {
            passive;
            metric 1;
        }
        interface 10.100.1.1 {
            passive;
            metric 1;
        }
    }
}
```

```
user@PE1# show routing-options
router-id 10.9.9.1;
autonomous-system 13979;
```


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Configuring Device PE2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE2:

1. Configure the interfaces.

```
[edit interfaces]
user@PE2# set fe-1/2/0 unit 11 description PE2-to-PE4
user@PE2# set fe-1/2/0 unit 11 family inet address 10.0.0.22/30
user@PE2# set fe-1/2/0 unit 11 family mpls
user@PE2# set lo0 unit 9 family inet address 10.9.9.5/32 primary
user@PE2# set lo0 unit 9 family inet address 10.100.1.5/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE2# set rsvp interface fe-1/2/0.11
user@PE2# set mpls label-switched-path PE2-to-PE4 to 10.9.9.4
user@PE2# set mpls interface fe-1/2/0.11
```

3. Configure BGP.

```
[edit protocols bgp]
user@PE2# set group external type external
user@PE2# set group external multihop ttl 2
user@PE2# set group external local-address 10.9.9.5
user@PE2# set group external export next-hop
user@PE2# set group external export aigp
user@PE2# set group external export SET_EXPORT_ROUTES
user@PE2# set group external vpn-apply-export
user@PE2# set group external peer-as 13979
user@PE2# set group external neighbor 10.9.9.4
```

4. Enable AIGP.

```
[edit protocols bgp]
user@PE2# set group external family inet labeled-unicast aigp
```

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5. Originate a prefix, and configure an AIGP distance.

   By default, a prefix is originated using the current IGP distance. Optionally, you can configure a distance for the AIGP attribute, using the **distance** option, as shown here.

```
[edit policy-options policy-statement aigp]
user@PE2# set term 10 from route-filter 55.0.0.0/24 exact
user@PE2# set term 10 then aigp-originate distance 20
user@PE2# set term 10 then next-hop 10.100.1.5
user@PE2# set term 10 then accept
user@PE2# set term 20 from route-filter 99.0.0.0/24 exact
user@PE2# set term 20 then aigp-originate distance 30
user@PE2# set term 20 then next-hop 10.100.1.5
user@PE2# set term 20 then accept
```

6. Enable the policies.

```
[edit policy-options]
user@PE2# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  direct
user@PE2# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  static
user@PE2# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  bgp
user@PE2# set policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.5
user@PE2# set policy-statement SET_EXPORT_ROUTES term 10 then accept
user@PE2# set policy-statement next-hop term 10 from protocol bgp
user@PE2# set policy-statement next-hop term 10 then next-hop 10.100.1.5
user@PE2# set policy-statement next-hop term 10 then accept
user@PE2# set policy-statement next-hop term 20 from protocol direct
user@PE2# set policy-statement next-hop term 20 from route-filter 10.9.9.5/32
  exact
user@PE2# set policy-statement next-hop term 20 from route-filter 10.100.1.5/32
  exact
user@PE2# set policy-statement next-hop term 20 then next-hop 10.100.1.5
user@PE2# set policy-statement next-hop term 20 then accept
```

7. Enable some static routes.

```
[edit routing-options]
user@PE2# set static route 99.0.0.0/24 discard
user@PE2# set static route 55.0.0.0/24 discard
```

8. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf area 0.0.0.2]
user@PE2# set interface 10.9.9.5 passive
user@PE2# set interface 10.9.9.5 metric 1
user@PE2# set interface 10.100.1.5 passive
```


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```
user@PE2# set interface 10.100.1.5 metric 1
user@PE2# set interface fe-1/2/0.11 metric 1
```

9. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE2# set router-id 10.9.9.5
user@PE2# set autonomous-system 7018
```

10. If you are done configuring the device, commit the configuration.

```
user@PE2# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
fe-1/2/0 {
   unit 11 {
      description PE2-to-PE4;
      family inet {
         address 10.0.0.22/30;
      }
      family mpls;
   }
}
lo0 {
   unit 9 {
      family inet {
         address 10.9.9.5/32 {
            primary;
         }
         address 10.100.1.5/32;
      }
   }
}
```

```
user@PE2# show policy-options
policy-statement SET_EXPORT_ROUTES {
   term 10 {
      from protocol [ direct static bgp ];
      then {
         next-hop 10.100.1.5;
         accept;
      }
   }
}
```

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```
policy-statement aigp {
    term 10 {
        from {
            route-filter 55.0.0.0/24 exact;
        }
        then {
            aigp-originate distance 20;
            next-hop 10.100.1.5;
            accept;
        }
    }
    term 20 {
        from {
            route-filter 99.0.0.0/24 exact;
        }
        then {
            aigp-originate distance 30;
            next-hop 10.100.1.5;
            accept;
        }
    }
}
policy-statement next-hop {
    term 10 {
        from protocol bgp;
        then {
            next-hop 10.100.1.5;
            accept;
        }
    }
    term 20 {
        from {
            protocol direct;
            route-filter 10.9.9.5/32 exact;
            route-filter 10.100.1.5/32 exact;
        }
        then {
            next-hop 10.100.1.5;
            accept;
        }
    }
}
```

```
user@PE2# show protocols
rsvp {
    interface fe-1/2/0.11;
}
mpls {
    label-switched-path PE2-to-PE4 {
        to 10.9.9.4;
    }
    interface fe-1/2/0.11;
}
bgp {
```


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```
    group external {
        type external;
        multihop {
            ttl 2;
        }
        local-address 10.9.9.5;
        family inet {
            labeled-unicast {
                aigp;
            }
        }
        export [ next-hop aigp SET_EXPORT_ROUTES ];
        vpn-apply-export;
        peer-as 13979;
        neighbor 10.9.9.4;
    }
}
ospf {
    area 0.0.0.2 {
        interface 10.9.9.5 {
            passive;
            metric 1;
        }
        interface 10.100.1.5 {
            passive;
            metric 1;
        }
        interface fe-1/2/0.11 {
            metric 1;
        }
    }
}
```

```
user@PE2# show routing-options
static {
    route 99.0.0.0/24 discard;
    route 55.0.0.0/24 discard;
}
router-id 10.9.9.5;
autonomous-system 7018;
```

Configuring Device PE3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE3:

1. Configure the interfaces.

```
[edit interfaces]
user@PE3# set fe-1/2/0 unit 13 description PE3-to-PE4
```

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```
user@PE3# set fe-1/2/0 unit 13 family inet address 10.0.0.26/30
user@PE3# set fe-1/2/0 unit 13 family mpls
user@PE3# set lo0 unit 11 family inet address 10.9.9.6/32
user@PE3# set lo0 unit 11 family inet address 10.100.1.6/32
```

2. Configure MPLS and a signaling protocol, such as RSVP or LDP.

```
[edit protocols]
user@PE3# set rsvp interface fe-1/2/0.13
user@PE3# set mpls label-switched-path PE3-to-PE4 to 10.9.9.4
user@PE3# set mpls interface fe-1/2/0.13
```

3. Configure BGP.

```
[edit protocols bgp group external]
user@PE3# set type external
user@PE3# set multihop ttl 2
user@PE3# set local-address 10.9.9.6
user@PE3# set export next-hop
user@PE3# set export SET_EXPORT_ROUTES
user@PE3# set vpn-apply-export
user@PE3# set peer-as 13979
user@PE3# set neighbor 10.9.9.4
```

4. Enable AIGP.

```
[edit protocols bgp group external]
user@PE3# set family inet labeled-unicast aigp
```

5. Enable the policies.

```
[edit policy-options]
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  direct
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  static
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 from protocol
  bgp
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 then next-hop
  10.100.1.6
user@PE3# set policy-statement SET_EXPORT_ROUTES term 10 then accept
user@PE3# set policy-statement next-hop term 10 from protocol bgp
user@PE3# set policy-statement next-hop term 10 then next-hop 10.100.1.6
user@PE3# set policy-statement next-hop term 10 then accept
user@PE3# set policy-statement next-hop term 20 from protocol direct
user@PE3# set policy-statement next-hop term 20 from route-filter 10.9.9.6/32
  exact
user@PE3# set policy-statement next-hop term 20 from route-filter 10.100.1.6/32
  exact
```


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```
user@PE3# set policy-statement next-hop term 20 then next-hop 10.100.1.6
user@PE3# set policy-statement next-hop term 20 then accept
```

6. Configure an IGP, such as OSPF, RIP, or IS-IS.

```
[edit protocols ospf area 0.0.0.3]
user@PE3# set interface 10.9.9.6 passive
user@PE3# set interface 10.9.9.6 metric 1
user@PE3# set interface 10.100.1.6 passive
user@PE3# set interface 10.100.1.6 metric 1
user@PE3# set interface fe-1/2/0.13 metric 1
```

7. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE3# set router-id 10.9.9.6
user@PE3# set autonomous-system 7018
```

8. If you are done configuring the device, commit the configuration.

```
user@PE3# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE3# show interfaces
fe-1/2/0 {
   unit 13 {
      description PE3-to-PE4;
      family inet {
         address 10.0.0.26/30;
      }
      family mpls;
   }
}
lo0 {
   unit 11 {
      family inet {
         address 10.9.9.6/32;
         address 10.100.1.6/32;
      }
   }
}
```

```
user@PE3# show policy-options
```

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```
policy-statement SET_EXPORT_ROUTES {
   term 10 {
      from protocol [ direct static bgp ];
      then {
         next-hop 10.100.1.6;
         accept;
      }
   }
}
policy-statement next-hop {
   term 10 {
      from protocol bgp;
      then {
         next-hop 10.100.1.6;
         accept;
      }
   }
   term 20 {
      from {
         protocol direct;
         route-filter 10.9.9.6/32 exact;
         route-filter 10.100.1.6/32 exact;
      }
      then {
         next-hop 10.100.1.6;
         accept;
      }
   }
}
```

```
user@PE3# show protocols
rsvp {
   interface fe-1/2/0.13;
}
mpls {
   label-switched-path PE3-to-PE4 {
      to 10.9.9.4;
   }
   interface fe-1/2/0.13;
}
bgp {
   group external {
      type external;
      multihop {
         ttl 2;
      }
      local-address 10.9.9.6;
      family inet {
         labeled-unicast {
            aigp;
         }
      }
      export [ next-hop SET_EXPORT_ROUTES ];
      vpn-apply-export;
```


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```
    peer-as 13979;
    neighbor 10.9.9.4;
  }
}
ospf {
  area 0.0.0.3 {
    interface 10.9.9.6 {
      passive;
      metric 1;
    }
    interface 10.100.1.6 {
      passive;
      metric 1;
    }
    interface fe-1/2/0.13 {
      metric 1;
    }
  }
}
```

```
user@PE3# show routing-options
router-id 10.9.9.6;
autonomous-system 7018;
```

Configuring Device PE7

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE7:

1. Configure the interfaces.

```
[edit interfaces]
user@PE7# set fe-1/2/0 unit 15 description PE7-to-PE1
user@PE7# set fe-1/2/0 unit 15 family inet address 10.0.0.10/30
user@PE7# set lo0 unit 13 family inet address 10.9.9.7/32
user@PE7# set lo0 unit 13 family inet address 10.100.1.7/32
```

2. Configure BGP.

```
[edit protocols bgp group external]
user@PE7# set type external
user@PE7# set export SET_EXPORT_ROUTES
user@PE7# set peer-as 13979
user@PE7# set neighbor 10.0.0.9
```

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3. Enable AIGP.

```
[edit protocols bgp group external]
user@PE7# set family inet labeled-unicast aigp
```

4. Configure the routing policy.

```
[edit policy-options policy-statement SET_EXPORT_ROUTES term 10]
user@PE7# set from protocol direct
user@PE7# set from protocol bgp
user@PE7# set then next-hop 10.100.1.7
user@PE7# set then accept
```

5. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@PE7# set router-id 10.9.9.7
user@PE7# set autonomous-system 7019
```

6. If you are done configuring the device, commit the configuration.

```
user@PE7# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE7# show interfaces
interfaces {
   fe-1/2/0 {
      unit 15 {
         description PE7-to-PE1;
         family inet {
            address 10.0.0.10/30;
         }
      }
   }
   lo0 {
      unit 13 {
         family inet {
            address 10.9.9.7/32;
            address 10.100.1.7/32;
         }
      }
   }
}
```


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```
user@PE7# show policy-options
policy-statement SET_EXPORT_ROUTES {
   term 10 {
      from protocol [ direct bgp ];
      then {
         next-hop 10.100.1.7;
         accept;
      }
   }
}
```

```
user@PE7# show protocols
bgp {
   group external {
      type external;
      family inet {
         labeled-unicast {
            aigp;
         }
      }
      export SET_EXPORT_ROUTES;
      peer-as 13979;
      neighbor 10.0.0.9;
   }
}
```

```
user@PE7# show routing-options
router-id 10.9.9.7;
autonomous-system 7019;
```

Verification

Confirm that the configuration is working properly.

- Verifying That Device PE4 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE2 on page 153
- Checking the IGP Metric on page 154
- Verifying That Device PE4 Adds the IGP Metric to the AIGP Attribute on page 154
- Verifying That Device PE7 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE1 on page 155
- Verifying the Resolving AIGP Metric on page 156
- Verifying the Presence of AIGP Attributes in BGP Updates on page 159

Verifying That Device PE4 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE2

Purpose Make sure that the AIGP policy on Device PE2 is working.

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Action

```
user@PE4> show route receive-protocol bgp 10.9.9.5 extensive

* 55.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 299888
     Nexthop: 10.100.1.5
     AS path: 7018 I
     AIGP: 20

* 99.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 299888
     Nexthop: 10.100.1.5
     AS path: 7018 I
     AIGP: 30
```

Meaning On Device PE2, the **aigp-originate** statement is configured with a distance of 20 (**aigp-originate distance 20**). This statement is applied to route 55.0.0.0/24. Likewise, the **aigp-originate distance 30** statement is applied to route 99.0.0.0/24. Thus, when Device PE4 receives these routes, the AIGP attribute is attached with the configured metrics.

Checking the IGP Metric

Purpose From Device PE4, check the IGP metric to the BGP next hop 10.100.1.5.

Action

```
user@PE4> show route 10.100.1.5

inet.0: 30 destinations, 40 routes (30 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.100.1.5/32      *[OSPF/10] 05:35:50, metric 2
                    > to 10.0.0.22 via fe-1/2/2.10
                    [BGP/170] 03:45:07, localpref 100, from 10.9.9.5
                      AS path: 7018 I
                    > to 10.0.0.22 via fe-1/2/2.10
```

Meaning The IGP metric for this route is 2.

Verifying That Device PE4 Adds the IGP Metric to the AIGP Attribute

Purpose Make sure that Device PE4 adds the IGP metric to the AIGP attribute when it readvertises routes to its IBGP neighbor, Device PE1.

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Action

```
user@PE4> show route advertising-protocol bgp 10.9.9.1 extensive

* 55.0.0.0/24 (1 entry, 1 announced)
 BGP group internal type Internal
     Route Label: 300544
     Nexthop: 10.100.1.4
     Flags: Nexthop Change
     Localpref: 100
     AS path: [13979] 7018 I
     AIGP: 22

* 99.0.0.0/24 (1 entry, 1 announced)
 BGP group internal type Internal
     Route Label: 300544
     Nexthop: 10.100.1.4
     Flags: Nexthop Change
     Localpref: 100
     AS path: [13979] 7018 I
     AIGP: 32
```

Meaning The IGP metric is added to the AIGP metric (20 + 2 = 22 and 30 + 2 = 32), because the next hop is changed for these routes.

Verifying That Device PE7 Is Receiving the AIGP Attribute from Its EBGP Neighbor PE1

Purpose Make sure that the AIGP policy on Device PE1 is working.

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Action `user@PE7>` **show route receive-protocol bgp 10.0.0.9 extensive**

```
* 44.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300096
     Nexthop: 10.0.0.9
     AS path: 13979 I
     AIGP: 203

* 55.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300112
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
     AIGP: 25

* 99.0.0.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300112
     Nexthop: 10.0.0.9
     AS path: 13979 7018 I
     AIGP: 35
```

Meaning The 44.0.0.0/24 route is originated at Device PE4. The 55.0.0.0/24 and 99.0.0.0/24 routes are originated at Device PE2. The IGP distances are added to the configured AIGP distances.

Verifying the Resolving AIGP Metric

Purpose Confirm that if the prefix is resolved through recursion and the recursive next hops have AIGP metrics, the prefix has the sum of the AIGP values that are on the recursive BGP next hops.

Action

1. Add a static route to 66.0.0.0/24.

   ```
   [edit routing-options]
   user@PE2# set static route 66.0.0.0/24 discard
   ```

2. Delete the existing terms in the **aigp** policy statement on Device PE2.

   ```
   [edit policy-options policy-statement aigp]
   user@PE2# delete term 10
   user@PE2# delete term 20
   ```

3. Configure a recursive route lookup for the route to 66.0.0.0.

   The policy shows the AIGP metric for prefix 66.0.0.0/24 (none) and its recursive next hop. Prefix 66.0.0.0/24 is resolved by 55.0.0.1. Prefix 66.0.0.0/24 does not have its own AIGP metric being originated, but its recursive next hop, 55.0.0.1, has an AIGP value.

   ```
   [edit policy-options policy-statement aigp]
   ```


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```
user@PE2# set term 10 from route-filter 55.0.0.1/24 exact
user@PE2# set term 10 then aigp-originate distance 20
user@PE2# set term 10 then next-hop 10.100.1.5
user@PE2# set term 10 then accept
user@PE2# set term 20 from route-filter 66.0.0.0/24 exact
user@PE2# set term 20 then next-hop 55.0.0.1
user@PE2# set term 20 then accept
```

4. On Device PE4, run the **show route 55.0.0.0 extensive** command.

   The value of Metric2 is the IGP metric to the BGP next hop. When Device PE4 readvertises these routes to its IBGP peer, Device PE1, the AIGP metric is the sum of AIGP + its Resolving AIGP metric + Metric2.

   Prefix 55.0.0.0 shows its own IGP metric 20, as defined and advertised by Device PE2. It does not show a resolving AIGP value because it does not have a recursive BGP next hop. The value of Metric2 is 2.

```
user@PE4> show route 55.0.0.0 extensive

inet.0: 31 destinations, 41 routes (31 active, 0 holddown, 0 hidden)
55.0.0.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 55.0.0.0/24 -> {indirect(262151)}
Page 0 idx 0 Type 1 val 928d1b8
    Flags: Nexthop Change
    Nexthop: 10.100.1.4
    Localpref: 100
    AS path: [13979] 7018 I
    Communities:
    AIGP: 22
Path 55.0.0.0 from 10.9.9.5 Vector len 4.  Val: 0
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x925da38
                Next-hop reference count: 4
                Source: 10.9.9.5
                Next hop type: Router, Next hop index: 1004
                Next hop: 10.0.0.22 via fe-1/2/2.10, selected
                Label operation: Push 299888
                Label TTL action: prop-ttl
                Protocol next hop: 10.100.1.5
                Push 299888
                Indirect next hop: 93514d8 262151
                State: <Active Ext>
                Local AS: 13979 Peer AS:  7018
                Age: 22:03:26   Metric2: 2
                AIGP: 20
                Task: BGP_7018.10.9.9.5+58560
                Announcement bits (3): 3-KRT 4-BGP_RT_Background 5-Resolve tree 1
                AS path: 7018 I
                Accepted
                Route Label: 299888
                Localpref: 100
                Router ID: 10.9.9.5
                Indirect next hops: 1
                        Protocol next hop: 10.100.1.5 Metric: 2
                        Push 299888
                        Indirect next hop: 93514d8 262151
```

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```
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.0.0.22 via fe-1/2/2.10
                        10.100.1.5/32 Originating RIB: inet.0
                          Metric: 2                     Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.0.0.22 via fe-1/2/2.10
```

5. On Device PE4, run the **show route 66.0.0.0 extensive** command.

   Prefix 66.0.0.0/24 shows the Resolving AIGP, which is the sum of its own AIGP metric and its recursive BGP next hop:

   66.0.0.1 = 0, 55.0.0.1 = 20, 0+20 = 20

```
user@PE4> show route 66.0.0.0 extensive

inet.0: 31 destinations, 41 routes (31 active, 0 holddown, 0 hidden)
66.0.0.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 66.0.0.0/24 -> {indirect(262162)}
Page 0 idx 0 Type 1 val 928cefc
    Flags: Nexthop Change
    Nexthop: 10.100.1.4
    Localpref: 100
    AS path: [13979] 7018 I
    Communities:
Path 66.0.0.0 from 10.9.9.5 Vector len 4.  Val: 0
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x925d4e0
                Next-hop reference count: 4
                Source: 10.9.9.5
                Next hop type: Router, Next hop index: 1006
                Next hop: 10.0.0.22 via fe-1/2/2.10, selected
                Label operation: Push 299888, Push 299888(top)
                Label TTL action: prop-ttl, prop-ttl(top)
                Protocol next hop: 55.0.0.1
                Push 299888
                Indirect next hop: 9353e88 262162
                State: <Active Ext>
                Local AS: 13979 Peer AS:  7018
                Age: 31:42      Metric2: 2
                Resolving-AIGP: 20
                Task: BGP_7018.10.9.9.5+58560
                Announcement bits (3): 3-KRT 4-BGP_RT_Background 5-Resolve tree 1
                AS path: 7018 I
                Accepted
                Route Label: 299888
                Localpref: 100
                Router ID: 10.9.9.5
                Indirect next hops: 1
                        Protocol next hop: 55.0.0.1 Metric: 2 AIGP: 20
                        Push 299888
                        Indirect next hop: 9353e88 262162
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.0.0.22 via fe-1/2/2.10
                        55.0.0.0/24 Originating RIB: inet.0
                          Metric: 2                     Node path count: 1
```


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```
Indirect nexthops: 1
      Protocol Nexthop: 10.100.1.5 Metric: 2 Push 299888
      Indirect nexthop: 93514d8 262151
      Indirect path forwarding nexthops: 1
              Nexthop: 10.0.0.22 via fe-1/2/2.10
      10.100.1.5/32 Originating RIB: inet.0
        Metric: 2                              Node path count: 1
        Forwarding nexthops: 1
              Nexthop: 10.0.0.22 via fe-1/2/2.10
```

Verifying the Presence of AIGP Attributes in BGP Updates

Purpose If the AIGP attribute is not enabled under BGP (or the **group** or **neighbor** hierarchies), the AIGP attribute is silently discarded. Enable **traceoptions** and include the **packets** flag in the **detail** option in the configuration to confirm the presence of the AIGP attribute in transmitted or received BGP updates. This is useful when debugging AIGP issues.

Action

1. Configure Device PE2 and Device PE4 for **traceoptions**.

```
user@host> show protocols bgp
  traceoptions {
    file bgp size 1m files 5;
    flag packets detail;
  }
```

2. Check the **traceoptions** file on Device PE2.

   The following sample shows Device PE2 advertising prefix 99.0.0.0/24 to Device PE4 (10.9.9.4) with an AIGP metric of 20:

```
user@PE2> show log bgp
Mar 22 09:27:18.982150 BGP SEND 10.9.9.5+49652 -> 10.9.9.4+179
Mar 22 09:27:18.982178 BGP SEND message type 2 (Update) length 70
Mar 22 09:27:18.982198 BGP SEND Update PDU length 70
Mar 22 09:27:18.982248 BGP SEND flags 0x40 code Origin(1): IGP
Mar 22 09:27:18.982273 BGP SEND flags 0x40 code ASPath(2) length 6: 7018
Mar 22 09:27:18.982295 BGP SEND flags 0x80 code AIGP(26): AIGP: 20
Mar 22 09:27:18.982316 BGP SEND flags 0x90 code MP_reach(14): AFI/SAFI 1/4
Mar 22 09:27:18.982341 BGP SEND         nhop 10.100.1.5 len 4
Mar 22 09:27:18.982372 BGP SEND     99.0.0.0/24 (label 301664)
Mar 22 09:27:33.665412 bgp_send: sending 19 bytes to abcd::10:255:170:84
(External AS 13979)
```

3. Verify that the route was received on Device PE4 using the **show route receive-protocol** command.

   AIGP is not enabled on Device PE4, so the AIGP attribute is silently discarded for prefix 99.0.0.0/24 and does not appear in the following output:

```
user@PE4> show route receive-protocol bgp 10.9.9.5 extensive | find 55.0.0.0
* 99.0.0.0/24 (2 entries, 1 announced)
     Accepted
```

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```
    Route Label: 301728
    Nexthop: 10.100.1.5
    AS path: 7018 I
```

4. Check the **traceoptions** file on Device PE4.

   The following output from the **traceoptions** log shows that the 99.0.0.0/24 prefix was received with the AIGP attribute attached:

```
user@PE4> show log bgp
Mar 22 09:41:39.650295 BGP RECV 10.9.9.5+64690 -> 10.9.9.4+179
Mar 22 09:41:39.650331 BGP RECV message type 2 (Update) length 70
Mar 22 09:41:39.650350 BGP RECV Update PDU length 70
Mar 22 09:41:39.650370 BGP RECV flags 0x40 code Origin(1): IGP
Mar 22 09:41:39.650394 BGP RECV flags 0x40 code ASPath(2) length 6: 7018
Mar 22 09:41:39.650415 BGP RECV flags 0x80 code AIGP(26): AIGP: 20
Mar 22 09:41:39.650436 BGP RECV flags 0x90 code MP_reach(14): AFI/SAFI 1/4
Mar 22 09:41:39.650459 BGP RECV         nhop 10.100.1.5 len 4
Mar 22 09:41:39.650495 BGP RECV     99.0.0.0/24 (label 301728)
Mar 22 09:41:39.650574 bgp_rcv_nlri: 99.0.0.0/24
Mar 22 09:41:39.650607 bgp_rcv_nlri: 99.0.0.0/24 belongs to meshgroup
Mar 22 09:41:39.650629 bgp_rcv_nlri: 99.0.0.0/24 qualified bnp->ribact 0x0
l2afcb 0x0
```

Meaning Performing this verification helps with AIGP troubleshooting and debugging issues. It enables you to verify which devices in your network send and receive AIGP attributes.

Related Documentation

Understanding AS Override

The AS override feature allows a provider edge (PE) router to change the private autonomous system (AS) number used by a customer edge (CE) device on an external BGP (EBGP) session running on a VPN routing and forwarding (VRF) access link. The private AS number is changed to the PE AS number. Another CE device connected to another PE device sees the EBGP route coming from the first site with an AS path of provider-ASN provider-ASN, instead of provider-ASN site1-ASN. This allows enterprise networks to use the same private ASN on all sites.

The AS override feature offers a clear management advantage to the service provider because BGP by default does not accept BGP routes with an AS path attribute that contains the local AS number.

In an enterprise network with multiple sites, you might wish to use a single AS number across sites. Suppose, for example that two CE devices are in AS 64512 and that the provider network is in AS 65534.

When the service provider configures a Layer 3 VPN with this setup, even if the MPLS network has routes towards Device CE1 and Device CE2, Device CE1 and Device CE2 do

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not have routes to each other because the AS path attribute would appear as 64512 65534 64512. BGP uses the AS path attribute as its loop avoidance mechanism. If a site sees its own AS number more than once in the AS path, the route is considered invalid.

One way to overcome this difficulty is with the as-override statement, which is applied to the PE devices. The **as-override** statement replaces the CE device's AS number with that of the PE device, thus preventing the customer AS number from appearing more than once in the AS path attribute.

If a customer uses AS path prepending to make certain paths less desirable and the service provider uses AS override, each CE AS number occurrence in the AS-path is changed to the service provider AS number. For example, suppose that all customer sites use the same AS number, say 64512. If the ISP uses AS number 65534, one customer site sees the path to another site as 65534 65534. If the customer prepends 64512 on a particular path to make it less desirable, another customer site sees that path as 65534 65534 65534.

Related Documentation

- *Example: Configuring a Layer 3 VPN with Route Reflection and AS Override*

Example: Configuring a Layer 3 VPN with Route Reflection and AS Override

Suppose that you are a service provider providing a managed MPLS-based Layer 3 VPN service. Your customer has several sites and requires BGP routing to customer edge (CE) devices at each site.

- Requirements on page 161
- Overview on page 161
- Configuration on page 162
- Verification on page 170

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

This example has two CE devices, two provider edge (PE) devices, and several provider core devices. The provider network is also using IS-IS to support LDP and BGP loopback reachability Device P2 is acting as a route reflector (RR). Both CE devices are in autonomous system (AS) 64512. The provider network is in AS 65534.

The as-override statement is applied to the PE devices, thus replacing the CE device's AS number with that of the PE device. This prevents the customer AS number from appearing more than once in the AS path attribute.

Figure 12 on page 162 shows the topology used in this example.

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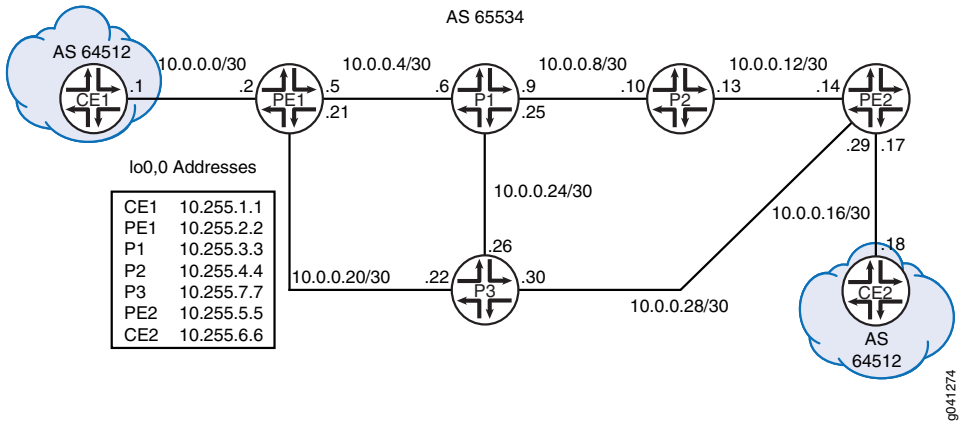
Figure 12: AS Override Topology



"CLI Quick Configuration" on page 162 shows the configuration for all of the devices in Figure 12 on page 162. The section "Step-by-Step Procedure" on page 166 describes the steps on Device PE1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device CE1

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 10.255.1.1/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0101.00
set protocols bgp group PE type external
set protocols bgp group PE family inet unicast
set protocols bgp group PE export ToBGP
set protocols bgp group PE peer-as 65534
set protocols bgp group PE neighbor 10.0.0.2
set policy-options policy-statement ToBGP term Direct from protocol direct
set policy-options policy-statement ToBGP term Direct then accept
set routing-options router-id 10.255.1.1
set routing-options autonomous-system 64512
```

Device P1

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.6/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/0 unit 0 family mpls
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.9/30
set interfaces ge-1/2/1 unit 0 family iso
set interfaces ge-1/2/1 unit 0 family mpls
set interfaces ge-1/2/2 unit 0 family inet address 10.0.0.25/30
set interfaces ge-1/2/2 unit 0 family iso
set interfaces ge-1/2/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.3.3/32
```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```
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0303.00
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group l3vpn type internal
set protocols bgp group l3vpn local-address 10.255.3.3
set protocols bgp group l3vpn family inet-vpn unicast
set protocols bgp group l3vpn peer-as 65534
set protocols bgp group l3vpn local-as 65534
set protocols bgp group l3vpn neighbor 10.255.4.4
set protocols isis interface all level 2 metric 10
set protocols isis interface all level 1 disable
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0 level 2 metric 0
set protocols ldp deaggregate
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set routing-options router-id 10.255.3.3
```

Device P2

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.10/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/0 unit 0 family mpls
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.13/30
set interfaces ge-1/2/1 unit 0 family iso
set interfaces ge-1/2/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.4.4/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0404.00
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group Core-RRClients type internal
set protocols bgp group Core-RRClients local-address 10.255.4.4
set protocols bgp group Core-RRClients family inet-vpn unicast
set protocols bgp group Core-RRClients cluster 10.255.4.4
set protocols bgp group Core-RRClients peer-as 65534
set protocols bgp group Core-RRClients neighbor 10.255.3.3
set protocols bgp group Core-RRClients neighbor 10.255.7.7
set protocols bgp group Core-RRClients neighbor 10.255.2.2
set protocols bgp group Core-RRClients neighbor 10.255.5.5
set protocols isis interface all level 2 metric 10
set protocols isis interface all level 1 disable
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0 level 2 metric 0
set protocols ldp deaggregate
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set routing-options router-id 10.255.4.4
set routing-options autonomous-system 65534
```

Device P3

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.22/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/0 unit 0 family mpls
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.26/30
set interfaces ge-1/2/1 unit 0 family iso
```

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```
set interfaces ge-1/2/1 unit 0 family mpls
set interfaces ge-1/2/2 unit 0 family inet address 10.0.0.30/30
set interfaces ge-1/2/2 unit 0 family iso
set interfaces ge-1/2/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.7.7/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0707.00
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group l3vpn type internal
set protocols bgp group l3vpn local-address 10.255.7.7
set protocols bgp group l3vpn family inet-vpn unicast
set protocols bgp group l3vpn peer-as 65534
set protocols bgp group l3vpn local-as 65534
set protocols bgp group l3vpn neighbor 10.255.4.4
set protocols isis interface all level 2 metric 10
set protocols isis interface all level 1 disable
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0 level 2 metric 0
set protocols ldp deaggregate
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set routing-options router-id 10.255.7.7
```

Device PE1

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/0 unit 0 family mpls
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.5/30
set interfaces ge-1/2/1 unit 0 family iso
set interfaces ge-1/2/1 unit 0 family mpls
set interfaces ge-1/2/2 unit 0 family inet address 10.0.0.21/30
set interfaces ge-1/2/2 unit 0 family iso
set interfaces ge-1/2/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.2.2/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0202.00
set protocols mpls interface ge-1/2/2.0
set protocols mpls interface ge-1/2/1.0
set protocols mpls interface lo0.0
set protocols mpls interface fxp0.0 disable
set protocols bgp group l3vpn type internal
set protocols bgp group l3vpn local-address 10.255.2.2
set protocols bgp group l3vpn family inet-vpn unicast
set protocols bgp group l3vpn peer-as 65534
set protocols bgp group l3vpn local-as 65534
set protocols bgp group l3vpn neighbor 10.255.4.4
set protocols isis interface ge-1/2/1.0 level 2 metric 10
set protocols isis interface ge-1/2/1.0 level 1 disable
set protocols isis interface ge-1/2/2.0 level 2 metric 10
set protocols isis interface ge-1/2/2.0 level 1 disable
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0 level 2 metric 0
set protocols ldp deaggregate
set protocols ldp interface ge-1/2/1.0
set protocols ldp interface ge-1/2/2.0
```


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```
set protocols ldp interface fxp0.0 disable
set protocols ldp interface lo0.0
set routing-instances VPN-A instance-type vrf
set routing-instances VPN-A interface ge-1/2/0.0
set routing-instances VPN-A route-distinguisher 65534:1234
set routing-instances VPN-A vrf-target target:65534:1234
set routing-instances VPN-A protocols bgp group CE type external
set routing-instances VPN-A protocols bgp group CE family inet unicast
set routing-instances VPN-A protocols bgp group CE neighbor 10.0.0.1 peer-as 64512
set routing-instances VPN-A protocols bgp group CE neighbor 10.0.0.1 as-override
set routing-options router-id 10.255.2.2
set routing-options autonomous-system 65534
```

Device PE2

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.14/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/0 unit 0 family mpls
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.17/30
set interfaces ge-1/2/1 unit 0 family iso
set interfaces ge-1/2/2 unit 0 family inet address 10.0.0.29/30
set interfaces ge-1/2/2 unit 0 family iso
set interfaces ge-1/2/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.5.5/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0505.00
set protocols mpls interface ge-1/2/0.0
set protocols mpls interface ge-1/2/2.0
set protocols mpls interface lo0.0
set protocols mpls interface fxp0.0 disable
set protocols bgp group l3vpn type internal
set protocols bgp group l3vpn local-address 10.255.5.5
set protocols bgp group l3vpn family inet-vpn unicast
set protocols bgp group l3vpn peer-as 65534
set protocols bgp group l3vpn local-as 65534
set protocols bgp group l3vpn neighbor 10.255.4.4
set protocols isis interface ge-1/2/0.0 level 2 metric 10
set protocols isis interface ge-1/2/0.0 level 1 disable
set protocols isis interface ge-1/2/2.0 level 2 metric 10
set protocols isis interface ge-1/2/2.0 level 1 disable
set protocols isis interface fxp0.0 disable
set protocols isis interface lo0.0 level 2 metric 0
set protocols ldp deaggregate
set protocols ldp interface ge-1/2/0.0
set protocols ldp interface ge-1/2/2.0
set protocols ldp interface fxp0.0 disable
set protocols ldp interface lo0.0
set routing-instances VPN-A instance-type vrf
set routing-instances VPN-A interface ge-1/2/1.0
set routing-instances VPN-A route-distinguisher 65534:1234
set routing-instances VPN-A vrf-target target:65534:1234
set routing-instances VPN-A protocols bgp group CE type external
set routing-instances VPN-A protocols bgp group CE family inet unicast
set routing-instances VPN-A protocols bgp group CE neighbor 10.0.0.18 peer-as 64512
set routing-instances VPN-A protocols bgp group CE neighbor 10.0.0.18 as-override
set routing-options router-id 10.255.5.5
```

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```
set routing-options autonomous-system 65534
```

Device CE2

```
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.18/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 10.255.6.6/32
set interfaces lo0 unit 0 family iso address 49.0001.0010.0000.0606.00
set protocols bgp group PE type external
set protocols bgp group PE family inet unicast
set protocols bgp group PE export ToBGP
set protocols bgp group PE peer-as 65534
set protocols bgp group PE neighbor 10.0.0.17
set policy-options policy-statement ToBGP term Direct from protocol direct
set policy-options policy-statement ToBGP term Direct then accept
set routing-options router-id 10.255.6.6
set routing-options autonomous-system 64512
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure AS override:

1. Configure the interfaces.

   To enable MPLS, include the protocol family on the interface so that the interface does not discard incoming MPLS traffic.

   ```
   [edit interfaces]
   user@PE1# set ge-1/2/0 unit 0 family inet address 10.0.0.2/30
   user@PE1# set ge-1/2/0 unit 0 family iso
   user@PE1# set ge-1/2/0 unit 0 family mpls
   user@PE1# set ge-1/2/1 unit 0 family inet address 10.0.0.5/30
   user@PE1# set ge-1/2/1 unit 0 family iso
   user@PE1# set ge-1/2/1 unit 0 family mpls
   user@PE1# set ge-1/2/2 unit 0 family inet address 10.0.0.21/30
   user@PE1# set ge-1/2/2 unit 0 family iso
   user@PE1# set ge-1/2/2 unit 0 family mpls
   user@PE1# set lo0 unit 0 family inet address 10.255.2.2/32
   user@PE1# set lo0 unit 0 family iso address 49.0001.0010.0000.0202.00
   ```

2. Add the interface to the MPLS protocol to establish the control plane level connectivity.

   Set up the IGP so that the provider devices can communicate with each other.

   To establish a mechanism to distribute MPLS labels, enable LDP. Optionally, for LDP, enable forwarding equivalence class (FEC) deaggregation, which results in faster global convergence.

   ```
   [edit protocols]
   user@PE1# set mpls interface ge-1/2/2.0
   ```


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```
user@PE1# set mpls interface ge-1/2/1.0
user@PE1# set mpls interface lo0.0
user@PE1# set mpls interface fxp0.0 disable
user@PE1# set isis interface ge-1/2/1.0 level 2 metric 10
user@PE1# set isis interface ge-1/2/1.0 level 1 disable
user@PE1# set isis interface ge-1/2/2.0 level 2 metric 10
user@PE1# set isis interface ge-1/2/2.0 level 1 disable
user@PE1# set isis interface fxp0.0 disable
user@PE1# set isis interface lo0.0 level 2 metric 0
user@PE1# set ldp deaggregate
user@PE1# set ldp interface ge-1/2/1.0
user@PE1# set ldp interface ge-1/2/2.0
user@PE1# set ldp interface fxp0.0 disable
user@PE1# set ldp interface lo0.0
```

3. Enable the internal BGP (IBGP) connection to peer with the RR only, using the IPv4 VPN unicast address family.

```
[edit protocols bgp group l3vpn]
user@PE1# set type internal
user@PE1# set local-address 10.255.2.2
user@PE1# set family inet-vpn unicast
user@PE1# set peer-as 65534
user@PE1# set local-as 65534
user@PE1# set neighbor 10.255.4.4
```

4. Configure the routing instance, including the **as-override** statement.

   Create the routing-Instance (VRF) on the PE device, setting up the BGP configuration to peer with Device CE1.

```
[edit routing-instances VPN-A]
user@PE1# set instance-type vrf
user@PE1# set interface ge-1/2/0.0
user@PE1# set route-distinguisher 65534:1234
user@PE1# set vrf-target target:65534:1234
user@PE1# set protocols bgp group CE type external
user@PE1# set protocols bgp group CE family inet unicast
user@PE1# set protocols bgp group CE neighbor 10.0.0.1 peer-as 64512
user@PE1# set protocols bgp group CE neighbor 10.0.0.1 as-override
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@PE1# set router-id 10.255.2.2
user@PE1# set autonomous-system 65534
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-instances**, and **show routing-options** commands. If the

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output does not display the intended configuration, repeat the configuration instructions in this example to correct it.

```
user@PE1# show interfaces
ge-1/2/0 {
   unit 2 {
      family inet {
         address 10.0.0.2/30;
      }
      family iso;
      family mpls;
   }
}
ge-1/2/1 {
   unit 5 {
      family inet {
         address 10.0.0.5/30;
      }
      family iso;
      family mpls;
   }
}
ge-1/2/2 {
   unit 21 {
      family inet {
         address 10.0.0.21/30;
      }
      family iso;
      family mpls;
   }
}
lo0 {
   unit 0 {
      family inet {
         address 10.255.2.2/32;
      }
      family iso {
         address 49.0001.0010.0000.0202.00;
      }
   }
}
```

```
user@PE1# show protocols
mpls {
   interface ge-1/2/2.0;
   interface ge-1/2/1.0;
   interface lo0.0;
   interface fxp0.0 {
      disable;
   }
}
bgp {
   group l3vpn {
      type internal;
```


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```
      local-address 10.255.2.2;
      family inet-vpn {
        unicast;
      }
      peer-as 65534;
      local-as 65534;
      neighbor 10.255.4.4;
    }
}
isis {
    interface ge-1/2/1.0 {
      level 2 metric 10;
      level 1 disable;
    }
    interface ge-1/2/2.0 {
      level 2 metric 10;
      level 1 disable;
    }
    interface fxp0.0 {
      disable;
    }
    interface lo0.0 {
      level 2 metric 0;
    }
}
ldp {
    deaggregate;
    interface ge-1/2/1.0;
    interface ge-1/2/2.0;
    interface fxp0.0 {
      disable;
    }
    interface lo0.0;
}
```

```
user@PE1# show routing-instances
VPN-A {
    instance-type vrf;
    interface ge-1/2/0.0;
    route-distinguisher 65534:1234;
    vrf-target target:65534:1234;
    protocols {
        bgp {
            group CE {
                type external;
                family inet {
                    unicast;
                }
                neighbor 10.0.0.1 {
                    peer-as 64512;
                    as-override;
                }
            }
        }
```

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```
  }
}
```

```
user@PE1# show routing-options
router-id 10.255.2.2;
autonomous-system 65534;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking AS Path to the CE Devices on page 170
- Checking How the Route to Device CE2 Is Advertised on page 170
- Checking the Route on Device CE1 on page 171

Checking AS Path to the CE Devices

Purpose Display information on Device PE1 about the AS path attribute for the route to Device CE2's loopback interface.

Action On Device PE1, from operational mode, enter the **show route table VPN-A.inet.0 10.255.6.6** command.

```
user@PE1> show route table VPN-A.inet.0 10.255.6.6

VPN-A.inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.6.6/32      *[BGP/170] 02:19:35, localpref 100, from 10.255.4.4
                      AS path: 64512 I, validation-state: unverified
                    > to 10.0.0.22 via ge-1/2/2.0, Push 300032, Push 299776(top)
```

Meaning The output shows that Device PE1 has an AS path for 10.255.6.6/32 as coming from AS 64512.

Checking How the Route to Device CE2 Is Advertised

Purpose Make sure the route to Device CE2 is advertised to Device CE1 as if it is coming from the MPLS core.

Action On Device PE1, from operational mode, enter the **show route advertising-protocol bgp 10.0.0.1** command.

```
user@PE1> show route advertising-protocol bgp 10.0.0.1
```


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```
VPN-A.inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.16/30            Self                                    I
* 10.255.1.1/32           10.0.0.1                                65534 I
* 10.255.6.6/32           Self                                    65534 I
```

Meaning The output indicates that Device PE1 is advertising only its own AS number in the AS path.

Checking the Route on Device CE1

Purpose Make sure that Device CE1 contains only the provider AS number in the AS path for the route to Device CE2.

Action From operational mode, enter the **show route table inet.0 terse 10.255.6.6** command.

```
user@CE1> show route table inet.0 terse 10.255.6.6

inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A V Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* ? 10.255.6.6/32      B 170        100                            65534 65534
I
  unverified                                      >10.0.0.2
```

Meaning The output indicates that Device CE1 has a route to Device CE2. The loop issue is resolved with the use of the **as-override** statement.

One route is hidden on the CE device. This is because Junos OS does not perform a BGP split horizon. Generally, split horizon in BGP is unnecessary, because any routes that might be received back by the originator are less preferred due to AS path length (for EBGP), AS path loop detection (IBGP), or other BGP metrics. Advertising routes back to the neighbor from which they were learned has a negligible effect on the router's performance, and is the correct thing to do.

Related Documentation

- Understanding AS Override on page 160
- Example: Enabling BGP Route Advertisements on page 171

Example: Enabling BGP Route Advertisements

Junos OS does not advertise the routes learned from one EBGP peer back to the same external BGP (EBGP) peer. In addition, the software does not advertise those routes back to any EBGP peers that are in the same autonomous system (AS) as the originating peer,

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regardless of the routing instance. You can modify this behavior by including the advertise-peer-as statement in the configuration.

If you include the **advertise-peer-as** statement in the configuration, BGP advertises the route regardless of this check.

To restore the default behavior, include the **no-advertise-peer-as** statement in the configuration:

```
no-advertise-peer-as;
```

The route suppression default behavior is disabled if the **as-override** statement is included in the configuration. If you include both the as-override and **no-advertise-peer-as** statements in the configuration, the **no-advertise-peer-as** statement is ignored.

- Requirements on page 172
- Overview on page 172
- Configuration on page 173
- Verification on page 177

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

This example shows three routing devices with external BGP (EBGP) connections. Device R2 has an EBGP connection to Device R1 and another EBGP connection to Device R3. Although separated by Device R2 which is in AS 64511, Device R1 and Device R3 are in the same AS (AS 64512). Device R1 and Device R3 advertise into BGP direct routes to their own loopback interface addresses.

Device R2 receives these loopback interface routes, and the **advertise peer-as** statement allows Device R2 to advertise them. Specifically, Device R1 sends the 192.168.0.1 route to Device R2, and because Device R2 has the **advertise peer-as** configured, Device R2 can send the 192.168.0.1 route to Device R3. Likewise, Device R3 sends the 192.168.0.3 route to Device R2, and **advertise peer-as** enables Device R2 to forward the route to Device R1.

To enable Device R1 and Device R3 to accept routes that contain their own AS number in the AS path, the **loops 2** statement is required on Device R1 and Device R3.

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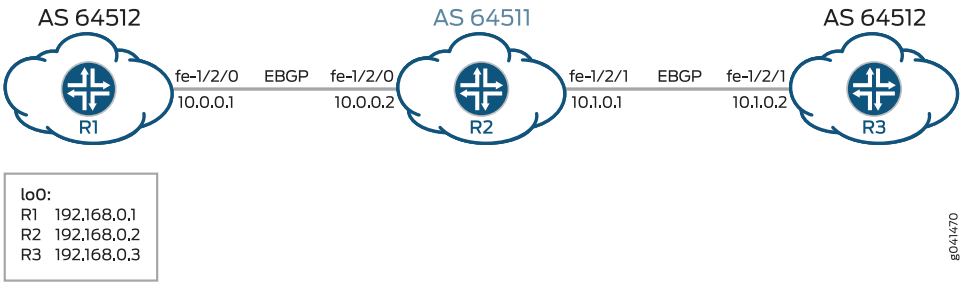
Topology

Figure 13: BGP Topology for advertise-peer-as



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp family inet unicast loops 2
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 64511
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64512
```

Device R2

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group ext type external
set protocols bgp group ext advertise-peer-as
set protocols bgp group ext export send-direct
set protocols bgp group ext neighbor 10.0.0.1 peer-as 64512
set protocols bgp group ext neighbor 10.1.0.2 peer-as 64512
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64511
```

Device R3

```
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp family inet unicast loops 2
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 64511
```

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```
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 64512
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the device interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 0 family inet address 10.0.0.1/30
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

2. Configure BGP.

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set peer-as 64511
user@R1# set neighbor 10.0.0.2
```

3. Prevent routes from Device R3 from being hidden on Device R1 by including the **loops 2** statement.

   The **loops 2** statement means that the local device's own AS number can appear in the AS path up to one time without causing the route to be hidden. The route is hidden if the local device's AS number is detected in the path two or more times.

```
[edit protocols bgp family inet unicast]
user@R1# set loops 2
```

4. Configure the routing policy that sends direct routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Apply the export policy to the BGP peering session with Device R2.

```
[edit protocols bgp group ext]
user@R1# set export send-direct
```

6. Configure the autonomous system (AS) number.

```
[edit routing-options ]
```


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```
user@R1# set autonomous-system 64512
```

Step-by-Step Procedure

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 0 family inet address 10.1.0.1/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure BGP.

```
[edit protocols bgp group ext]
user@R2# set type external
user@R2# set neighbor 10.0.0.1 peer-as 64512
user@R2# set neighbor 10.1.0.2 peer-as 64512
```

3. Configure Device R2 to advertise routes learned from one EBGP peer to another EBGP peer in the same AS.

   In other words, advertise to Device R1 routes learned from Device R3 (and the reverse), even though Device R1 and Device R3 are in the same AS.

```
[edit protocols bgp group ext]
user@R2# set advertise-peer-as
```

4. Configure a routing policy that sends direct routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

5. Apply the export policy.

```
[edit protocols bgp group ext]
user@R2# set export send-direct
```

6. Configure the AS number.

```
[edit routing-options]
user@R2# set autonomous-system 64511
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output

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does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device R1

```
user@R1# show interfaces
fe-1/2/0 {
   unit 0 {
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@R1# show protocols
bgp {
   family inet {
      unicast {
         loops 2;
      }
   }
   group ext {
      type external;
      export send-direct;
      peer-as 64511;
      neighbor 10.0.0.2;
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show routing-options
autonomous-system 64512;
```

Device R2

```
user@R2# show interfaces
fe-1/2/0 {
   unit 0 {
      family inet {
         address 10.0.0.2/30;
      }
   }
```


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```
}
fe-1/2/1 {
   unit 0 {
      family inet {
         address 10.1.0.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.2/32;
      }
   }
}
```

```
user@R2# show protocols
bgp {
   group ext {
      type external;
      advertise-peer-as;
      export send-direct;
      neighbor 10.0.0.1 {
         peer-as 64512;
      }
      neighbor 10.1.0.2 {
         peer-as 64512;
      }
   }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R2# show routing-options
autonomous-system 64511;
```

If you are done configuring the devices, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the BGP Routes

Purpose Make sure that the routing tables on Device R1 and Device R3 contain the expected routes.

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Action

1. On Device R2, deactivate the **advertise-peer-as** statement in the BGP configuration.

```
[edit protocols bgp group ext]
user@R2# deactivate advertise-peer-as
user@R2# commit
```

2. On Device R3, deactivate the **loops** statement in the BGP configuration.

```
[edit protocols bgp family inet unicast ]
user@R3# deactivate unicast loops
user@R3# commit
```

3. On Device R1, check to see what routes are advertised to Device R2.

```
user@R1> show route advertising-protocol bgp 10.0.0.2

inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                                    I
* 192.168.0.1/32          Self                                    I
```

4. On Device R2, check to see what routes are received from Device R1.

```
user@R2> show route receive-protocol bgp 10.0.0.1

inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
  10.0.0.0/30             10.0.0.1                                64512 I
* 192.168.0.1/32          10.0.0.1                                64512 I
```

5. On Device R2, check to see what routes are advertised to Device R3.

```
user@R2> show route advertising-protocol bgp 10.1.0.2

inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                                    I
* 10.1.0.0/30             Self                                    I
* 192.168.0.2/32          Self                                    I
```

6. On Device R2, activate the **advertise-peer-as** statement in the BGP configuration.

```
[edit protocols bgp group ext]
user@R2# activate advertise-peer-as
user@R2# commit
```

7. On Device R2, recheck the routes that are advertised to Device R3.

```
user@R2> show route advertising-protocol bgp 10.1.0.2

inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                                    I
* 10.1.0.0/30             Self                                    I
* 192.168.0.1/32          Self             64512 I
* 192.168.0.2/32          Self                                    I
* 192.168.0.3/32          10.1.0.2         64512 I
```


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8. On Device R3, check the routes that are received from Device R2.

```
user@R3> show route receive-protocol bgp 10.1.0.1

inet.0: 5 destinations, 6 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             10.1.0.1                                64511 I
  10.1.0.0/30             10.1.0.1                                64511 I
* 192.168.0.2/32          10.1.0.1                                64511 I
```

9. On Device R3, activate the **loops** statement in the BGP configuration.

```
[edit protocols bgp family inet unicast ]
user@R3# activate unicast loops
user@R3# commit
```

10. On Device R3, recheck the routes that are received from Device R2.

```
user@R3> show route receive-protocol bgp 10.1.0.1

inet.0: 6 destinations, 8 routes (6 active, 0 holddown, 1 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             10.1.0.1                                64511 I
  10.1.0.0/30             10.1.0.1                                64511 I
* 192.168.0.1/32          10.1.0.1                                64511 64512
 I
* 192.168.0.2/32          10.1.0.1                                64511 I
```

Meaning First the **advertise-peer-as** statement and the **loops** statement are deactivated so that the default behavior can be examined. Device R1 sends to Device R2 a route to Device R1's loopback interface address, 192.168.0.1/32. Device R2 does not advertise this route to Device R3. After activating the **advertise-peer-as** statement, Device R2 does advertise the 192.168.0.1/32 route to Device R3. Device R3 does not accept this route until after the **loops** statement is activated.

Related Documentation

- *Example: Configuring a Layer 3 VPN with Route Reflection and AS Override*

Disabling Attribute Set Messages on Independent AS Domains for BGP Loop Detection

BGP loop detection for a specific route uses the local autonomous system (AS) domain for the routing instance. By default, all routing instances belong to a single primary routing instance domain. Therefore, BGP loop detection uses the local ASs configured on all of the routing instances. Depending on your network configuration, this default behavior can cause routes to be looped and hidden.

To limit the local ASs in the primary routing instance, you can configure an independent AS domain for a routing instance. The independent domain is separate from the primary routing instance and keeps the AS paths of the independent domain from being shared with the AS path and the AS path attributes of other domains.

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By default, independent domains use transitive path attribute 128 (attribute set) messages to tunnel the independent domain's BGP attributes through the internal BGP (IBGP) core. However, the attribute set message behavior for independent domains is undesired in many cases. If you only want to configure independent domains to maintain the independence of local ASs in the routing instance, and perform BGP loop detection only for the specified local ASs in the routing instance, you can disable the attribute set messages.

To disable attribute set messages on an independent domain, include the **independent-domain no-attrset** statement:

1. Select the routing instance that contains the independent domain you want to modify. You can select the routing instance from the following hierarchy levels:
   - **[edit routing-instances *routing-instance-name*]**
   - **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]**
2. Disable attribute set messages on the independent domain.

```
[edit routing-instances instance-name]
user@host# set routing-options autonomous-system as-number independent-domain
  no-attrset
```

TIP: When you disable attribute set messages, we recommend that you specify the AS number of the primary routing instance. This ensures that the primary routing instance AS is treated as a local AS in the routing instance and is used for BGP loop detection.

After you specify a routing instance for an independent domain, the local ASs are only associated with that routing instance. That means BGP loop detection uses only the local ASs defined in the routing instance.

Related Documentation

- autonomous-system on page 1112
- *independent-domain*
- Example: Configuring a Local AS for EBGP Sessions on page 100

Example: Ignoring the AS Path Attribute When Selecting the Best Path

If multiple BGP routes to the same destination exist, BGP selects the best path based on the route attributes of the paths. One of the route attributes that affects the best-path decision is the length of the AS paths of each route. Routes with shorter AS paths are preferred over those with longer AS paths. Although not typically practical, some scenarios

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might require that the AS path length be ignored in the route selection process. This example shows how to configure a routing device to ignore the AS path attribute.

- Requirements on page 181
- Overview on page 181
- Configuration on page 182
- Verification on page 187

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

On externally connected routing devices, the purpose of skipping the AS path comparison might be to force an external BGP (EBGP) versus internal BGP (IBGP) decision to remove traffic from your network as soon as possible. On internally connected routing devices, you might want your IBGP-only routers to default to the local externally connected gateway. The local IBGP-only (internal) routers skip the AS path comparison and move down the decision tree to use the closest interior gateway protocol (IGP) gateway (lowest IGP metric). Doing this might be an effective way to force these routers to use a LAN connection instead of their WAN connection.

CAUTION: **When you include the as-path-ignore statement on a routing device in your network, you might need to include it on all other BGP-enabled devices in your network to prevent routing loops and convergence issues. This is especially true for IBGP path comparisons.**

In this example, Device R2 is learning about the loopback interface address on Device R4 (4.4.4.4/32) from Device R1 and Device R3. Device R1 is advertising 4.4.4.4/32 with an AS-path of 1 5 4, and Device R3 is advertising 4.4.4.4/32 with an AS-path of 3 4. Device R2 selects the path for 4.4.4.4/32 from Device R3 as the best path because the AS path is shorter than the AS path from Device R1.

This example modifies the BGP configuration on Device R2 so that the AS-path length is not used in the best-path selection.

Device R1 has a lower router ID (1.1.1.1) than Device R3 (1.1.1.1). If all other path selection criteria are equal (or, as in this case, ignored), the route learned from Device R1 is used. Because the AS-path attribute is being ignored, the best path is toward Device R1 because of its lower router ID value.

Figure 14 on page 182 shows the sample topology.

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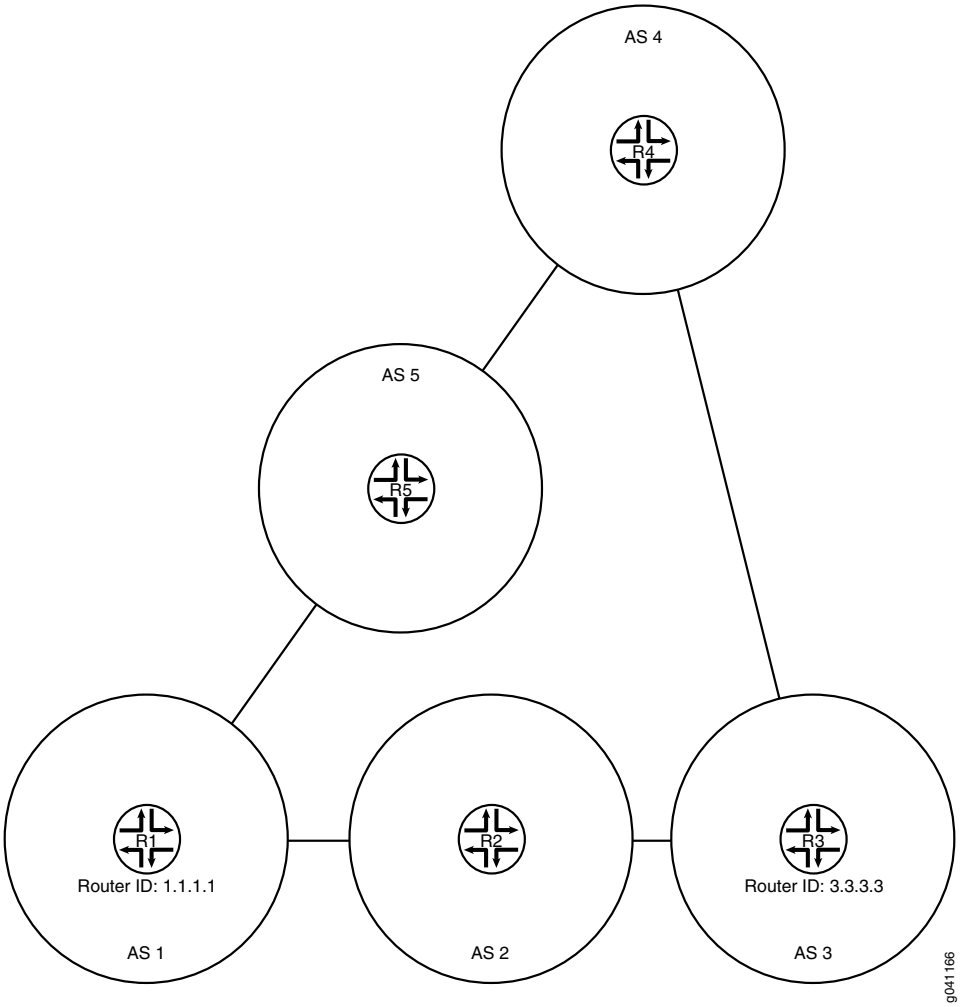
Figure 14: Topology for Ignoring the AS-Path Lengh



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 192.168.10.1/24
set interfaces fe-1/2/1 unit 10 family inet address 192.168.50.2/24
set interfaces lo0 unit 1 family inet address 1.1.1.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.10.2 peer-as 2
set protocols bgp group ext neighbor 192.168.50.1 peer-as 5
set policy-options policy-statement send-direct term 1 from protocol direct
```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```
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.20.0/24 next-hop 192.168.10.2
set routing-options static route 192.168.30.0/24 next-hop 192.168.10.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.50.1
set routing-options router-id 1.1.1.1
set routing-options autonomous-system 1
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 192.168.10.2/24
set interfaces fe-1/2/1 unit 3 family inet address 192.168.20.2/24
set interfaces lo0 unit 2 family inet address 2.2.2.2/32
set protocols bgp path-selection as-path-ignore
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.10.1 peer-as 1
set protocols bgp group ext neighbor 192.168.20.1 peer-as 3
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.50.0/24 next-hop 192.168.10.1
set routing-options static route 192.168.40.0/24 next-hop 192.168.10.1
set routing-options static route 192.168.30.0/24 next-hop 192.168.20.1
set routing-options router-id 2.2.2.2
set routing-options autonomous-system 2
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.20.1/24
set interfaces fe-1/2/1 unit 5 family inet address 192.168.30.1/24
set interfaces lo0 unit 3 family inet address 1.1.1.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.20.2 peer-as 2
set protocols bgp group ext neighbor 192.168.30.2 peer-as 4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.20.2
set routing-options static route 192.168.50.0/24 next-hop 192.168.20.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.30.2
set routing-options router-id 3.3.3.3
```

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```
set routing-options autonomous-system 3
```

Device R4

```
set interfaces fe-1/2/0 unit 6 family inet address 192.168.30.2/24
set interfaces fe-1/2/1 unit 7 family inet address 192.168.40.1/24
set interfaces lo0 unit 4 family inet address 4.4.4.4/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.30.1 peer-as 3
set protocols bgp group ext neighbor 192.168.40.2 peer-as 5
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.40.2
set routing-options static route 192.168.50.0/24 next-hop 192.168.40.2
set routing-options static route 192.168.40.0/24 next-hop 192.168.30.1
set routing-options router-id 4.4.4.4
set routing-options autonomous-system 4
```

Device R5

```
set interfaces fe-1/2/0 unit 8 family inet address 192.168.40.2/24
set interfaces fe-1/2/1 unit 9 family inet address 192.168.50.1/24
set interfaces lo0 unit 5 family inet address 5.5.5.5/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext export send-local
set protocols bgp group ext neighbor 192.168.40.1 peer-as 4
set protocols bgp group ext neighbor 192.168.50.2 peer-as 1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-local term 1 from protocol local
set policy-options policy-statement send-local term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.50.2
set routing-options static route 192.168.20.0/24 next-hop 192.168.50.2
set routing-options static route 192.168.30.0/24 next-hop 192.168.40.1
set routing-options router-id 5.5.5.5
set routing-options autonomous-system 5
```


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Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 2 family inet address 192.168.10.2/24
user@R2# set fe-1/2/1 unit 3 family inet address 192.168.20.2/24
user@R2# set lo0 unit 2 family inet address 2.2.2.2/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@R2# set type external
user@R2# set export send-direct
user@R2# set export send-static
user@R2# set export send-local
user@R2# set neighbor 192.168.10.1 peer-as 1
user@R2# set neighbor 192.168.20.1 peer-as 3
```

3. Configure the autonomous system (AS) path attribute to be ignored in the Junos OS path selection algorithm.

```
[edit protocols bgp]
user@R2# set path-selection as-path-ignore
```

4. Configure the routing policy.

```
[edit policy-options]
user@R2# set policy-statement send-direct term 1 from protocol direct
user@R2# set policy-statement send-direct term 1 then accept
user@R2# set policy-statement send-local term 1 from protocol local
user@R2# set policy-statement send-local term 1 then accept
user@R2# set policy-statement send-static term 1 from protocol static
user@R2# set policy-statement send-static term 1 then accept
```

5. Configure some static routes.

```
[edit routing-options static]
user@R2# set route 192.168.50.0/24 next-hop 192.168.10.1
user@R2# set route 192.168.40.0/24 next-hop 192.168.10.1
user@R2# set route 192.168.30.0/24 next-hop 192.168.20.1
```

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6. Configure the autonomous system (AS) number and the router ID.

```
[edit routing-options]
user@R2# set router-id 2.2.2.2
user@R2# set autonomous-system 2
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 2 {
      family inet {
         address 192.168.10.2/24;
      }
   }
}
fe-1/2/1 {
   unit 3 {
      family inet {
         address 192.168.20.2/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 2.2.2.2/32;
      }
   }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
policy-statement send-local {
   term 1 {
      from protocol local;
      then accept;
   }
}
policy-statement send-static {
   term 1 {
      from protocol static;
      then accept;
   }
```


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```
}
```

```
user@R2# show protocols
bgp {
   path-selection as-path-ignore;
   group ext {
      type external;
      export [ send-direct send-static send-local ];
      neighbor 192.168.10.1 {
         peer-as 1;
      }
      neighbor 192.168.20.1 {
         peer-as 3;
      }
   }
}
```

```
user@R2# show routing-options
static {
   route 192.168.50.0/24 next-hop 192.168.10.1;
   route 192.168.40.0/24 next-hop 192.168.10.1;
   route 192.168.30.0/24 next-hop 192.168.20.1;
}
router-id 2.2.2.2;
autonomous-system 2;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on the other devices in the network, changing the interface names and IP addresses, as needed.

Verification

Confirm that the configuration is working properly.

- Checking the Neighbor Status on page 187

Checking the Neighbor Status

Purpose Make sure that from Device R2, the active path to get to AS 4 is through AS 1 and AS 5, not through AS 3.

NOTE: To verify the functionality of the **as-path-ignore** statement, you might need to run the **restart routing** command to force reevaluation of the active path. This is because for BGP, if both paths are external, the Junos OS behavior is to prefer the currently active path. This behavior helps to minimize route-flapping. Use caution when restarting the routing protocol process in a production network.

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Action From operational mode, enter the restart **routing** command.

```
user@R2> restart routing
Routing protocols process started, pid 49396
```

From operational mode, enter the **show route 4.4.4.4 protocol bgp** command.

```
user@R2> show route 4.4.4.4 protocol bgp
inet.0: 12 destinations, 25 routes (12 active, 0 holddown, 4 hidden)
+ = Active Route, - = Last Active, * = Both

4.4.4.4/32         *[BGP/170] 00:00:12, localpref 100
                      AS path: 1 5 4 I
                    > to 192.168.10.1 via fe-1/2/0.2
                    [BGP/170] 00:00:08, localpref 100
                      AS path: 3 4 I
                    > to 192.168.20.1 via fe-1/2/1.3
```

Meaning The asterisk (*) is next to the path learned from R1, meaning that this is the active path. The AS path for the active path is 1 5 4, which is longer than the AS path (3 4) for the nonactive path learned from Router R3.

Related Documentation

- Understanding BGP Path Selection on page 14

Understanding Private AS Number Removal from AS Paths

By default, when BGP advertises AS paths to remote systems, it includes all AS numbers, including private AS numbers. You can configure the software so that it removes private AS numbers from AS paths. Doing this is useful when any of the following circumstances are true:

- A remote AS for which you provide connectivity is multihomed, but only to the local AS.
- The remote AS does not have an officially allocated AS number.
- It is not appropriate to make the remote AS a confederation member AS of the local AS.

Most companies acquire their own AS number. Some companies also use private AS numbers to connect to their public AS network. These companies might use a different private AS number for each region in which their company does business. In any implementation, announcing a private AS number to the Internet must be avoided. Service providers can use the remove-private statement to prevent advertising private AS numbers to the Internet.

In an enterprise scenario, suppose that you have multiple AS numbers in your company, some of which are private AS numbers, and one with a public AS number. The one with

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a public AS number has a direct connection to the service provider. In the AS that connects directly to the service provider, you can use the **remove-private** statement to filter out any private AS numbers in the advertisements that are sent to the service provider.

The AS numbers are stripped from the AS path starting at the left end of the AS path (the end where AS paths have been most recently added). The routing device stops searching for private ASs when it finds the first nonprivate AS or a peer's private AS. If the AS path contains the AS number of the external BGP (EBGP) neighbor, BGP does not remove the private AS number.

NOTE: **As of Junos OS 10.0R2 and later, if there is a need to send prefixes to an EBGP peer that has an AS number that matches an AS number in the AS path, consider using the as-override statement instead of the remove-private statement.**

The operation takes place after any confederation member ASs have already been removed from the AS path, if applicable.

The software is preconfigured with knowledge of the set of AS numbers that is considered private, a range that is defined in the Internet Assigned Numbers Authority (IANA) assigned numbers document. The set of 16 bit AS numbers reserved as private are in the range from 64,512 through 65,534, inclusive. The 32 bit AS numbers reserved as private are in the range from 4,200,000,000 through 4,294,967,294 inclusive.

Related Documentation

- Example: Removing Private AS Numbers from AS Paths on page 189

Example: Removing Private AS Numbers from AS Paths

This example demonstrates the removal of a private AS number from the advertised AS path to avoid announcing the private AS number to the Internet.

- Requirements on page 189
- Overview on page 189
- Configuration on page 190
- Verification on page 193

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Service providers and enterprise networks use the remove-private statement to prevent advertising private AS numbers to the Internet. The **remove-private** statement works in the outbound direction. You configure the **remove-private** statement on a device that has a public AS number and that is connected to one or more devices that have private

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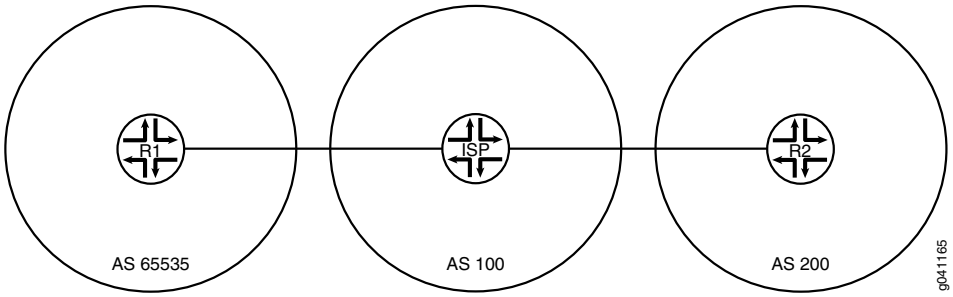
AS numbers. Generally, you would not configure this statement on a device that has a private AS number.

Figure 15 on page 190 shows the sample topology.

Figure 15: Topology for Removing a Private AS from the Advertised AS Path



In this example, Device R1 is connected to its service provider using private AS number 65530. The example shows the **remove-private** statement configured on Device ISP to prevent Device R1's private AS number from being announced to Device R2. Device R2 sees only the AS number of the service provider.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 192.168.10.1/24
set interfaces lo0 unit 1 family inet address 10.10.10.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 100
set protocols bgp group ext neighbor 192.168.10.10
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.20.0/24 next-hop 192.168.10.10
set routing-options autonomous-system 65530
```

Device ISP

```
set interfaces fe-1/2/0 unit 2 family inet address 192.168.10.10/24
set interfaces fe-1/2/1 unit 3 family inet address 192.168.20.20/24
set interfaces lo0 unit 2 family inet address 10.10.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext neighbor 192.168.10.1 peer-as 65530
set protocols bgp group ext neighbor 192.168.20.1 remove-private
set protocols bgp group ext neighbor 192.168.20.1 peer-as 200
set routing-options autonomous-system 100
```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Device R2

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.20.1/24
set interfaces lo0 unit 3 family inet address 10.10.20.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 100
set protocols bgp group ext neighbor 192.168.20.20
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 192.168.10.0/24 next-hop 192.168.20.20
set routing-options autonomous-system 200
```

Device ISP

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device ISP:

1. Configure the interfaces.

```
[edit interfaces]
user@ISP# set fe-1/2/0 unit 2 family inet address 192.168.10.10/24
user@ISP# set fe-1/2/1 unit 3 family inet address 192.168.20.20/24
user@ISP# set lo0 unit 2 family inet address 10.10.0.1/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@ISP# set type external
user@ISP# set neighbor 192.168.10.1 peer-as 65530
user@ISP# set neighbor 192.168.20.1 peer-as 200
```

3. For the neighbor in autonomous system (AS) 200 (Device R2), remove private AS numbers from the advertised AS paths.

```
[edit protocols bgp group ext]
user@ISP# set neighbor 192.168.20.1 remove-private
```

4. Configure the AS number.

```
[edit routing-options]
user@ISP# set autonomous-system 100
```

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Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@ISP# show interfaces
fe-1/2/0 {
   unit 2 {
      family inet {
         address 192.168.10.10/24;
      }
   }
}
fe-1/2/1 {
   unit 3 {
      family inet {
         address 192.168.20.20/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 10.10.0.1/32;
      }
   }
}
```

```
user@ISP# show protocols
bgp {
   group ext {
      type external;
      neighbor 192.168.10.1 {
         peer-as 65530;
      }
      neighbor 192.168.20.1 {
         remove-private;
         peer-as 200;
      }
   }
}
```

```
user@ISP# show routing-options
autonomous-system 100;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on Device R1 and Device R2, changing the interface names and IP address, as needed, and adding the routing policy configuration.

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Verification

Confirm that the configuration is working properly.

- Checking the Neighbor Status on page 193
- Checking the Routing Tables on page 194
- Checking the AS Path When the remove-private Statement Is Deactivated on page 194

Checking the Neighbor Status

Purpose Make sure that Device ISP has the **remove-private** setting enabled in its neighbor session with Device R2.

Action From operational mode, enter the **show bgp neighbor 192.168.20.1** command.

```
user@ISP> show bgp neighbor 192.168.20.1
Peer: 192.168.20.1+179 AS 200  Local: 192.168.20.20+60216 AS 100
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference RemovePrivateAS PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.20.1      Local ID: 10.10.0.1         Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: fe-1/2/1.3
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 200)
  Peer does not support Addpath
  Table inet.0 Bit: 10001
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          1
  Last traffic (seconds): Received 10   Sent 16   Checked 55
  Input messages:  Total 54     Updates 3       Refreshes 0     Octets 1091
  Output messages: Total 54     Updates 1       Refreshes 0     Octets 1118
  Output Queue[0]: 0
```

Meaning The **RemovePrivateAS** option shows that Device ISP has the expected setting.

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Checking the Routing Tables

Purpose Make sure that the devices have the expected routes and AS paths.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.20.1/32      *[BGP/170] 00:28:57, localpref 100
                      AS path: 100 200 I
                    > to 192.168.10.10 via fe-1/2/0.1
```

```
user@ISP> show route protocol bgp

inet.0: 7 destinations, 11 routes (7 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:29:40, localpref 100
                      AS path: 65530 I
                    > to 192.168.10.1 via fe-1/2/0.2
10.10.20.1/32      *[BGP/170] 00:29:36, localpref 100
                      AS path: 200 I
                    > to 192.168.20.1 via fe-1/2/1.3
192.168.10.0/24     [BGP/170] 00:29:40, localpref 100
                      AS path: 65530 I
                    > to 192.168.10.1 via fe-1/2/0.2
192.168.20.0/24     [BGP/170] 00:29:36, localpref 100
                      AS path: 200 I
                    > to 192.168.20.1 via fe-1/2/1.3
```

```
user@R2> show route protocol bgp
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:29:53, localpref 100
                      AS path: 100 I
                    > to 192.168.20.20 via fe-1/2/0.4
```

Meaning Device ISP has the private AS number 65530 in its AS path to Device R1. However, Device ISP does not advertise this private AS number to Device R2. This is shown in the routing table of Device R2. Device R2's path to Device R1 contains only the AS number for Device ISP.

Checking the AS Path When the remove-private Statement Is Deactivated

Purpose Verify that without the **remove-private** statement, the private AS number appears in Device R2's routing table.

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Action From configuration mode on Device ISP, enter the **deactivate remove-private** command and then recheck the routing table on Device R2.

```
[protocols bgp group ext neighbor 192.168.20.1]
user@ISP# deactivate remove-private
user@ISP# commit
```

```
user@R2> show route protocol bgp

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.1/32      *[BGP/170] 00:00:54, localpref 100
                      AS path: 100 65530 I
                    > to 192.168.20.20 via fe-1/2/0.4
```

Meaning Private AS number 65530 appears in Device R2's AS path to Device R1.

Related Documentation

- Understanding Private AS Number Removal from AS Paths on page 188

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CHAPTER 6

Connecting to Autonomous Systems

- 4-Byte Autonomous System Numbers Overview on page 197
- Implementing 4-Byte Autonomous System Numbers on page 198
- Configuring 4-Byte Autonomous System Numbers on page 200
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Example: Enforcing Correct Autonomous System Number in AS-Path in BGP Network on page 212

4-Byte Autonomous System Numbers Overview

This Technology Overview describes 4-byte autonomous system (AS) numbers and the operation of BGP in a network with a mix of 2-byte and 4-byte AS numbers.

The 2-byte AS number, also known as a 16-bit AS number or 2-octet AS number, provides a pool of 65,536 AS numbers. The 2-byte AS number range has been exhausted. 4-byte AS numbers are specified in RFC 4893, *BGP Support for Four-Octet AS Number Space* and provide a pool of 4,294,967,296 AS numbers.

As of January 1, 2009 the Internet Assigned Numbers Authority (IANA) only assigns 4-byte AS numbers, unless a 2-byte AS number is specifically requested. The Internet Engineering Task Force (IETF) RFC 4893 defines a method for smooth transition from 2-byte AS numbers to 4-byte AS numbers and for maintaining backward compatibility.

RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers.

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RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893.

RFC 7300, *Reservation of Last Autonomous System (AS) Numbers* and the Internet draft *draft-ietf-idr-as0-06* restrict the use of 2-byte AS number 65535, 4-byte AS number 4294967295UL, and AS number 0 in a configuration. Therefore, when you use these restricted AS numbers, the commit operation fails.

Related Documentation

- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
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Implementing 4-Byte Autonomous System Numbers

Junos OS Release 9.1 and later supports 4-byte AS numbers.

If your network is currently using 2-byte AS numbers, you are not required to get new 4-byte AS numbers. The 2-byte AS number range is a subset of the 4-byte AS number range. A Juniper networks router that supports 4-byte AS numbers simply prepends a string of zeros in front of the 2-byte AS number. For example, the 2-byte AS number 65000 becomes the 4-byte AS number 00000.65000.

If your Juniper Networks router supports 4-byte AS numbers and has a peer relationship with a router that does not support 4-byte AS numbers, the following sequence takes place in the adjacent RIB-in routing table after the router that supports 4-byte AS numbers advertises this capability to the new peer:

1. The router that supports 4-byte AS numbers receives an advertisement from the peer that supports only 2-byte AS numbers.
2. On the router that supports 4-byte AS numbers, the 2-byte AS path is converted into the 4-byte AS number by prepending a string of zeros in front of the 2-byte AS number.
3. If a 4-byte AS number is also present in the path, it is merged with the 2-byte AS numbers in the path.
4. If the AGGREGATOR and AS4_AGGREGATOR attributes are present, these attributes are also merged.

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If your Juniper Networks router supports 4-byte AS numbers and has a peer relationship with a router that does not support 4-byte AS numbers, the following sequence takes place in the adjacent RIB-out routing table:

1. Update message are reformatted before being sent to the router that does not support 4-byte AS numbers.
2. The router that supports 4-byte AS numbers sends the 4-byte AS number in the AS4_PATH attribute.
3. The AS_PATH attribute is also sent. It is encoded with the 2-byte AS numbers. Mappable 4-byte AS numbers, below 64537, are sent as 2-byte AS numbers. Non-mappable 4-byte AS numbers, above 64536, are represented by the well-known 2-byte AS number, AS 23456.
4. A single peer group is used for the routers that support 4-byte AS numbers and the routers that support only 2-byte AS numbers.

Release History Table

Release	Description
9.1	Junos OS Release 9.1 and later supports 4-byte AS numbers.

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
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Configuring 4-Byte Autonomous System Numbers

This section describes how to configure a 4-byte AS number and how to verify if the BGP peer supports 4-byte AS numbers.

The AS number can be specified in plain number format or in AS-dot notation format on routers running Junos OS Release 9.2 and later. For example, the 4-byte AS number of 65,546 is represented in plain-number format as 65546. The same AS number is represented in AS-dot notation format as 1.10 on routers running Junos OS Release 9.2 and later.

- To configure a 4-byte AS number in AS-dot notation format, include the **autonomous-system** statement and specify the 4-byte AS number. In the following example the AS number is set to **1.10**.

  ```
  user@host# set routing-options autonomous-system 1.10
  ```

- To configure a 4-byte AS number in plain number format, include the **autonomous-system** statement and specify the 4-byte AS number. In the following example the AS number is set to **65546**.

  ```
  user@host# set routing-options autonomous-system 65546
  ```

- After a BGP peer session has been negotiated, you can verify whether the peer supports 4-byte AS numbers or not. To verify whether the peer supports 4-byte AS numbers or not, use the **show bgp neighbor** command. In the following example the peer does not support 4-byte AS numbers.

  ```
  user@host# show bgp neighbor 192.168.1.9 | match "AS"
  Peer: 192.168.1.9+179 AS 65056 Local: 192.168.1.3+52616 AS 65000
    Peer does not support 4 byte AS extension
  ```

- In the following example the peer does support 4-byte AS numbers.

  ```
  user@host# show bgp neighbor 192.168.1.9 | match "AS"
  Peer: 192.168.1.10+52679 AS 1000000000 Local: 192.168.1.3+179 AS 65000
    Peer supports 4 byte AS extension (peer-as 1000000000)
  ```

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201

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- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203
- Disabling Attribute Set Messages on Independent AS Domains for BGP Loop Detection on page 179

Prepending 4-Byte AS Numbers in an AS Path

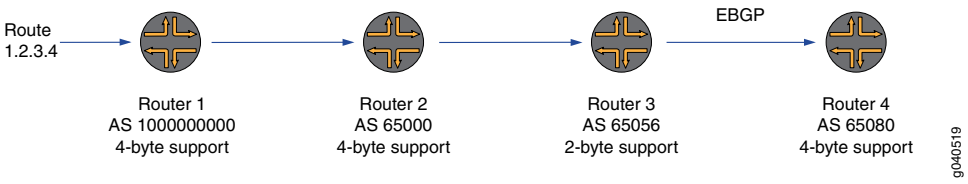
When an address prefix advertisement transits a domain, the domain effectively "signs" the prefix advertisement by prepending its autonomous system number (ASN) to the AS path associated with the address prefix. At any point in the network the AS path describes a sequence of connected domains that forms a path from the current point to the originating domain. The left-most number in the AS path list is the ASN of the adjacent AS from which the address prefix advertisement was received. The sequence of numbers indicates the sequence of ASs though which this update was propagated.

This section describes how to prepend one or more AS numbers at the beginning of an AS path. The AS numbers are added at the beginning of the path after the actual AS number from which the route originates has been added to the path. Prepending an AS path makes a shorter AS path look longer and therefore less preferable to BGP.

NOTE: **As of Junos OS Release 15.1, the enforce-first-as statement enforces the first (left-most) autonomous system number (ASN) in AS-path is the previous neighbor's ASN as the domain is transited.**

In Figure 16 on page 201, Router 2 is configured to prepend AS 1000000000 4 times in front of AS number 65000.

Figure 16: EBGP with 4-Byte AS Numbers Prepended to the AS Path



You can display the route details using the show route command on Router 3. In the following example, notice that the prepended AS number displayed in the AS path on Router 3 is the AS_TRANS number, AS 23456. This is because Router 3 does not support 4-byte AS numbers.

```
user@Router3# show route 1.2.3.4 detail

...
1.2.3.4/32        *[BGP/170] 01:39:55, localpref 100, from 192.168.1.3
                      AS path: 65000 23456 23456 23456 23456 I
```

You can display the route details using the show route command on Router 4. In the following example, notice that the prepended AS number displayed in the AS path on Router 4 is AS 1000000000. This is because Router 4 supports 4-byte AS numbers and merges the AS_PATH and AS4_PATH attributes.

```
user@Router4# show route 1.2.3.4 detail

...
1.2.3.4/32         *[BGP/170] 01:39:55, localpref 100, from 192.168.1.9
                       AS path: 65056 65000 1000000000 1000000000 1000000000 1000000000 I
```

Related Documentation

- enforce-first-as on page 1159
- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203

Configuring 4-Byte AS Numbers and BGP Extended Community Attributes

A BGP community is a group of destinations that share a common property. You can configure the standard community attribute and extended community attributes for inclusion in BGP update messages.

For example, when configuring a VPN routing and forwarding (VRF) instance, you need to configure a route target. A route target is one type of BGP extended community attribute. To create a named BGP extended community attribute, include the **community** statement and specify the community members:

```
community name {
  members [ community-ids ];
}
```

To specify the community members, you must specify the community ID. The community ID consists of three components that you specify in the following format:

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```
type:administrator:assigned-number
```

The ***administrator*** field of some BGP extended community attributes is an AS number. To configure a **target** extended community, which includes a 4-byte AS number in the plain-number format, append the letter "L" to the end of the number.

In the following example, a **target** community with the 4-byte AS number **334324** and an assigned number of **132** is represented as **target:334324L:132**.

```
[edit policy-options]
community vpn_blue members [ target:334324L:132 ];
```

NOTE: If you display the target extended community information on a peer router that does not support 4-byte AS numbers, the router displays **target:unknown format**.

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
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- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203

Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain

This section describes what happens when a router that supports 4-byte AS numbers sends the AS path statement to a router that only supports 2-byte AS numbers if the first router is configured with an AS number outside the 2-byte AS number range.

In Figure 17 on page 204 Router 1 supports 4-byte AS numbers. Router 1 is configured to use a 4-byte AS number, AS 1000000000. Router 2 supports 2-byte AS numbers. Router 2 is configured with a 2-byte AS number, AS 65056.

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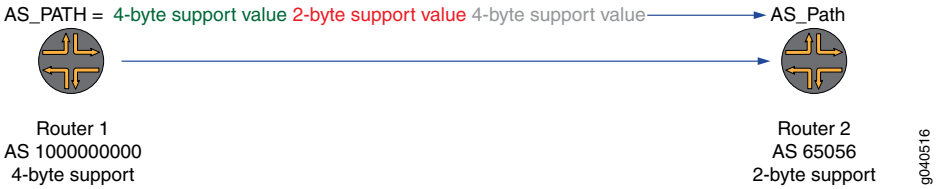
Figure 17: 4-Byte Capable Router AS Path to a 2-Byte Capable Router

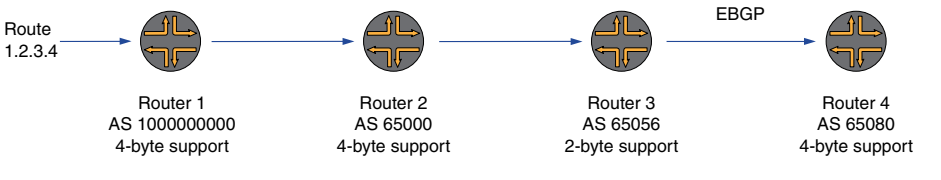


- Router 2 does not accept 4-byte AS numbers in the AS_PATH attribute. You can verify this using the **show bgp neighbor** command on Router 1.

```
user@Router1# show bgp neighbor 192.168.1.9 | match "AS"
Peer: 192.168.1.9+179 AS 65056 Local: 192.168.1.2+64053 AS 65080
  Peer does not support 4 byte AS extension
```

Figure 18 on page 204 shows four routers running EBGP. Router 1, Router 2, and Router 4 support 4-byte AS numbers. Router 3 does not support 4-byte AS numbers.

Figure 18: EBGP 4-Byte AS Path Through a 2-Byte AS Domain



In this case:

- Router 1 sends the 4-byte AS number, AS 1000000000, in the AS_PATH attribute to Router 2.
- Router 2 knows that Router 3 does not support 4-byte AS numbers.
- Router 2 sends the AS_TRANS number, AS 23456, in the AS_PATH attribute in place of the 4-byte AS number to Router 3.
- Router 2 sends the 4-byte AS number, AS 1000000000 in the AS4_PATH attribute to Router 3.
- Because the AS4_PATH attribute is transitive, Router 3 sends both the AS_PATH attribute and the AS4_PATH attribute to Router 4.
- When Router 4 receives the AS_PATH and AS4_PATH attributes, it merges the path statements to create an accurate AS path.

You can display the AS path using the **show route** command on Router 3. In the following example, notice that the AS number 23456 appears in the AS path and that the AS4_PATH attribute is **Unrecognized**. Because the AS4_PATH attribute is a transitive attribute, it is forwarded to the next router.

```
user@Router3# show route 1.2.3.4 detail
AS path: 65000 23456 I Unrecognized Attributes: 13 bytes
```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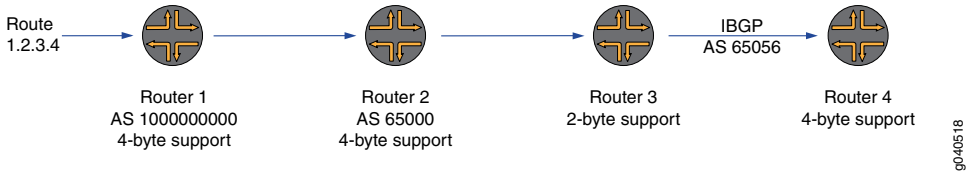
You can display the route details using the **show route** command on Router 4. In the following example, notice that as the AS path transitions Router 3, as shown in the AS2 (2-byte AS) path, the AS number is displayed as AS_TRANS. This means that Router 3 sees the AS number as 23456. In the AS4 (4-byte AS) path the AS number is displayed as 1000000000. In the merged AS path the correct AS path numbers are displayed for AS 65056, AS 65000, and AS 1000000000.

```
user@Router4# show route 1.2.3.4 detail

...
AS path: AS2 PA[3]:65056 65000 AS_TRANS

AS path: AS4 PA[2]:65056 1000000000

AS path: Merged[3]:65056 65000 1000000000 I
```

Figure 19 on page 205 shows 4 routers running IBGP. Router 1, Router 2, and Router 4 support 4-byte AS numbers. Router 3 does not support 4-byte AS numbers.

Figure 19: IBGP 4-Byte AS Path Through a 2-Byte AS Domain



In this case:

- Router 1 sends the 4-byte AS number, AS 1000000000, in the AS_PATH attribute to Router 2.
- Router 2 knows that Router 3 does not support 4-byte AS numbers.
- Router 2 sends the AS_TRANS number, AS 23456, in the AS_PATH attribute in place of the 4-byte AS number to Router 3.
- Router 3 sends both the AS_PATH attribute and the AS4_PATH attribute to Router 4.
- When Router 4 receives the AS_PATH and AS4_PATH attributes, it merges the path statements to create an accurate AS path.

You can display the route details using the **show route** command on Router 2. In the following example, notice that the AS path is displayed as 1000000000.

```
user@Router2# show route 1.2.3.4 detail

...
AS path: 1000000000
```

You can display the route details using the **show route** command on Router 3. In the following example, notice that the AS path is displayed as 65000 23456.

```
user@Router3# show route 1.2.3.4 detail
```

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```
...
AS path: 65000 23456 I
```

You can display the route details using the **show route** command on Router 4. In the following example, notice that the merged AS path is displayed as 65000 1000000000.

```
user@Router4# show route 1.2.3.4 detail
...
AS path: 65000 1000000000 I
```

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207

Understanding 4-Byte AS Numbers and Route Distinguishers

A route distinguisher (RD) is an 8-byte field prefixed to a service provider customer's IPv4 address. The resulting 12-byte field is a unique VPN-IPv4 address. The RD in BGP messages consists of two major fields, the type field (2 bytes) and value field (6 bytes). The type field determines how the value field should be interpreted.

The route distinguisher is configured as a 6-byte value that you can specify as ***as-number*:*number***, where ***as-number*** is your assigned AS number and ***number*** (also known as an administrative number or assigned number subfield) is any 2-byte or 4-byte value. The AS number can be in the range from 1 through 4,294,967,295. If the AS number is a 2-byte value, the administrative number is a 4-byte value. If the AS number is 4-byte value, the administrative number is a 2-byte value.

An RD consisting of a 4-byte AS number and a 2-byte administrative number is defined as a type 2 route distinguisher in RFC 4364, *BGP/MPLS IP Virtual Private Networks*.

To configure an RD using a 4-byte AS number, append the letter “L” to the end of the number. In the following example, the 4-byte AS number is 7765000 and the administrative number is 1000:

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```
user@Router1# set routing-instances 4B route-distinguisher 7765000L:1000
```

If the router you are configuring is a BGP peer of a router that does not support 4-byte AS numbers, you also need to configure a local AS number as discussed in "Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number" on page 211. To configure the local AS number, include the **local-as** statement, specify the 2-byte AS number to use (65001), and include the **private** option.

```
user@Router1# set routing-instances 4B protocols bgp group 4B2Bpeers local-as 65001
    private
```

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203

Understanding 4-Byte AS Numbers and Route Loop Detection

One of the most important functions in BGP is route loop detection at the autonomous system level using the AS_PATH attribute. A simple way of thinking of the AS_PATH is that it is the list of autonomous systems that a route goes through to reach its destination. Loops are detected and avoided by the router checking for its own AS number in the AS_PATH received from a neighboring AS.

This section describes how route loop detection works with a mix of routers that support and do not support 4-byte AS numbers. Figure 20 on page 208 shows a small network with the potential for BGP loops.

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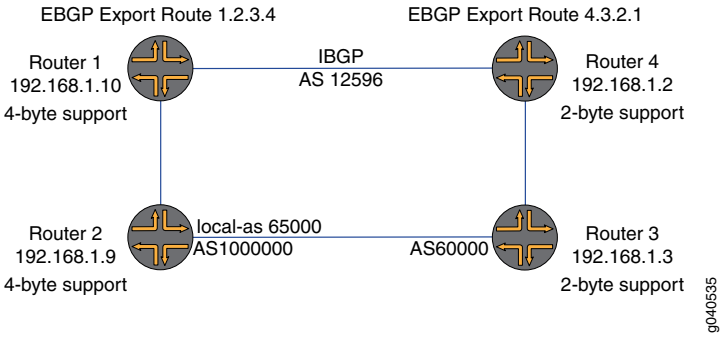
Figure 20: 4-Byte AS Numbers and Loop Detection



In the first example, an EBGP route, route 1.2.3.4, is first advertised by Router 1. The first AS in the path is AS 12596 as configured on Router 1. The second AS that is in the path is AS 1000000 as configured on Router 2. AS 1000000 is sent in the AS4_path attribute and the AS_TRANS number, AS 23456, is sent in the AS_PATH attribute to Router 3. The third AS that is in the path is AS 60000, as configured on Router 3.

The **show route** command output shows the AS path for route 1.2.3.4 as advertised by Router 3 to Router 4. In the **show route** command output, you see AS 12596 first. Because Router 3 does not support 4-byte AS numbers, you see AS 23456 second. Because Router 2 used a local AS of 65000 to establish a peer relationship with Router 3, you see AS 65000 third. AS 60000 is not in the **show route** command output because the command was entered on the router configured with AS 60000.

```
user@Router3# show route advertising-protocol bgp 192.168.1.2

...
Prefix Nexthop MED Lclpref AS path
10.255.14.172/32 Self   65000 23456 12596 I
```

In this case, when Router 4 sees its own AS number, AS 12596, in the path, it detects a routing loop.

In the second example, an EBGP route, route 4.3.2.1, is first advertised by Router 4. The first AS in the path is AS 12596 as configured on Router 4. The second AS in the path is AS 60000 as configured on Router 3. The third AS is in the path is AS 1000000 as configured on Router 2.

The **show route** command output shows the AS path for route 4.3.2.1 as advertised by Router 2 to Router 1. In the **show route** command output, you see AS 12596 first and AS 60000 second. AS 1000000 is not in the **show route** command output because the command was entered on the router configured with AS 1000000.

```
user@Router2# show route advertising-protocol bgp 192.168.1.10

...
Prefix Nexthop MED Lclpref AS path
10.255.14.172/32 Self   60000 12596 I
```

When Router 1 sees its own AS number, AS 12596, in the path, it detects a routing loop.

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Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203
- Disabling Attribute Set Messages on Independent AS Domains for BGP Loop Detection on page 179

Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number

This section describes what happens when a router that supports 4-byte AS numbers establishes a peer relationship with a router that only supports 2-byte AS numbers if both routers are configured with AS numbers in the 2-byte AS number range.

In Figure 21 on page 209, Router 1 is running Junos OS Release 9.2 that supports 4-byte AS numbers. Router 1 is configured to use a 2-byte AS number, AS 12596. Router 2 is running Junos OS Release 8.5 that supports 2-byte AS numbers. Router 2 is configured with a 2-byte AS number, AS 60000.

Figure 21: 4-Byte Capable Router Having a Peer Relationship with a 2-Byte Capable Router Using a 2-Byte AS Number

- The following example shows the relevant portion of the Router 1 configuration.

```
user@Router1# show configuration
```

```
…
autonomous-system 12596;
…
local-address 192.168.1.10;
export static-to-bgp;
peer-as 60000;
```

- To verify that the AS path of route 1.2.3.4 contains AS 12596, use the **show route** command on Router 2. The following example shows that the BGP peer session is established in the normal way and that the AS path of route 1.2.3.4 contains AS 12596:

```
user@Router2# show route 1.2.3.4

1.2.3.4/32         *[BGP/170] 00:01:29, localpref 100, from 192.168.1.10
                      AS path: 12596 I
                    > via at-0/1/0.1001
```

- To display the session-establishment messages logged on Router 1, use the **show log messages** command. The following example shows that Router 1 discovers that Router 2 does not support 4-byte AS numbers:

```
user@Router1# show log messages

Nov  7 09:41:39.443493 bgp_4byte_aspath_add_cap():153 AS4-Peer 192.168.1.9
(External AS 60000)(SEND): 4 byte AS capability added, AS 12596
Nov  7 09:41:39.443582 bgp_send: sending 67 bytes to 192.168.1.9 (External AS
60000)
[…]
Nov  7 09:41:39.448055 bgp_4byte_aspath_adjust():1279 AS4-Peer 192.168.1.9
(External AS 60000)(SEND): Adjust BGP update to Old/New BGP speaker format
Nov  7 09:41:39.448132 bgp_4byte_aspath_adjust():1290 AS4-Peer 192.168.1.9
(External AS 60000)(SEND): Cached information of previous update format is not
used
Nov  7 09:41:39.448162 bgp_generate_2byte_aspath():422 AS4-Peer 192.168.1.9
(External AS 60000)(SEND): Generating 2 byte AS path from 4 byte as-path
Nov  7 09:41:39.448198 bgp_send: sending 64 bytes to 192.168.1.9 (External AS
60000)
```

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number on page 211
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203

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Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 4-Byte AS Number

This section describes what happens when a router that supports 4-byte AS numbers establishes a peer relationship with a router that only supports 2-byte AS numbers if the first router is configured with an AS number outside the 2-byte AS number range.

In Figure 22 on page 211, Router 2 is running Junos OS Release 9.2 that supports 4-byte AS numbers. Router 2 is configured to use a 4-byte AS number, AS 1000000. Router 3 is running Junos OS Release 8.5 that supports 2-byte AS numbers. Router 3 is configured with a 2-byte AS number, AS 60000.

Figure 22: 4-Byte Capable Router Having a Peer Relationship with a 2-Byte Capable Router Using a 4-Byte AS Number

You can configure a local AS number to be used only during the establishment of the BGP session with a BGP neighbor, but to be hidden in the AS path sent to external BGP peers. To configure the local AS number, include the **local-as** statement, specify the 2-byte AS number to use, 65530, and include the **private** option. With this configuration, only the global AS number, 1000000, is included in the AS path sent to external peers. The following example shows the relevant portion of the Router 2 configuration:

```
user@Router2# show configuration
…
autonomous-system 1000000;
…
local-address 192.168.1.9;
export static-to-bgp;
neighbor 192.168.1.3 {
    peer-as 60000;
    local-as 65530 private;
}
```

The peer AS number on Router 3 should equal the local AS number on Router 1. The following example shows the relevant portion of the Router 3 configuration:

```
user@Router3# show configuration
…
autonomous-system 60000;
…
local-address 192.168.1.3;
neighbor 192.168.1.9 {
    peer-as 65530;
```

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To verify that the AS path of route 22.1.2.3 contains AS 65530, use the **show route** command on Router 3. The following example shows that the BGP peer session is established and that the AS path of route 22.1.2.3 contains AS 65530:

```
user@Router3# show route 22.1.2.3

...
22.1.2.3/32        *[BGP/170] 01:39:55, localpref 100, from 192.168.1.9
                      AS path: 65530 I
                    > via so-1/0/3.0
```

Related Documentation

- 4-Byte Autonomous System Numbers Overview on page 197
- Configuring 4-Byte AS Numbers and BGP Extended Community Attributes on page 202
- Configuring 4-Byte Autonomous System Numbers on page 200
- Establishing a Peer Relationship Between a 4-Byte Capable Router and a 2-Byte Capable Router Using a 2-Byte AS Number on page 209
- Implementing 4-Byte Autonomous System Numbers on page 198
- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Understanding 4-Byte AS Numbers and Route Distinguishers on page 206
- Understanding 4-Byte AS Numbers and Route Loop Detection on page 207
- Understanding a 4-Byte Capable Router AS Path Through a 2-Byte Capable Domain on page 203

Example: Enforcing Correct Autonomous System Number in AS-Path in BGP Network

This example shows how the **enforce-first-as** statement, set at the **[edit protocols bgp]** hierarchy level, can be used as a security measure. Configuring this statement creates a consistency check to ensure a BGP peer is a legitimate sender of routing information.

- Requirements on page 212
- Overview on page 212
- Configure enforce-first-as Statement to Check Routes on page 213
- Verification on page 215

Requirements

Before you begin, set up an BGP network of at least three autonomous systems. Three separate routers is sufficient.

Overview

The **enforce-first-as** statement enforces that the first (left-most) autonomous system number (ASN) in the AS-path is consistent with the advertising neighbor's ASN.

The topology is set up with Router C advertising in BGP a static route to Router B, which then readvertises the route to Router A. Then an export policy towards Router A to prepend

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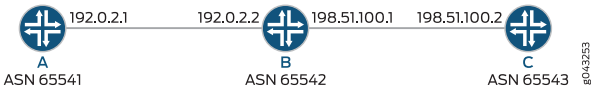
an unrelated ASN is added to Router B. Lastly, the **enforce-first-as** statement is configured on Router A towards Router B. When Router A gets AS-path, it checks if the left-most ASN in the AS-path is the previous neighbor's ASN and invalidates the route coming from Router B.



Configure enforce-first-as Statement to Check Routes

CLI Quick Configuration

To quickly configure the initial configuration for this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Initial Configuration on Router A

```
set interfaces ge-1/0/0 unit 0 family inet address 192.0.2.1/29
set interfaces ge-1/0/0 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 127.0.0.1/29
set routing-options router-id 127.0.0.1
set routing-options autonomous-system 65541
set protocols mpls interface ge-1/0/0.0
set protocols bgp group pe type external
set protocols bgp group pe peer-as 65542
set protocols bgp group pe neighbor 192.0.2.2
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/0.0
set protocols ldp interface ge-1/0/0.0
set protocols ldp interface lo0.0
```

Initial Configuration on Router B

```
set interfaces ge-0/0/0 unit 0 family inet address 192.0.2.2/29
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 family inet address 198.51.100.1/29
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 127.0.0.2/29
set routing-options router-id 127.0.0.2
set routing-options autonomous-system 65542
set protocols bgp group pe1 type external
set protocols bgp group pe1 peer-as 65541
set protocols bgp group pe1 neighbor 192.0.2.1
set protocols bgp group pe3 type external
set protocols bgp group pe3 peer-as 65543
set protocols bgp group pe3 neighbor 198.51.100.2
```

Initial Configuration on Router C

```
set interfaces ge-1/0/0 unit 0 family inet address 198.51.100.2/29
set interfaces ge-1/0/0 unit 0 family mpls
set interfaces ge-1/0/3 unit 0 family inet address 203.0.113.1/29
set interfaces lo0 unit 0 family inet address 127.0.0.3/29
set routing-options router-id 127.0.0.3
```

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```
set routing-options autonomous-system 65543
set protocols mpls interface ge-1/0/0.0
set protocols bgp group pe type external
set protocols bgp group pe peer-as 65542
set protocols bgp group pe neighbor 198.51.100.1
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/0.0
set protocols ldp interface ge-1/0/0.0
set protocols ldp interface lo0.0
```

Step-by-Step Procedure

1. Configure a static route on Router C.

```
C-re0# set routing-options static route 198.51.100.17/29 next-hop 198.51.100.20
C-re0# set routing-options static route 198.51.100.17/29 readvertise
C-re0# commit
```

2. Configure an export policy for the static route.

```
C-re0# set policy-options policy-statement export-static from protocol bgp
C-re0# set policy-options policy-statement export-static then accept
C-re0# set protocols bgp group pe export export-static
C-re0# commit
```

3. Verify that the static route is getting through to Router B and Router A.

```
B-re0# run show route 198.51.100.17
inet.0: 49 destinations, 49 routes (49 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.17/29      *[BGP/170] 00:11:40, localpref 100
                       AS path: 65543 I, validation-state: unverified
                     > to 198.51.100.2 via ge-0/0/1.0
```

```
A-re0# run show route 198.51.100.17
inet.0: 49 destinations, 49 routes (49 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.17/29      *[BGP/170] 00:10:31, localpref 100
                       AS path: 65542 65543 I, validation-state: unverified
                     > to 192.0.2.2 via ge-1/0/0.0
```

Notice that on Router A, route is shown with an AS-path of 65542 65543. Route from Router B to Router A has had the ASN for Router A prepended to the AS-path.

4. Set an export policy to prepend ASN from Router B.

```
B-re0# set policy-options policy-statement as-prepender from neighbor 198.51.100.2
B-re0# set policy-options policy-statement as-prepender then as-path-prepend
  65555
B-re0# set protocols bgp group pe1 export as-prepender
```


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```
B-re0# commit
```

5. Verify route 198.51.100.17 on Router A.

```
A-re0# run show route 198.51.100.17
inet.0: 49 destinations, 49 routes (49 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.17/29      *[BGP/170] 00:00:50, localpref 100
                      AS path: 65555 65542 65543 I, validation-state:
unverified
                    > to 192.0.2.2 via ge-1/0/0.0

[edit]
A-re0#
```

Notice that ASN 65555 is prepended to the AS path.

6. Configure the **enforce-first-as** statement on Router A.

```
A-re0# set protocols bgp enforce-first-as
A-re0# commit
```

When you check the route again, you see that route 198.51.100.17 in no longer getting through on Router A.

Verification

- Verify the BGP Session on page 215
- Verify the Static Route on page 216
- Verify Prepend Export Policy on page 217
- Verify the enforce-first-as Statement Is Working on page 217

Verify the BGP Session

Purpose Verify that a BGP session has been established and with which neighbors the router has established a peering session with.

Action From operational mode, run the **show bgp summary** command.

```
B-re0> show bgp summary
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.0.2.1                65541        367        369       0       0     2:43:57
 0/0/0/0              0/0/0/0
```

```
198.51.100.2                65543        369        368       0       0
2:44:00 0/0/0/0             0/0/0/0
```

Meaning The first line shows the number of groups configured and the number of peers that are up or down. This output shows there are two peers, 192.0.2.1 and 198.51.100.2, up. The table portion shows that there are no paths in the inet.0 table. We can see that Router B has two peers, 65541 and 65543. When the **State** column shows three numbers separated by slashes, the BGP session is up.

Verify the Static Route

Purpose Verify that a static route is being exported to routers B and A from Router C.

Action From operational mode, run the **show bgp neighbor** command.

```
C-re0#> show bgp neighbor
```

```
Peer: 198.51.100.1+179 AS 65542       Local: 198.51.100.2+62588 AS 65543
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ export-static ]
```

From operational mode, run the **show bgp summary** command.

```
B-re0> show bgp summary
```

```
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                      1          1          0          0          0          0
Peer                    AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.0.2.1                65541          8         10       0       0        2:59
 0/0/0/0             0/0/0/0
198.51.100.2                 65543         10         10       0       0
3:02 1/1/1/0              0/0/0/0
```

From operational mode, run the **show route protocol bgp** command.

```
A-re0> show route protocol bgp
```

```
inet.0: 49 destinations, 49 routes (49 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.17/29      *[BGP/170] 00:12:35, localpref 100
                      AS path: 65542 65543 I, validation-state: unverified
                    > to 192.0.2.2 via ge-1/0/0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```


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```
mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

Meaning With the **show bgp neighbor** command you can see the export policy by name.

With the **show bgp summary** command you can see that there is now one route in the inet.0 table, showing that the table has learned this route.

The **show route protocol bgp** command confirms that the router is learning routes. You can see the route and the AS path. Notice that in Router A we can see the AS path is appended with the ASNs of Routers C and B (65543 and 65542).

Verify Prepend Export Policy

Purpose Verify ASNs are in AS path of router receiving from Router B.

show bgp neighbor. Lists the BGP routers to which this router is connected. Shows which neighbors the router has established peering sessions with.

show bgp summary. Lists BGP group, peer, and session state information. Helps determine whether a BGP session has been established.

show route protocol bgp. Lists the routes learned from BGP. Confirms that the router is learning routes only from desired neighbors.

Action From operational mode, run the **show route protocol bgp** command.

```
A-re0> show route protocol bgp
inet.0: 49 destinations, 49 routes (49 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.17/29      *[BGP/170] 00:00:24, localpref 100
                      AS path: 65555 65542 65543 I, validation-state: unverified

                    > to 192.0.2.2 via ge-1/0/0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

Meaning You can see that 65555 has been prepended to the AS path.

Verify the enforce-first-as Statement Is Working

Purpose Verify that the router is learning routes only from desired neighbors.

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Action Verify route 198.51.100.17.

```
A-re0> show route 198.51.100.17 all detail
inet.0: 49 destinations, 49 routes (48 active, 0 holddown, 1 hidden)
198.51.100.17/29 (1 entry, 0 announced)
         BGP                 /-101
                Next hop type: Router, Next hop index: 581
                Address: 0x9db5ad0
                Next-hop reference count: 1
                Source: 192.0.2.2
                Next hop: 192.0.2.2 via ge-1/0/0.0, selected
                Session Id: 0x141
                State: <Hidden Ext>
                Local AS:   65541 Peer AS:   65542
                Age: 1w2d 23:48:47
                Validation State: unverified
                Task: BGP_65542.192.0.2.2
                AS path: 65555 65542 65543 I
                Localpref: 100
                Router ID: 127.0.0.2
                Hidden reason: fails enforce-first-as check
```

If you issue the **show route** command, the route information is not displayed.

```
A-re0> show route 198.51.100.17


[edit]
A-re0#
```

Meaning The static route is hidden because it contained an unrelated ASN and the **enforce-first-as** statement was configured.

Related Documentation

- enforce-first-as on page 1159

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CHAPTER 7

Configuring the Local Preference for BGP Routes

- Understanding the Local Preference Metric for Internal BGP Routes on page 219
- Example: Configuring the Local Preference Value for BGP Routes on page 220
- Understanding Route Preference Values (Administrative Distance) on page 233
- Example: Configuring the Preference Value for BGP Routes on page 235
- Example: Configuring BGP to Advertise Inactive Routes on page 241
- Example: Using Routing Policy to Set a Preference Value for BGP Routes on page 248

Understanding the Local Preference Metric for Internal BGP Routes

Internal BGP (IBGP) sessions use a metric called the *local preference*, which is carried in IBGP update packets in the path attribute LOCAL_PREF. When an autonomous system (AS) has multiple routes to another AS, the local preference indicates the degree of preference for one BGP route over the other BGP routes. The BGP route with the highest local preference value is preferred.

The LOCAL_PREF path attribute is always advertised to IBGP peers and to neighboring confederations. It is never advertised to external BGP (EBGP) peers. The default behavior is to not modify the LOCAL_PREF path attribute if it is present.

The default LOCAL_PREF path attribute value of 100 applies at export time only, when the routes are exported from the routing table into BGP.

If a BGP route is received without a LOCAL_PREF attribute, the route is stored in the routing table and advertised by BGP as if it were received with a LOCAL_PREF value of 100. A non-BGP route that is advertised by BGP is advertised with a LOCAL_PREF value of 100 by default.

Related Documentation

- Example: Configuring the Local Preference Value for BGP Routes on page 220

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Example: Configuring the Local Preference Value for BGP Routes

This example shows how to configure local preference in internal BGP (IBGP) peer sessions.

- Requirements on page 220
- Overview on page 220
- Configuration on page 221
- Verification on page 232

Requirements

No special configuration beyond device initialization is required before you configure this example.

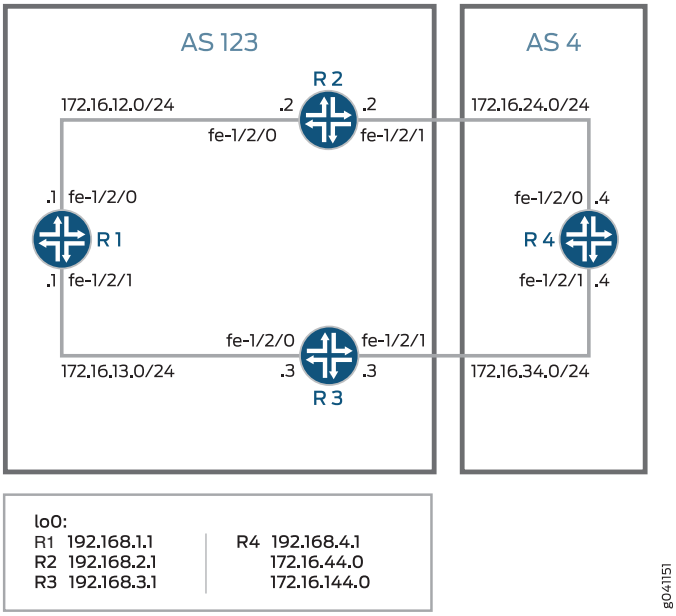
Overview

To change the local preference metric advertised in the path attribute, you must include the local-preference statement, specifying a value from 0 through 4,294,967,295 ($2^{32}-1$).

There are several reasons you might want to prefer one path over another. For example, compared to other paths, one path might be less expensive to use, might have higher bandwidth, or might be more stable.

Figure 23 on page 220 shows a typical network with internal peer sessions and multiple exit points to a neighboring AS.

Figure 23: Typical Network with IBGP Sessions and Multiple Exit Points



To reach Device R4, Device R1 can take a path through either Device R2 or Device R3. By default, the local preference is 100 for either route. When the local preferences are equal,

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Junos OS has rules for breaking the tie and choosing a path. (See "Understanding BGP Path Selection" on page 14.) In this example, the active route is through Device R2 because the router ID of Device R2 is lower than the router ID of Device R3. The following example shows how to override the default behavior with an explicit setting for the local preference. The example configures a local preference of 300 on Device R3, thereby making Device R3 the preferred path to reach Device R4.

Configuration

- Configuring Device R1 on page 222
- Configuring Device R2 on page 225
- Configuring Device R3 on page 227
- Configuring Device R4 on page 230

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 12.12.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 13.13.13.1/24
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 12.12.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 24.24.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 24.24.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
```

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```
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 13.13.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 34.34.34.3/24
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 34.34.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 24.24.24.4/24
set interfaces fe-1/2/1 unit 8 family inet address 34.34.34.4/24
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 34.34.34.3
set protocols bgp group external neighbor 24.24.24.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R1# set family inet address 12.12.12.1/24
```


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```
[edit interfaces fe-1/2/1 unit 2]
user@R1# set family inet address 13.13.13.1/24
[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.1.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.1.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.2.1
user@R1# set neighbor 192.168.3.1
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface fe-1/2/0.1
user@R1# set interface fe-1/2/1.2
```

4. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 123
user@R1# set router-id 192.168.1.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
```

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```
      family inet {
        address 12.12.12.1/24;
      }
    }
}
fe-1/2/1 {
    unit 2 {
      family inet {
        address 13.13.13.1/24;
      }
    }
}
lo0 {
    unit 1 {
      family inet {
        address 192.168.1.1/32;
      }
    }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
    term 1 {
      from protocol direct;
      then accept;
    }
}
```

```
user@R1# show protocols
bgp {
    group internal {
      type internal;
      local-address 192.168.1.1;
      export send-direct;
      neighbor 192.168.2.1;
      neighbor 192.168.3.1;
    }
}
ospf {
    area 0.0.0.0 {
      interface lo0.1 {
        passive;
      }
      interface fe-1/2/0.1;
      interface fe-1/2/1.2;
    }
}
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 3]
user@R2# set family inet address 12.12.12.21/24
[edit interfaces fe-1/2/1 unit 4]
user@R2# set family inet address 24.24.24.2/24
[edit interfaces lo0 unit 2]
user@R2# set family inet address 192.168.2.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R2# set type internal
user@R2# set local-address 192.168.2.1
user@R2# set export send-direct
user@R2# set neighbor 192.168.1.1
user@R2# set neighbor 192.168.3.1
[edit protocols bgp group external]
user@R2# set type external
user@R2# set export send-direct
user@R2# set peer-as 4
user@R2# set neighbor 24.24.24.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R2# set interface lo0.2 passive
user@R2# set interface fe-1/2/0.3
user@R2# set interface fe-1/2/1.4
```

4. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

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5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 123
user@R2# set router-id 192.168.2.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 3 {
      family inet {
         address 12.12.12.2/24;
      }
   }
}
fe-1/2/1 {
   unit 4 {
      family inet {
         address 24.24.24.2/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.168.2.1/32;
      }
   }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R2# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.2.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.3.1;
   }
```

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```
    group external {
        type external;
        export send-direct;
        peer-as 4;
        neighbor 24.24.24.4;
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.2 {
            passive;
        }
        interface fe-1/2/0.3;
        interface fe-1/2/1.4;
    }
}
```

```
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 5]
user@R3# set family inet address 13.13.13.3/24
[edit interfaces fe-1/2/1 unit 6]
user@R3# set family inet address 34.34.34.3/24
[edit interfaces lo0 unit 3]
user@R3# set family inet address 192.168.3.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R3# set type internal
user@R3# set local-address 192.168.3.1
user@R3# set export send-direct
user@R3# set neighbor 192.168.1.1
user@R3# set neighbor 192.168.2.1
[edit protocols bgp group external]
user@R3# set type external
user@R3# set export send-direct
user@R3# set peer-as 4
```

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```
user@R3# set neighbor 34.34.34.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R3# set interface lo0.3 passive
user@R3# set interface fe-1/2/0.5
user@R3# set interface fe-1/2/1.6
```

4. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
   unit 5 {
      family inet {
         address 13.13.13.3/24;
      }
   }
}
fe-1/2/1 {
   unit 6 {
      family inet {
         address 34.34.34.3/24;
      }
   }
}
lo0 {
```


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```
    unit 3 {
      family inet {
        address 192.168.3.1/32;
      }
    }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
    term 1 {
      from protocol direct;
      then accept;
    }
}
```

```
user@R3# show protocols
bgp {
    group internal {
      type internal;
      local-address 192.168.3.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.2.1;
    }
    group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 34.34.34.4;
    }
}
ospf {
    area 0.0.0.0 {
      interface lo0.3 {
        passive;
      }
      interface fe-1/2/0.5;
      interface fe-1/2/1.6;
    }
}
```

```
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 7]
user@R4# set family inet address 24.24.24.4/24
[edit interfaces fe-1/2/1 unit 8]
user@R4# set family inet address 34.34.34.4/24
[edit interfaces lo0 unit 4]
user@R4# set family inet address 192.168.4.1/32
```

2. Configure BGP.

```
[edit protocols bgp group external]
user@R4# set type external
user@R4# set export send-direct
user@R4# set peer-as 123
user@R4# set neighbor 34.34.34.3
user@R4# set neighbor 24.24.24.2
```

3. Configure a policy that accepts direct routes.

NOTE: Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R4# set from protocol direct
user@R4# set then accept
```

4. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

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```
user@R4# show interfaces
fe-1/2/0 {
   unit 7 {
      family inet {
         address 24.24.24.4/24;
      }
   }
}
fe-1/2/1 {
   unit 8 {
      family inet {
         address 34.34.34.4/24;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.4.1/32;
      }
   }
}
```

```
user@R4# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R4# show protocols
bgp {
   group external {
      type external;
      export send-direct;
      peer-as 123;
      neighbor 34.34.34.3;
      neighbor 24.24.24.2;
   }
}
```

```
user@R4# show routing-options
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Checking the Active Path From Device R1 to Device R4 on page 232
- Altering the Local Preference to Change the Path Selection on page 232
- Rechecking the Active Path From Device R1 to Device R4 on page 233

Checking the Active Path From Device R1 to Device R4

Purpose Verify that the active path from Device R1 to Device R4 goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 11 destinations, 18 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.2.1/32      [BGP/170] 00:11:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 00:11:48, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:05:14, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
                    [BGP/170] 00:05:14, localpref 100, from 192.168.3.1
                      AS path: 4 I
                    > to 13.13.13.3 via fe-1/2/1.2
```

Meaning The asterisk (*) shows that the preferred path is through Device R2. In the default configuration, Device R2 has a lower router ID than Device R3. The router ID is controlling the path selection.

Altering the Local Preference to Change the Path Selection

Purpose Change the path so that it goes through Device R3.

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Action From configuration mode, enter the **set local-preference 300** command.

```
[edit protocols bgp group internal]
user@R3# set local-preference 300
user@R3# commit
```

Rechecking the Active Path From Device R1 to Device R4

Purpose Verify that the active path from Device R1 to Device R4 goes through Device R3.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 11 destinations, 17 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.2.1/32      [BGP/170] 00:16:48, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 00:00:22, localpref 300, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:00:21, localpref 300, from 192.168.3.1
                      AS path: 4 I
                    > to 13.13.13.3 via fe-1/2/1.2
```

Meaning The asterisk (*) shows that the preferred path is through Device R3. In the altered configuration, Device R3 has a higher local preference than Device R2. The local preference is controlling the path selection.

Related Documentation

- BGP Configuration Overview on page 13

Understanding Route Preference Values (Administrative Distance)

The Junos OS routing protocol process assigns a default preference value (also known as an *administrative distance*) to each route that the routing table receives. The default value depends on the source of the route. The preference value is a value from 0

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through 4,294,967,295 ($2^{32} - 1$), with a lower value indicating a more preferred route. Table 6 on page 234 lists the default preference values.

Table 6: Default Route Preference Values

How Route Is Learned	Default Preference	Statement to Modify Default Preference
Directly connected network	0	–
System routes	4	–
Static and Static LSPs	5	*static*
Static LSPs	6	MPLS *preference* NOTE: In Junos OS Releases prior to 10.4, if you configure a static MPLS LSP using the **static-path** statement, the default preference value is 5. Starting in Junos OS Release 10.4, if you configure a **static-label-switched-path** the default preference value is 6. The previous configuration statement **static-path** is hidden in Junos OS Release 10.4 and later releases.
RSVP-signaled LSPs	7	RSVP **preference** as described in the *MPLS Applications Feature Guide*
LDP-signaled LSPs	9	LDP **preference**, as described in the *MPLS Applications Feature Guide*
OSPF internal route	10	OSPF *preference*
access-internal route	12	–
access route	13	–
IS-IS Level 1 internal route	15	IS-IS *preference*
IS-IS Level 2 internal route	18	IS-IS *preference*
Redirects	30	–
Kernel	40	–
SNMP	50	–
Router discovery	55	–
RIP	100	RIP *preference*
RIPng	100	RIPng *preference*

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Table 6: Default Route Preference Values (continued)

How Route Is Learned	Default Preference	Statement to Modify Default Preference
PIM	105	*Multicast Protocols Feature Guide*
DVMRP	110	*Multicast Protocols Feature Guide*
Aggregate	130	*aggregate*
OSPF AS external routes	150	OSPF *external-preference*
IS-IS Level 1 external route	160	IS-IS *external-preference*
IS-IS Level 2 external route	165	IS-IS *external-preference*
BGP	170	BGP preference, export, import
MSDP	175	*Multicast Protocols Feature Guide*

In general, the narrower the scope of the statement, the higher precedence its preference value is given, but the smaller the set of routes it affects. To modify the default preference value for routes learned by routing protocols, you generally apply routing policy when configuring the individual routing protocols. You also can modify some preferences with other configuration statements, which are indicated in the table.

Release History Table

Release	Description
10.4	Starting in Junos OS Release 10.4, if you configure a **static-label-switched-path** the default preference value is 6.

Related Documentation

- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*

Example: Configuring the Preference Value for BGP Routes

This example shows how to specify the preference for routes learned from BGP. Routing information can be learned from multiple sources. To break ties among equally specific routes learned from multiple sources, each source has a preference value. Routes that are learned through explicit administrative action, such as static routes, are preferred over routes learned from a routing protocol, such as BGP or OSPF. This concept is called *administrative distance* by some vendors.

- Requirements on page 236
- Overview on page 236
- Configuration on page 237
- Verification on page 240

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Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Routing information can be learned from multiple sources, such as through static configuration, BGP, or an interior gateway protocol (IGP). When Junos OS determines a route's preference to become the active route, it selects the route with the lowest preference as the active route and installs this route into the forwarding table. By default, the routing software assigns a preference of 170 to routes that originated from BGP. Of all the routing protocols, BGP has the highest default preference value, which means that routes learned by BGP are the least likely to become the active route.

Some vendors have a preference (distance) of 20 for external BGP (EBGP) and a distance of 200 for internal BGP (IGBP). Junos OS uses the same value (170) for both EBGP and IBGP. However, this difference between vendors has no operational impact because Junos OS always prefers EBGP routes over IBGP routes.

Another area in which vendors differ is in regard to IGP distance compared to BGP distance. For example, some vendors assign a distance of 110 to OSPF routes. This is higher than the EBGP distance of 20 , and results in the selection of an EBGP route over an equivalent OSPF route. In the same scenario, Junos OS chooses the OSPF route, because of the default preference 10 for an internal OSPF route and 150 for an external OSPF route, which are both lower than the 170 preference assigned to all BGP routes.

In a multivendor environment, you might want to change the preference value for BGP routes so that Junos OS chooses an EBGP route instead of an OSPF route. To accomplish this goal, one option is to include the preference statement in the EBGP configuration. To modify the default BGP preference value, include the **preferece** statement, specifying a value from 0 through 4,294,967,295 ($2^{32} - 1$).

TIP: Another way to achieve multivendor compatibility is to include the advertise-inactive statement in the EBGP configuration. This causes the routing table to export to BGP the best route learned by BGP even if Junos OS did not select it to be an active route. By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. The advertise-inactive statement causes Junos OS to advertise the best BGP route that is inactive because of IGP preference. When you use the advertise-inactive statement, the Junos OS device uses the OSPF route for forwarding, and the other vendor's device uses the EBGP route for forwarding. However, from the perspective of an EBGP peer in a neighboring AS, both vendors' devices appear to behave the same way.

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Topology

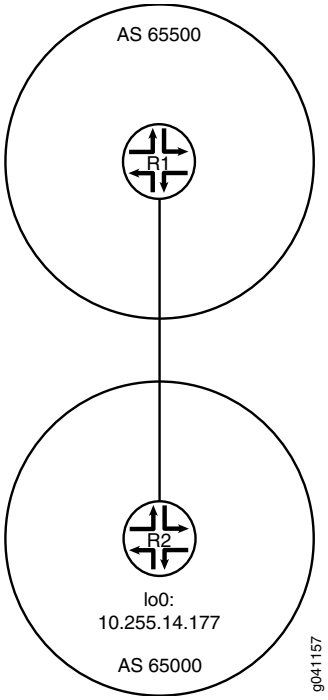
In the sample network, Device R1 and Device R2 have EBGP routes to each other and also OSPF routes to each other.

This example shows the routing tables in the following cases:

- Accept the default preference values of 170 for BGP and 10 for OSPF.
- Change the BGP preference to 8.

Figure 24 on page 237 shows the sample network.

Figure 24: BGP Preference Value Topology



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 4 family inet address 1.12.0.1/30
set interfaces lo0 unit 2 family inet address 10.255.71.24/32
set protocols bgp export send-direct
set protocols bgp group ext type external
set protocols bgp group ext preference 8
set protocols bgp group ext peer-as 65000
set protocols bgp group ext neighbor 1.12.0.2
```

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```
set protocols ospf area 0.0.0.0 interface fe-1/2/0.4
set protocols ospf area 0.0.0.0 interface 10.255.71.24
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 65500
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 1.12.0.2/30
set interfaces lo0 unit 3 family inet address 10.255.14.177/32
set protocols bgp export send-direct
set protocols bgp group ext type external
set protocols bgp group ext peer-as 65500
set protocols bgp group ext neighbor 1.12.0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/0.6
set protocols ospf area 0.0.0.0 interface 10.255.14.177
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 4 family inet address 1.12.0.1/30
user@R1# set lo0 unit 2 family inet address 10.255.71.24/32
```

2. Configure the local autonomous system.

```
[edit routing-options]
user@R1# set autonomous-system 65500
```

3. Configure the external peering with Device R2.

```
[edit protocols bgp]
user@R1# set export send-direct
user@R1# set group ext type external
user@R1# set group ext preference 8
user@R1# set group ext peer-as 65000
user@R1# set group ext neighbor 1.12.0.2
```

4. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/0.4
user@R1# set interface 10.255.71.24
```


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5. Configure the routing policy.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 4 {
      family inet {
         address 1.12.0.1/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 10.255.71.24/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
protocols {
   bgp {
      export send-direct;
      group ext {
         type external;
         preference 8;
         peer-as 65000;
         neighbor 1.12.0.2;
      }
   }
   ospf {
      area 0.0.0.0 {
         interface fe-1/2/0.4;
         interface 10.255.71.24;
      }
```

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```
  }
}
```

```
user@R1# show routing-options
autonomous-system 65500;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps on Device R2.

Verification

Confirm that the configuration is working properly.

Verifying the Preference

Purpose Make sure that the routing tables on Device R1 and Device R2 reflect the fact that Device R1 is using the configured EBGP preference of 8, and Device R2 is using the default EBGP preference of 170.

Action From operational mode, enter the **show route** command.

```
user@R1> show route
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.12.0.0/30        *[Direct/0] 3d 07:03:01
                    > via fe-1/2/0.4
                    [BGP/8] 01:04:49, localpref 100
                      AS path: 65000 I
                    > to 1.12.0.2 via fe-1/2/0.4
1.12.0.1/32        *[Local/0] 3d 07:03:01
                      Local via fe-1/2/0.4
10.255.14.177/32   *[BGP/8] 01:04:49, localpref 100
                      AS path: 65000 I
                    > to 1.12.0.2 via fe-1/2/0.4
                    [OSPF/10] 3d 07:02:16, metric 1
                    > to 1.12.0.2 via fe-1/2/0.4
10.255.71.24/32    *[Direct/0] 3d 07:03:01
                    > via lo0.2
224.0.0.5/32       *[OSPF/10] 5d 03:42:16, metric 1
                      MultiRecv
```

```
user@R2> show route
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.12.0.0/30        *[Direct/0] 3d 07:03:30
                    > via fe-1/2/0.6
                    [BGP/170] 00:45:36, localpref 100
                      AS path: 65500 I
                    > to 1.12.0.1 via fe-1/2/0.6
1.12.0.2/32        *[Local/0] 3d 07:03:30
                      Local via fe-1/2/0.6
```


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```
10.255.14.177/32   *[Direct/0] 3d 07:03:30
                    > via lo0.3
10.255.71.24/32    *[OSPF/10] 3d 07:02:45, metric 1
                    > to 1.12.0.1 via fe-1/2/0.6
                    [BGP/170] 00:45:36, localpref 100
                      AS path: 65500 I
                    > to 1.12.0.1 via fe-1/2/0.6
224.0.0.5/32       *[OSPF/10] 5d 03:42:45, metric 1
                      MultiRecv
```

Meaning The output shows that on Device R1, the active path to Device R2's loopback interface (10.255.14.177/32) is a BGP route. The output also shows that on Device R2, the active path to Device R1's loopback interface (10.255.71.24/32) is an OSPF route.

Related Documentation

- *Route Preferences Overview*
- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Example: Configuring BGP to Advertise Inactive Routes

By default, BGP readvertises only active routes. To have the routing table export to BGP the best route learned by BGP even if Junos OS did not select it to be an active route, include the **advertise-inactive** statement:

```
advertise-inactive;
```

In Junos OS, BGP advertises BGP routes that are installed or active, which are routes selected as the best based on the BGP path selection rules. The **advertise-inactive** statement allows nonactive BGP routes to be advertised to other peers.

NOTE: If the routing table has two BGP routes where one is active and the other is inactive, the **advertise-inactive** statement does not advertise the inactive BGP prefix. This statement does not advertise an inactive BGP route in the presence of another active BGP route. However, if the active route is a static route, the **advertise-inactive** statement advertises the inactive BGP route.

Junos OS also provides support for configuring a BGP export policy that matches the state of an advertised route. You can match either active or inactive routes, as follows:

```
policy-options {
  policy-statement name{
    from state (active|inactive);
  }
}
```

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This qualifier only matches when used in the context of an export policy. When a route is being advertised by a protocol that can advertise inactive routes (such as BGP), **state inactive** matches routes advertised as a result of the **advertise-inactive** (or **advertise-external**) statement.

For example, the following configuration can be used as a BGP export policy to mark routes advertised due to the **advertise-inactive** setting with a user-defined community. That community can be later used by the receiving routers to filter out such routes from the forwarding table. Such a mechanism can be used to address concerns that advertising paths not used for forwarding by the sender might lead to forwarding loops.

```
user@host# show policy-options
policy-statement mark-inactive {
   term inactive {
      from state inactive;
      then {
         community set comm-inactive;
      }
   }
   term default {
      from protocol bgp;
      then accept;
   }
   then reject;
}
community comm-inactive members 65536:65284;
```


- Requirements on page 242
- Overview on page 242
- Configuration on page 243
- Verification on page 246

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

In this example, Device R2 has two external BGP (EBGP) peers, Device R1 and Device R3.

Device R1 has a static route to 172.16.5/24. Likewise, Device R2 also has a static route to 172.16.5/24. Through BGP, Device R1 sends information about its static route to Device R2. Device R2 now has information about 172.16.5/24 from two sources—its own static route and the BGP-learned route received from Device R1. Static routes are preferred over BGP-learned routes, so the BGP route is inactive on Device R2. Normally Device R2 would send the BGP-learned information to Device R3, but Device R2 does not do this because the BGP route is inactive. Device R3, therefore, has no information about 172.16.5/24 unless you enable the **advertise-inactive** command on Device R2, which causes Device R2 to send the BGP-learned to Device R3.

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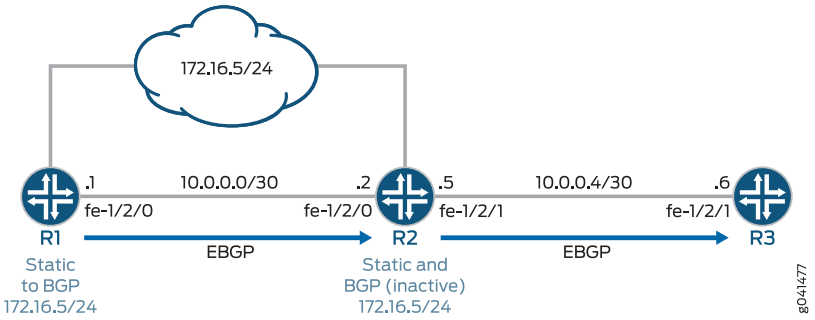
Topology

Figure 25 on page 243 shows the sample network.

Figure 25: BGP Topology for advertise-inactive



"CLI Quick Configuration" on page 243 shows the configuration for all of the devices in Figure 25 on page 243.

The section "Step-by-Step Procedure" on page 244 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group to_R2 type external
set protocols bgp group to_R2 export send-static
set protocols bgp group to_R2 neighbor 10.0.0.2 peer-as 200
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 172.16.5.0/24 discard
set routing-options static route 172.16.5.0/24 install
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.5/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group to_R1 type external
set protocols bgp group to_R1 neighbor 10.0.0.1 peer-as 100
set protocols bgp group to_R3 type external
set protocols bgp group to_R3 advertise-inactive
set protocols bgp group to_R3 neighbor 10.0.0.6 peer-as 300
set routing-options static route 172.16.5.0/24 discard
set routing-options static route 172.16.5.0/24 install
set routing-options autonomous-system 200
```

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Device R3

```
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.6/30
set interfaces fe-1/2/0 unit 9 family inet address 10.0.0.9/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.5
set routing-options autonomous-system 300
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 0 family inet address 10.0.0.5/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure the EBGP connection to Device R1.

```
[edit protocols bgp group to_R1]
user@R2# set type external
user@R2# set neighbor 10.0.0.1 peer-as 100
```

3. Configure the EBGP connection to Device R3.

```
[edit protocols bgp group to_R3]
user@R2# set type external
user@R2# set neighbor 10.0.0.6 peer-as 300
```

4. Add the **advertise-inactive** statement to the EBGP group peering session with Device R3.

```
[edit protocols bgp group to_R3]
user@R2# set advertise-inactive
```

5. Configure the static route to the 172.16.5.0/24 network.

```
[edit routing-options static]
user@R2# set route 172.16.5.0/24 discard
user@R2# set route 172.16.5.0/24 install
```

6. Configure the autonomous system (AS) number.

```
[edit routing-options]
```


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```
user@R2# set autonomous-system 200
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
    unit 0 {
        family inet {
            address 10.0.0.2/30;
        }
    }
}
fe-1/2/1 {
    unit 0 {
        family inet {
            address 10.0.0.5/30;
        }
    }
}
lo0 {
    unit 0 {
        family inet {
            address 192.168.0.2/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    group to_R1 {
        type external;
        neighbor 10.0.0.1 {
            peer-as 100;
        }
    }
    group to_R3 {
        type external;
        advertise-inactive;
        neighbor 10.0.0.6 {
            peer-as 300;
        }
    }
}
```

```
user@R2# show routing-options
static {
    route 172.16.5.0/24 {
        discard;
```

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```
    install;
  }
}
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying the BGP Active Path on page 246
- Verifying the External Route Advertisement on page 246
- Verifying the Route on Device R3 on page 247
- Experimenting with the advertise-inactive Statement on page 247

Verifying the BGP Active Path

Purpose On Device R2, make sure that the 172.16.5.0/24 prefix is in the routing table and has the expected active path.

Action `user@R2>` **show route 172.16.5**

```
inet.0: 7 destinations, 8 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.5.0/24      *[Static/5] 21:24:38
                      Discard
                    [BGP/170] 21:21:41, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
```

Meaning Device R2 receives the 172.16.5.0/24 route from both Device R1 and from its own statically configured route. The static route is the active path, as designated by the asterisk (*). The static route path has the lowest route preference (5) as compared to the BGP preference (170). Therefore, the static route becomes active.

Verifying the External Route Advertisement

Purpose On Device R2, make sure that the 172.16.5.0/24 route is advertised toward Device R3.

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Action

```
user@R2> show route advertising-protocol bgp 10.0.0.6


inet.0: 6 destinations, 7 routes (6 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
  172.16.5.0/24           Self                                    100 I
```

Meaning Device R2 is advertising the 172.16.5.0/24 route toward Device R3

Verifying the Route on Device R3

Purpose Make sure that the 172.16.6.0/24 prefix is in Device R3's routing table.

Action

```
user@R3> show route 172.16.5.0/24

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.5.0/24      *[BGP/170] 00:01:19, localpref 100
                      AS path: 200 100 I, validation-state: unverified
                    > to 10.0.0.5 via fe-1/2/1.0
```

Meaning Device R3 has the BGP-learned route for 172.16.5.0/24.

Experimenting with the advertise-inactive Statement

Purpose See what happens when the **advertise-inactive** statement is removed from the BGP configuration on Device R2.

Action

1. On Device R2, deactivate the **advertise-inactive** statement.

   ```
   [edit protocols bgp group to_R3]
   user@R2# deactivate advertise-inactive
   user@R2# commit
   ```

2. On Device R2, check to see if the 172.16.5.0/24 route is advertised toward Device R3.

   ```
   user@R2> show route advertising-protocol bgp 10.0.0.6
   ```

   As expected, the route is no longer advertised.

3. On Device R3, ensure that the 172.16.5/24 route is absent from the routing table.

   ```
   user@R3> show route 172.16.5/24
   ```

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Meaning Device R1 advertises route 172.16.5/24 to Device R2, but Device R2 has a manually configured static route for this prefix. Static routes are preferred over BGP routes, so Device R2 installs the BGP route as an inactive route. Because the BGP route is not active, Device R2 does not readvertise the BGP route to Device R3. This is the default behavior in Junos OS. If you add the **advertise-inactive** statement to the BGP configuration on Device R2, Device R2 readvertises nonactive routes.

Related Documentation

- Example: Configuring a Routing Policy to Advertise the Best External Route to Internal Peers on page 333
- Understanding BGP Path Selection on page 14

Example: Using Routing Policy to Set a Preference Value for BGP Routes

This example shows how to use routing policy to set the preference for routes learned from BGP. Routing information can be learned from multiple sources. To break ties among equally specific routes learned from multiple sources, each source has a preference value. Routes that are learned through explicit administrative action, such as static routes, are preferred over routes learned from a routing protocol, such as BGP or OSPF. This concept is called *administrative distance* by some vendors.

- Requirements on page 248
- Overview on page 248
- Configuration on page 249
- Verification on page 253

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Routing information can be learned from multiple sources, such as through static configuration, BGP, or an interior gateway protocol (IGP). When Junos OS determines a route's preference to become the active route, it selects the route with the lowest preference as the active route and installs this route into the forwarding table. By default, the routing software assigns a preference of 170 to routes that originated from BGP. Of all the routing protocols, BGP has the highest default preference value, which means that routes learned by BGP are the least likely to become the active route.

Some vendors have a preference (distance) of 20 for external BGP (EBGP) and a distance of 200 for internal BGP (IGBP). Junos OS uses the same value (170) for both EBGP and IBGP. However, this difference between vendors has no operational impact because Junos OS always prefers EBGP routes over IBGP routes.

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Another area in which vendors differ is in regard to IGP distance compared to BGP distance. For example, some vendors assign a distance of 110 to OSPF routes. This is higher than the EBGP distance of 20 , and results in the selection of an EBGP route over an equivalent OSPF route. In the same scenario, Junos OS chooses the OSPF route, because of the default preference 10 for an internal OSPF route and 150 for an external OSPF route, which are both lower than the 170 preference assigned to all BGP routes.

This example shows a routing policy that matches routes from specific next hops and sets a preference. If a route does not match the first term, it is evaluated by the second term.

Topology

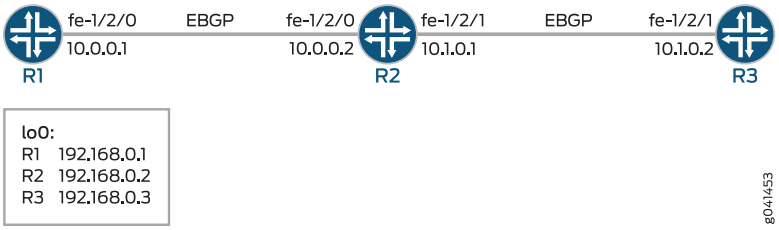
In the sample network, Device R1 and Device R3 have EBGP sessions with Device R2.

On Device R2, an import policy takes the following actions:

- For routes received through BGP from next-hop 10.0.0.1 (Device R1), set the route preference to 10.
- For routes received through BGP from next-hop 10.1.0.2 (Device R3), set the route preference to 15.

Figure 26 on page 249 shows the sample network.

Figure 26: BGP Preference Value Topology



"CLI Quick Configuration" on page 249 shows the configuration for all of the devices in Figure 26 on page 249.

The section "Step-by-Step Procedure" on page 250 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.2
```

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```
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group ext type external
set protocols bgp group ext import set-preference
set protocols bgp group ext export send-direct
set protocols bgp group ext neighbor 10.0.0.1 peer-as 100
set protocols bgp group ext neighbor 10.1.0.2 peer-as 300
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement set-preference term term1 from protocol bgp
set policy-options policy-statement set-preference term term1 from next-hop 10.0.0.1
set policy-options policy-statement set-preference term term1 then preference 10
set policy-options policy-statement set-preference term term2 from protocol bgp
set policy-options policy-statement set-preference term term2 from next-hop 10.1.0.2
set policy-options policy-statement set-preference term term2 then preference 15
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 300
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 0 family inet address 10.1.0.1/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure the local autonomous system.

```
[edit routing-options]
user@R2# set autonomous-system 200
```


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3. Configure the routing policy that sends direct routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

4. Configure the routing policy that changes the preference of received routes.

```
[edit policy-options policy-statement set-preference]
user@R2# set term term1 from protocol bgp
user@R2# set term term1 from next-hop 10.0.0.1
user@R2# set term term1 then preference 10
user@R2# set term term2 from protocol bgp
user@R2# set term term2 from next-hop 10.1.0.2
user@R2# set term term2 then preference 15
```

5. Configure the external peering with Device R2.

```
[edit protocols bgp group ext]
user@R2# set type external
user@R2# set export send-direct
user@R2# set neighbor 10.0.0.1 peer-as 100
user@R2# set neighbor 10.1.0.2 peer-as 300
```

6. Apply the **set-preference** policy as an import policy.

   This affects Device R2's routing table and has no impact on Device R1 and Device R3.

```
[edit protocols bgp group ext]
user@R2# set import set-preference
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 0 {
      family inet {
         address 10.0.0.2/30;
      }
   }
}
fe-1/2/1 {
   unit 0 {
      family inet {
         address 10.1.0.1/30;
```

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```
    }
  }
}
lo0 {
  unit 0{
    family inet {
      address 192.168.0.2/32;
    }
  }
}
```

```
user@R2# show protocols
bgp {
  group ext {
    type external;
    import set-preference;
    export send-direct;
    neighbor 10.0.0.1 {
      peer-as 100;
    }
    neighbor 10.1.0.2 {
      peer-as 300;
    }
  }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
policy-statement set-preference {
  term term1 {
    from {
      protocol bgp;
      next-hop 10.0.0.1;
    }
    then {
      preference 10;
    }
  }
  term term2 {
    from {
      protocol bgp;
      next-hop 10.1.0.2;
    }
    then {
      preference 15;
    }
  }
}
```


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```
user@R2# show routing-options
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the Preference

Purpose Make sure that the routing tables on Device R1 and Device R2 reflect the fact that Device R1 is using the configured EBGP preference of 8, and Device R2 is using the default EBGP preference of 170.

Action From operational mode, enter the **show route protocols bgp** command.

```
user@R2> show route protocols bgp
inet.0: 7 destinations, 9 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/30         [BGP/10] 04:42:23, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
10.1.0.0/30         [BGP/15] 04:42:23, localpref 100
                      AS path: 300 I, validation-state: unverified
                    > to 10.1.0.2 via fe-1/2/1.0
192.168.0.1/32     *[BGP/10] 04:42:23, localpref 100
                      AS path: 100 I, validation-state: unverified
                     > to 10.0.0.1 via fe-1/2/0.0
192.168.0.3/32     *[BGP/15] 04:42:23, localpref 100
                      AS path: 300 I, validation-state: unverified
                     > to 10.1.0.2 via fe-1/2/1.0
```

Meaning The output shows that on Device R2, the preference values have been changed to 15 for routes learned from Device R3, and the preference values have been changed to 10 for routes learned from Device R1.

Related Documentation

- *Route Preferences Overview*
- Understanding External BGP Peering Sessions on page 23

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CHAPTER 8

Configuring the MED Attribute for BGP

- Understanding the MED Attribute That Determines the Exit Point in an AS on page 255
- Example: Configuring the MED Attribute That Determines the Exit Point in an AS on page 258
- Example: Configuring the MED Using Route Filters on page 272
- Example: Configuring the MED Using Communities on page 286
- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 286

Understanding the MED Attribute That Determines the Exit Point in an AS

The BGP multiple exit discriminator (MED, or MULTI_EXIT_DISC) is a non-transitive attribute, meaning that it is not propagated throughout the Internet, but only to adjacent autonomous systems (ASs). The MED attribute is optional, meaning that it is not always sent with the BGP updates. The purpose of MED is to influence how other ASs enter your AS to reach a certain prefix.

The MED attribute has a value that is referred to as a *metric*. If all other factors in determining an exit point are equal, the exit point with the lowest metric is preferred.

If a MED is received over an external BGP link, it is propagated over internal links to other BGP-enabled devices within the AS.

BGP update messages include a MED metric if the route was learned from BGP and already had a MED metric associated with it, or if you configure the MED metric in the configuration file.

A MED metric is advertised with a route according to the following general rules:

- A more specific metric overrides a less specific metric. That is, a group-specific metric overrides a global BGP metric, and a peer-specific metric overrides a global BGP or group-specific metric.
- A metric defined with a routing policy overrides a metric defined with the **metric-out** statement.

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- If any metric is defined, it overrides a metric received in a route.
- If the received route does not have an associated MED metric, and if you do not explicitly configure a metric value, no metric is advertised. When you do not explicitly configure a metric value, the MED value is equivalent to zero (0) when advertising an active route.

Because the AS path rather than the number of hops between hosts is the primary criterion for BGP route selection, an AS with multiple connections to a peer AS can have multiple equivalent AS paths. When the routing table contains two routes to the same host in a neighboring AS, a MED metric assigned to each route can determine which to include in the forwarding table. The MED metric you assign can force traffic through a particular exit point in an AS.

Figure 27 on page 256 illustrates how MED metrics are used to determine route selection.

Figure 27: Default MED Example

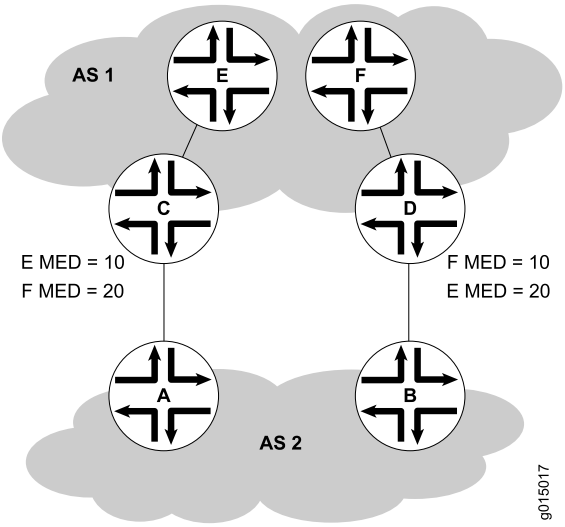

Figure 27 on page 256 shows AS 1 and AS 2 connected by two separate BGP links to Routers C and D. Host E in AS 1 is located nearer to Router C. Host F, also in AS 1, is located nearer to Router D. Because the AS paths are equivalent, two routes exist for each host, one through Router C and one through Router D. To force all traffic destined for Host E through Router C, the network administrator for AS 1 assigns a MED metric for each router to Host E at its exit point. A MED metric of 10 is assigned to the route to Host E through Router C, and a MED metric of 20 is assigned to the route to Host E through Router D. BGP routers in AS 2 select the route with the lower MED metric for the forwarding table.

By default, only the MEDs of routes that have the same peer ASs are compared. However, you can configure the routing table path selection options listed in Table 7 on page 257 to compare MEDs in different ways. The MED options are not mutually exclusive and can be configured in combination or independently. For the MED options to take effect, you must configure them uniformly all through your network. The MED option or options you configure determine the route selected. Thus we recommend that you carefully evaluate your network for preferred routes before configuring the MED options.

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Table 7: MED Options for Routing Table Path Selection

Option (Name)	Function	Use
Always comparing MEDs (**always-compare-med**)	Ensures that the MEDs for paths from peers in different ASs are always compared in the route selection process.	Useful when all enterprises participating in a network agree on a uniform policy for setting MEDs. For example, in a network shared by two ISPs, both must agree that a certain path is the better path to configure the MED values correctly.
Adding IGP cost to MED (**med-plus-igp**)	Before comparing MED values for path selection, adds to the MED the cost of the IGP route to the BGP next-hop destination. This option replaces the MED value for the router, but does not affect the IGP metric comparison. As a result, when multiple routes have the same value after the MED-plus-IPG comparison, and route selection continues, the IGP route metric is also compared, even though it was added to the MED value and compared earlier in the selection process.	Useful when the downstream AS requires the complete cost of a certain route that is received across multiple ASs.
Applying Cisco IOS nondeterministic behavior (**cisco-non-deterministic**)	Specifies the nondeterministic behavior of the Cisco IOS software: • The active path is always first. All nonactive but eligible paths follow the active path and are maintained in the order in which they were received. Ineligible paths remain at the end of the list. • When a new path is added to the routing table, path comparisons are made among all routes, including those paths that must never be selected because they lose the MED tie-breaking rule.	We recommend that you do not configure this option, because the nondeterministic behavior sometimes prevents the system from properly comparing the MEDs between paths.

Related Documentation

- Example: Configuring the MED Using Route Filters on page 272
- *Example: Creating a Named Scope for Multicast Scoping*
- Example: Configuring the MED Attribute That Determines the Exit Point in an AS on page 258
- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 286

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Example: Configuring the MED Attribute That Determines the Exit Point in an AS

This example shows how to configure a multiple exit discriminator (MED) metric to advertise in BGP update messages.

- Requirements on page 258
- Overview on page 258
- Configuration on page 259
- Verification on page 270

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

To directly configure a MED metric to advertise in BGP update messages, include the **metric-out** statement:

```
metric-out (metric | minimum-igp offset | igp delay-med-update | offset);
```

metric is the primary metric on all routes sent to peers. It can be a value in the range from 0 through 4,294,967,295 ($2^{32} - 1$).

The following optional settings are also supported:

- **minimum-igp**—Sets the metric to the minimum metric value calculated in the interior gateway protocol (IGP) to get to the BGP next hop. If a newly calculated metric is greater than the minimum metric value, the metric value remains unchanged. If a newly calculated metric is lower, the metric value is lowered to that value.
- **igp**—Sets the metric to the most recent metric value calculated in the IGP to get to the BGP next hop.
- **delay-med-update**—Delays sending MED updates when the MED value increases. Include the **delay-med-update** statement when you configure the **igp** statement. The default interval to delay sending updates, unless the MED is lower or another attribute associated with the route has changed is 10 minutes. Include the **med-igp-update-interval *minutes*** statement at the **[edit routing-options]** hierarchy level to modify the default interval.
- ***offset***—Specifies a value for ***offset*** to increase or decrease the metric that is used from the metric value calculated in the IGP. The metric value is offset by the value specified. The metric calculated in the IGP (by specifying either **igp** or **igp-minimum**) is increased if the ***offset*** value is positive. The metric calculated in the IGP (by specifying either **igp** or **igp-minimum**) is decreased if the ***offset*** value is negative.

  offset can be a value in the range from -2^{31} through $2^{31} - 1$. Note that the adjusted metric can never go below 0 or above $2^{32} - 1$.

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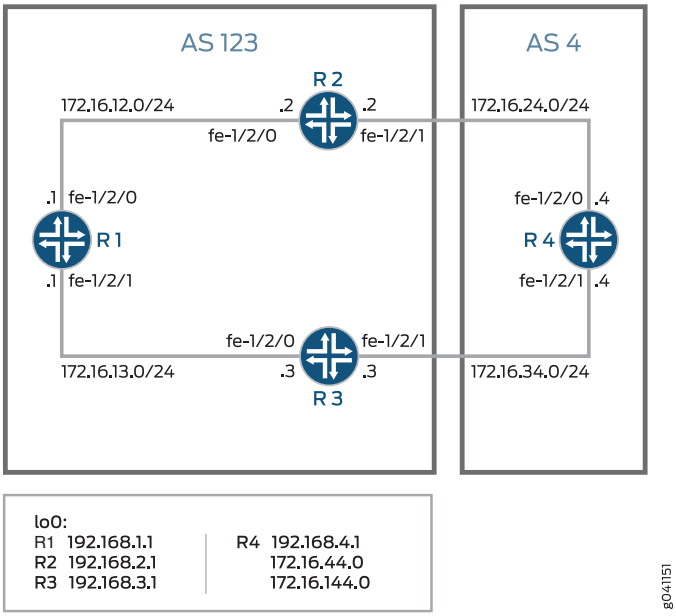
Figure 28 on page 259 shows a typical network with internal peer sessions and multiple exit points to a neighboring autonomous system (AS).

Figure 28: Typical Network with IBGP Sessions and Multiple Exit Points



Device R4 has multiple loopback interfaces configured to simulate advertised prefixes. The extra loopback interface addresses are 44.44.44.44/32 and 144.144.144.144/32. This example shows how to configure Device R4 to advertise a MED value of 30 to Device R3 and a MED value of 20 to Device R2. This causes all of the devices in AS 123 to prefer the path through Device R2 to reach AS 4.

Configuration

- Configuring Device R1 on page 261
- Configuring Device R2 on page 263
- Configuring Device R3 on page 265
- Configuring Device R4 on page 268

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 12.12.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 13.13.13.1/24
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
```

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```
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 12.12.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 24.24.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 24.24.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 13.13.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 34.34.34.3/24
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 34.34.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 24.24.24.4/24
set interfaces fe-1/2/1 unit 8 family inet address 34.34.34.4/24
```


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```
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set interfaces lo0 unit 4 family inet address 44.44.44.44/32
set interfaces lo0 unit 4 family inet address 144.144.144.144/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 34.34.34.3 metric-out 30
set protocols bgp group external neighbor 24.24.24.2 metric-out 20
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R1# set family inet address 12.12.12.1/24
[edit interfaces fe-1/2/1 unit 2]
user@R1# set family inet address 13.13.13.1/24
[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.1.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.1.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.2.1
user@R1# set neighbor 192.168.3.1
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface fe-1/2/0.1
user@R1# set interface fe-1/2/1.2
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

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```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 123
user@R1# set router-id 192.168.1.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 12.12.12.1/24;
      }
   }
}
fe-1/2/1 {
   unit 2 {
      family inet {
         address 13.13.13.1/24;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 192.168.1.1/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
bgp {
   group internal {
      type internal;
```


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```
    local-address 192.168.1.1;
    export send-direct;
    neighbor 192.168.2.1;
    neighbor 192.168.3.1;
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.1 {
      passive;
    }
    interface fe-1/2/0.1;
    interface fe-1/2/1.2;
  }
}
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 3]
user@R2# set family inet address 12.12.12.21/24
[edit interfaces fe-1/2/1 unit 4]
user@R2# set family inet address 24.24.24.2/24
[edit interfaces lo0 unit 2]
user@R2# set family inet address 192.168.2.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R2# set type internal
user@R2# set local-address 192.168.2.1
user@R2# set export send-direct
user@R2# set neighbor 192.168.1.1
user@R2# set neighbor 192.168.3.1
[edit protocols bgp group external]
user@R2# set type external
user@R2# set export send-direct
user@R2# set peer-as 4
user@R2# set neighbor 24.24.24.4
```

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3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R2# set interface lo0.2 passive
user@R2# set interface fe-1/2/0.3
user@R2# set interface fe-1/2/1.4
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 123
user@R2# set router-id 192.168.2.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 3 {
      family inet {
         address 12.12.12.2/24;
      }
   }
}
fe-1/2/1 {
   unit 4 {
      family inet {
         address 24.24.24.2/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.168.2.1/32;
      }
   }
}
```


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```
user@R2# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R2# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.2.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.3.1;
   }
   group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 24.24.24.4;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.2 {
         passive;
      }
      interface fe-1/2/0.3;
      interface fe-1/2/1.4;
   }
}
```

```
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 5]
user@R3# set family inet address 13.13.13.3/24
```

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```
[edit interfaces fe-1/2/1 unit 6]
user@R3# set family inet address 34.34.34.3/24
[edit interfaces lo0 unit 3]
user@R3# set family inet address 192.168.3.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R3# set type internal
user@R3# set local-address 192.168.3.1
user@R3# set export send-direct
user@R3# set neighbor 192.168.1.1
user@R3# set neighbor 192.168.2.1
[edit protocols bgp group external]
user@R3# set type external
user@R3# set export send-direct
user@R3# set peer-as 4
user@R3# set neighbor 34.34.34.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R3# set interface lo0.3 passive
user@R3# set interface fe-1/2/0.5
user@R3# set interface fe-1/2/1.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
```


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```
fe-1/2/0 {
   unit 5 {
      family inet {
         address 13.13.13.3/24;
      }
   }
}
fe-1/2/1 {
   unit 6 {
      family inet {
         address 34.34.34.3/24;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.3.1/32;
      }
   }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R3# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.3.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.2.1;
   }
   group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 34.34.34.4;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.3 {
         passive;
      }
      interface fe-1/2/0.5;
      interface fe-1/2/1.6;
   }
```

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```
}
```

```
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 7]
user@R4# set family inet address 24.24.24.4/24
[edit interfaces fe-1/2/1 unit 8]
user@R4# set family inet address 34.34.34.4/24
[edit interfaces lo0 unit 4]
user@R4# set family inet address 192.168.4.1/32
user@R4# set family inet address 44.44.44.44/32
user@R4# set family inet address 144.144.144.144/32
```

   Device R4 has multiple loopback interface addresses to simulate advertised prefixes.

2. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R4# set from protocol direct
user@R4# set then accept
```

3. Configure BGP.

```
[edit protocols bgp group external]
user@R4# set type external
user@R4# set export send-direct
user@R4# set peer-as 123
```

4. Configure a MED value of 30 for neighbor Device R3, and a MED value of 20 for neighbor Device R2.

```
[edit protocols bgp group external]
user@R4# set neighbor 34.34.34.3 metric-out 30
```


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```
user@R4# set neighbor 24.24.24.2 metric-out 20
```

This configuration causes autonomous system (AS) 123 (of which Device R1, Device R2, and Device R3 are members) to prefer the path through Device R2 to reach AS 4.

5. Configure the router ID and AS number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
   unit 7 {
      family inet {
         address 24.24.24.4/24;
      }
   }
}
fe-1/2/1 {
   unit 8 {
      family inet {
         address 34.34.34.4/24;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.4.1/32;
         address 44.44.44.44/32;
         address 144.144.144.144/32;
      }
   }
}
```

```
user@R4# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

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```
user@R4# show protocols
bgp {
  group external {
    type external;
    export send-direct;
    peer-as 123;
    neighbor 34.34.34.3 {
      metric-out 30;
    }
    neighbor 24.24.24.2 {
      metric-out 20;
    }
  }
}
```

```
user@R4# show routing-options
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Active Path From Device R1 to Device R4 on page 270
- Verifying That Device R4 Is Sending Its Routes Correctly on page 271

Checking the Active Path From Device R1 to Device R4

Purpose Verify that the active path goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 13 destinations, 19 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

12.12.12.0/24       [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
13.13.13.0/24       [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
24.24.24.0/24       [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
34.34.34.0/24       [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
44.44.44.44/32     *[BGP/170] 01:41:11, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
```


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```
144.144.144.144/32 *[BGP/170] 00:08:13, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.2.1/32      [BGP/170] 3d 22:52:38, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 12.12.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 3d 03:15:16, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 13.13.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 01:41:11, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 12.12.12.2 via fe-1/2/0.1
```

Meaning The asterisk (*) shows that the preferred path is through Device R2. The reason for the path selection is listed as MED 20.

Verifying That Device R4 Is Sending Its Routes Correctly

Purpose Make sure that Device R4 is sending update messages with a value of 20 to Device R2 and a value of 30 to Device R3.

Action From operational mode, enter the **show route advertising-protocol bgp 24.24.24.2** command.

```
user@R4> show route advertising-protocol bgp 24.24.24.2

inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 20                 I
* 34.34.34.0/24           Self                 20                 I
* 44.44.44.44/32          Self                 20                 I
* 144.144.144.144/32      Self                 20                 I
* 192.168.4.1/32          Self                 20                 I
```

```
user@R4> show route advertising-protocol bgp 34.34.34.3

inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 24.24.24.0/24           Self                 30                 I
* 34.34.34.0/24           Self                 30                 I
* 44.44.44.44/32          Self                 30                 I
* 144.144.144.144/32      Self                 30                 I
* 192.168.4.1/32          Self                 30                 I
```

Meaning The MED column shows that Device R4 is sending the correct MED values to its two external BGP (EBGP) neighbors.

Related Documentation

- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 286

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- Understanding BGP Path Selection on page 14
- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Example: Configuring the MED Using Route Filters

This example shows how to configure a policy that uses route filters to modify the multiple exit discriminator (MED) metric to advertise in BGP update messages.

- Requirements on page 272
- Overview on page 272
- Configuration on page 273
- Verification on page 284

Requirements

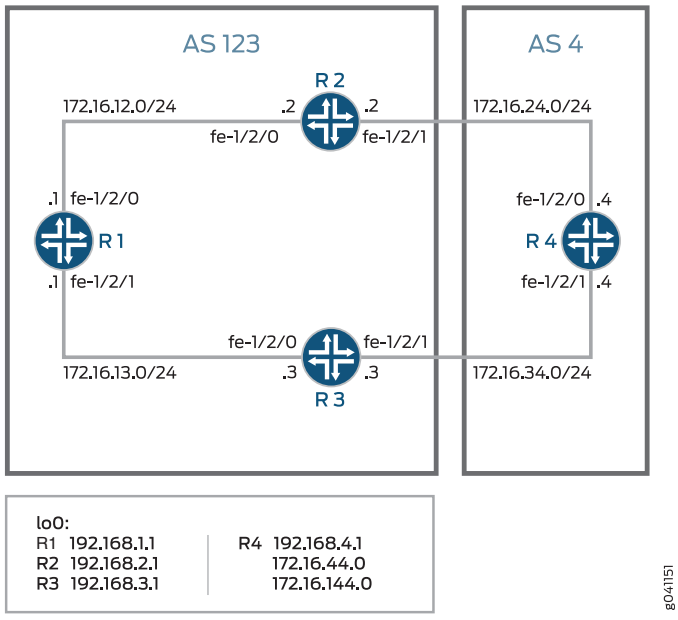
No special configuration beyond device initialization is required before you configure this example.

Overview

To configure a route-filter policy that modifies the advertised MED metric in BGP update messages, include the **metric** statement in the policy action.

Figure 29 on page 272 shows a typical network with internal peer sessions and multiple exit points to a neighboring autonomous system (AS).

Figure 29: Typical Network with IBGP Sessions and Multiple Exit Points



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Device R4 has multiple loopback interfaces configured to simulate advertised prefixes. The extra loopback interface addresses are 172.16.44.0/32 and 172.16.144.0/32. This example shows how to configure Device R4 to advertise a MED value of 30 to Device R3 for all routes except 172.16.144.0. For 172.16.144.0, a MED value of 10 is advertised to Device 3. A MED value of 20 is advertised to Device R2, regardless of the route prefix.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 172.16.12.1/24
set interfaces fe-1/2/1 unit 2 family inet address 172.16.13.1/24
set interfaces lo0 unit 1 family inet address 192.168.1.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.1.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.2
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.1.1
```

Device R2

```
set interfaces fe-1/2/0 unit 3 family inet address 172.16.12.2/24
set interfaces fe-1/2/1 unit 4 family inet address 172.16.24.2/24
set interfaces lo0 unit 2 family inet address 192.168.2.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.2.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.3.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 172.16.24.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.2.1
```

Device R3

```
set interfaces fe-1/2/0 unit 5 family inet address 172.16.13.3/24
set interfaces fe-1/2/1 unit 6 family inet address 172.16.34.3/24
```

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```
set interfaces lo0 unit 3 family inet address 192.168.3.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.3.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.1.1
set protocols bgp group internal neighbor 192.168.2.1
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 4
set protocols bgp group external neighbor 172.16.34.4
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.5
set protocols ospf area 0.0.0.0 interface fe-1/2/1.6
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 123
set routing-options router-id 192.168.3.1
```

Device R4

```
set interfaces fe-1/2/0 unit 7 family inet address 172.16.24.4/24
set interfaces fe-1/2/1 unit 8 family inet address 172.16.34.4/24
set interfaces lo0 unit 4 family inet address 192.168.4.1/32
set interfaces lo0 unit 4 family inet address 172.16.44.0/32
set interfaces lo0 unit 4 family inet address 172.16.144.0/32
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 123
set protocols bgp group external neighbor 172.16.34.3 export med-10
set protocols bgp group external neighbor 172.16.34.3 export med-30
set protocols bgp group external neighbor 172.16.24.2 metric-out 20
set policy-options policy-statement med-10 from route-filter 172.16.144.0/32 exact
set policy-options policy-statement med-10 then metric 10
set policy-options policy-statement med-10 then accept
set policy-options policy-statement med-30 from route-filter 0.0.0.0/0 longer
set policy-options policy-statement med-30 then metric 30
set policy-options policy-statement med-30 then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options autonomous-system 4
set routing-options router-id 192.168.4.1
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R1# set family inet address 172.16.12.1/24
```


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```
[edit interfaces fe-1/2/1 unit 2]
user@R1# set family inet address 172.16.13.1/24
[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.1.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.1.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.2.1
user@R1# set neighbor 192.168.3.1
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface lo0.1 passive
user@R1# set interface fe-1/2/0.1
user@R1# set interface fe-1/2/1.2
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 123
user@R1# set router-id 192.168.1.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 172.16.12.1/24;
      }
```

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```
    }
}
fe-1/2/1 {
    unit 2 {
        family inet {
            address 172.16.13.1/24;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 192.168.1.1/32;
        }
    }
}
```

```
user@R1# show protocols
bgp {
    group internal {
        type internal;
        local-address 192.168.1.1;
        export send-direct;
        neighbor 192.168.2.1;
        neighbor 192.168.3.1;
    }
}
ospf {
    area 0.0.0.0 {
        interface lo0.1 {
            passive;
        }
        interface fe-1/2/0.1;
        interface fe-1/2/1.2;
    }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
```

```
user@R1# show routing-options
autonomous-system 123;
router-id 192.168.1.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 3]
user@R2# set family inet address 172.16.12.21/24
[edit interfaces fe-1/2/1 unit 4]
user@R2# set family inet address 172.16.24.2/24
[edit interfaces lo0 unit 2]
user@R2# set family inet address 192.168.2.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R2# set type internal
user@R2# set local-address 192.168.2.1
user@R2# set export send-direct
user@R2# set neighbor 192.168.1.1
user@R2# set neighbor 192.168.3.1
[edit protocols bgp group external]
user@R2# set type external
user@R2# set export send-direct
user@R2# set peer-as 4
user@R2# set neighbor 172.16.24.4
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R2# set interface lo0.2 passive
user@R2# set interface fe-1/2/0.3
user@R2# set interface fe-1/2/1.4
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

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```
[edit routing-options]
user@R2# set autonomous-system 123
user@R2# set router-id 192.168.2.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 3 {
      family inet {
         address 172.16.12.2/24;
      }
   }
}
fe-1/2/1 {
   unit 4 {
      family inet {
         address 172.16.24.2/24;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.168.2.1/32;
      }
   }
}
```

```
user@R2# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.2.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.3.1;
   }
   group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 172.16.24.4;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.2 {
```


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```
        passive;
      }
      interface fe-1/2/0.3;
      interface fe-1/2/1.4;
    }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R2# show routing-options
autonomous-system 123;
router-id 192.168.2.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R3

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R3:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 5]
user@R3# set family inet address 172.16.13.3/24
[edit interfaces fe-1/2/1 unit 6]
user@R3# set family inet address 172.16.34.3/24
[edit interfaces lo0 unit 3]
user@R3# set family inet address 192.168.3.1/32
```

2. Configure BGP.

```
[edit protocols bgp group internal]
user@R3# set type internal
user@R3# set local-address 192.168.3.1
user@R3# set export send-direct
user@R3# set neighbor 192.168.1.1
user@R3# set neighbor 192.168.2.1
[edit protocols bgp group external]
user@R3# set type external
user@R3# set export send-direct
user@R3# set peer-as 4
user@R3# set neighbor 172.16.34.4
```

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3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R3# set interface lo0.3 passive
user@R3# set interface fe-1/2/0.5
user@R3# set interface fe-1/2/1.6
```

4. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R3# set from protocol direct
user@R3# set then accept
```

5. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set autonomous-system 123
user@R3# set router-id 192.168.3.1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/2/0 {
   unit 5 {
      family inet {
         address 172.16.13.3/24;
      }
   }
}
fe-1/2/1 {
   unit 6 {
      family inet {
         address 172.16.34.3/24;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.3.1/32;
      }
   }
}
```


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```
user@R3# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.3.1;
      export send-direct;
      neighbor 192.168.1.1;
      neighbor 192.168.2.1;
   }
   group external {
      type external;
      export send-direct;
      peer-as 4;
      neighbor 172.16.34.4;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.3 {
         passive;
      }
      interface fe-1/2/0.5;
      interface fe-1/2/1.6;
   }
}
```

```
user@R3# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R3# show routing-options
autonomous-system 123;
router-id 192.168.3.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the device interfaces.

```
[edit interfaces fe-1/2/0 unit 7]
user@R4# set family inet address 172.16.24.4/24
```

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```
[edit interfaces fe-1/2/1 unit 8]
user@R4# set family inet address 172.16.34.4/24
[edit interfaces lo0 unit 4]
user@R4# set family inet address 192.168.4.1/32
user@R4# set family inet address 172.16.44.0/32
user@R4# set family inet address 172.16.144.0/32
```

Device R4 has multiple loopback interface addresses to simulate advertised prefixes.

2. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R4# set from protocol direct
user@R4# set then accept
```

3. Configure BGP.

```
[edit protocols bgp group external]
user@R4# set type external
user@R4# set export send-direct
user@R4# set peer-as 123
```

4. Configure the two MED policies.

```
[edit policy-options]
set policy-statement med-10 from route-filter 172.16.144.0/32 exact
set policy-statement med-10 then metric 10
set policy-statement med-10 then accept
set policy-statement med-30 from route-filter 0.0.0.0/0 longer
set policy-statement med-30 then metric 30
set policy-statement med-30 then accept
```

5. Configure the two EBGP neighbors, applying the two MED policies to Device R3, and a MED value of 20 to Device R2.

```
[edit protocols bgp group external]
user@R4# set neighbor 172.16.34.3 export med-10
user@R4# set neighbor 172.16.34.3 export med-30
user@R4# set neighbor 172.16.24.2 metric-out 20
```

6. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R4# set autonomous-system 4
user@R4# set router-id 192.168.4.1
```


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Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
   unit 7 {
      family inet {
         address 172.16.24.4/24;
      }
   }
}
fe-1/2/1 {
   unit 8 {
      family inet {
         address 172.16.34.4/24;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.4.1/32;
         address 172.16.44.0/32;
         address 172.16.144.0/32;
      }
   }
}
```

```
user@R4# show protocols
bgp {
   group external {
      type external;
      export send-direct;
      peer-as 123;
      neighbor 172.16.24.2 {
         metric-out 20;
      }
      neighbor 172.16.34.3 {
         export [ med-10 med-30 ];
      }
   }
}
```

```
user@R4# show policy-options
policy-statement med-10 {
   from {
      route-filter 172.16.144.0/32 exact;
   }
   then {
      metric 10;
      accept;
```

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```
  }
}
policy-statement med-30 {
  from {
    route-filter 0.0.0.0/0 longer;
  }
  then {
    metric 30;
    accept;
  }
}
policy-statement send-direct {
  term 1 {
    from protocol direct;
    then accept;
  }
}
```

```
user@R4# show routing-options
autonomous-system 4;
router-id 192.168.4.1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Active Path from Device R1 to Device R4 on page 284
- Verifying That Device R4 Is Sending Its Routes Correctly on page 285

Checking the Active Path from Device R1 to Device R4

Purpose Verify that the active path goes through Device R2.

Action From operational mode, enter the **show route protocol bgp** command.

```
user@R1> show route protocol bgp
inet.0: 13 destinations, 19 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.12.0/24       [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 172.16.12.2 via fe-1/2/0.1
172.16.13.0/24       [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 172.16.13.3 via fe-1/2/1.2
172.16.24.0/24       [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 172.16.12.2 via fe-1/2/0.1
172.16.34.0/24       [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 172.16.13.3 via fe-1/2/1.2
```


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```
172.16.44.0/32     *[BGP/170] 00:06:03, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 172.16.12.2 via fe-1/2/0.1
172.16.144.0/32 *[BGP/170] 00:06:03, MED 10, localpref 100, from 192.168.3.1
                      AS path: 4 I
                    > to 172.16.13.3 via fe-1/2/1.2
192.168.2.1/32      [BGP/170] 4d 01:13:32, localpref 100, from 192.168.2.1
                      AS path: I
                    > to 172.16.12.2 via fe-1/2/0.1
192.168.3.1/32      [BGP/170] 3d 05:36:10, localpref 100, from 192.168.3.1
                      AS path: I
                    > to 172.16.13.3 via fe-1/2/1.2
192.168.4.1/32     *[BGP/170] 00:06:03, MED 20, localpref 100, from 192.168.2.1
                      AS path: 4 I
                    > to 172.16.12.2 via fe-1/2/0.1
```

Meaning The output shows that the preferred path to the routes advertised by Device R4 is through Device R2 for all routes except 172.16.144.0/32. For 172.16.144.0/32, the preferred path is through Device R3.

Verifying That Device R4 Is Sending Its Routes Correctly

Purpose Make sure that Device R4 is sending update messages with a value of 20 to Device R2 and a value of 30 to Device R3.

Action From operational mode, enter the **show route advertising-protocol bgp** command.

```
user@R4> show route advertising-protocol bgp 172.16.24.2
```

```
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.24.0/24           Self                 20                 I
* 172.16.34.0/24           Self                 20                 I
* 172.16.44.0/32          Self                 20                 I
* 172.16.144.0/32      Self                 20                 I
* 192.168.4.1/32          Self                 20                 I
```

```
user@R4> show route advertising-protocol bgp 172.16.34.3
```

```
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.24.0/24           Self                 30                 I
* 172.16.34.0/24           Self                 30                 I
* 172.16.44.0/32          Self                 30                 I
* 172.16.144.0/32      Self                 10                 I
* 192.168.4.1/32          Self                 30                 I
```

Meaning The MED column shows that Device R4 is sending the correct MED values to its two EBGP neighbors.

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Related Documentation

- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 286
- *Understanding Route Filters for Use in Routing Policy Match Conditions*
- Understanding BGP Path Selection on page 14
- Understanding External BGP Peering Sessions on page 23

Example: Configuring the MED Using Communities

Set the multiple exit discriminator (MED) metric to 20 for all routes from a particular community.

```
[edit]
routing-options {
   router-id 10.0.0.1;
   autonomous-system 23;
}
policy-options {
   policy-statement from-otago {
      from community otago;
      then metric 20;
   }
   community otago members [56:2379 23:46944];
}
protocols {
   bgp {
      import from-otago;
      group 23 {
         type external;
         peer-as 56;
         neighbor 192.168.0.1 {
            traceoptions {
               file bgp-log-peer;
               flag packets;
            }
            log-updown;
         }
      }
   }
}
```

Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates

This example shows how to associate the multiple exit discriminator (MED) path attribute with the interior gateway protocol (IGP) metric, and configure a timer to delay update of the MED attribute.

- Requirements on page 287
- Overview on page 287

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- Configuration on page 289
- Verification on page 295

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

BGP can be configured to advertise the MED attribute for a route based on the IGP distance of its internal BGP (IBGP) route next-hop. The IGP metric enables internal routing to follow the shortest path according to the administrative setup. In some deployments, it might be ideal to communicate IGP shortest-path knowledge to external BGP (EBGP) peers in a neighboring autonomous system (AS). This allows those EBGP peers to forward traffic into your AS using the shortest paths possible.

Routes learned from an EBGP peer usually have a next hop on a directly connected interface, and thus the IGP value is equal to zero. Zero is the value advertised. The IGP metric is a nonzero value when a BGP peer sends third-party next hops that require the local system to perform next-hop resolution—IBGP configurations, configurations within confederation peers, or EBGP configurations that include the **multihop** command. In these scenarios, it might make sense to associate the MED value with the IGP metric by including the metric-out **minimum-igp** or metric-out **igp** option.

The drawback of associating the MED with the IGP metric is the risk of excessive route advertisements when there are IGP instabilities in the network. Configuring a delay for the MED update provides a mechanism to reduce route advertisements in such scenarios. The delay works by slowing down MED updates when the IGP metric for the next hop changes. The approach uses a timer to periodically advertise MED updates. When the timer expires, the MED attribute for routes with **metric-out igp delay-updates** configured is updated to the current IGP metric of the next hop. The BGP-enabled device sends out advertisements for routes for which the MED attribute has changed.

The **delay-updates** option identifies the BGP groups (or peers) for which the MED updates must be suppressed. The time for advertising MED updates is set to 10 minutes by default. You can increase the interval up to 600 minutes by including the **med-igp-update-interval** statement in the **routing-options** configuration.

NOTE: If you have nonstop active routing (NSR) enabled and a switchover occurs, the delayed MED updates might be advertised as soon as the switchover occurs.

When you configure the **metric-out igp** option, the IGP metric directly tracks the IGP cost to the IBGP peer. When the IGP cost goes down, so does the advertised MED value. Conversely, when the IGP cost goes up, the MED value goes up as well.

When you configure the **metric-out minimum-igp** option, the advertised MED value changes only when the IGP cost to the IBGP peer goes down. An increase in the IGP cost does not

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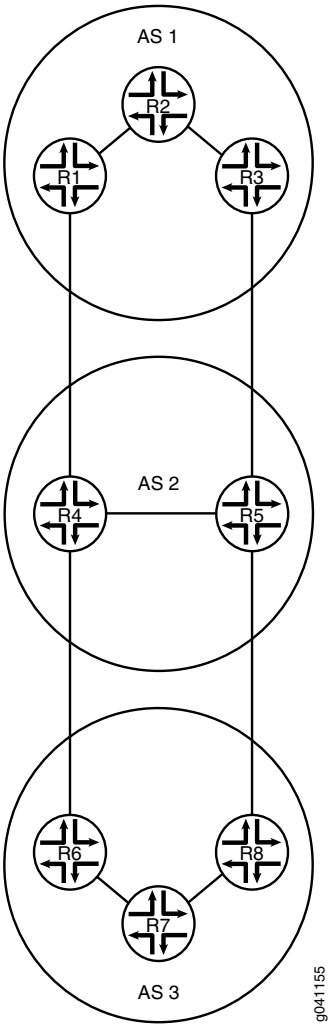
affect the MED value. The router monitors and remembers the lowest IGP cost until the routing process (rpd) is restarted. The BGP peer sends an update only if the MED is lower than the previously advertised value or another attribute associated with the route has changed, or if the BGP peer is responding to a refresh route request.

This example uses the **metric** statement in the OSPF configuration to demonstrate that when the IGP metric changes, the MED also changes after the configured delay interval. The OSPF metric can range from 1 through 65,535.

Figure 30 on page 288 shows the sample topology.

Figure 30: Topology for Delaying the MED Update



In this example, the MED value advertised by Device R1 is associated with the IGP running in AS 1. The MED value advertised by Device R1 impacts the decisions of the neighboring AS (AS 2) when AS 2 is forwarding traffic into AS 1.

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Configuration

- Configuring Device R1 on page 292

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 2 description R1->R2
set interfaces fe-1/2/0 unit 2 family inet address 10.0.0.1/30
set interfaces fe-1/2/1 unit 7 description R1->R4
set interfaces fe-1/2/1 unit 7 family inet address 172.16.0.1/30
set interfaces lo0 unit 1 family inet address 192.168.0.1/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.1
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.2
set protocols bgp group internal neighbor 192.168.0.3
set protocols bgp group external type external
set protocols bgp group external metric-out igp delay-med-update
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.2
set protocols ospf area 0.0.0.0 interface fe-1/2/0.2 metric 600
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options med-igp-update-interval 12
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 1
```

Device R2

```
set interfaces fe-1/2/0 unit 1 description R2->R1
set interfaces fe-1/2/0 unit 1 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 4 description R2->R3
set interfaces fe-1/2/1 unit 4 family inet address 10.0.2.2/30
set interfaces lo0 unit 2 family inet address 192.168.0.2/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.2
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.1
set protocols bgp group internal neighbor 192.168.0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.2
set routing-options autonomous-system 1
```

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Device R3

```
set interfaces fe-1/2/0 unit 3 description R3->R2
set interfaces fe-1/2/0 unit 3 family inet address 10.0.2.1/30
set interfaces fe-1/2/1 unit 5 description R3->R5
set interfaces fe-1/2/1 unit 5 family inet address 172.16.0.5/30
set interfaces lo0 unit 3 family inet address 192.168.0.3/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.3
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.1
set protocols bgp group internal neighbor 192.168.0.2
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.6
set protocols ospf area 0.0.0.0 interface fe-1/2/0.3
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 1
```

Device R4

```
set interfaces fe-1/2/0 unit 8 description R4->R1
set interfaces fe-1/2/0 unit 8 family inet address 172.16.0.2/30
set interfaces fe-1/2/1 unit 9 description R4->R5
set interfaces fe-1/2/1 unit 9 family inet address 10.0.4.1/30
set interfaces fe-1/2/2 unit 13 description R4->R6
set interfaces fe-1/2/2 unit 13 family inet address 172.16.0.9/30
set interfaces lo0 unit 4 family inet address 192.168.0.4/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.4
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.5
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 172.16.0.10 peer-as 3
set protocols bgp group external neighbor 172.16.0.1 peer-as 1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.9
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.4
set routing-options autonomous-system 2
```

Device R5

```
set interfaces fe-1/2/0 unit 6 description R5->R3
set interfaces fe-1/2/0 unit 6 family inet address 172.16.0.6/30
set interfaces fe-1/2/1 unit 10 description R5->R4
set interfaces fe-1/2/1 unit 10 family inet address 10.0.4.2/30
set interfaces fe-1/2/2 unit 11 description R5->R8
set interfaces fe-1/2/2 unit 11 family inet address 172.16.0.13/30
set interfaces lo0 unit 5 family inet address 192.168.0.5/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.5
```


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```
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.4
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external neighbor 172.16.0.5 peer-as 1
set protocols bgp group external neighbor 172.16.0.14 peer-as 3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.10
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.5
set routing-options autonomous-system 2
```

Device R6

```
set interfaces fe-1/2/0 unit 14 description R6->R4
set interfaces fe-1/2/0 unit 14 family inet address 172.16.0.10/30
set interfaces fe-1/2/1 unit 15 description R6->R7
set interfaces fe-1/2/1 unit 15 family inet address 10.0.6.1/30
set interfaces lo0 unit 6 family inet address 192.168.0.6/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.6
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.7
set protocols bgp group internal neighbor 192.168.0.8
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.9 peer-as 2
set protocols ospf area 0.0.0.0 interface fe-1/2/1.15
set protocols ospf area 0.0.0.0 interface lo0.6 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.6
set routing-options autonomous-system 3
```

Device R7

```
set interfaces fe-1/2/0 unit 16 description R7->R6
set interfaces fe-1/2/0 unit 16 family inet address 10.0.6.2/30
set interfaces fe-1/2/1 unit 17 description R7->R8
set interfaces fe-1/2/1 unit 17 family inet address 10.0.7.2/30
set interfaces lo0 unit 7 family inet address 192.168.0.7/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.7
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.6
set protocols bgp group internal neighbor 192.168.0.8
set protocols ospf area 0.0.0.0 interface fe-1/2/0.16
set protocols ospf area 0.0.0.0 interface fe-1/2/1.17
set protocols ospf area 0.0.0.0 interface lo0.7 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.7
set routing-options autonomous-system 3
```

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Device R8

```
set interfaces fe-1/2/0 unit 12 description R8->R5
set interfaces fe-1/2/0 unit 12 family inet address 172.16.0.14/30
set interfaces fe-1/2/1 unit 18 description R8->R7
set interfaces fe-1/2/1 unit 18 family inet address 10.0.7.1/30
set interfaces lo0 unit 8 family inet address 192.168.0.8/32
set protocols bgp group internal type internal
set protocols bgp group internal local-address 192.168.0.8
set protocols bgp group internal export send-direct
set protocols bgp group internal neighbor 192.168.0.6
set protocols bgp group internal neighbor 192.168.0.7
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 2
set protocols bgp group external neighbor 172.16.0.13 peer-as 2
set protocols ospf area 0.0.0.0 interface fe-1/2/1.18
set protocols ospf area 0.0.0.0 interface lo0.8 passive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options router-id 192.168.0.8
set routing-options autonomous-system 3
```

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 2]
user@R1# set description R1->R2
user@R1# set family inet address 10.0.0.1/30
[edit interfaces fe-1/2/1 unit 7]
user@R1# set description R1->R4
user@R1# set family inet address 172.16.0.1/30
[edit interfaces lo0 unit 1]
user@R1# set family inet address 192.168.0.1/32
```

2. Configure IBGP.

```
[edit protocols bgp group internal]
user@R1# set type internal
user@R1# set local-address 192.168.0.1
user@R1# set export send-direct
user@R1# set neighbor 192.168.0.2
user@R1# set neighbor 192.168.0.3
```

3. Configure EBGP.

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```
[edit protocols bgp group external]
user@R1# set type external
user@R1# set export send-direct
user@R1# set peer-as 2
user@R1# set neighbor 172.16.0.2
```

4. Associate the MED value with the IGP metric.

```
[edit protocols bgp group external]
user@R1# set metric-out igp delay-med-update
```

The default for the MED update is 10 minutes when you include the **delay-med-update** option. When you exclude the **delay-med-update** option, the MED update occurs immediately after the IGP metric changes.

5. (Optional) Configure the update interval for the MED update.

```
[edit routing-options]
user@R1# set med-igp-update-interval 12
```

You can configure the interval from 10 minutes through 600 minutes.

6. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/0.2 metric 600
user@R1# set interface lo0.1 passive
```

The **metric** statement is used here to demonstrate what happens when the IGP metric changes.

7. Configure a policy that accepts direct routes.

Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-direct term 1]
user@R1# set from protocol direct
user@R1# set then accept
```

8. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set router-id 192.168.0.1
user@R1# set autonomous-system 1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output

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does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 2 {
      description R1->R2;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
fe-1/2/1 {
   unit 7 {
      description R1->R4;
      family inet {
         address 172.16.0.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
```

```
user@R1# show protocols
bgp {
   group internal {
      type internal;
      local-address 192.168.0.1;
      export send-direct;
      neighbor 192.168.0.2;
      neighbor 192.168.0.3;
   }
   group external {
      type external;
      metric-out igp delay-med-update;
      export send-direct;
      peer-as 2;
      neighbor 172.16.0.2;
   }
}
ospf {
```


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```
    area 0.0.0.0 {
      interface fe-1/2/0.2 {
        metric 600;
      }
      interface lo0.1 {
        passive;
      }
    }
}
```

```
user@R1# show routing-options
med-igp-update-interval 12;
router-id 192.168.0.1;
autonomous-system 1;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration steps on the other devices in the topology, as needed for your network.

Verification

Confirm that the configuration is working properly.

- Checking the BGP Advertisements on page 295
- Verifying That the MED Value Changes When the OSPF Metric Changes on page 295
- Testing the minimum-igp Setting on page 296

Checking the BGP Advertisements

Purpose Verify that Device R1 is advertising to Device R4 a BGP MED value that reflects the IGP metric.

Action From operational mode, enter the **show route advertising-protocol bgp** command.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
* 172.16.0.4/30           Self                 601                I
* 192.168.0.1/32          Self                 0                  I
```

Meaning The 601 value in the MED column shows that the MED value has been updated to reflect the configured OSPF metric.

Verifying That the MED Value Changes When the OSPF Metric Changes

Purpose Make sure that when you raise the OSPF metric to 700, the MED value is updated to reflect this change.

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Action From configuration mode, enter the **set protocols ospf area 0 interface fe-1/2/0.2 metric 700** command.

```
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 700
user@R1# commit
```

After waiting 12 minutes (the configured delay period), enter the **show route advertising-protocol bgp** command from operational mode.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
* 172.16.0.4/30           Self                 701                I
* 192.168.0.1/32          Self                 0                  I
```

Meaning The 701 value in the MED column shows that the MED value has been updated to reflect the configured OSPF metric.

Testing the minimum-igp Setting

Purpose Change the configuration to use the **minimum-igp** statement instead of the **igp** statement. When you increase the OSPF metric, the MED value remains unchanged, but when you decrease the OSPF metric, the MED value reflects the new OSPF metric.

Action From configuration mode, delete the **igp** statement, add the **minimum-igp** statement, and increase the OSPF metric.

```
user@R1# delete protocols bgp group external metric-out igp
user@R1# set protocols bgp group external metric-out minimum-igp
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 800
user@R1# commit
```

From operational mode, enter the **show route advertising-protocol bgp** command to make sure that the MED value does not change.

```
user@R1> show route advertising-protocol bgp 172.16.0.2
inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
* 172.16.0.4/30           Self                 701                I
* 192.168.0.1/32          Self                 0                  I
```

From configuration mode, decrease the OSPF metric.

```
user@R1# set protocols ospf area 0 interface fe-1/2/0.2 metric 20
user@R1# commit
```


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From operational mode, enter the **show route advertising-protocol bgp** command to make sure that the MED value does change.

```
user@R1> show route advertising-protocol bgp 172.16.0.2

inet.0: 19 destinations, 33 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.0/30             Self                 0                  I
* 172.16.0.0/30           Self                 0                  I
* 172.16.0.4/30           Self                 21                 I
* 192.168.0.1/32          Self                 0                  I
```

Meaning When the **minimum-igp** statement is configured, the MED value changes only when a shorter path is available.

Related Documentation

- Understanding BGP Path Selection on page 14
- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

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CHAPTER 9

Configuring BGP Multihop Sessions

- Understanding EBGP Multihop on page 299
- Example: Configuring EBGP Multihop Sessions on page 300

Understanding EBGP Multihop

BGP is an exterior gateway protocol (EGP) that is used to exchange routing information among routers in different autonomous systems (ASs). The following are two ways of establishing EBGP multihop between routers:

1. When external BGP (EBGP) peers are not directly connected to each other, they must cross one or more non-BGP routers to reach each other.

Configuring multihop EBGP enables the peers to pass through the other routers to form peer relationships and exchange update messages. This type of configuration is typically used when a Juniper Networks routing device needs to run EBGP with a third-party router that does not allow direct connection of the two EBGP peers. EBGP multihop enables a neighbor connection between two EBGP peers that do not have a direct connection.

2. The default behavior for an EBGP connection is to peer over a single physical hop using the physical interface address of the peer. In some cases, it is advantageous to alter this default, one-hop, physical peering EBGP behavior. One such case is when multiple physical links connect two routers that are to be EBGP peers. In this case, if one of the point-to-point links fails, reachability on the alternate link still exists.

Figure 31: EBGP Multihop Peering

In figure 1, router R1 belongs to AS 1 and router R2 belongs to AS 2. The two physical links between the routers is used for load balancing. The EBGP multihop peering works with one physical link as well.

The following configuration example helps to establish a single BGP peering session across these multiple physical links:

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1. Each router must establish the peering session with the loopback address of the remote router. You can configure this session using the **local-address** statement, which alters the peer address header information in the BGP packets.

2. Use the **multihop** statement to alter the default use of the neighbor's physical address. In addition, you can also specify a time-to-live (TTL) value in the BGP packets to control how far they propagate. We use a TTL value of 1 to ensure that the session cannot be established across any other backdoor links in the network.

NOTE: When multihop is configured, the Junos OS sets the TTL value of 64, by default.

A TTL value of 1 is sufficient to enable an EBGP session to the loopback address of a directly connected neighbor.

3. Each router must have IP routing capability to the remote router's loopback address. This capability is often accomplished by using a static route to map the loopback address to the interface physical addresses.

```
[edit protocols bgp group ext-peers]
type external;
local-address 192.168.3.4;
neighbor 172.16.128.1 {
   multihop ttl 1;
   }
```

```
[edit routing-options]
static {
   route 172.16.128.1 next-hop (10.10.1.1 | 10.10.2.1);
   }
```

Related Documentation

- Example: Configuring EBGP Multihop Sessions on page 300
- *Example: Configuring EBGP Multihop Sessions on Logical Systems*

Example: Configuring EBGP Multihop Sessions

This example shows how to configure an external BGP (EBGP) peer that is more than one hop away from the local router. This type of session is called a *multihop* BGP session.

- Requirements on page 301
- Overview on page 301
- Configuration on page 301
- Verification on page 309

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Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

The configuration to enable multihop EBGP sessions requires connectivity between the two EBGP peers. This example uses static routes to provide connectivity between the devices.

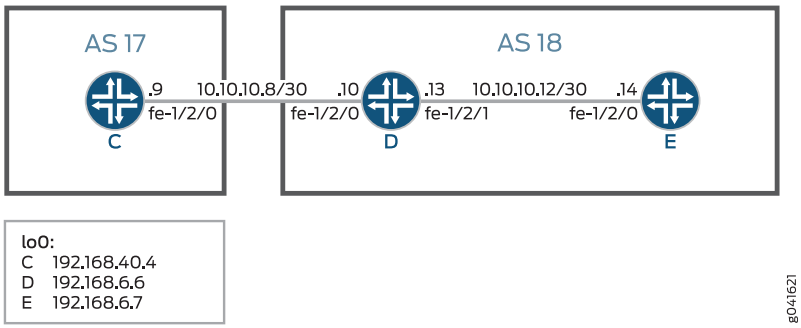
Unlike directly connected EBGP sessions in which physical address are typically used in the **neighbor** statements, you must use loopback interface addresses for multihop EBGP by specifying the loopback interface address of the indirectly connected peer. In this way, EBGP multihop is similar to internal BGP (IBGP).

Finally, you must add the multihop statement. Optionally, you can set a maximum time-to-live (TTL) value with the **ttl** statement. The TTL is carried in the IP header of BGP packets. If you do not specify a TTL value, the system's default maximum TTL value is used. The default TTL value is 64 for multihop EBGP sessions. Another option is to retain the BGP next-hop value for route advertisements by including the **no-nexthop-change** statement.

Figure 32 on page 301 shows a typical EBGP multihop network.

Device C and Device E have an established EBGP session. Device D is not a BGP-enabled device. All of the devices have connectivity via static routes.

Figure 32: Typical Network with EBGP Multihop Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device C

```
set interfaces fe-1/2/0 unit 9 description to-D
set interfaces fe-1/2/0 unit 9 family inet address 10.10.10.9/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
```

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```
set protocols bgp group external-peers type external
set protocols bgp group external-peers multihop ttl 2
set protocols bgp group external-peers local-address 192.168.40.4
set protocols bgp group external-peers export send-static
set protocols bgp group external-peers peer-as 18
set protocols bgp group external-peers neighbor 192.168.6.7
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.10.10.14/32 next-hop 10.10.10.10
set routing-options static route 192.168.6.7/32 next-hop 10.10.10.10
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Device D

```
set interfaces fe-1/2/0 unit 10 description to-C
set interfaces fe-1/2/0 unit 10 family inet address 10.10.10.10/30
set interfaces fe-1/2/1 unit 13 description to-E
set interfaces fe-1/2/1 unit 13 family inet address 10.10.10.13/30
set interfaces lo0 unit 4 family inet address 192.168.6.6/32
set routing-options static route 192.168.40.4/32 next-hop 10.10.10.9
set routing-options static route 192.168.6.7/32 next-hop 10.10.10.14
set routing-options router-id 192.168.6.6
```

Device E

```
set interfaces fe-1/2/0 unit 14 description to-D
set interfaces fe-1/2/0 unit 14 family inet address 10.10.10.14/30
set interfaces lo0 unit 5 family inet address 192.168.6.7/32
set protocols bgp group external-peers multihop ttl 2
set protocols bgp group external-peers local-address 192.168.6.7
set protocols bgp group external-peers export send-static
set protocols bgp group external-peers peer-as 17
set protocols bgp group external-peers neighbor 192.168.40.4
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 10.10.10.8/30 next-hop 10.10.10.13
set routing-options static route 192.168.40.4/32 next-hop 10.10.10.13
set routing-options router-id 192.168.6.7
set routing-options autonomous-system 18
```

Device C

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device C:

1. Configure the interface to the directly connected device (to-D), and configure the loopback interface.

```
[edit interfaces fe-1/2/0 unit 9]
user@C# set description to-D
```


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```
user@C# set family inet address 10.10.10.9/30
[edit interfaces lo0 unit 3]
user@C# set family inet address 192.168.40.4/32
```

2. Configure an EBGP session with Device E.

   The **neighbor** statement points to the loopback interface on Device E.

```
[edit protocols bgp group external-peers]
user@C# set type external
user@C# set local-address 192.168.40.4
user@C# set export send-static
user@C# set peer-as 18
user@C# set neighbor 192.168.6.7
```

3. Configure the multihop statement to enable Device C and Device E to become EBGP peers.

   Because the peers are two hops away from each other, the example uses the **ttl 2** statement.

```
[edit protocols bgp group external-peers]
user@C# set multihop ttl 2
```

4. Configure connectivity to Device E, using static routes.

   You must configure a route to both the loopback interface address and to the address on the physical interface.

```
[edit routing-options]
user@C# set static route 10.10.10.14/32 next-hop 10.10.10.10
user@C# set static route 192.168.6.7/32 next-hop 10.10.10.10
```

5. Configure the local router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@C# set router-id 192.168.40.4
user@C# set autonomous-system 17
```

6. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-static term 1]
user@C# set from protocol static
user@C# set then accept
```

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Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@C# show interfaces
fe-1/2/0 {
   unit 9 {
      description to-D;
      family inet {
         address 10.10.10.9/30;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 192.168.40.4/32;
      }
   }
}
```

```
user@C# show protocols
bgp {
   group external-peers {
      type external;
      multihop {
         ttl 2;
      }
      local-address 192.168.40.4;
      export send-static;
      peer-as 18;
      neighbor 192.168.6.7;
   }
}
```

```
user@C# show policy-options
policy-statement send-static {
   term 1 {
      from protocol static;
      then accept;
   }
}
```

```
user@C# show routing-options
static {
   route 10.10.10.14/32 next-hop 10.10.10.10;
   route 192.168.6.7/32 next-hop 10.10.10.10;
}
router-id 192.168.40.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Repeat these steps for all BFD sessions in the topology.

Configuring Device D

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device D:

1. Set the CLI to Device D.

```
user@host> set cli logical-system D
```

2. Configure the interfaces to the directly connected devices, and configure a loopback interface.

```
[edit interfaces fe-1/2/0 unit 10]
user@D# set description to-C
user@D# set family inet address 10.10.10.10/30
[edit interfaces fe-1/2/1 unit 13]
user@D# set description to-E
user@D# set family inet address 10.10.10.13/30
[edit interfaces lo0 unit 4]
user@D# set family inet address 192.168.6.6/32
```

3. Configure connectivity to the other devices using static routes to the loopback interface addresses.

   On Device D, you do not need static routes to the physical addresses because Device D is directly connected to Device C and Device E.

```
[edit routing-options]
user@D# set static route 192.168.40.4/32 next-hop 10.10.10.9
user@D# set static route 192.168.6.7/32 next-hop 10.10.10.14
```

4. Configure the local router ID.

```
[edit routing-options]
user@D# set router-id 192.168.6.6
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@D# show interfaces
fe-1/2/0 {
    unit 10 {
```

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```
    description to-C;
    family inet {
      address 10.10.10.10/30;
    }
  }
}
fe-1/2/1 {
  unit 13 {
    description to-E;
    family inet {
      address 10.10.10.13/30;
    }
  }
}
lo0 {
  unit 4 {
    family inet {
      address 192.168.6.6/32;
    }
  }
}
```

```
user@D# show protocols
```

```
user@D# show routing-options
static {
  route 192.168.40.4/32 next-hop 10.10.10.9;
  route 192.168.6.7/32 next-hop 10.10.10.14;
}
router-id 192.168.6.6;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps for all BFD sessions in the topology.

Configuring Device E

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device E:

1. Set the CLI to Device E.

   ```
   user@host> set cli logical-system E
   ```

2. Configure the interface to the directly connected device (to-D), and configure the loopback interface.

   ```
   [edit interfaces fe-1/2/0 unit 14]
   user@E# set description to-D
   ```


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```
user@E# set family inet address 10.10.10.14/30
[edit interfaces lo0 unit 5]
user@E# set family inet address 192.168.6.7/32
```

3. Configure an EBGP session with Device E.

   The **neighbor** statement points to the loopback interface on Device C.

```
[edit protocols bgp group external-peers]
user@E# set local-address 192.168.6.7
user@E# set export send-static
user@E# set peer-as 17
user@E# set neighbor 192.168.40.4
```

4. Configure the **multihop** statement to enable Device C and Device E to become EBGP peers.

   Because the peers are two hops away from each other, the example uses the **ttl 2** statement.

```
[edit protocols bgp group external-peers]
user@E# set multihop ttl 2
```

5. Configure connectivity to Device E, using static routes.

   You must configure a route to both the loopback interface address and to the address on the physical interface.

```
[edit routing-options]
user@E# set static route 10.10.10.8/30 next-hop 10.10.10.13
user@E# set static route 192.168.40.4/32 next-hop 10.10.10.13
```

6. Configure the local router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@E# set router-id 192.168.6.7
user@E# set autonomous-system 18
```

7. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

```
[edit policy-options policy-statement send-static term 1]
user@E# set from protocol static
user@E# set then accept
```

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Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@E# show interfaces
fe-1/2/0 {
   unit 14 {
      description to-D;
      family inet {
         address 10.10.10.14/30;
      }
   }
}
lo0 {
   unit 5 {
      family inet {
         address 192.168.6.7/32;
      }
   }
}
```

```
user@E# show protocols
bgp {
   group external-peers {
      multihop {
         ttl 2;
      }
      local-address 192.168.6.7;
      export send-static;
      peer-as 17;
      neighbor 192.168.40.4;
   }
}
```

```
user@E# show policy-options
policy-statement send-static {
   term 1 {
      from protocol static;
      then accept;
   }
}
```

```
user@E# show routing-options
static {
   route 10.10.10.8/30 next-hop 10.10.10.13;
   route 192.168.40.4/32 next-hop 10.10.10.13;
}
router-id 192.168.6.7;
autonomous-system 18;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Verifying Connectivity on page 309
- Verifying That BGP Sessions Are Established on page 309
- Viewing Advertised Routes on page 310

Verifying Connectivity

Purpose Make sure that Device C can ping Device E, specifying the loopback interface address as the source of the ping request.

The loopback interface address is the source address that BGP will use.

Action From operational mode, enter the **ping 10.10.10.14 source 192.168.40.4** command from Device C, and enter the **ping 10.10.10.9 source 192.168.6.7** command from Device E.

```
user@C> ping 10.10.10.14 source 192.168.40.4

PING 10.10.10.14 (10.10.10.14): 56 data bytes
64 bytes from 10.10.10.14: icmp_seq=0 ttl=63 time=1.262 ms
64 bytes from 10.10.10.14: icmp_seq=1 ttl=63 time=1.202 ms
^C
--- 10.10.10.14 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.202/1.232/1.262/0.030 ms
```

```
user@E> ping 10.10.10.9 source 192.168.6.7

PING 10.10.10.9 (10.10.10.9): 56 data bytes
64 bytes from 10.10.10.9: icmp_seq=0 ttl=63 time=1.255 ms
64 bytes from 10.10.10.9: icmp_seq=1 ttl=63 time=1.158 ms
^C
--- 10.10.10.9 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max/stddev = 1.158/1.206/1.255/0.049 ms
```

Meaning The static routes are working if the pings work.

Verifying That BGP Sessions Are Established

Purpose Verify that the BGP sessions are up.

Action From operational mode, enter the show bgp summary command.

```
user@C> show bgp summary
```

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```
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 2          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.6.7              18        147        147       0       1     1:04:27
0/2/2/0              0/0/0/0
```

user@E> **show bgp summary**

```
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 2          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.168.40.4             17        202        202       0       1     1:02:18
0/2/2/0              0/0/0/0
```

Meaning The output shows that both devices have one peer each. No peers are down.

Viewing Advertised Routes

Purpose Check to make sure that routes are being advertised by BGP.

Action From operational mode, enter the show route advertising-protocol **bgp *neighbor*** command.

user@E> **show route advertising-protocol bgp 192.168.6.7**

```
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.10.10.14/32          Self                                    I
* 192.168.6.7/32          Self                                    I
```

user@C> **show route advertising-protocol bgp 192.168.40.4**

```
inet.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.10.10.8/30           Self                                    I
* 192.168.40.4/32         Self                                    I
```

Meaning The **send-static** routing policy is exporting the static routes from the routing table into BGP. BGP is advertising these routes between the peers because the BGP peer session is established.

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Related Documentation

- Understanding EBGP Multihop on page 299
- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

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PART 5

Configuring BGP Session Policies

- Configuring Basic Routing Policies for BGP Sessions on page 315
- Defining Routing Policies for BGP Communities on page 373

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CHAPTER 10

Configuring Basic Routing Policies for BGP Sessions

- Understanding Routing Policies on page 315
- Example: Applying Routing Policies at Different Levels of the BGP Hierarchy on page 316
- Example: Injecting OSPF Routes into the BGP Routing Table on page 325
- Configuring Routing Policies to Control BGP Route Advertisements on page 328
- Example: Configuring a Routing Policy to Advertise the Best External Route to Internal Peers on page 333
- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 342
- Understanding the Default BGP Routing Policy on Packet Transport Routers on page 346
- Example: Overriding the Default BGP Routing Policy on PTX Series Packet Transport Routers on page 348
- Conditional Advertisement Enabling Conditional Installation of Prefixes Use Cases on page 351
- Conditional Advertisement and Import Policy (Routing Table) with certain match conditions on page 353
- Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table on page 355

Understanding Routing Policies

Each routing policy is identified by a policy name. The name can contain letters, numbers, and hyphens (-) and can be up to 255 characters long. To include spaces in the name, enclose the entire name in double quotation marks. Each routing policy name must be unique within a configuration.

Once a policy is created and named, it must be applied before it is active. You apply routing policies using the **import** and **export** statements at the **protocols>*protocol-name*** level in the configuration hierarchy.

In the **import** statement, you list the name of the routing policy to be evaluated when routes are imported into the routing table from the routing protocol.

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In the **export** statement, you list the name of the routing policy to be evaluated when routes are being exported from the routing table into a dynamic routing protocol. Only active routes are exported from the routing table.

To specify more than one policy and create a policy chain, you list the policies using a space as a separator. If multiple policies are specified, the policies are evaluated in the order in which they are specified. As soon as an accept or reject action is executed, the policy chain evaluation ends.

Related Documentation

- Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS on page 375
- *Example: Configuring a Global Policy with No Zone Restrictions*

Example: Applying Routing Policies at Different Levels of the BGP Hierarchy

This example shows BGP configured in a simple network topology and explains how routing polices take effect when they are applied at different levels of the BGP configuration.

- Requirements on page 316
- Overview on page 316
- Configuration on page 318
- Verification on page 322

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

For BGP, you can apply policies as follows:

- BGP global **import** and **export** statements—Include these statements at the **[edit protocols bgp]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp]** hierarchy level).
- Group **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name*]** hierarchy level).
- Peer **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]** hierarchy level).

A peer-level **import** or **export** statement overrides a group **import** or **export** statement. A group-level **import** or **export** statement overrides a global BGP **import** or **export** statement.

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In this example, a policy named **send-direct** is applied at the global level, another policy named **send-192.168.0.1** is applied at the group level, and a third policy named **send-192.168.20.1** is applied at the neighbor level.

```
user@host# show protocols
bgp {
   local-address 172.16.1.1;
   export send-direct;
   group internal-peers {
      type internal;
      export send-192.168.0.1;
      neighbor 172.16.2.2 {
         export send-192.168.20.1;
      }
      neighbor 172.16.3.3;
   }
   group other-group {
      type internal;
      neighbor 172.16.4.4;
   }
}
```

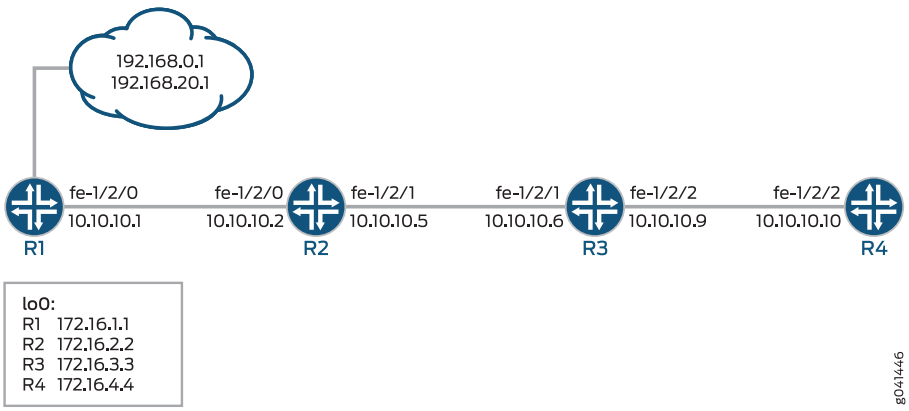
A key point, and one that is often misunderstood and that can lead to problems, is that in such a configuration, only the most explicit policy is applied. A neighbor-level policy is more explicit than a group-level policy, which in turn is more explicit than a global policy.

The neighbor 172.16.2.2 is subjected only to the send-192.168.20.1 policy. The neighbor 172.16.3.3, lacking anything more specific, is subjected only to the send-192.168.0.1 policy. Meanwhile, neighbor 172.16.4.4 in group other-group has no group or neighbor-level policy, so it uses the send-direct policy.

If you need to have neighbor 172.16.2.2 perform the function of all three policies, you can write and apply a new neighbor-level policy that encompasses the functions of the other three, or you can apply all three existing policies, as a chain, to neighbor 172.16.2.2.

Figure 33 on page 317 shows the sample network.

Figure 33: Applying Routing Policies to BGP



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"CLI Quick Configuration" on page 318 shows the configuration for all of the devices in Figure 33 on page 317.

The section "Step-by-Step Procedure" on page 319 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 description to-R2
set interfaces fe-1/2/0 unit 0 family inet address 10.10.10.1/30
set interfaces lo0 unit 0 family inet address 172.16.1.1/32
set protocols bgp local-address 172.16.1.1
set protocols bgp export send-direct
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers export send-static-192.168.0
set protocols bgp group internal-peers neighbor 172.16.2.2 export send-static-192.168.20
set protocols bgp group internal-peers neighbor 172.16.3.3
set protocols bgp group other-group type internal
set protocols bgp group other-group neighbor 172.16.4.4
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.0
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static-192.168.0 term 1 from protocol static
set policy-options policy-statement send-static-192.168.0 term 1 from route-filter
  192.168.0.0/24 orlonger
set policy-options policy-statement send-static-192.168.0 term 1 then accept
set policy-options policy-statement send-static-192.168.20 term 1 from protocol static
set policy-options policy-statement send-static-192.168.20 term 1 from route-filter
  192.168.20.0/24 orlonger
set policy-options policy-statement send-static-192.168.20 term 1 then accept
set routing-options static route 192.168.0.1/32 discard
set routing-options static route 192.168.20.1/32 discard
set routing-options router-id 172.16.1.1
set routing-options autonomous-system 17
```

Device R2

```
set interfaces fe-1/2/0 unit 0 description to-R1
set interfaces fe-1/2/0 unit 0 family inet address 10.10.10.2/30
set interfaces fe-1/2/1 unit 0 description to-R3
set interfaces fe-1/2/1 unit 0 family inet address 10.10.10.5/30
set interfaces lo0 unit 0 family inet address 172.16.2.2/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 172.16.2.2
set protocols bgp group internal-peers neighbor 172.16.3.3
set protocols bgp group internal-peers neighbor 172.16.1.1
set protocols bgp group internal-peers neighbor 172.16.4.4
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.0
```


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```
set protocols ospf area 0.0.0.0 interface fe-1/2/1.0
set routing-options router-id 172.16.2.2
set routing-options autonomous-system 17
```

Device R3

```
set interfaces fe-1/2/1 unit 0 description to-R2
set interfaces fe-1/2/1 unit 0 family inet address 10.10.10.6/30
set interfaces fe-1/2/2 unit 0 description to-R4
set interfaces fe-1/2/2 unit 0 family inet address 10.10.10.9/30
set interfaces lo0 unit 0 family inet address 172.16.3.3/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 172.16.3.3
set protocols bgp group internal-peers neighbor 172.16.2.2
set protocols bgp group internal-peers neighbor 172.16.1.1
set protocols bgp group internal-peers neighbor 172.16.4.4
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/1.0
set protocols ospf area 0.0.0.0 interface fe-1/2/2.0
set routing-options router-id 172.16.3.3
set routing-options autonomous-system 17
```

Device R4

```
set interfaces fe-1/2/2 unit 0 description to-R3
set interfaces fe-1/2/2 unit 0 family inet address 10.10.10.10/30
set interfaces lo0 unit 0 family inet address 172.16.4.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 172.16.4.4
set protocols bgp group internal-peers neighbor 172.16.2.2
set protocols bgp group internal-peers neighbor 172.16.1.1
set protocols bgp group internal-peers neighbor 172.16.3.3
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/2.0
set routing-options router-id 172.16.4.4
set routing-options autonomous-system 17
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure an IS-IS default route policy:

1. Configure the device interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 0 description to-R2
user@R1# set fe-1/2/0 unit 0 family inet address 10.10.10.1/30
user@R1# set lo0 unit 0 family inet address 172.16.1.1/32
```

2. Enable OSPF, or another interior gateway protocols (IGP), on the interfaces.

```
[edit protocols OSPF area 0.0.0.0]
```

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```
user@R1# set interface lo0.0 passive
user@R1# set interface fe-1/2/0.0
```

3. Configure static routes.

```
[edit routing-options]
user@R1# set static route 192.168.0.1/32 discard
user@R1# set static route 192.168.20.1/32 discard
```

4. Enable the routing policies.

```
[edit protocols policy-options]
user@R1# set policy-statement send-direct term 1 from protocol direct
user@R1# set policy-statement send-direct term 1 then accept
user@R1# set policy-statement send-static-192.168.0 term 1 from protocol static
user@R1# set policy-statement send-static-192.168.0 term 1 from route-filter
  192.168.0.0/24 orlonger
user@R1# set policy-statement send-static-192.168.0 term 1 then accept
user@R1# set policy-statement send-static-192.168.20 term 1 from protocol static
user@R1# set policy-statement send-static-192.168.20 term 1 from route-filter
  192.168.20.0/24 orlonger
user@R1# set policy-statement send-static-192.168.20 term 1 then accept
```

5. Configure BGP and apply the export policies.

```
[edit protocols bgp]
user@R1# set local-address 172.16.1.1
user@R1# set group internal-peers type internal
user@R1# set group internal-peers export send-static-192.168.0
user@R1# set group internal-peers neighbor 172.16.2.2 export send-static-192.168.20
user@R1# set group internal-peers neighbor 172.16.3.3
user@R1# set group other-group type internal
user@R1# set group other-group neighbor 172.16.4.4
```

6. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R1# set router-id 172.16.1.1
user@R1# set autonomous-system 17
```

7. If you are done configuring the device, commit the configuration.

```
[edit]
user@R1# commit
```


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Results

From configuration mode, confirm your configuration by issuing the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 0 {
      description to-R2;
      family inet {
         address 10.10.10.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 172.16.1.1/32;
      }
   }
}
```

```
user@R1# show protocols
bgp {
   local-address 172.16.1.1;
   export send-direct;
   group internal-peers {
      type internal;
      export send-static-192.168.0;
      neighbor 172.16.2.2 {
         export send-static-192.168.20;
      }
      neighbor 172.16.3.3;
   }
   group other-group {
      type internal;
      neighbor 172.16.4.4;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.0 {
         passive;
      }
      interface fe-1/2/0.0;
   }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
   term 1 {
```

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```
      from protocol direct;
      then accept;
    }
}
policy-statement send-static-192.168.0 {
    term 1 {
      from {
        protocol static;
        route-filter 192.168.0.0/24 orlonger;
      }
      then accept;
    }
}
policy-statement send-static-192.168.20 {
    term 1 {
      from {
        protocol static;
        route-filter 192.168.20.0/24 orlonger;
      }
      then accept;
    }
}
```

```
user@R1# show routing-options
static {
    route 192.168.0.1/32 discard;
    route 192.168.20.1/32 discard;
}
router-id 172.16.1.1;
autonomous-system 17;
```

Verification

Confirm that the configuration is working properly.

- Verifying BGP Route Learning on page 322
- Verifying BGP Route Receiving on page 324

Verifying BGP Route Learning

Purpose Make sure that the BGP export policies are working as expected by checking the routing tables.

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Action

```
user@R1> show route protocol direct

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.1.1/32         *[Direct/0] 1d 22:19:47
                       > via lo0.0
10.10.10.0/30        *[Direct/0] 1d 22:19:47
                       > via fe-1/2/0.0
```

```
user@R1> show route protocol static

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.0.1/32     *[Static/5] 02:20:03
                      Discard
192.168.20.1/32    *[Static/5] 02:20:03
                      Discard
```

```
user@R2> show route protocol bgp
inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.20.1/32    *[BGP/170] 02:02:40, localpref 100, from 172.16.1.1
                      AS path: I, validation-state: unverified
                     > to 10.10.10.1 via fe-1/2/0.0
```

```
user@R3> show route protocol bgp
inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.0.1/32     *[BGP/170] 02:02:51, localpref 100, from 172.16.1.1
                      AS path: I, validation-state: unverified
                     > to 10.10.10.5 via fe-1/2/1.0
```

```
user@R4> show route protocol bgp
inet.0: 9 destinations, 11 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.1.1/32          [BGP/170] 1d 20:38:54, localpref 100, from 172.16.1.1
                      AS path: I, validation-state: unverified
                     > to 10.10.10.9 via fe-1/2/2.0
10.10.10.0/30        [BGP/170] 1d 20:38:54, localpref 100, from 172.16.1.1
                      AS path: I, validation-state: unverified
                     > to 10.10.10.9 via fe-1/2/2.0
```

Meaning On Device R1, the **show route protocol direct** command displays two direct routes: 172.16.1.1/32 and 10.10.10.0/30. The **show route protocol static** command displays two static routes: 192.168.0.1/32 and 192.168.20.1/32.

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On Device R2, the **show route protocol bgp** command shows that the only route that Device R2 has learned through BGP is the 192.168.20.1/32 route.

On Device R3, the **show route protocol bgp** command shows that the only route that Device R3 has learned through BGP is the 192.168.0.1/32 route.

On Device R4, the **show route protocol bgp** command shows that the only routes that Device R4 has learned through BGP are the 172.16.1.1/32 and 10.10.10.0/30 routes.

Verifying BGP Route Receiving

Purpose Make sure that the BGP export policies are working as expected by checking the BGP routes received from Device R1.

Action

```
user@R2> show route receive-protocol bgp 172.16.1.1

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 192.168.20.1/32         172.16.1.1                      100        I
```

```
user@R3> show route receive-protocol bgp 172.16.1.1

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 192.168.0.1/32          172.16.1.1                      100        I
```

```
user@R4> show route receive-protocol bgp 172.16.1.1

inet.0: 9 destinations, 11 routes (9 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
  172.16.1.1/32              172.16.1.1                      100        I
  10.10.10.0/30           172.16.1.1                      100        I
```

Meaning On Device R2, the **route receive-protocol bgp 172.16.1.1** command shows that Device R2 received only one BGP route, 192.168.20.1/32, from Device R1.

On Device R3, the **route receive-protocol bgp 172.16.1.1** command shows that Device R3 received only one BGP route, 192.168.0.1/32, from Device R1.

On Device R4, the **route receive-protocol bgp 172.16.1.1** command shows that Device R4 received two BGP routes, 172.16.1.1/32 and 10.10.10.0/30, from Device R1.

In summary, when multiple policies are applied at different CLI hierarchies in BGP, only the most specific application is evaluated, to the exclusion of other, less specific policy applications. Although this point might seem to make sense, it is easily forgotten during router configuration, when you mistakenly believe that a neighbor-level policy is combined

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with a global or group-level policy, only to find that your policy behavior is not as anticipated.

Related Documentation

- *Example: Configuring Policy Chains and Route Filters*
- *Example: Configuring a Policy Subroutine*
- *Example: Configuring Routing Policy Prefix Lists*
- export on page 1163
- import on page 1204

Example: Injecting OSPF Routes into the BGP Routing Table

This example shows how to create a policy that injects OSPF routes into the BGP routing table.

- Requirements on page 325
- Overview on page 325
- Configuration on page 325
- Verification on page 328
- Troubleshooting on page 328

Requirements

Before you begin:

- Configure network interfaces.
- Configure external peer sessions. See "Example: Configuring External BGP Point-to-Point Peer Sessions" on page 24.
- Configure interior gateway protocol (IGP) sessions between peers.

Overview

In this example, you create a routing policy called **injectpolicy1** and a routing term called **injectterm1**. The policy injects OSPF routes into the BGP routing table.

Configuration

- Configuring the Routing Policy on page 325
- Configuring Tracing for the Routing Policy on page 327

Configuring the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the [edit] hierarchy level, and then enter **commit** from configuration mode.

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```
set policy-options policy-statement injectpolicy1 term injectterm1 from protocol ospf
set policy-options policy-statement injectpolicy1 term injectterm1 from area 0.0.0.1
set policy-options policy-statement injectpolicy1 term injectterm1 then accept
set protocols bgp export injectpolicy1
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To inject OSPF routes into a BGP routing table:

1. Create the policy term.

```
[edit policy-options policy-statement injectpolicy1]
user@host# set term injectterm1
```

2. Specify OSPF as a match condition.

```
[edit policy-options policy-statement injectpolicy1 term injectterm1]
user@host# set from protocol ospf
```

3. Specify the routes from an OSPF area as a match condition.

```
[edit policy-options policy-statement injectpolicy1 term injectterm1]
user@host# set from area 0.0.0.1
```

4. Specify that the route is to be accepted if the previous conditions are matched.

```
[edit policy-options policy-statement injectpolicy1 term injectterm1]
user@host# set then accept
```

5. Apply the routing policy to BGP.

```
[edit]
user@host# set protocols bgp export injectpolicy1
```

Results

Confirm your configuration by entering the **show policy-options** and **show protocols bgp** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
   term injectterm1 {
      from {
         protocol ospf;
```


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```
        area 0.0.0.1;
      }
      then accept;
    }
}
```

```
user@host# show protocols bgp
export injectpolicy1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Tracing for the Routing Policy

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the [edit] hierarchy level, and then enter **commit** from configuration mode.

```
set policy-options policy-statement injectpolicy1 term injectterm1 then trace
set routing-options traceoptions file ospf-bgp-policy-log
set routing-options traceoptions file size 5m
set routing-options traceoptions file files 5
set routing-options traceoptions flag policy
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Include a trace action in the policy.

```
[edit policy-options policy-statement injectpolicy1 term injectterm1]
user@host# then trace
```

2. Configure the tracing file for the output.

```
[edit routing-options traceoptions]
user@host# set file ospf-bgp-policy-log
user@host# set file size 5m
user@host# set file files 5
user@host# set flag policy
```

Results

Confirm your configuration by entering the **show policy-options** and **show routing-options** commands from configuration mode. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
policy-statement injectpolicy1 {
```

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```
    term injectterm1 {
      then {
        trace;
      }
    }
}
```

```
user@host# show routing-options
traceoptions {
  file ospf-bgp-policy-log size 5m files 5;
  flag policy;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Expected BGP Routes Are Present

Purpose Verify the effect of the export policy.

Action From operational mode, enter the **show route** command.

Troubleshooting

- Using the show log Command to Examine the Actions of the Routing Policy on page 328

Using the show log Command to Examine the Actions of the Routing Policy

Problem The routing table contains unexpected routes, or routes are missing from the routing table.

Solution If you configure policy tracing as shown in this example, you can run the **show log ospf-bgp-policy-log** command to diagnose problems with the routing policy. The **show log ospf-bgp-policy-log** command displays information about the routes that the **injectpolicy1** policy term analyzes and acts upon.

Related Documentation

- Understanding Routing Policies on page 315

Configuring Routing Policies to Control BGP Route Advertisements

All routing protocols use the Junos OS routing table to store the routes that they learn and to determine which routes they should advertise in their protocol packets. Routing policy allows you to control which routes the routing protocols store in and retrieve from

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the routing table. For information about routing policy, see the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*.

When configuring BGP routing policy, you can perform the following tasks:

- Applying Routing Policy on page 329
- Setting BGP to Advertise Inactive Routes on page 330
- Configuring BGP to Advertise the Best External Route to Internal Peers on page 330
- Configuring How Often BGP Exchanges Routes with the Routing Table on page 331
- Disabling Suppression of Route Advertisements on page 332

Applying Routing Policy

You define routing policy at the **[edit policy-options]** hierarchy level. To apply policies you have defined for BGP, include the **import** and **export** statements within the BGP configuration.

You can apply policies as follows:

- BGP global **import** and **export** statements—Include these statements at the **[edit protocols bgp]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp]** hierarchy level).
- Group **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name*]** hierarchy level).
- Peer **import** and **export** statements—Include these statements at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level (for routing instances, include these statements at the **[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]** hierarchy level).

A peer-level **import** or **export** statement overrides a group **import** or **export** statement. A group-level **import** or **export** statement overrides a global BGP **import** or **export** statement.

To apply policies, see the following sections:

- Applying Policies to Routes Being Imported into the Routing Table from BGP on page 329
- Applying Policies to Routes Being Exported from the Routing Table into BGP on page 330

Applying Policies to Routes Being Imported into the Routing Table from BGP

To apply policy to routes being imported into the routing table from BGP, include the **import** statement, listing the names of one or more policies to be evaluated:

```
import [ policy-names ];
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

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If you specify more than one policy, they are evaluated in the order specified, from first to last, and the first matching filter is applied to the route. If no match is found, BGP places into the routing table only those routes that were learned from BGP routing devices.

Applying Policies to Routes Being Exported from the Routing Table into BGP

To apply policy to routes being exported from the routing table into BGP, include the **export** statement, listing the names of one or more policies to be evaluated:

```
export [ policy-names ];
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

If you specify more than one policy, they are evaluated in the order specified, from first to last, and the first matching filter is applied to the route. If no routes match the filters, the routing table exports into BGP only the routes that it learned from BGP.

Setting BGP to Advertise Inactive Routes

By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. To have the routing table export to BGP the best route learned by BGP even if Junos OS did not select it to be an active route, include the **advertise-inactive** statement:

```
advertise-inactive;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Configuring BGP to Advertise the Best External Route to Internal Peers

In general, deployed BGP implementations do not advertise the external route with the highest local preference value to internal peers unless it is the best route. Although this behavior was required by an earlier version of the BGP version 4 specification, RFC 1771, it was typically not followed in order to minimize the amount of advertised information and to prevent routing loops. However, there are scenarios in which advertising the best external route is beneficial, in particular, situations that can result in IBGP route oscillation.

In Junos OS Release 9.3 and later, you can configure BGP to advertise the best external route into an internal BGP (IBGP) mesh group, a route reflector cluster, or an autonomous system (AS) confederation, even when the best route is an internal route.

NOTE: **In order to configure the advertise-external statement on a route reflector, you must disable intracluster reflection with the no-client-reflect statement.**

When a routing device is configured as a route reflector for a cluster, a route advertised by the route reflector is considered internal if it is received from an internal peer with the

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same cluster identifier or if both peers have no cluster identifier configured. A route received from an internal peer that belongs to another cluster, that is, with a different cluster identifier, is considered external.

In a confederation, when advertising a route to a confederation border router, any route from a different confederation sub-AS is considered external.

You can also configure BGP to advertise the external route only if the route selection process reaches the point where the multiple exit discriminator (MED) metric is evaluated. As a result, an external route with an AS path worse (that is, longer) than that of the active path is not advertised.

Junos OS also provides support for configuring a BGP export policy that matches on the state of an advertised route. You can match on either active or inactive routes. For more information, see the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*.

To configure BGP to advertise the best external path to internal peers, include the **advertise-external** statement:

```
advertise-external;
```

NOTE: The advertise-external statement is supported at both the group and neighbor level. If you configure the statement at the neighbor level, you must configure it for all neighbors in a group. Otherwise, the group is automatically split into different groups.

For a complete list of hierarchy levels at which you can configure this statement, see the statement summary section for this statement.

To configure BGP to advertise the best external path only if the route selection process reaches the point where the MED value is evaluated, include the **conditional** statement:

```
advertise-external {
  conditional;
}
```

Configuring How Often BGP Exchanges Routes with the Routing Table

BGP stores the route information it receives from update messages in the routing table, and the routing table exports active routes from the routing table into BGP. BGP then advertises the exported routes to its peers. By default, the exchange of route information between BGP and the routing table occurs immediately after the routes are received. This immediate exchange of route information might cause instabilities in the network reachability information. To guard against this, you can delay the time between when BGP and the routing table exchange route information.

To configure how often BGP and the routing table exchange route information, include the **out-delay** statement:

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```
out-delay seconds;
```

By default, the routing table retains some of the route information learned from BGP. To have the routing table retain all or none of this information, include the **keep** statement:

```
keep (all | none);
```

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

The routing table can retain the route information learned from BGP in one of the following ways:

- Default (omit the **keep** statement)—Keep all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.
- **keep all**—Keep all route information that was learned from BGP.
- **keep none**—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking, such as AS path or next hop. When you configure **keep none** for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

In an AS path healing situation, routes with looped paths theoretically could become usable during a soft reconfiguration when the AS path loop limit is changed. However, there is a significant memory usage difference between the default and **keep all**.

Consider the following scenarios:

- A peer readvertises routes back to the peer from which it learned them.

  This can happen in the following cases:

  - Another vendor's routing device advertises the routes back to the sending peer.
  - The Junos OS peer's default behavior of not readvertising routes back to the sending peer is overridden by configuring **advertise-peer-as**.

- A provider edge (PE) routing device discards any VPN route that does not have any of the expected route targets.

When **keep all** is configured, the behavior of discarding routes received in the above scenarios is overridden.

Disabling Suppression of Route Advertisements

Junos OS does not advertise the routes learned from one EBGP peer back to the same external BGP (EBGP) peer. In addition, the software does not advertise those routes back to any EBGP peers that are in the same AS as the originating peer, regardless of the routing instance. You can modify this behavior by including the **advertise-peer-as** statement in the configuration. To disable the default advertisement suppression, include the **advertise-peer-as** statement:

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```
advertise-peer-as;
```

NOTE: The route suppression default behavior is disabled if the **as-override** statement is included in the configuration.

If you include the **advertise-peer-as** statement in the configuration, BGP advertises the route regardless of this check.

To restore the default behavior, include the **no-advertise-peer-as** statement in the configuration:

```
no-advertise-peer-as;
```

If you include both the as-override and **no-advertise-peer-as** statements in the configuration, the **no-advertise-peer-as** statement is ignored. You can include these statements at multiple hierarchy levels.

For a list of hierarchy levels at which you can include these statements, see the statement summary section for these statements.

Related Documentation

- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 342

Example: Configuring a Routing Policy to Advertise the Best External Route to Internal Peers

The BGP protocol specification, as defined in RFC 1771, specifies that a BGP peer shall advertise to its internal peers the higher preference external path, even if this path is not the overall best (in other words, even if the best path is an internal path). In practice, deployed BGP implementations do not follow this rule. The reasons for deviating from the specification are as follows:

- Minimizing the amount of advertised information. BGP scales according to the number of available paths.
- Avoiding routing and forwarding loops.

There are, however, several scenarios in which the behavior, specified in RFC 1771, of advertising the best external route might be beneficial. Limiting path information is not always desirable as path diversity might help reduce restoration times. Advertising the best external path can also address internal BGP (IBGP) route oscillation issues as described in RFC 3345, *Border Gateway Protocol (BGP) Persistent Route Oscillation Condition*.

The advertise-external statement modifies the behavior of a BGP speaker to advertise the best external path to IBGP peers, even when the best overall path is an internal path.

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NOTE: The **advertise-external** statement is supported at both the group and neighbor level. If you configure the statement at the neighbor level, you must configure it for all neighbors in a group. Otherwise, the group is automatically split into different groups.

The **conditional** option limits the behavior of the **advertise-external** setting, such that the external route is advertised only if the route selection process reaches the point where the multiple exit discriminator (MED) metric is evaluated. Thus, an external route is not advertised if it has, for instance, an AS path that is worse (longer) than that of the active path. The **conditional** option restricts external path advertisement to when the best external path and the active path are equal until the MED step of the route selection process. Note that the criteria used for selecting the best external path is the same whether or not the **conditional** option is configured.

Junos OS also provides support for configuring a BGP export policy that matches the state of an advertised route. You can match either active or inactive routes, as follows:

```
policy-options {
  policy-statement name{
    from state (active|inactive);
  }
}
```

This qualifier only matches when used in the context of an export policy. When a route is being advertised by a protocol that can advertise inactive routes (such as BGP), **state inactive** matches routes advertised as a result of the **advertise-inactive** and **advertise-external** statements.

For example, the following configuration can be used as a BGP export policy toward internal peers to mark routes advertised due to the **advertise-external** setting with a user-defined community. That community can be later used by the receiving routers to filter out such routes from the forwarding table. Such a mechanism can be used to address concerns that advertising paths not used for forwarding by the sender might lead to forwarding loops.

```
user@host# show policy-options
policy-statement mark-inactive {
  term inactive {
    from state inactive;
    then {
      community set comm-inactive;
    }
  }
  term default {
    from protocol bgp;
    then accept;
  }
  then reject;
}
```


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```
community comm-inactive members 65536:65284;
```


- Requirements on page 335
- Overview on page 335
- Configuration on page 336
- Verification on page 339

Requirements

Junos OS 9.3 or later is required.

Overview

This example shows three routing devices. Device R2 has an external BGP (EBGP) connection to Device R1. Device R2 has an IBGP connection to Device R3.

Device R1 advertises 172.16.6.0/24. Device R2 does not set the local preference in an import policy for Device R1's routes, and thus 172.16.6.0/24 has the default local preference of 100.

Device R3 advertises 172.16.6.0/24 with a local preference of 200.

When the **advertise-external** statement is not configured on Device R2, 172.16.6.0/24 is not advertised by Device R2 toward Device R3.

When the **advertise-external** statement is configured on Device R2 on the session toward Device R3, 172.16.6.0/24 is advertised by Device R2 toward Device R3.

When **advertise-external conditional** is configured on Device R2 on the session toward Device R3, 172.16.6.0/24 is not advertised by Device R2 toward Device R3. If you remove the **then local-preference 200** setting on Device R3 and add the **path-selection as-path-ignore** setting on Device R2 (thus making the path selection criteria equal until the MED step of the route selection process), 172.16.6.0/24 is advertised by Device R2 toward Device R3.

NOTE: To configure the advertise-external statement on a route reflector, you must disable intracluster reflection with the no-client-reflect statement, and the client cluster must be fully meshed to prevent the sending of redundant route advertisements.

When a routing device is configured as a route reflector for a cluster, a route advertised by the route reflector is considered internal if it is received from an internal peer with the same cluster identifier or if both peers have no cluster identifier configured. A route received from an internal peer that belongs to another cluster, that is, with a different cluster identifier, is considered external.

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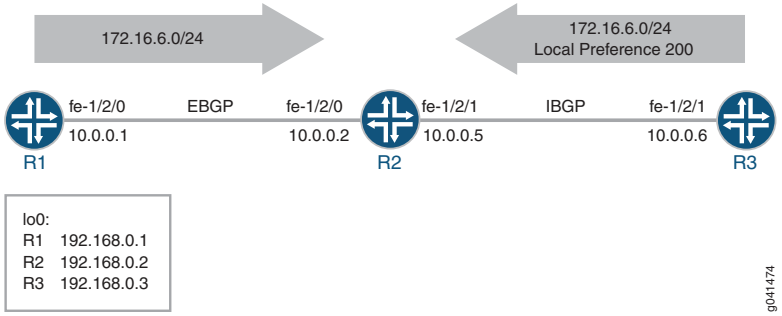
Topology

Figure 34 on page 336 shows the sample network.

Figure 34: BGP Topology for advertise-external



"CLI Quick Configuration" on page 336 shows the configuration for all of the devices in Figure 34 on page 336.

The section "Step-by-Step Procedure" on page 337 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 description to-R2
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 from route-filter 172.16.6.0/24
    exact
set policy-options policy-statement send-static term 1 then accept
set policy-options policy-statement send-static term 2 then reject
set routing-options static route 172.16.6.0/24 reject
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 0 description to-R1
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 description to-R3
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.5/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group ext type external
set protocols bgp group ext peer-as 100
```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```
set protocols bgp group ext neighbor 10.0.0.1
set protocols bgp group int type internal
set protocols bgp group int local-address 192.168.0.2
set protocols bgp group int advertise-external
set protocols bgp group int neighbor 192.168.0.3
set protocols ospf area 0.0.0.0 interface fe-1/2/1.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set routing-options router-id 192.168.0.2
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group int type internal
set protocols bgp group int local-address 192.168.0.3
set protocols bgp group int export send-static
set protocols bgp group int neighbor 192.168.0.2
set protocols ospf area 0.0.0.0 interface fe-1/2/0.6
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then local-preference 200
set policy-options policy-statement send-static term 1 then accept
set routing-options static route 172.16.6.0/24 reject
set routing-options static route 0.0.0.0/0 next-hop 10.0.0.5
set routing-options autonomous-system 200
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the device interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 0 description to-R1
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 0 description to-R3
user@R2# set fe-1/2/1 unit 0 family inet address 10.0.0.5/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure OSPF or another interior gateway protocol (IGP).

```
[edit protocols ospf area 0.0.0.0]
user@R2# set interface fe-1/2/1.0
user@R2# set interface lo0.0 passive
```

3. Configure the EBGP connection to Device R1.

```
[edit protocols bgp group ext]
user@R2# set type external
```

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```
user@R2# set peer-as 100
user@R2# set neighbor 10.0.0.1
```

4. Configure the IBGP connection to Device R3.

```
[edit protocols bgp group int]
user@R2# set type internal
user@R2# set local-address 192.168.0.2
user@R2# set neighbor 192.168.0.3
```

5. Add the **advertise-external** statement to the IBGP group peering session.

```
[edit protocols bgp group int]
user@R2# set advertise-external
```

6. Configure the autonomous system (AS) number and the router ID.

```
[edit routing-options ]
user@R2# set router-id 192.168.0.2
user@R2# set autonomous-system 200
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 0{
      description to-R1;
      family inet {
         address 10.0.0.2/30;
      }
   }
}
fe-1/2/1 {
   unit 0 {
      description to-R3;
      family inet {
         address 10.0.0.5/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.2/32;
      }
```


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```
    }
}
```

```
user@R2# show protocols
bgp {
    group ext {
        type external;
        peer-as 100;
        neighbor 10.0.0.1;
    }
    group int {
        type internal;
        local-address 192.168.0.2;
        advertise-external;
        neighbor 192.168.0.3;
    }
}
ospf {
    area 0.0.0.0 {
        interface fe-1/2/1.0;
        interface lo0.0 {
            passive;
        }
    }
}
```

```
user@R2# show routing-options
router-id 192.168.0.2;
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying the BGP Active Path on page 339
- Verifying the External Route Advertisement on page 340
- Verifying the Route on Device R3 on page 340
- Experimenting with the conditional Option on page 341

Verifying the BGP Active Path

Purpose On Device R2, make sure that the 172.16.6.0/24 prefix is in the routing table and has the expected active path.

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Action `user@R2>` **show route 172.16.6**

```
inet.0: 8 destinations, 9 routes (8 active, 1 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.6.0/24      *[BGP/170] 00:00:07, localpref 200, from 192.168.0.3
                      AS path: I, validation-state: unverified
                    > to 10.0.0.6 via fe-1/2/1.0
                    [BGP/170] 03:23:03, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
```

Meaning Device R2 receives the 172.16.6.0/24 route from both Device R1 and Device R3. The route from Device R3 is the active path, as designated by the asterisk (*). The active path has the highest local preference. Even if the local preferences of the two routes were equal, the route from Device R3 would remain active because it has the shortest AS path.

Verifying the External Route Advertisement

Purpose On Device R2, make sure that the 172.16.6.0/24 route is advertised toward Device R3.

Action `user@R2>` **show route advertising-protocol bgp 192.168.0.3**

```
inet.0: 8 destinations, 9 routes (8 active, 1 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
  172.16.6.0/24           10.0.0.1                     100        100 I
```

Meaning Device R2 is advertising the 172.16.6.0/24 route toward Device R3.

Verifying the Route on Device R3

Purpose Make sure that the 172.16.6.0/24 prefix is in Device R3's routing table.

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Action

```
user@R3> show route 172.16.6.0/24

inet.0: 7 destinations, 8 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.6.0/24      *[Static/5] 03:34:14
                      Reject
                    [BGP/170] 06:34:43, localpref 100, from 192.168.0.2
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.5 via fe-1/2/0.6
```

Meaning Device R3 has the static route and the BGP route for 172.16.6.0/24.

Note that the BGP route is hidden on Device R3 if the route is not reachable or if the next hop cannot be resolved. To fulfill this requirement, this example includes a static default route on Device R3 (**static route 0.0.0.0/0 next-hop 10.0.0.5**).

Experimenting with the conditional Option

Purpose See how the **conditional** option works in the context of the BGP path selection algorithm.

Action

1. On Device R2, add the **conditional** option.

   ```
   [edit protocols bgp group int]
   user@R2# set advertise-external conditional
   user@R2# commit
   ```

2. On Device R2, check to see if the 172.16.6.0/24 route is advertised toward Device R3.

   ```
   user@R2> show route advertising-protocol bgp 192.168.0.3
   ```

   As expected, the route is no longer advertised. You might need to wait a few seconds to see this result.

3. On Device R3, deactivate the **then local-preference** policy action.

   ```
   [edit policy-options policy-statement send-static term 1]
   user@R3# deactivate logical-systems R3 then local-preference
   user@R3# commit
   ```

4. On Device R2, ensure that the local preferences of the two paths are equal.

   ```
   user@R2> show route 172.16.6.0/24

   inet.0: 8 destinations, 9 routes (8 active, 0 holddown, 0 hidden)
   + = Active Route, - = Last Active, * = Both

   172.16.6.0/24      *[BGP/170] 08:02:59, localpref 100
                         AS path: 100 I, validation-state: unverified
   ```

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```
                    > to 10.0.0.1 via fe-1/2/0.0
                    [BGP/170] 00:07:51, localpref 100, from 192.168.0.3
                      AS path: I, validation-state: unverified
                    > to 10.0.0.6 via fe-1/2/1.0
```

5. On Device R2, add the **as-path-ignore** statement.

```
[edit protocols bgp]
user@R2# set path-selection as-path-ignore
user@R2# commit
```

6. On Device R2, check to see if the 172.16.6.0/24 route is advertised toward Device R3.

```
user@R2> show route advertising-protocol bgp 192.168.0.3

inet.0: 8 destinations, 9 routes (8 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.6.0/24           10.0.0.1                     100        100 I
```

As expected, the route is now advertised because the AS path length is ignored and because the local preferences are equal.

Related Documentation

- Example: Configuring BGP to Advertise Inactive Routes on page 241
- Understanding BGP Path Selection on page 14

Example: Configuring BGP Prefix-Based Outbound Route Filtering

This example shows how to configure a Juniper Networks router to accept route filters from remote peers and perform outbound route filtering using the received filters.

- Requirements on page 342
- Overview on page 342
- Configuration on page 343
- Verification on page 345

Requirements

Before you begin:

- Configure the router interfaces.
- Configure an interior gateway protocol (IGP).

Overview

You can configure a BGP peer to accept route filters from remote peers and perform outbound route filtering using the received filters. By filtering out unwanted updates, the sending peer saves resources needed to generate and transmit updates, and the receiving peer saves resources needed to process updates. This feature can be useful, for example,

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in a virtual private network (VPN) in which subsets of customer edge (CE) devices are not capable of processing all the routes in the VPN. The CE devices can use prefix-based outbound route filtering to communicate to the provider edge (PE) routing device to transmit only a subset of routes, such as routes to the main data centers only.

The maximum number of prefix-based outbound route filters that a BGP peer can accept is 5000. If a remote peer sends more than 5000 outbound route filters to a peer address, the additional filters are discarded, and a system log message is generated.

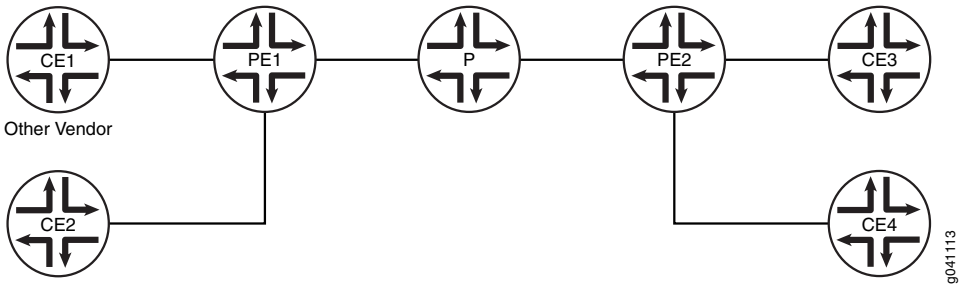
You can configure interoperability for the routing device as a whole or for specific BGP groups or peers only.

Topology

In the sample network, Device CE1 is a router from another vendor. The configuration shown in this example is on Juniper Networks Router PE1.

Figure 35 on page 343 shows the sample network.

Figure 35: BGP Prefix-Based Outbound Route Filtering



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

PE1

```
set protocols bgp group cisco-peers type external
set protocols bgp group cisco-peers description “to CE1”
set protocols bgp group cisco-peers local-address 192.168.165.58
set protocols bgp group cisco-peers peer-as 35
set protocols bgp group cisco-peers outbound-route-filter bgp-orf-cisco-mode
set protocols bgp group cisco-peers outbound-route-filter prefix-based accept inet
set protocols bgp group cisco-peers neighbor 192.168.165.56
set routing-options autonomous-system 65500
```

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Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router PE1 to accept route filters from Device CE1 and perform outbound route filtering using the received filters:

1. Configure the local autonomous system.

```
[edit routing-options]
user@PE1# set autonomous-system 65500
```

2. Configure external peering with Device CE1.

```
[edit protocols bgp group cisco-peers]
user@PE1# set type external
user@PE1# set description “to CE1”
user@PE1# set local-address 192.168.165.58
user@PE1# set peer-as 35
user@PE1# set neighbor 192.168.165.56
```

3. Configure Router PE1 to accept IPv4 route filters from Device CE1 and perform outbound route filtering using the received filters.

```
[edit protocols bgp group cisco-peers]
user@PE1# set outbound-route-filter prefix-based accept inet
```

4. (Optional) Enable interoperability with routing devices that use the vendor-specific compatibility code of 130 for outbound route filters and the code type of 128.

   The IANA standard code is 3, and the standard code type is 64.

```
[edit protocols bgp group cisco-peers]
user@PE1# set outbound-route-filter bgp-orf-cisco-mode
```

Results

From configuration mode, confirm your configuration by entering the **show protocols** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show protocols
group cisco-peers {
   type external;
   description “to CE1”;
   local-address 192.168.165.58;
   peer-as 35;
   outbound-route-filter {
      bgp-orf-cisco-mode;
      prefix-based {
         accept {
```


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```
        inet;
      }
    }
  }
  neighbor 192.168.165.56;
}
```

```
user@PE1# show routing-options
autonomous-system 65500;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying the Outbound Route Filter on page 345
- Verifying the BGP Neighbor Mode on page 345

Verifying the Outbound Route Filter

Purpose Display information about the prefix-based outbound route filter received from Device CE1.

Action From operational mode, enter the show bgp neighbor **orf detail** command.

```
user@PE1> show bgp neighbor orf 192.168.165.56 detail
  Peer: 192.168.165.56 Type: External
  Group: cisco-peers

  inet-unicast
   Filter updates recv:          4 Immediate:          0
   Filter: prefix-based            receive
           Updates recv:          4
     Received filter entries:
       seq 10 2.2.0.0/16 deny minlen 0 maxlen 0
       seq 20 3.3.0.0/16 deny minlen 24 maxlen 0
       seq 30 4.4.0.0/16 deny minlen 0 maxlen 28
       seq 40 5.5.0.0/16 deny minlen 24 maxlen 28
```

Verifying the BGP Neighbor Mode

Purpose Verify that the **bgp-orf-cisco-mode** setting is enabled for the peer by making sure that the **ORFCiscoMode** option is displayed in the **show bgp neighbor** command output.

Action From operational mode, enter the show bgp neighbor command.

```
user@PE1> show bgp neighbor
Peer: 192.168.165.56 AS 35       Local: 192.168.165.58 AS 65500
  Type: External    State: Active         Flags: <>
```

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```
Last State: Idle          Last Event: Start
Last Error: None
Export: [ adv_stat ]
Options: <Preference LocalAddress AddressFamily PeerAS Refresh>
Options: <ORF ORFCiscoMode>
Address families configured: inet-unicast
Local Address: 192.168.165.58 Holdtime: 90 Preference: 170
Number of flaps: 0
Trace options: detail open detail refresh
Trace file: /var/log/orf size 5242880 files 20
```

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Understanding the Default BGP Routing Policy on Packet Transport Routers

On PTX Series Packet Transport Routers, the default BGP routing policy differs from that of other Junos OS routing devices.

The PTX Series routers are MPLS transit platforms that do IP forwarding, typically using interior gateway protocol (IGP) routes. The PTX Series Packet Forwarding Engine can accommodate a relatively small number of variable-length prefixes.

NOTE: A PTX Series router can support full BGP routes in the control plane so that it can be used as a route reflector (RR). It can do exact-length lookup multicast forwarding and can build the multicast forwarding plane for use by the unicast control plane (for example. to perform a reverse-path forwarding lookup for multicast).

Given the PFE limitation, the default routing policy for PTX Series routers is for BGP routes not to be installed in the forwarding table. You can override the default routing policy and select certain BGP routes to install in the forwarding table.

The default behavior for load balancing and BGP routes on PTX Series routers is as follows. It has the following desirable characteristics:

- Allows you to override the default behavior without needing to alter the default policy directly
- Reduces the chance of accidental changes that nullify the defaults
- Sets no flow-control actions, such as accept and reject

The default routing policy on the PTX Series routers is as follows:

```
user@host# show policy-options | display inheritance defaults no-comments
policy-options {
```


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```
    policy-statement junos-ptx-series-default {
      term t1 {
        from {
          protocol bgp;
          rib inet.0;
        }
        then no-install-to-fib;
      }
      term t2 {
        from {
          protocol bgp;
          rib inet6.0;
        }
        then no-install-to-fib;
      }
      term t3 {
        then load-balance per-packet;
      }
    }
}
routing-options {
    forwarding-table {
      default-export junos-ptx-series-default;
    }
}
user@host# show routing-options forwarding-table default-export | display inheritance
    defaults no-comments
default-export junos-ptx-series-default;
```

As shown here, the **junos-ptx-series-default** policy is defined in **[edit policy-options]**. The policy is applied in **[edit routing-options forwarding-table]**, using the **default-export** statement. You can view these default configurations by using the **| display inheritance** flag.

Also, you can use the **show policy** command to view the default policy.

```
user@host> show policy junos-ptx-series-default
Policy junos-ptx-series-default:
    Term t1:
        from proto BGP
         inet.0
        then install-to-fib no
    Term t2:
        from proto BGP
         inet6.0
        then install-to-fib no
    Term t3:
        then load-balance per-packet
```

CAUTION: We strongly recommend that you do not alter the **junos-ptx-series-default** routing policy directly.

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Junos OS chains the **junos-ptx-series-default** policy and any user-configured export policy. Because the **junos-ptx-series-default** policy does not use flow-control actions, any export policy that you configure is executed (by way of the implicit next-policy action) for every route. Thus you can override any actions set by the **junos-ptx-series-default** policy. If you do not configure an export policy, the actions set by **junos-ptx-series-default** policy are the only actions.

You can use the policy action **install-to-fib** to override the **no-install-to-fib** action.

Similarly, you can set the **load-balance per-prefix** action to override the **load-balance per-packet** action.

Related Documentation

- Example: Overriding the Default BGP Routing Policy on PTX Series Packet Transport Routers on page 348

Example: Overriding the Default BGP Routing Policy on PTX Series Packet Transport Routers

This example shows how to override the default routing policy on packet transport routers, such as the PTX Series Packet Transport Routers.

- Requirements on page 348
- Overview on page 348
- Configuration on page 349
- Verification on page 350

Requirements

This example requires Junos OS Release 12.1 or later.

Overview

By default, the PTX Series routers do not install BGP routes in the forwarding table.

For PTX Series routers, the configuration of the **from protocols bgp** condition with the **then accept** action does not have the usual result that it has on other Junos OS routing devices. With the following routing policy on PTX Series routers, BGP routes do not get installed in the forwarding table.

```
user@host# show policy-options
policy-statement accept-no-install {
   term 1 {
      from protocol bgp;
      then accept;
   }
}
user@host# show routing-options
forwarding-table {
   export accept-no-install;
```


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```
}
```

```
user@host> show route forwarding-table
```

```
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    36     2
```

No BGP routes are installed in the forwarding table. This is the expected behavior.

This example shows how to use the **then install-to-fib** action to effectively override the default BGP routing policy.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options prefix-list install-bgp 66.0.0.1/32
set policy-options policy-statement override-ptx-series-default term 1 from prefix-list
  install-bgp
set policy-options policy-statement override-ptx-series-default term 1 then load-balance
  per-prefix
set policy-options policy-statement override-ptx-series-default term 1 then install-to-fib
set routing-options forwarding-table export override-ptx-series-default
```

Installing Selected BGP Routes in the Forwarding Table

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To install selected BGP routes in the forwarding table:

1. Configure a list of prefixes to install in the forwarding table.

   ```
   [edit policy-options prefix-list install-bgp]
   user@host# set 66.0.0.1/32
   ```

2. Configure the routing policy, applying the prefix list as a condition.

   ```
   [edit policy-options policy-statement override-ptx-series-default term 1]
   user@host# set from prefix-list install-bgp
   user@host# set then install-to-fib
   user@host# set then load-balance per-prefix
   ```

3. Apply the routing policy to the forwarding table.

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```
[edit routing-options forwarding-table]
user@host# set export override-ptx-series-default
```

Results From configuration mode, confirm your configuration by entering the **show policy-options** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
prefix-list install-bgp {
   66.0.0.1/32;
}
policy-statement override-ptx-series-default {
   term 1 {
      from {
         prefix-list install-bgp;
      }
      then {
         load-balance per-prefix;
         install-to-fib;
      }
   }
}
```

```
user@host# show routing-options
forwarding-table {
   export override-ptx-series-default;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Selected Route Is Installed in the Forwarding Table

Purpose Make sure that the configured policy overrides the default policy.

Action From operational mode, enter the show route forwarding-table command.

```
user@host> show route forwarding-table destination 66.0.0.1
```

```
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
66.0.0.1/32        user     0                    indr 2097159     3
                                                 ulst 2097156     2
                              5.1.0.2            ucst   574     1 et-6/0/0.1
                              5.2.0.2            ucst   575     1 et-6/0/0.2
```


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Meaning This output shows that the route to 66.0.0.1/32 is installed in the forwarding table.

Related Documentation
- Understanding the Default BGP Routing Policy on Packet Transport Routers on page 346

Conditional Advertisement Enabling Conditional Installation of Prefixes Use Cases

Networks are usually subdivided into smaller, more-manageable units called autonomous systems (ASs). When BGP is used by routers to form peer relationships in the same AS, it is referred to as internal BGP (IBGP). When BGP is used by routers to form peer relationships in different ASs, it is referred to as external BGP (EBGP).

After performing route sanity checks, a BGP router accepts the routes received from its peers and installs them into the routing table. By default, all routers in IBGP and EBGP sessions follow the standard BGP advertisement rules. While a router in an IBGP session advertises only the routes learned from its direct peers, a router in an EBGP session advertises all routes learned from its direct and indirect peers (peers of peers). Hence, in a typical network configured with EBGP, a router adds all routes received from an EBGP peer into its routing table and advertises nearly all routes to all EBGP peers.

A service provider exchanging BGP routes with both customers and peers on the Internet is at risk of malicious and unintended threats that can compromise the proper routing of traffic, as well as the operation of the routers.

This has several disadvantages:

- **Non-aggregated route advertisements**—A customer could erroneously advertise all its prefixes to the ISP rather than an aggregate of its address space. Given the size of the Internet routing table, this must be carefully controlled. An edge router might also need only a default route out toward the Internet and instead be receiving the entire BGP routing table from its upstream peer.
- **BGP route manipulation**—If a malicious administrator alters the contents of the BGP routing table, it could prevent traffic from reaching its intended destination.
- **BGP route hijacking**—A rogue administrator of a BGP peer could maliciously announce a network's prefixes in an attempt to reroute the traffic intended for the victim network to the administrator's network to either gain access to the contents of traffic or to block the victim's online services.
- **BGP denial of service (DoS)**—If a malicious administrator sends unexpected or undesirable BGP traffic to a router in an attempt to use all of the router's available BGP resources, it might result in impairing the router's ability to process valid BGP route information.

Conditional installation of prefixes can be used to address all the problems previously mentioned. If a customer requires access to remote networks, it is possible to install a specific route in the routing table of the router that is connected with the remote network. This does not happen in a typical EBGP network and hence, conditional installation of prefixes becomes essential.

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ASs are not only bound by physical relationships but by business or other organizational relationships. An AS can provide services to another organization, or act as a transit AS between two other ASs. These transit ASs are bound by contractual agreements between the parties that include parameters on how to connect to each other and most importantly, the type and quantity of traffic they carry for each other. Therefore, for both legal and financial reasons, service providers must implement policies that control how BGP routes are exchanged with neighbors, which routes are accepted from those neighbors, and how those routes affect the traffic between the ASs.

There are many different options available to filter routes received from a BGP peer to both enforce inter-AS policies and mitigate the risks of receiving potentially harmful routes. Conventional route filtering examines the attributes of a route and accepts or rejects the route based on such attributes. A policy or filter can examine the contents of the AS-Path, the next-hop value, a community value, a list of prefixes, the address family of the route, and so on.

In some cases, the standard “acceptance condition” of matching a particular attribute value is not enough. The service provider might need to use another condition outside of the route itself, for example, another route in the routing table. As an example, it might be desirable to install a default route received from an upstream peer, only if it can be verified that this peer has reachability to other networks further upstream. This conditional route installation avoids installing a default route that is used to send traffic toward this peer, when the peer might have lost its routes upstream, leading to black-holed traffic. To achieve this, the router can be configured to search for the presence of a particular route in the routing table, and based on this knowledge accept or reject another prefix.

“Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table” on page 355 explains how the conditional installation of prefixes can be configured and verified.

Related Documentation

- Conditional Advertisement and Import Policy (Routing Table) with certain match conditions on page 353
- Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table on page 355

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Conditional Advertisement and Import Policy (Routing Table) with certain match conditions

BGP accepts all non-looped routes learned from neighbors and imports them into the RIB-In table. If these routes are accepted by the BGP import policy, they are then imported into the inet.0 routing table. In cases where only certain routes are required to be imported, provisions can be made such that the peer routing device exports routes based on a condition or a set of conditions.

The condition for exporting a route can be based on:

- The peer the route was learned from
- The interface the route was learned on
- Some other required attribute

For example:

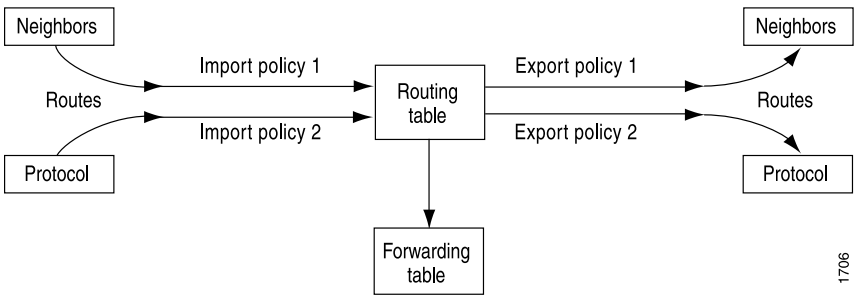
```
[edit]
policy-options {
   condition condition-name {
      if-route-exists address table table-name;
   }
}
```

This is known as conditional installation of prefixes and is described in "Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table" on page 355.

The Juniper Networks® Junos® Operating System (Junos OS) supports conditional export of routes based on the existence of another route in the routing table. Junos OS does not, however, support policy conditions for import policy.

Figure 36 on page 353 illustrates where BGP import and export policies are applied. An import policy is applied to inbound routes that are visible in the output of the **show route receive-protocol bgp *neighbor-address*** command. An export policy is applied to outbound routes that are visible in the output of the **show route advertising-protocol bgp *neighbor-address*** command.

Figure 36: BGP Import and Export Policies



To enable conditional installation of prefixes, an export policy must be configured on the device where the prefix export has to take place. The export policy evaluates each route to verify that it satisfies all the match conditions under the **from** statement. It also searches for the existence of the route defined under the **condition** statement (also configured under the **from** statement).

If the route does not match the entire set of required conditions defined in the policy, or if the route defined under the **condition** statement does not exist in the routing table, the route is not exported to its BGP peers. Thus, a conditional export policy matches the routes for the desired route or prefix you want installed in the peers' routing table.

To configure the conditional installation of prefixes with the help of an export policy:

1. Create a **condition** statement to check prefixes.

```
[edit]
policy-options {
  condition condition-name {
    if-route-exists address table table-name;
  }
}
```

2. Create an export policy with the newly created condition using the **condition** statement.

```
[edit]
policy-options {
  policy-statement policy-name {
    term 1 {
      from {
        protocols bgp;
        condition condition-name;
      }
      then {
        accept;
      }
    }
  }
}
```

3. Apply the export policy to the device that requires only selected prefixes to be exported from the routing table.

```
[edit]
protocols bgp {
  group group-name {
    export policy-name;
  }
}
```

Related Documentation

- Conditional Advertisement Enabling Conditional Installation of Prefixes Use Cases on page 351

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- Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table on page 355

Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table

This example shows how to configure conditional installation of prefixes in a routing table using BGP export policy.

- Requirements on page 355
- Overview on page 355
- Configuration on page 358
- Verification on page 365

Requirements

This example uses the following hardware and software components:

- M Series Multiservice Edge Routers, MX Series 5G Universal Routing Platforms, or T Series Core Routers
- Junos OS Release 9.0 or later

Overview

In this example, three routers in three different autonomous systems (ASs) are connected and configured with the BGP protocol. The router labeled Internet, which is the upstream router, has five addresses configured on its lo0.0 loopback interface (172.16.11.1/32, 172.16.12.1/32, 172.16.13.1/32, 172.16.14.1/32, and 172.16.15.1/32), and an extra loopback address (192.168.9.1/32) is configured as the router ID. These six addresses are exported into BGP to emulate the contents of a BGP routing table of a router connected to the Internet, and advertised to North.

The North and South routers use the 10.0.89.12/30 and 10.0.78.12/30 networks, respectively, and use 192.168.7.1 and 192.168.8.1 for their respective loopback addresses.

Figure 37 on page 356 shows the topology used in this example.

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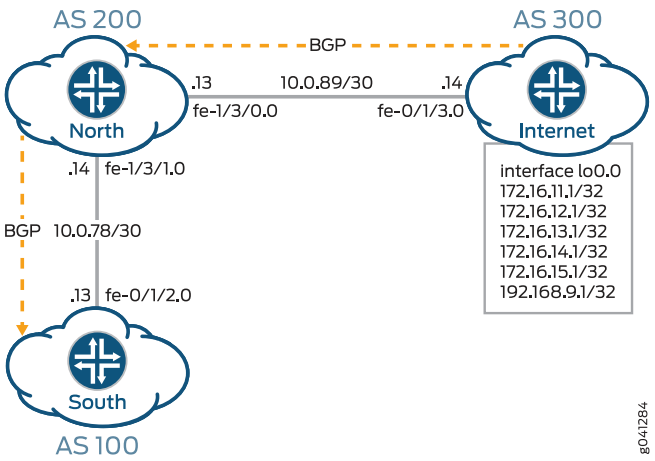
Figure 37: Conditional Installation of Prefixes



Router North exports a default route into BGP, and advertises the default route and the five BGP routes to Router South, which is the downstream router. Router South receives the default route and only one other route (172.16.11.1/32), and installs this route and the default route in its routing table.

To summarize, the example meets the following requirements:

- On North, send 0/0 to South only if a particular route is also sent (in the example 172.16.11.1/32).
- On South, accept the default route and the 172.16.11.1/32 route. Drop all other routes. Consider that South might be receiving the entire Internet table, while the operator only wants South to have the default and one other specific prefix.

The first requirement is met with an export policy on North:

```
user@North# show policy-options
policy-statement conditional-export-bgp {
   term prefix_11 {
      from {
         protocol bgp;
         route-filter 10.11.0.0/5 orlonger;
      }
      then accept;
   }
   term conditional-default {
      from {
         route-filter 0.0.0.0/0 exact;
         condition prefix_11;
      }
      then accept;
   }
   term others {
      then reject;
   }
}
```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```
condition prefix_11 {
   if-route-exists {
      172.16.11.1/32;
      table inet.0;
   }
}
```

The logic of the conditional export policy can be summarized as follows: If 0/0 is present, and if 172.16.11.1/32 is present, then send the 0/0 prefix. This implies that if 172.16.11.1/32 is not present, then do not send 0/0.

The second requirement is met with an import policy on South:

```
user@South# show policy-options
policy-statement import-selected-routes {
   term 1 {
      from {
         rib inet.0;
         neighbor 10.0.78.14;
         route-filter 0.0.0.0/0 exact;
         route-filter 10.11.0.0/8 orlonger;
      }
      then accept;
   }
   term 2 {
      then reject;
   }
}
```

In this example, four routes are dropped as a result of the import policy on South. This is because the export policy on North leaks all of the routes received from Internet, and the import policy on South excludes some of these routes.

It is important to understand that in Junos OS, although an import policy (inbound route filter) might reject a route, not use it for traffic forwarding, and not include it in an advertisement to other peers, the router retains these routes as hidden routes. These hidden routes are not available for policy or routing purposes. However, they do occupy memory space on the router. A service provider filtering routes to control the amount of information being kept in memory and processed by a router might want the router to entirely drop the routes being rejected by the import policy.

Hidden routes can be viewed by using the **show route receive-protocol bgp** *neighbor-address* **hidden** command. The hidden routes can then be retained or dropped from the routing table by configuring the **keep all | none** statement at the **[edit protocols bgp]** or **[edit protocols bgp group** *group-name***]** hierarchy level.

The rules of BGP route retention are as follows:

- By default, all routes learned from BGP are retained, except those where the AS path is looped. (The AS path includes the local AS.)
- By configuring the **keep all** statement, all routes learned from BGP are retained, even those with the local AS in the AS path.

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- By configuring the **keep none** statement, BGP discards routes that were received from a peer and that were rejected by import policy or other sanity checking. When this statement is configured and the inbound policy changes, Junos OS re-advertises all the routes advertised by the peer.

When you configure **keep all** or **keep none** and the peers support route refresh, the local speaker sends a refresh message and performs an import evaluation. For these peers, the sessions do not restart. To determine if a peer supports refresh, check for **Peer supports Refresh capability** in the output of the **show bgp neighbor** command.

CAUTION: If you configure keep all or keep none and the peer does not support session restart, the associated BGP sessions are restarted (flapped).

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Router Internet

```
set interfaces lo0 unit 0 family inet address 172.16.11.1/32
set interfaces lo0 unit 0 family inet address 172.16.12.1/32
set interfaces lo0 unit 0 family inet address 172.16.13.1/32
set interfaces lo0 unit 0 family inet address 172.16.14.1/32
set interfaces lo0 unit 0 family inet address 172.16.15.1/32
set interfaces lo0 unit 0 family inet address 192.168.9.1/32
set interfaces fe-0/1/3 unit 0 family inet address 10.0.89.14/30
set protocols bgp group toNorth local-address 10.0.89.14
set protocols bgp group toNorth peer-as 200
set protocols bgp group toNorth neighbor 10.0.89.13
set protocols bgp group toNorth export into-bgp
set policy-options policy-statement into-bgp term 1 from interface lo0.0
set policy-options policy-statement into-bgp term 1 then accept
set routing-options router-id 192.168.9.1
set routing-options autonomous-system 300
```

Router North

```
set interfaces fe-1/3/1 unit 0 family inet address 10.0.78.14/30
set interfaces fe-1/3/0 unit 0 family inet address 10.0.89.13/30
set interfaces lo0 unit 0 family inet address 192.168.8.1/32
set protocols bgp group toInternet local-address 10.0.89.13
set protocols bgp group toInternet peer-as 300
set protocols bgp group toInternet neighbor 10.0.89.14
set protocols bgp group toSouth local-address 10.0.78.14
set protocols bgp group toSouth export conditional-export-bgp
set protocols bgp group toSouth peer-as 100
set protocols bgp group toSouth neighbor 10.0.78.13
set policy-options policy-statement conditional-export-bgp term prefix_11 from protocol
  bgp
```


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```
set policy-options policy-statement conditional-export-bgp term prefix_11 from route-filter
  10.11.0.0/5 orlonger
set policy-options policy-statement conditional-export-bgp term prefix_11 then accept
set policy-options policy-statement conditional-export-bgp term conditional-default
  from route-filter 0.0.0.0/0 exact
set policy-options policy-statement conditional-export-bgp term conditional-default
  from condition prefix_11
set policy-options policy-statement conditional-export-bgp term conditional-default
  then accept
set policy-options policy-statement conditional-export-bgp term others then reject
set policy-options condition prefix_11 if-route-exists 172.16.11.1/32
set policy-options condition prefix_11 if-route-exists table inet.0
set routing-options static route 0/0 reject
set routing-options router-id 192.168.8.1
set routing-options autonomous-system 200
```

Router South

```
set interfaces fe-0/1/2 unit 0 family inet address 10.0.78.13/30
set interfaces lo0 unit 0 family inet address 192.168.7.1/32
set protocols bgp group toNorth local-address 10.0.78.13
set protocols bgp group toNorth import import-selected-routes
set protocols bgp group toNorth peer-as 200
set protocols bgp group toNorth neighbor 10.0.78.14
set policy-options policy-statement import-selected-routes term 1 from neighbor 10.0.78.14
set policy-options policy-statement import-selected-routes term 1 from route-filter
  10.11.0.0/8 orlonger
set policy-options policy-statement import-selected-routes term 1 from route-filter
  0.0.0.0/0 exact
set policy-options policy-statement import-selected-routes term 1 then accept
set policy-options policy-statement import-selected-routes term 2 then reject
set routing-options router-id 192.168.7.1
set routing-options autonomous-system 100
```

Configuring Conditional Installation of Prefixes

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the Junos OS CLI User Guide.

To configure conditional installation of prefixes:

1. Configure the router interfaces forming the links between the three routers.

   Router Internet
   ```
   [edit interfaces]
   user@Internet# set fe-0/1/3 unit 0 family inet address 10.0.89.14/30
   ```

   Router North
   ```
   [edit interfaces]
   user@North# set fe-1/3/1 unit 0 family inet address 10.0.78.14/30
   user@North# set fe-1/3/0 unit 0 family inet address 10.0.89.13/30
   ```

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```
Router South
[edit interfaces]
user@South# set fe-0/1/2 unit 0 family inet address 10.0.78.13/30
```

2. Configure five loopback interface addresses on Router Internet to emulate BGP routes learned from the Internet that are to be imported into the routing table of Router South, and configure an additional address (192.168.9.1/32) that will be configured as the router ID.

```
Router Internet
[edit interfaces lo0 unit 0 family inet]
user@Internet# set address 172.16.11.1/32
user@Internet# set address 172.16.12.1/32
user@Internet# set address 172.16.13.1/32
user@Internet# set address 172.16.14.1/32
user@Internet# set address 172.16.15.1/32
user@Internet# set address 192.168.9.1/32
```

Also, configure the loopback interface addresses on Routers North and South.

```
Router North
[edit interfaces lo0 unit 0 family inet]
user@North# set address 192.168.8.1/32
```

```
Router South
[edit interfaces lo0 unit 0 family inet]
user@South# set address 192.168.7.1/32
```

3. Configure the static default route on Router North to be advertised to Router South.

```
[edit routing-options]
user@North# set static route 0/0 reject
```

4. Define the condition for exporting prefixes from the routing table on Router North.

```
[edit policy-options condition prefix_11]
user@North# set if-route-exists 172.16.11.1/32
user@North# set if-route-exists table inet.0
```

5. Define export policies (**into-bgp** and **conditional-export-bgp**) on Routers Internet and North respectively, to advertise routes to BGP.

NOTE: Ensure that you reference the condition, **prefix_11** (configured in Step 4), in the export policy.

```
Router Internet
```


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```
[edit policy-options policy-statement into-bgp ]
user@Internet# set term 1 from interface lo0.0
user@Internet# set term 1 then accept
```

```
Router North
[edit policy-options policy-statement conditional-export-bgp]
user@North# set term prefix_11 from protocol bgp
user@North# set term prefix_11 from route-filter 10.11.0.0/5 orlonger
user@North# set term prefix_11 then accept
user@North# set term conditional-default from route-filter 0.0.0.0/0 exact
user@North# set term conditional-default from condition prefix_11
user@North# set term conditional-default then accept
user@North# set term others then reject
```

6. Define an import policy (**import-selected-routes**) on Router South to import some of the routes advertised by Router North into its routing table.

```
[edit policy-options policy-statement import-selected-routes ]
user@South# set term 1 from neighbor 10.0.78.14
user@South# set term 1 from route-filter 10.11.0.0/8 orlonger
user@South# set term 1 from route-filter 0.0.0.0/0 exact
user@South# set term 1 then accept
user@South# set term 2 then reject
```

7. Configure BGP on all three routers to enable the flow of prefixes between the autonomous systems.

NOTE: Ensure that you apply the defined import and export policies to the respective BGP groups for prefix advertisement to take place.

```
Router Internet
[edit protocols bgp group toNorth]
user@Internet# set local-address 10.0.89.14
user@Internet# set peer-as 200
user@Internet# set neighbor 10.0.89.13
user@Internet# set export into-bgp
```

```
Router North
[edit protocols bgp group toInternet]
user@North# set local-address 10.0.89.13
user@North# set peer-as 300
user@North# set neighbor 10.0.89.14
```

```
[edit protocols bgp group toSouth]
user@North# set local-address 10.0.78.14
user@North# set peer-as 100
user@North# set neighbor 10.0.78.13
user@North# set export conditional-export-bgp
```

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```
Router South
[edit protocols bgp group toNorth]
user@South# set local-address 10.0.78.13
user@South# set peer-as 200
user@South# set neighbor 10.0.78.14
user@South# set import import-selected-routes
```

8. Configure the router ID and autonomous system number for all three routers.

NOTE: In this example, the router ID is configured based on the IP address configured on the lo0.0 interface of the router.

```
Router Internet
[edit routing options]
user@Internet# set router-id 192.168.9.1
user@Internet# set autonomous-system 300
```

```
Router North
[edit routing options]
user@North# set router-id 192.168.8.1
user@North# set autonomous-system 200
```

```
Router South
[edit routing options]
user@South# set router-id 192.168.7.1
user@South# set autonomous-system 100
```

Results

From configuration mode, confirm your configuration by issuing the **show interfaces**, **show protocols bgp**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device Internet

```
user@Internet# show interfaces
fe-0/1/3 {
   unit 0 {
      family inet {
         address 10.0.89.14/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 172.16.11.1/32;
```


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```
        address 172.16.12.1/32;
        address 172.16.13.1/32;
        address 172.16.14.1/32;
        address 172.16.15.1/32;
        address 192.168.9.1/32;
      }
    }
}
```

```
user@Internet# show protocols bgp
group toNorth {
  local-address 10.0.89.14;
  export into-bgp;
  peer-as 200;
  neighbor 10.0.89.13;
}
```

```
user@Internet# show policy-options
policy-statement into-bgp {
  term 1 {
    from interface lo0.3;
    then accept;
  }
}
```

```
user@Internet# show routing-options
router-id 192.168.9.1;
autonomous-system 300;
```

Device North

```
user@North# show interfaces
fe-1/3/1 {
  unit 0 {
    family inet {
      address 10.0.78.14/30;
    }
  }
}
fe-1/3/0 {
  unit 0 {
    family inet {
      address 10.0.89.13/30;
    }
  }
}
lo0 {
  unit 0 {
    family inet {
      address 192.168.8.1/32;
    }
  }
}
```

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```
user@North# show protocols bgp
group toInternet {
   local-address 10.0.89.13;
   peer-as 300;
   neighbor 10.0.89.14;
}
group toSouth {
   local-address 10.0.78.14;
   export conditional-export-bgp;
   peer-as 100;
   neighbor 10.0.78.13;
}
```

```
user@North# show policy-options
policy-statement conditional-export-bgp {
   term prefix_11 {
      from {
         protocol bgp;
         route-filter 10.11.0.0/5 orlonger;
      }
      then accept;
   }
   term conditional-default {
      from {
         route-filter 0.0.0.0/0 exact;
         condition prefix_11;
      }
      then accept;
   }
   term others {
      then reject;
   }
}
condition prefix_11 {
   if-route-exists {
      172.16.11.1/32;
      table inet.0;
   }
}
```

```
user@North# show routing-options
static {
   route 0.0.0.0/0 reject;
}
router-id 192.168.8.1;
autonomous-system 200;
```

Device South

```
user@South# show interfaces
fe-0/1/2 {
   unit 0 {
      family inet {
         address 10.0.78.13/30;
      }
```


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```
    }
}
lo0 {
    unit 0 {
        family inet {
            address 192.168.7.1/32;
        }
    }
}
```

```
user@South# show protocols bgp
bgp {
    group toNorth {
        local-address 10.0.78.13;
        import import-selected-routes;
        peer-as 200;
        neighbor 10.0.78.14;
    }
}
```

```
user@South# show policy-options
policy-statement import-selected-routes {
    term 1 {
        from {
            neighbor 10.0.78.14;
            route-filter 10.11.0.0/8 orlonger;
            route-filter 0.0.0.0/0 exact;
        }
        then accept;
    }
    term 2 {
        then reject;
    }
}
```

```
user@South# show routing-options
router-id 192.168.7.1;
autonomous-system 100;
```

If you are done configuring the routers, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying BGP on page 366
- Verifying Prefix Advertisement from Router Internet to Router North on page 367
- Verifying Prefix Advertisement from Router North to Router South on page 368
- Verifying BGP Import Policy for Installation of Prefixes on page 369

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- Verifying Conditional Export from Router North to Router South on page 369
- Verifying the Presence of Routes Hidden by Policy (Optional) on page 370

Verifying BGP

Purpose Verify that BGP sessions have been established between the three routers.

Action From operational mode, run the **show bgp neighbor *neighbor-address*** command.

1. Check the BGP session on Router Internet to verify that Router North is a neighbor.

```
user@Internet> show bgp neighbor 10.0.89.13
Peer: 10.0.89.13+179 AS 200   Local: 10.0.89.14+56187 AS 300
  Type: External    State: Established    Flags: [ImportEval Sync]
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ into-bgp ]
  Options: [Preference LocalAddress PeerAS Refresh]
  Local Address: 10.0.89.14 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.8.1     Local ID: 192.168.9.1       Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  BFD: disabled, down
  Local Interface: fe-0/1/3.0
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 200)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            0
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 9    Sent 18   Checked 28
  Input messages:  Total 12     Updates 1       Refreshes 0     Octets 232
  Output messages: Total 14     Updates 1       Refreshes 0     Octets 383
  Output Queue[0]: 0
```

2. Check the BGP session on Router North to verify that Router Internet is a neighbor.

```
user@North> show bgp neighbor 10.0.89.14
Peer: 10.0.89.14+56187 AS 300  Local: 10.0.89.13+179 AS 200
  Type: External    State: Established    Flags: [ImportEval Sync]
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: [Preference LocalAddress PeerAS Refresh]
```


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```
Local Address: 10.0.89.13 Holdtime: 90 Preference: 170
Number of flaps: 0
Peer ID: 192.168.9.1     Local ID: 192.168.8.1       Active Holdtime: 90
Keepalive Interval: 30         Group index: 0    Peer index: 0
BFD: disabled, down
Local Interface: fe-1/3/0.0
NLRI for restart configured on peer: inet-unicast
NLRI advertised by peer: inet-unicast
NLRI for this session: inet-unicast
Peer supports Refresh capability (2)
Stale routes from peer are kept for: 300
Peer does not support Restarter functionality
NLRI that restart is negotiated for: inet-unicast
NLRI of received end-of-rib markers: inet-unicast
NLRI of all end-of-rib markers sent: inet-unicast
Peer supports 4 byte AS extension (peer-as 300)
Peer does not support Addpath
Table inet.0 Bit: 10001
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              6
  Received prefixes:            6
  Accepted prefixes:            6
  Suppressed due to damping:    0
  Advertised prefixes:          0
Last traffic (seconds): Received 14   Sent 3    Checked 3
Input messages:  Total 16     Updates 2       Refreshes 0     Octets 402
Output messages: Total 15     Updates 0       Refreshes 0     Octets 348
Output Queue[0]: 0
```

Check the following fields in these outputs to verify that BGP sessions have been established:

- **Peer**—Check if the peer AS number is listed.
- **Local**—Check if the local AS number is listed.
- **State**—Ensure that the value is **Established**. If not, check the configuration again and see show bgp neighbor for more details on the output fields.

Similarly, verify that Routers North and South form peer relationships with each other.

Meaning BGP sessions are established between the three routers.

Verifying Prefix Advertisement from Router Internet to Router North

Purpose Verify that the routes sent from Router Internet are received by Router North.

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Action

1. From operational mode on Router Internet, run the **show route advertising-protocol bgp *neighbor-address*** command.

```
user@Internet> show route advertising-protocol bgp 10.0.89.13

inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.11.1/32            Self                                    I
* 172.16.12.1/32            Self                                    I
* 172.16.13.1/32            Self                                    I
* 172.16.14.1/32            Self                                    I
* 172.16.15.1/32            Self                                    I
* 192.168.9.1/32          Self                                    I
```

   The output verifies that Router Internet advertises the routes 172.16.11.1/32, 172.16.12.1/32, 172.16.13.1/32, 172.16.14.1/32, 172.16.15.1/32, and 192.168.9.1/32 (the loopback address used as router ID) to Router North.

2. From operational mode on Router North, run the **show route receive-protocol bgp *neighbor-address*** command.

```
user@North> show route receive-protocol bgp 10.0.89.14

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.11.1/32            10.0.89.14                              300 I
* 172.16.12.1/32            10.0.89.14                              300 I
* 172.16.13.1/32            10.0.89.14                              300 I
* 172.16.14.1/32            10.0.89.14                              300 I
* 172.16.15.1/32            10.0.89.14                              300 I
* 192.168.9.1/32          10.0.89.14                              300 I
```

   The output verifies that Router North has received all the routes advertised by Router Internet.

Meaning Prefixes sent by Router Internet have been successfully installed into the routing table on Router North.

Verifying Prefix Advertisement from Router North to Router South

Purpose Verify that the routes received from Router Internet and the static default route are advertised by Router North to Router South.

Action

1. From operational mode on Router North, run the **show route 0/0 exact** command.

```
user@North> show route 0/0 exact

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 00:10:22
                       Reject
```


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The output verifies the presence of the static default route (0.0.0.0/0) in the routing table on Router North.

2. From operational mode on Router North, run the **show route advertising-protocol bgp *neighbor-address*** command.

```
user@North> show route advertising-protocol bgp 10.0.78.13

inet.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 0.0.0.0/0               Self                                    I
* 172.16.11.1/32             Self                                    300 I
* 172.16.12.1/32             Self                                    300 I
* 172.16.13.1/32             Self                                    300 I
* 172.16.14.1/32             Self                                    300 I
* 172.16.15.1/32             Self                                    300 I
```

The output verifies that Router North is advertising the static route and the 172.16.11.1/32 route received from Router Internet, as well as many other routes, to Router South.

Verifying BGP Import Policy for Installation of Prefixes

Purpose Verify that the BGP import policy successfully installs the required prefixes.

Action See if the import policy on Router South is operational by checking if only the static default route from Router North and the 172.16.11.1/32 route from Router South are installed in the routing table.

From operational mode, run the **show route receive-protocol bgp *neighbor-address*** command.

```
user@South> show route receive-protocol bgp 10.0.78.14

inet.0: 10 destinations, 11 routes (6 active, 0 holddown, 4 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 0.0.0.0/0               10.0.78.14                              200 I
* 172.16.11.1/32             10.0.78.14                              200 300 I
```

The output verifies that the BGP import policy is operational on Router South, and only the static default route of 0.0.0.0/0 from Router North and the 172.16.11.1/32 route from Router Internet have leaked into the routing table on Router South.

Meaning The installation of prefixes is successful because of the configured BGP import policy.

Verifying Conditional Export from Router North to Router South

Purpose Verify that when Device Internet stops sending the 172.16.11.1/32 route, Device North stops sending the default 0/0 route.

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Action

1. Cause Device Internet to stop sending the 172.16.11.1/32 route by deactivating the 172.16.11.1/32 address on the loopback interface.

```
[edit interfaces lo0 unit 0 family inet]
user@Internet# deactivate address 172.16.11.1/32
user@Internet# commit
```

2. From operational mode on Router North, run the **show route advertising-protocol bgp *neighbor-address*** command.

```
user@North> show route advertising-protocol bgp 10.0.78.13

inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 172.16.12.1/32            Self                                    300 I
* 172.16.13.1/32            Self                                    300 I
* 172.16.14.1/32            Self                                    300 I
* 172.16.15.1/32            Self                                    300 I
```

   The output verifies that Router North is not advertising the default route to Router South. This is the expected behavior when the 172.16.11.1/32 route is not present.

3. Reactivate the 172.16.11.1/32 address on Device Internet's loopback interface.

```
[edit interfaces lo0 unit 0 family inet]
user@Internet# activate address 172.16.11.1/32
user@Internet# commit
```

Verifying the Presence of Routes Hidden by Policy (Optional)

Purpose Verify the presence of routes hidden by the import policy configured on Router South.

NOTE: This section demonstrates the effects of various changes you can make to the configuration depending on your needs.

Action View routes hidden from the routing table of Router South by:

- Using the **hidden** option for the **show route receive-protocol bgp *neighbor-address*** command.
- Deactivating the import policy.

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1. From operational mode, run the **show route receive-protocol bgp *neighbor-address* hidden** command to view hidden routes.

```
user@South> show route receive-protocol bgp 10.0.78.14 hidden
inet.0: 10 destinations, 11 routes (6 active, 0 holddown, 4 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
  172.16.12.1/32             10.0.78.14                               200 300
I
  172.16.13.1/32             10.0.78.14                               200 300
I
  172.16.14.1/32             10.0.78.14                               200 300
I
  172.16.15.1/32             10.0.78.14                               200 300
I
```

   The output verifies the presence of routes hidden by the import policy (172.16.12.1/32, 172.16.13.1/32, 172.16.14.1/32, and 172.16.15.1/32) on Router South.

2. Deactivate the BGP import policy by configuring the **deactivate import** statement at the **[edit protocols bgp group *group-name*]** hierarchy level.

```
[edit protocols bgp group toNorth]
user@South# deactivate import
user@South# commit
```

3. Run the **show route receive-protocol bgp *neighbor-address*** operational mode command to check the routes after deactivating the import policy.

```
user@South> show route receive-protocol bgp 10.0.78.14
inet.0: 10 destinations, 11 routes (10 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 0.0.0.0/0                10.0.78.14                               200 I
* 172.16.11.1/32            10.0.78.14                               200 300
I
* 172.16.12.1/32            10.0.78.14                               200 300
I
* 172.16.13.1/32            10.0.78.14                               200 300
I
* 172.16.14.1/32            10.0.78.14                               200 300
I
* 172.16.15.1/32            10.0.78.14                               200 300
I
```

   The output verifies the presence of previously hidden routes (172.16.12.1/32, 172.16.13.1/32, 172.16.14.1/32, and 172.16.15.1/32).

4. Activate the BGP import policy and remove the hidden routes from the routing table by configuring the **activate import** and **keep none** statements respectively at the **[edit protocols bgp group *group-name*]** hierarchy level.

```
[edit protocols bgp group toNorth]
user@South# activate import
```

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```
user@South# set keep none
user@South# commit
```

5. From operational mode, run the **show route receive-protocol bgp** *neighbor-address* **hidden** command to check the routes after activating the import policy and configuring the **keep none** statement.

```
user@South> show route receive-protocol bgp 10.0.78.14 hidden

inet.0: 6 destinations, 7 routes (6 active, 0 holddown, 0 hidden)
```

The output verifies that the hidden routes are not maintained in the routing table because of the configured **keep none** statement.

Related Documentation

- Conditional Advertisement Enabling Conditional Installation of Prefixes Use Cases on page 351
- Conditional Advertisement and Import Policy (Routing Table) with certain match conditions on page 353

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CHAPTER 11

Defining Routing Policies for BGP Communities

- Understanding BGP Communities, Extended Communities, and Large Communities as Routing Policy Match Conditions on page 373
- Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS on page 375
- Example: Configuring a Routing Policy That Removes BGP Communities on page 384
- Example: Configuring a Routing Policy Based on the Number of BGP Communities on page 392

Understanding BGP Communities, Extended Communities, and Large Communities as Routing Policy Match Conditions

A *BGP community* is a group of destinations that share a common property. Community information is included as a path attribute in BGP update messages. This information identifies community members and enables you to perform actions on a group without having to elaborate upon each member. You can use community and extended communities attributes to trigger routing decisions, such as acceptance, rejection, preference, or redistribution.

You can assign community tags to non-BGP routes through configuration (for static, aggregate, or generated routes) or an import routing policy. These tags can then be matched when BGP exports the routes.

A community value is a 32-bit field that is divided into two main sections. The first 16 bits of the value encode the AS number of the network that originated the community, while the last 16 bits carry a unique number assigned by the AS. This system attempts to guarantee a globally unique set of community values for each AS in the Internet. Junos OS uses a notation of ***as-number:community-value***, where each value is a decimal number. The AS values of 0 and 65,535 are reserved, as are all of the community values within those AS numbers. Each community, or set of communities, is given a name within the **[edit policy-options]** configuration hierarchy. The name of the community uniquely identifies it to the routing device and serves as the method by which routes are categorized. For example, a route with a community value of 64510:1111 might belong to the community named **AS64510-routes**. The community name is also used within a routing policy as a match criterion or as an action. The command syntax for creating a community is:

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policy-options **community *name* members [*community-ids*]**. The ***community-ids*** are either a single community value or multiple community values. When more than one value is assigned to a community name, the routing device interprets this as a logical AND of the community values. In other words, a route must have all of the configured values before being assigned the community name.

The regular community attribute is four octets. Networking enhancements, such as VPNs, have functionality requirements that can be satisfied by an attribute such as a community. However, the 4-octet community value does not provide enough expansion and flexibility to accommodate VPN requirements. This leads to the creation of extended communities. An extended community is an 8-octet value that is also divided into two main sections. The first 2 octets of the community encode a type field while the last 6 octets carry a unique set of data in a format defined by the type field. Extended communities provide a larger range for grouping or categorizing communities.

The BGP extended communities attribute format has three fields: ***type*:*administrator*:*assigned-number***. The routing device expects you to use the words **target** or **origin** to represent the type field. The administrator field uses a decimal number for the AS or an IPv4 address, while the assigned number field expects a decimal number no larger than the size of the field (65,535 for 2 octets or 4,294,967,295 for 4 octets).

When specifying community IDs for standard and extended community attributes, you can use UNIX-style regular expressions. The only exception is for VPN import policies (**vrf-import**), which do not support regular expressions for the extended communities attribute.

Regular BGP communities attributes are a variable length attribute consisting of a set of one or more 4-byte values that was split into 16 bit values. The most significant word is interpreted as an AS number and least significant word is a locally defined value assigned by the operator of the AS. Since the adoption of 4-byte ASNs, the 4-byte BGP regular community and 6-byte BGP extended community can no longer support BGP community attributes. Operators often encode AS number in the local portion of the BGP community that means that sometimes the format of the community is ASN:ASN. With the 4-byte ASN , you need 8-bytes to encode it. Although BGP extended community permits a 4-byte AS to be encoded as the global administrator filed, the local administrator field has only 2-byte of available space. Thus, 6-byte extended community attribute is also unsuitable. To overcome this, Junos OS allows you to configure optional transitive path attribute - a 12-byte BGP large community that provides the most significant 4-byte value to encode autonomous system number as the global administrator and the remaining two 4-byte assigned numbers to encode the local values as defined in RFC 8092. You can configure BGP large community at the **[edit policy-options community *community-name* members]** and **[edit routing-options static route *ip-address* community]** hierarchy levels. The BGP large community attributes format has four fields: **large:*global administrator*:*assigned number*:*assigned number***.

NOTE: **The length of the BGP large communities attribute value should be a non-zero multiple of 12.**

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Related Documentation

- *Understanding How to Define BGP Communities and Extended Communities*
- *How BGP Communities and Extended Communities Are Evaluated in Routing Policy Match Conditions*
- Example: Configuring a Routing Policy That Removes BGP Communities on page 384
- *Example: Configuring Communities in a Routing Policy*
- *Example: Configuring Extended Communities in a Routing Policy*
- Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS on page 375

Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS

This example defines a policy that takes BGP routes from the **Edu** community and places them into IS-IS with a metric of 63.

- Requirements on page 375
- Overview on page 375
- Configuration on page 376
- Verification on page 383

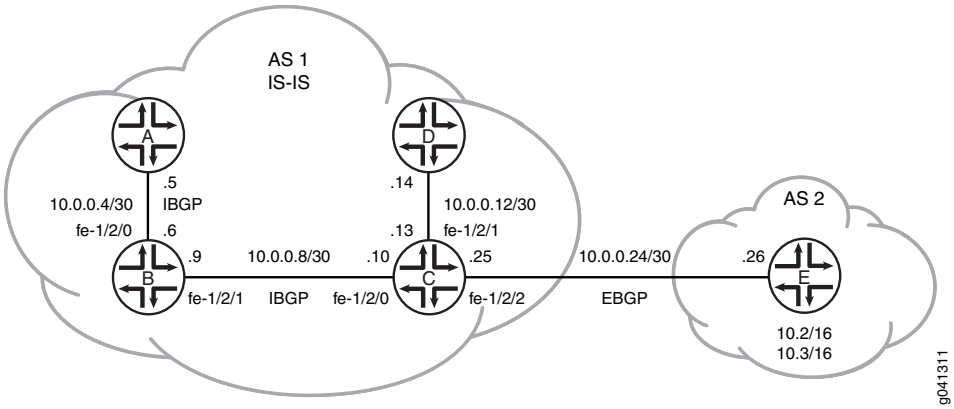
Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

Figure 38 on page 375 shows the topology used in this example.

Figure 38: Redistributing BGP Routes with a Specific Community Tag into IS-IS



In this example, Device A, Device B, Device C, and Device D are in autonomous system (AS) 1 and are running IS-IS. All of the AS 1 devices, except Device D, are running internal BGP (IBGP).

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Device E is in AS 2 and has an external BGP (EBGP) peering session with Device C. Device E has two static routes, 10.2.0.0/16 and 10.3.0.0/16. These routes are tagged with the Edu 2:5 community attribute and are advertised by way of EBGP to Device C.

Device C accepts the BGP routes that are tagged with the Edu 2:5 community attribute, redistributes the routes into IS-IS, and applies an IS-IS metric of 63 to these routes.

"CLI Quick Configuration" on page 376 shows the configuration for all of the devices in Figure 38 on page 375. The section "Step-by-Step Procedure" on page 378 describes the steps on Device C and Device E.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.5/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0001.00
set protocols bgp group int type internal
set protocols bgp group int local-address 192.168.0.1
set protocols bgp group int neighbor 192.168.0.2
set protocols bgp group int neighbor 192.168.0.3
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface lo0.0
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 1
```

Device B

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.6/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.9/30
set interfaces fe-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0002.00
set protocols bgp group int type internal
set protocols bgp group int local-address 192.168.0.2
set protocols bgp group int neighbor 192.168.0.1
set protocols bgp group int neighbor 192.168.0.3
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface fe-1/2/1.0 level 1 disable
set protocols isis interface lo0.0
set routing-options router-id 192.168.0.2
set routing-options autonomous-system 1
```

Device C

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.10/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces fe-1/2/1 unit 0 family inet address 10.0.0.13/30
```


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```
set interfaces fe-1/2/1 unit 0 family iso
set interfaces fe-1/2/2 unit 0 family inet address 10.0.0.25/30
set interfaces fe-1/2/2 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0003.00
set protocols bgp group int type internal
set protocols bgp group int local-address 192.168.0.3
set protocols bgp group int neighbor 192.168.0.1
set protocols bgp group int neighbor 192.168.0.2
set protocols bgp group external-peers type external
set protocols bgp group external-peers export send-isis-and-direct
set protocols bgp group external-peers peer-as 2
set protocols bgp group external-peers neighbor 10.0.0.26
set protocols isis export Edu-to-isis
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface fe-1/2/1.0 level 1 disable
set protocols isis interface fe-1/2/2.0 level 1 disable
set protocols isis interface fe-1/2/2.0 level 2 passive
set protocols isis interface lo0.0
set policy-options policy-statement Edu-to-isis term 1 from protocol bgp
set policy-options policy-statement Edu-to-isis term 1 from community Edu
set policy-options policy-statement Edu-to-isis term 1 then metric 63
set policy-options policy-statement Edu-to-isis term 1 then accept
set policy-options policy-statement send-isis-and-direct term 1 from protocol isis
set policy-options policy-statement send-isis-and-direct term 1 from protocol direct
set policy-options policy-statement send-isis-and-direct term 1 from route-filter
  10.0.0.0/16 orlonger
set policy-options policy-statement send-isis-and-direct term 1 from route-filter
  192.168.0.0/16 orlonger
set policy-options policy-statement send-isis-and-direct term 1 then accept
set policy-options community Edu members 2:5
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 1
```

Device D

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.14/30
set interfaces fe-1/2/0 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.4/32
set interfaces lo0 unit 0 family iso address 49.0002.0192.0168.0004.00
set protocols isis interface fe-1/2/0.0 level 1 disable
set protocols isis interface lo0.0
set routing-options router-id 192.168.0.4
set routing-options autonomous-system 1
```

Device E

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.26/30
set interfaces lo0 unit 7 family inet address 192.168.0.5/32 primary
set interfaces lo0 unit 7 family inet address 10.2.0.1/32
set interfaces lo0 unit 7 family inet address 10.3.0.1/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers export statics
set protocols bgp group external-peers peer-as 1
set protocols bgp group external-peers neighbor 10.0.0.25
set policy-options policy-statement statics from protocol static
```

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```
set policy-options policy-statement statics then community add Edu
set policy-options policy-statement statics then accept
set policy-options community Edu members 2:5
set routing-options static route 10.2.0.0/16 reject
set routing-options static route 10.2.0.0/16 install
set routing-options static route 10.3.0.0/16 reject
set routing-options static route 10.3.0.0/16 install
set routing-options router-id 192.168.0.5
set routing-options autonomous-system 2
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device E:

1. Configure the interfaces.

```
[edit interfaces]
user@E# set fe-1/2/0 unit 0 family inet address 10.0.0.26/30
user@E# set lo0 unit 7 family inet address 192.168.0.5/32 primary
user@E# set lo0 unit 7 family inet address 10.2.0.1/32
user@E# set lo0 unit 7 family inet address 10.3.0.1/32
```

2. Configure the **statics** policy, which adds the **Edu** community attribute to the static routes.

```
[edit policy-options]
user@E# set policy-statement statics from protocol static
user@E# set policy-statement statics then community add Edu
user@E# set policy-statement statics then accept
user@E# set community Edu members 2:5
```

3. Configure EBGP and apply the **statics** policy.

```
[edit protocols bgp group external-peers]
user@E# set type external
user@E# set export statics
user@E# set peer-as 1
user@E# set protocols bgp group external-peers neighbor 10.0.0.25
```

4. Configure the static routes.

```
[edit routing-options static]
user@E# set route 10.2.0.0/16 reject
user@E# set route 10.2.0.0/16 install
user@E# set route 10.3.0.0/16 reject
user@E# set route 10.3.0.0/16 install
```


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5. Configure the router ID and the AS number.

```
[edit routing-options]
user@E# set router-id 192.168.0.5
user@E# set autonomous-system 2
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device C:

1. Configure the interfaces.

```
[edit interfaces]
user@C# set fe-1/2/0 unit 0 family inet address 10.0.0.10/30
user@C# set fe-1/2/0 unit 0 family iso
user@C# set fe-1/2/1 unit 0 family inet address 10.0.0.13/30
user@C# set fe-1/2/1 unit 0 family iso
user@C# set fe-1/2/2 unit 0 family inet address 10.0.0.25/30
user@C# set fe-1/2/2 unit 0 family iso
user@C# set lo0 unit 0 family inet address 192.168.0.3/32
user@C# set lo0 unit 0 family iso address 49.0002.0192.0168.0003.00
```

2. Configure IBGP.

```
[edit protocols bgp group int]
user@C# set type internal
user@C# set local-address 192.168.0.3
user@C# set neighbor 192.168.0.1
user@C# set neighbor 192.168.0.2
```

3. Configure the Edu-to-isis policy, which redistributes the Edu-tagged BGP routes learned from Device E and applies a metric of 63.

```
[edit policy-options]
user@C# set policy-statement Edu-to-isis term 1 from protocol bgp
user@C# set policy-statement Edu-to-isis term 1 from community Edu
user@C# set policy-statement Edu-to-isis term 1 then metric 63
user@C# set policy-statement Edu-to-isis term 1 then accept
user@C# set community Edu members 2:5
```

4. Enable IS-IS on the interfaces, and apply the Edu-to-isis policy.

```
[edit protocols isis]
user@C# set export Edu-to-isis
user@C# set interface fe-1/2/0.0 level 1 disable
user@C# set interface fe-1/2/1.0 level 1 disable
user@C# set interface fe-1/2/2.0 level 1 disable
```

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```
user@C# set interface fe-1/2/2.0 level 2 passive
user@C# set interface lo0.0
```

5. Configure the send-isis-and-direct policy, which redistributes routes to Device E, through EBGP.

   Without this policy, Device E would not have connectivity to the networks in AS 1.

```
[edit policy-options policy-statement send-isis-and-direct term 1]
user@C# set from protocol isis
user@C# set from protocol direct
user@C# set from route-filter 10.0.0.0/16 orlonger
user@C# set from route-filter 192.168.0.0/16 orlonger
user@C# set then accept
```

6. Configure EBGP and apply the send-isis-and-direct policy.

```
[edit protocols bgp group external-peers]
user@C# set type external
user@C# set export send-isis-and-direct
user@C# set peer-as 2
user@C# set neighbor 10.0.0.26
```

7. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@C# set router-id 192.168.0.3
user@C# set autonomous-system 1
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device E

```
user@E# show interfaces
fe-1/2/0 {
    unit 0 {
        family inet {
            address 10.0.0.26/30;
        }
    }
}
lo0 {
    unit 0 {
        family inet {
            address 192.168.0.5/32 {
                primary;
            }
```


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```
        address 10.2.0.1/32;
        address 10.3.0.1/32;
      }
    }
}
```

```
user@E# show protocols
bgp {
    group external-peers {
        type external;
        export statics;
        peer-as 1;
        neighbor 10.0.0.25;
    }
}
```

```
user@E# show policy-options
policy-statement statics {
    from protocol static;
    then {
        community add Edu;
        accept;
    }
}
community Edu members 2:5;
```

```
user@E# show routing-options
static {
    route 10.2.0.0/16 {
        reject;
        install;
    }
    route 10.3.0.0/16 {
        reject;
        install;
    }
}
router-id 192.168.0.5;
autonomous-system 2;
```

Device C

```
user@C# show interfaces
fe-1/2/0 {
    unit 0 {
        family inet {
            address 10.0.0.10/30;
        }
        family iso;
    }
}
fe-1/2/1 {
    unit 0 {
        family inet {
```

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```
        address 10.0.0.13/30;
      }
      family iso;
    }
}
fe-1/2/2 {
    unit 0 {
      family inet {
        address 10.0.0.25/30;
      }
      family iso;
    }
}
lo0 {
    unit 0 {
      family inet {
        address 192.168.0.3/32;
      }
      family iso {
        address 49.0002.0192.0168.0003.00;
      }
    }
}
```

```
user@C# show protocols
bgp {
    group int {
      type internal;
      local-address 192.168.0.3;
      neighbor 192.168.0.1;
      neighbor 192.168.0.2;
    }
    group external-peers {
      type external;
      export send-isis-and-direct;
      peer-as 2;
      neighbor 10.0.0.26;
    }
}
isis {
    export Edu-to-isis;
    interface fe-1/2/0.0 {
      level 1 disable;
    }
    interface fe-1/2/1.0 {
      level 1 disable;
    }
    interface fe-1/2/2.0 {
      level 1 disable;
      level 2 passive;
    }
    interface lo0.0;
}
```


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```
user@C# show policy-options
policy-statement Edu-to-isis {
   term 1 {
      from {
         protocol bgp;
         community Edu;
      }
      then {
         metric 63;
         accept;
      }
   }
}
policy-statement send-isis-and-direct {
   term 1 {
      from {
         protocol [ isis direct ];
         route-filter 10.0.0.0/16 orlonger;
         route-filter 192.168.0.0/16 orlonger;
      }
      then accept;
   }
}
community Edu members 2:5;
```

```
user@C# show routing-options
router-id 192.168.0.3;
autonomous-system 1;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the IS-IS Neighbor

Purpose Verify that the BGP routes from Device E are communicated on the IS-IS network in AS 1.

Action From operational mode, enter the **show route protocol isis** command.

```
user@D> show route protocol isis
inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.4/30        *[IS-IS/18] 22:30:53, metric 30
                    > to 10.0.0.13 via fe-1/2/0.0
10.0.0.8/30        *[IS-IS/18] 22:30:53, metric 20
                    > to 10.0.0.13 via fe-1/2/0.0
10.0.0.24/30       *[IS-IS/18] 03:31:21, metric 20
                    > to 10.0.0.13 via fe-1/2/0.0
10.2.0.0/16        *[IS-IS/165] 02:36:31, metric 73
```

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```
                    > to 10.0.0.13 via fe-1/2/0.0
10.3.0.0/16         *[IS-IS/165] 02:36:31, metric 73
                    > to 10.0.0.13 via fe-1/2/0.0
192.168.0.1/32      *[IS-IS/18] 03:40:28, metric 30
                    > to 10.0.0.13 via fe-1/2/0.0
192.168.0.2/32      *[IS-IS/18] 22:30:53, metric 20
                    > to 10.0.0.13 via fe-1/2/0.0
192.168.0.3/32      *[IS-IS/18] 22:30:53, metric 10
                    > to 10.0.0.13 via fe-1/2/0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

Meaning As expected, the 10.2.0.0/16 and 10.3.0.0/16 routes are in Device D's routing table as IS-IS external routes with a metric of 73. If Device C had not added 63 to the metric, Device D would have a metric of 10 for these routes.

Related Documentation

- *Advertising LSPs into IGPs*

Example: Configuring a Routing Policy That Removes BGP Communities

This example shows how to create a policy that accepts BGP routes, but removes BGP communities from the routes.

- Requirements on page 384
- Overview on page 384
- Configuration on page 385
- Verification on page 390

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

This example shows two routing devices with an external BGP (EBGP) connection between them. Device R2 uses the BGP session to send two static routes to Device R1. On Device R1, an import policy specifies that all BGP communities must be removed from the routes.

By default, when communities are configured on EBGP peers, they are sent and accepted. To suppress the acceptance of communities received from a neighbor, you can remove all communities or a specified set of communities. When the result of a policy is an empty set of communities, the community attribute is not included. To remove all communities, first define a wildcard set of communities (here, the community is named **wild**):

```
[edit policy-options]
community wild members "* : *";
```


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Then, in the routing policy statement, specify the **community delete** action:

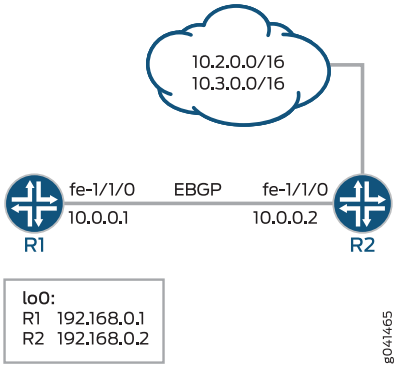
```
[edit policy-options]
policy-statement policy-name {
   term term-name {
      then community delete wild;
   }
}
```

To suppress a particular community from any autonomous system (AS), define the community as **community wild members "*:*community-value*"**.

Topology

Figure 39 on page 385 shows the sample network.

Figure 39: BGP Policy That Removes Communities



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/1/0 unit 0 description to-R2
set interfaces fe-1/1/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 2
set protocols bgp group external-peers neighbor 10.0.0.2 import remove-communities
set policy-options policy-statement remove-communities term 1 from protocol bgp
set policy-options policy-statement remove-communities term 1 then community delete
   wild
set policy-options policy-statement remove-communities term 1 then accept
set policy-options policy-statement remove-communities term 2 then reject
set policy-options community wild members *:*
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 1
```

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Device R2

```
set interfaces fe-1/1/0 unit 0 description to-R1
set interfaces fe-1/1/0 unit 0 family inet address 10.0.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers export statics
set protocols bgp group external-peers peer-as 1
set protocols bgp group external-peers neighbor 10.0.0.1
set policy-options policy-statement statics from protocol static
set policy-options policy-statement statics then community add 1
set policy-options policy-statement statics then accept
set policy-options community 1 members 2:1
set policy-options community 1 members 2:2
set policy-options community 1 members 2:3
set policy-options community 1 members 2:4
set policy-options community 1 members 2:5
set policy-options community 1 members 2:6
set policy-options community 1 members 2:7
set policy-options community 1 members 2:8
set policy-options community 1 members 2:9
set policy-options community 1 members 2:10
set routing-options static route 10.2.0.0/16 reject
set routing-options static route 10.2.0.0/16 install
set routing-options static route 10.3.0.0/16 reject
set routing-options static route 10.3.0.0/16 install
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 2
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/1/0 unit 0 description to-R2
user@R1# set fe-1/1/0 unit 0 family inet address 10.0.0.1/30
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

2. Configure BGP.

   Apply the import policy to the BGP peering session with Device R2.

```
[edit protocols bgp group external-peers]
user@R1# set type external
user@R1# set peer-as 2
user@R1# set neighbor 10.0.0.2 import remove-communities
```

3. Configure the routing policy that deletes communities.

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```
[edit policy-options policy-statement remove-communities]
user@R1# set term 1 from protocol bgp
user@R1# set term 1 then community delete wild
user@R1# set term 1 then accept
user@R1# set term 2 then reject
```

4. Configure the autonomous system (AS) number and the router ID.

```
[edit routing-options ]
user@R1# set router-id 192.168.0.1
user@R1# set autonomous-system 1
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set fe-1/1/0 unit 0 description to-R1
user@R2# set fe-1/1/0 unit 0 family inet address 10.0.0.2/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@R2# set router-id 192.168.0.3
user@R2# set autonomous-system 2
```

3. Configure BGP.

```
[edit protocols bgp group external-peers]
user@R2# set type external
user@R2# set peer-as 1
user@R2# set neighbor 10.0.0.1
```

4. Configure multiple communities, or configure a single community with multiple members.

```
[edit policy-options community 1]
user@R2# set members 2:1
user@R2# set members 2:2
user@R2# set members 2:3
user@R2# set members 2:4
user@R2# set members 2:5
user@R2# set members 2:6
```

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```
user@R2# set members 2:7
user@R2# set members 2:8
user@R2# set members 2:9
user@R2# set members 2:10
```

5. Configure the static routes.

```
[edit routing-options static]
user@R2# set route 10.2.0.0/16 reject
user@R2# set route 10.2.0.0/16 install
user@R2# set route 10.3.0.0/16 reject
user@R2# set route 10.3.0.0/16 install
```

6. Configure a routing policy that advertises static routes into BGP and adds the BGP community to the routes.

```
[edit policy-options policy-statement statics]
user@R2# set from protocol static
user@R2# set then community add 1
user@R2# set then accept
```

7. Apply the export policy.

```
[edit protocols bgp group external-peers]
user@R2# set export statics
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device R1

```
user@R1# show interfaces
fe-1/1/0 {
   unit 0{
      description to-R2;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```


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```
user@R1# show protocols
bgp {
   group external-peers {
      type external;
      peer-as 2;
      neighbor 10.0.0.2 {
         import remove-communities;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement remove-communities {
   term 1 {
      from protocol bgp;
      then {
         community delete wild;
         accept;
      }
   }
   term 2 {
      then reject;
   }
}
community wild members *:*;
```

```
user@R1# show routing-options
router-id 192.168.0.1;
autonomous-system 1;
```

Device R2

```
user@R2# show interfaces
fe-1/1/0 {
   unit 0 {
      description to-R1;
      family inet {
         address 10.0.0.2/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.2/32;
      }
   }
}
```

```
user@R2# show protocols
bgp {
   group external-peers {
      type external;
      export statics;
```

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```
    peer-as 1;
    neighbor 10.0.0.1;
  }
}
```

```
user@R2# show policy-options
policy-statement statics {
  from protocol static;
  then {
    community add 1;
    accept;
  }
}
community 1 members [ 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10 ];
```

```
user@R2# show routing-options
static {
  route 10.2.0.0/16 {
    reject;
    install;
  }
  route 10.3.0.0/16 {
    reject;
    install;
  }
}
router-id 192.168.0.3;
autonomous-system 2;
```

If you are done configuring the devices, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the BGP Routes

Purpose Make sure that the routing table on Device R1 does not contain BGP communities.

Action 1. On Device R1, run the **show route protocols bgp extensive** command.

```
user@R1> show route protocols bgp extensive

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
10.2.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.2.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
```


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```
                Next hop: 10.0.0.2 via lt-1/1/0.5, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 20:39:01
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3

10.3.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.3.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via lt-1/1/0.5, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 20:39:01
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3
```

2. On Device R1, deactivate the **community remove** configuration in the import policy.

```
[edit policy-options policy-statement remove-communities term 1]
user@R1# deactivate then community delete wild
user@R1# commit
```

3. On Device R1, run the **show route protocols bgp extensive** command to view the advertised communities.

```
user@R1> show route protocols bgp extensive
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
10.2.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.2.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via lt-1/1/0.5, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 20:40:53
```

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```
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Communities: 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3

10.3.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.3.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via lt-1/1/0.5, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 20:40:53
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Communities: 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3
```

Meaning The output shows that in Device R1's routing table, the communities are suppressed in the BGP routes sent from Device R2. When the **community remove** setting in Device R1's import policy is deactivated, the communities are no longer suppressed.

Related Documentation

- Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS on page 375
- Understanding External BGP Peering Sessions on page 23

Example: Configuring a Routing Policy Based on the Number of BGP Communities

This example shows how to create a policy that accepts BGP routes based on the number of BGP communities.

- Requirements on page 393
- Overview on page 393
- Configuration on page 393
- Verification on page 398

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Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

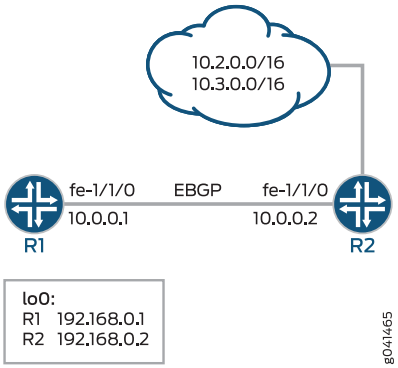
This example shows two routing devices with an external BGP (EBGP) connection between them. Device R2 uses the BGP session to send two static routes to Device R1. On Device R1, an import policy specifies that the BGP-received routes can contain up to five communities to be considered a match. For example, if a route contains three communities, it is considered a match and is accepted. If a route contains six or more communities, it is considered a nonmatch and is rejected.

It is important to remember that the default policy for EBGP is to accept all routes. To ensure that the nonmatching routes are rejected, you must include a **then reject** action at the end of the policy definition.

Topology

Figure 40 on page 393 shows the sample network.

Figure 40: BGP Policy with a Limit on the Number of Communities Accepted



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/1/0 unit 0 description to-R2
set interfaces fe-1/1/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 2
set protocols bgp group external-peers neighbor 10.0.0.2 import import-communities
set policy-options policy-statement import-communities term 1 from protocol bgp
set policy-options policy-statement import-communities term 1 from community-count
    5 orlower
```

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```
set policy-options policy-statement import-communities term 1 then accept
set policy-options policy-statement import-communities term 2 then reject
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 1
```

Device R2

```
set interfaces fe-1/1/0 unit 0 description to-R1
set interfaces fe-1/1/0 unit 0 family inet address 10.0.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers export statics
set protocols bgp group external-peers peer-as 1
set protocols bgp group external-peers neighbor 10.0.0.1
set policy-options policy-statement statics from protocol static
set policy-options policy-statement statics then community add 1
set policy-options policy-statement statics then accept
set policy-options community 1 members 2:1
set policy-options community 1 members 2:2
set policy-options community 1 members 2:3
set policy-options community 1 members 2:4
set policy-options community 1 members 2:5
set policy-options community 1 members 2:6
set policy-options community 1 members 2:7
set policy-options community 1 members 2:8
set policy-options community 1 members 2:9
set policy-options community 1 members 2:10
set routing-options static route 10.2.0.0/16 reject
set routing-options static route 10.2.0.0/16 install
set routing-options static route 10.3.0.0/16 reject
set routing-options static route 10.3.0.0/16 install
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 2
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set fe-1/1/0 unit 0 description to-R2
user@R1# set fe-1/1/0 unit 0 family inet address 10.0.0.1/30
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

2. Configure BGP.

   Apply the import policy to the BGP peering session with Device R2.

```
[edit protocols bgp group external-peers]
user@R1# set type external
```


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```
user@R1# set peer-as 2
user@R1# set neighbor 10.0.0.2 import import-communities
```

3. Configure the routing policy that sends direct routes.

```
[edit policy-options policy-statement import-communities]
user@R1# set term 1 from protocol bgp
user@R1# set term 1 from community-count 5 orlower
user@R1# set term 1 then accept
user@R1# set term 2 then reject
```

4. Configure the autonomous system (AS) number and the router ID.

```
[edit routing-options ]
user@R1# set router-id 192.168.0.1
user@R1# set autonomous-system 1
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set fe-1/1/0 unit 0 description to-R1
user@R2# set fe-1/1/0 unit 0 family inet address 10.0.0.2/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@R2# set router-id 192.168.0.3
user@R2# set autonomous-system 2
```

3. Configure BGP.

```
[edit protocols bgp group external-peers]
user@R2# set type external
user@R2# set peer-as 1
user@R2# set neighbor 10.0.0.1
```

4. Configure multiple communities, or configure a single community with multiple members.

```
[edit policy-options community 1]
```

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```
user@R2# set members 2:1
user@R2# set members 2:2
user@R2# set members 2:3
user@R2# set members 2:4
user@R2# set members 2:5
user@R2# set members 2:6
user@R2# set members 2:7
user@R2# set members 2:8
user@R2# set members 2:9
user@R2# set members 2:10
```

5. Configure the static routes.

```
[edit routing-options static]
user@R2# set route 10.2.0.0/16 reject
user@R2# set route 10.2.0.0/16 install
user@R2# set route 10.3.0.0/16 reject
user@R2# set route 10.3.0.0/16 install
```

6. Configure a routing policy that advertises static routes into BGP and adds the BGP community to the routes.

```
[edit policy-options policy-statement statics]
user@R2# set from protocol static
user@R2# set then community add 1
user@R2# set then accept
```

7. Apply the export policy.

```
[edit protocols bgp group external-peers]
user@R2# set export statics
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

Device R1

```
user@R1# show interfaces
fe-1/1/0 {
   unit 0{
      description to-R2;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 0 {
```


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```
    family inet {
      address 192.168.0.1/32;
    }
  }
}
}
```

```
user@R1# show protocols
bgp {
  group external-peers {
    type external;
    peer-as 2;
    neighbor 10.0.0.2 {
      import import-communities;
    }
  }
}
```

```
user@R1# show policy-options
policy-statement import-communities {
  term 1 {
    from {
      protocol bgp;
      community-count 5 orlower;
    }
    then accept;
  }
  term 2 {
    then reject;
  }
}
```

```
user@R1# show routing-options
router-id 192.168.0.1;
autonomous-system 1;
```

Device R2

```
user@R2# show interfaces
fe-1/1/0 {
  unit 0 {
    description to-R1;
    family inet {
      address 10.0.0.2/30;
    }
  }
}
lo0 {
  unit 0 {
    family inet {
      address 192.168.0.2/32;
    }
  }
}
```

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```
user@R2# show protocols
bgp {
   group external-peers {
      type external;
      export statics;
      peer-as 1;
      neighbor 10.0.0.1;
   }
}
```

```
user@R2# show policy-options
policy-statement statics {
   from protocol static;
   then {
      community add 1;
      accept;
   }
}
community 1 members [ 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10 ];
```

```
user@R2# show routing-options
static {
   route 10.2.0.0/16 {
      reject;
      install;
   }
   route 10.3.0.0/16 {
      reject;
      install;
   }
}
router-id 192.168.0.3;
autonomous-system 2;
```

If you are done configuring the devices, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying the BGP Routes

Purpose Make sure that the routing table on Device R1 contains the expected BGP routes.

Action

1. On Device R1, run the **show route protocols bgp** command.

```
user@R1> show route protocols bgp

inet.0: 5 destinations, 5 routes (3 active, 0 holddown, 2 hidden)
```

2. On Device R1, change the **community-count** configuration in the import policy.

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```
[edit policy-options policy-statement import-communities term 1]
user@R1# set from community-count 5 orhigher
user@R1# commit
```

3. On Device R1, run the **show route protocols bgp** command.

```
user@R1> show route protocols bgp

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.2.0.0/16        *[BGP/170] 18:29:53, localpref 100
                      AS path: 2 I, validation-state: unverified
                    > to 10.0.0.2 via fe-1/1/0.0
10.3.0.0/16        *[BGP/170] 18:29:53, localpref 100
                      AS path: 2 I, validation-state: unverified
                    > to 10.0.0.2 via fe-1/1/0.0
```

4. On Device R1, run the **show route protocols bgp extensive** command to view the advertised communities.

```
user@R1> show route protocols bgp extensive
inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
10.2.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.2.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via fe-1/1/0.0, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
                Age: 18:56:10
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Communities: 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3

10.3.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.3.0.0/16 -> {10.0.0.2}
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 671
                Address: 0x9458270
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via fe-1/1/0.0, selected
                Session Id: 0x100001
                State: <Active Ext>
                Local AS:     1 Peer AS:     2
```

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```
                Age: 18:56:10
                Validation State: unverified
                Task: BGP_2.10.0.0.2+179
                Announcement bits (1): 0-KRT
                AS path: 2 I
                Communities: 2:1 2:2 2:3 2:4 2:5 2:6 2:7 2:8 2:9 2:10
                Accepted
                Localpref: 100
                Router ID: 192.168.0.3
```

Meaning The output shows that in Device R1's routing table, the BGP routes sent from Device R2 are hidden. When the **community-count** setting in Device R1's import policy is modified, the BGP routes are no longer hidden.

Related Documentation

- Example: Configuring a Routing Policy to Redistribute BGP Routes with a Specific Community Tag into IS-IS on page 375
- Understanding External BGP Peering Sessions on page 23

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PART 6

Configuration BFD for BGP

- Configuring BFD for a BGP Session on page 403

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CHAPTER 12

Configuring BFD for a BGP Session

- Example: Configuring BFD for BGP on page 403
- Example: Configuring BFD Authentication for BGP on page 414

Example: Configuring BFD for BGP

- Understanding BFD for BGP on page 403
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404

Understanding BFD for BGP

The Bidirectional Forwarding Detection (BFD) protocol is a simple hello mechanism that detects failures in a network. Hello packets are sent at a specified, regular interval. A neighbor failure is detected when the routing device stops receiving a reply after a specified interval. BFD works with a wide variety of network environments and topologies. The failure detection timers for BFD have shorter time limits than default failure detection mechanisms for BGP, so they provide faster detection.

NOTE: Configuring both BFD and graceful restart for BGP on the same device is counterproductive. When an interface goes down, BFD detects this instantly, stops traffic forwarding and the BGP session goes down whereas graceful restart forwards traffic despite the interface failure, this behavior might cause network issues. Hence we do not recommend configuring both BFD and graceful restart on the same device.

The BFD failure detection timers can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds (15000 milliseconds). A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

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NOTE: On all SRX Series devices, high CPU utilization triggered for reasons such as CPU intensive commands and SNMP walks causes the BFD protocol to flap while processing large BGP updates. (Platform support depends on the Junos OS release in your installation.)

Starting with Junos OS Release 15.1X49-D100, SRX340, SRX345, and SRX1500 devices support dedicated BFD.

Starting with Junos OS Release 15.1X49-D100, SRX300 and SRX320 devices support real-time BFD.

Starting with Junos OS Release 15.1X49-D110, SRX550M devices support dedicated BFD.

In Junos OS Release 8.3 and later, BFD is supported on internal BGP (IBGP) and multihop external BGP (EBGP) sessions as well as on single-hop EBGP sessions. In Junos OS Release 9.1 through Junos OS Release 11.1, BFD supports IPv6 interfaces in static routes only. In Junos OS Release 11.2 and later, BFD supports IPv6 interfaces with BGP.

See Also

- *Enabling Dedicated and Real-Time BFD*
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404

Example: Configuring BFD on Internal BGP Peer Sessions

This example shows how to configure internal BGP (IBGP) peer sessions with the Bidirectional Forwarding Detection (BFD) protocol to detect failures in a network.

- Requirements on page 404
- Overview on page 404
- Configuration on page 406
- Verification on page 410

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

The minimum configuration to enable BFD on IBGP sessions is to include the **bfd-liveness-detection** **minimum-interval** statement in the BGP configuration of all neighbors participating in the BFD session. The **minimum-interval** statement specifies the minimum transmit and receive intervals for failure detection. Specifically, this value represents the minimum interval after which the local routing device transmits hello packets as well as the minimum interval that the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value from 1 through 255,000 milliseconds.

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Optionally, you can specify the minimum transmit and receive intervals separately using the **transmit-interval minimum-interval** and **minimum-receive-interval** statements. For information about these and other optional BFD configuration statements, see bfd-liveness-detection.

NOTE: BFD is an intensive protocol that consumes system resources. Specifying a minimum interval for BFD less than 100 milliseconds for Routing Engine-based sessions and less than 10 milliseconds for distributed BFD sessions can cause undesired BFD flapping.

Depending on your network environment, these additional recommendations might apply:

- To prevent BFD flapping during the general Routing Engine switchover event, specify a minimum interval of 5000 milliseconds for Routing Engine-based sessions. This minimum value is required because, during the general Routing Engine switchover event, processes such as RPD, MIBD, and SNMPD utilize CPU resources for more than the specified threshold value. Hence, BFD processing and scheduling is affected because of this lack of CPU resources.
- For BFD sessions to remain up during the dual chassis cluster control link scenario, when the first control link fails, specify the minimum interval of 6000 milliseconds to prevent the LACP from flapping on the secondary node for Routing Engine-based sessions.
- For large-scale network deployments with a large number of BFD sessions, specify a minimum interval of 300 milliseconds for Routing Engine-based sessions and 100 milliseconds for distributed BFD sessions.
- For very large-scale network deployments with a large number of BFD sessions, contact Juniper Networks customer support for more information.
- For BFD sessions to remain up during a Routing Engine switchover event when nonstop active routing (NSR) is configured, specify a minimum interval of 2500 milliseconds for Routing Engine-based sessions. For distributed BFD sessions with NSR configured, the minimum interval recommendations are unchanged and depend only on your network deployment.

BFD is supported on the default routing instance (the main router), routing instances, and logical systems. This example shows BFD on logical systems.

Figure 41 on page 406 shows a typical network with internal peer sessions.

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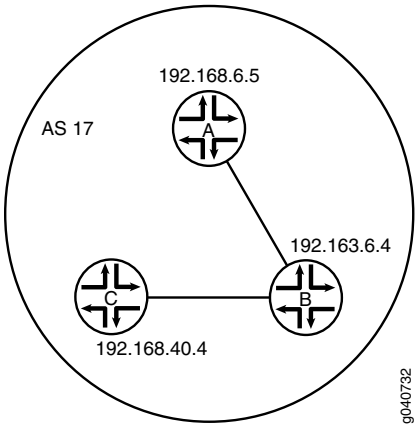
Figure 41: Typical Network with IBGP Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set logical-systems A interfaces lt-1/2/0 unit 1 description to-B
set logical-systems A interfaces lt-1/2/0 unit 1 encapsulation ethernet
set logical-systems A interfaces lt-1/2/0 unit 1 peer-unit 2
set logical-systems A interfaces lt-1/2/0 unit 1 family inet address 10.10.10.1/30
set logical-systems A interfaces lo0 unit 1 family inet address 192.168.6.5/32
set logical-systems A protocols bgp group internal-peers type internal
set logical-systems A protocols bgp group internal-peers traceoptions file bgp-bfd
set logical-systems A protocols bgp group internal-peers traceoptions flag bfd detail
set logical-systems A protocols bgp group internal-peers local-address 192.168.6.5
set logical-systems A protocols bgp group internal-peers export send-direct
set logical-systems A protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems A protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems A protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems A protocols ospf area 0.0.0.0 interface lo0.1 passive
set logical-systems A protocols ospf area 0.0.0.0 interface lt-1/2/0.1
set logical-systems A policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems A policy-options policy-statement send-direct term 2 then accept
set logical-systems A routing-options router-id 192.168.6.5
set logical-systems A routing-options autonomous-system 17
```

Device B

```
set logical-systems B interfaces lt-1/2/0 unit 2 description to-A
set logical-systems B interfaces lt-1/2/0 unit 2 encapsulation ethernet
set logical-systems B interfaces lt-1/2/0 unit 2 peer-unit 1
set logical-systems B interfaces lt-1/2/0 unit 2 family inet address 10.10.10.2/30
set logical-systems B interfaces lt-1/2/0 unit 5 description to-C
set logical-systems B interfaces lt-1/2/0 unit 5 encapsulation ethernet
```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```
set logical-systems B interfaces lt-1/2/0 unit 5 peer-unit 6
set logical-systems B interfaces lt-1/2/0 unit 5 family inet address 10.10.10.5/30
set logical-systems B interfaces lo0 unit 2 family inet address 192.163.6.4/32
set logical-systems B protocols bgp group internal-peers type internal
set logical-systems B protocols bgp group internal-peers local-address 192.163.6.4
set logical-systems B protocols bgp group internal-peers export send-direct
set logical-systems B protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems B protocols bgp group internal-peers neighbor 192.168.40.4
set logical-systems B protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems B protocols ospf area 0.0.0.0 interface lo0.2 passive
set logical-systems B protocols ospf area 0.0.0.0 interface lt-1/2/0.2
set logical-systems B protocols ospf area 0.0.0.0 interface lt-1/2/0.5
set logical-systems B policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems B policy-options policy-statement send-direct term 2 then accept
set logical-systems B routing-options router-id 192.163.6.4
set logical-systems B routing-options autonomous-system 17
```

Device C

```
set logical-systems C interfaces lt-1/2/0 unit 6 description to-B
set logical-systems C interfaces lt-1/2/0 unit 6 encapsulation ethernet
set logical-systems C interfaces lt-1/2/0 unit 6 peer-unit 5
set logical-systems C interfaces lt-1/2/0 unit 6 family inet address 10.10.10.6/30
set logical-systems C interfaces lo0 unit 3 family inet address 192.168.40.4/32
set logical-systems C protocols bgp group internal-peers type internal
set logical-systems C protocols bgp group internal-peers local-address 192.168.40.4
set logical-systems C protocols bgp group internal-peers export send-direct
set logical-systems C protocols bgp group internal-peers bfd-liveness-detection
  minimum-interval 1000
set logical-systems C protocols bgp group internal-peers neighbor 192.163.6.4
set logical-systems C protocols bgp group internal-peers neighbor 192.168.6.5
set logical-systems C protocols ospf area 0.0.0.0 interface lo0.3 passive
set logical-systems C protocols ospf area 0.0.0.0 interface lt-1/2/0.6
set logical-systems C policy-options policy-statement send-direct term 2 from protocol
  direct
set logical-systems C policy-options policy-statement send-direct term 2 then accept
set logical-systems C routing-options router-id 192.168.40.4
set logical-systems C routing-options autonomous-system 17
```

Configuring Device A

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device A:

1. Set the CLI to Logical System A.

   ```
   user@host> set cli logical-system A
   ```

2. Configure the interfaces.

```
[edit interfaces lt-1/2/0 unit 1]
user@host:A# set description to-B
user@host:A# set encapsulation ethernet
user@host:A# set peer-unit 2
user@host:A# set family inet address 10.10.10.1/30
[edit interfaces lo0 unit 1]
user@host:A# set family inet address 192.168.6.5/32
```

3. Configure BGP.

   The **neighbor** statements are included for both Device B and Device C, even though Device A is not directly connected to Device C.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# set type internal
   user@host:A# set local-address 192.168.6.5
   user@host:A# set export send-direct
   user@host:A# set neighbor 192.163.6.4
   user@host:A# set neighbor 192.168.40.4
   ```

4. Configure BFD.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# set bfd-liveness-detection minimum-interval 1000
   ```

   You must configure the same minimum interval on the connecting peer.

5. (Optional) Configure BFD tracing.

   ```
   [edit protocols bgp group internal-peers]
   user@host:A# set traceoptions file bgp-bfd
   user@host:A# set traceoptions flag bfd detail
   ```

6. Configure OSPF.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@host:A# set interface lo0.1 passive
   user@host:A# set interface lt-1/2/0.1
   ```

7. Configure a policy that accepts direct routes.

   Other useful options for this scenario might be to accept routes learned through OSPF or local routes.

   ```
   [edit policy-options policy-statement send-direct term 2]
   user@host:A# set from protocol direct
   user@host:A# set then accept
   ```

8. Configure the router ID and the autonomous system (AS) number.

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```
[edit routing-options]
user@host:A# set router-id 192.168.6.5
user@host:A# set autonomous-system 17
```

9. If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps to configure Device B and Device C.

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host:A# show interfaces
lt-1/2/0 {
  unit 1 {
    description to-B;
    encapsulation ethernet;
    peer-unit 2;
    family inet {
      address 10.10.10.1/30;
    }
  }
}
lo0 {
  unit 1 {
    family inet {
      address 192.168.6.5/32;
    }
  }
}
```

```
user@host:A# show policy-options
policy-statement send-direct {
  term 2 {
    from protocol direct;
    then accept;
  }
}
```

```
user@host:A# show protocols
bgp {
  group internal-peers {
    type internal;
    traceoptions {
      file bgp-bfd;
      flag bfd detail;
    }
    local-address 192.168.6.5;
    export send-direct;
    bfd-liveness-detection {
```

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```
        minimum-interval 1000;
      }
      neighbor 192.163.6.4;
      neighbor 192.168.40.4;
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.1 {
        passive;
      }
      interface lt-1/2/0.1;
    }
  }
```

```
user@host:A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```

Verification

Confirm that the configuration is working properly.

- Verifying That BFD Is Enabled on page 410
- Verifying That BFD Sessions Are Up on page 411
- Viewing Detailed BFD Events on page 411
- Viewing Detailed BFD Events After Deactivating and Reactivating a Loopback Interface on page 412

Verifying That BFD Is Enabled

Purpose Verify that BFD is enabled between the IBGP peers.

Action From operational mode, enter the **show bgp neighbor** command. You can use the **| match bfd** filter to narrow the output.

```
user@host:A> show bgp neighbor | match bfd
Options: <BfdEnabled>
  BFD: enabled, up
  Trace file: /var/log/A/bgp-bfd size 131072 files 10
  Options: <BfdEnabled>
  BFD: enabled, up
  Trace file: /var/log/A/bgp-bfd size 131072 files 10
```

Meaning The output shows that Logical System A has two neighbors with BFD enabled. When BFD is not enabled, the output displays **BFD: disabled, down**, and the **<BfdEnabled>** option is absent. If BFD is enabled and the session is down, the output displays **BFD: enabled, down**. The output also shows that BFD-related events are being written to a log file because trace operations are configured.

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Verifying That BFD Sessions Are Up

Purpose Verify that the BFD sessions are up, and view details about the BFD sessions.

Action From operational mode, enter the show bfd session **extensive** command.

```
user@host:A> show bfd session extensive
                                                  Detect   Transmit
Address                 State     Interface       Time     Interval  Multiplier
192.163.6.4             Up                        3.000     1.000        3
 Client BGP, TX interval 1.000, RX interval 1.000
 Session up time 00:54:40
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 12, routing table index 25
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 10, remote discriminator 9
 Echo mode disabled/inactive
 Multi-hop route table 25, local-address 192.168.6.5

                                                  Detect   Transmit
Address                 State     Interface       Time     Interval  Multiplier
192.168.40.4            Up                        3.000     1.000        3
 Client BGP, TX interval 1.000, RX interval 1.000
 Session up time 00:48:03
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Logical system 12, routing table index 25
 Min async interval 1.000, min slow interval 1.000
 Adaptive async TX interval 1.000, RX interval 1.000
 Local min TX interval 1.000, minimum RX interval 1.000, multiplier 3
 Remote min TX interval 1.000, min RX interval 1.000, multiplier 3
 Local discriminator 14, remote discriminator 13
 Echo mode disabled/inactive
 Multi-hop route table 25, local-address 192.168.6.5

2 sessions, 2 clients
Cumulative transmit rate 2.0 pps, cumulative receive rate 2.0 pps
```

Meaning The **TX interval 1.000, RX interval 1.000** output represents the setting configured with the **minimum-interval** statement. All of the other output represents the default settings for BFD. To modify the default settings, include the optional statements under the bfd-liveness-detection statement.

Viewing Detailed BFD Events

Purpose View the contents of the BFD trace file to assist in troubleshooting, if needed.

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Action From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

```
user@host:A> file show /var/log/A/bgp-bfd
Aug 15 17:07:25 trace_on: Tracing to "/var/log/A/bgp-bfd" started
Aug 15 17:07:26.492190 bgp_peer_init: BGP peer 192.163.6.4 (Internal AS 17) local
 address 192.168.6.5 not found.  Leaving peer idled
Aug 15 17:07:26.493176 bgp_peer_init: BGP peer 192.168.40.4 (Internal AS 17) local
 address 192.168.6.5 not found.  Leaving peer idled
Aug 15 17:07:32.597979 task_connect: task BGP_17.192.163.6.4+179 addr
192.163.6.4+179: No route to host
Aug 15 17:07:32.599623 bgp_connect_start: connect 192.163.6.4 (Internal AS 17):
No route to host
Aug 15 17:07:36.869394 task_connect: task BGP_17.192.168.40.4+179 addr
192.168.40.4+179: No route to host
Aug 15 17:07:36.870624 bgp_connect_start: connect 192.168.40.4 (Internal AS 17):
 No route to host
Aug 15 17:08:04.599220 task_connect: task BGP_17.192.163.6.4+179 addr
192.163.6.4+179: No route to host
Aug 15 17:08:04.601135 bgp_connect_start: connect 192.163.6.4 (Internal AS 17):
No route to host
Aug 15 17:08:08.869717 task_connect: task BGP_17.192.168.40.4+179 addr
192.168.40.4+179: No route to host
Aug 15 17:08:08.869934 bgp_connect_start: connect 192.168.40.4 (Internal AS 17):
 No route to host
Aug 15 17:08:36.603544 advertising receiving-speaker only capabilty to neighbor
192.163.6.4 (Internal AS 17)
Aug 15 17:08:36.606726 bgp_read_message: 192.163.6.4 (Internal AS 17): 0 bytes
buffered
Aug 15 17:08:36.609119 Initiated BFD session to peer 192.163.6.4 (Internal AS
17): address=192.163.6.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
ver=255
Aug 15 17:08:36.734033 advertising receiving-speaker only capabilty to neighbor
192.168.40.4 (Internal AS 17)
Aug 15 17:08:36.738436 Initiated BFD session to peer 192.168.40.4 (Internal AS
17): address=192.168.40.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
ver=255
Aug 15 17:08:40.537552 BFD session to peer 192.163.6.4 (Internal AS 17) up
Aug 15 17:08:40.694410 BFD session to peer 192.168.40.4 (Internal AS 17) up
```

Meaning Before the routes are established, the **No route to host** message appears in the output. After the routes are established, the last two lines show that both BFD sessions come up.

Viewing Detailed BFD Events After Deactivating and Reactivating a Loopback Interface

Purpose Check to see what happens after bringing down a router or switch and then bringing it back up. To simulate bringing down a router or switch, deactivate the loopback interface on Logical System B.

Action 1. From configuration mode, enter the **deactivate logical-systems B interfaces lo0 unit 2 family inet** command.

```
user@host:A# deactivate logical-systems B interfaces lo0 unit 2 family inet
user@host:A# commit
```

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2. From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

```
user@host:A> file show /var/log/A/bgp-bfd
...
Aug 15 17:20:55.995648 bgp_read_v4_message:9747: NOTIFICATION received from
192.163.6.4 (Internal AS 17): code 6 (Cease) subcode 6 (Other Configuration
Change)
Aug 15 17:20:56.004508 Terminated BFD session to peer 192.163.6.4 (Internal
AS 17)
Aug 15 17:21:28.007755 task_connect: task BGP_17.192.163.6.4+179 addr
192.163.6.4+179: No route to host
Aug 15 17:21:28.008597 bgp_connect_start: connect 192.163.6.4 (Internal AS
17): No route to host
```

3. From configuration mode, enter the **activate logical-systems B interfaces lo0 unit 2 family inet** command.

```
user@host:A# activate logical-systems B interfaces lo0 unit 2 family inet
user@host:A# commit
```

4. From operational mode, enter the **file show /var/log/A/bgp-bfd** command.

```
user@host:A> file show /var/log/A/bgp-bfd
...
Aug 15 17:25:53.623743 advertising receiving-speaker only capabilty to neighbor
 192.163.6.4 (Internal AS 17)
Aug 15 17:25:53.631314 Initiated BFD session to peer 192.163.6.4 (Internal AS
 17): address=192.163.6.4 ifindex=0 ifname=(none) txivl=1000 rxivl=1000 mult=3
 ver=255
Aug 15 17:25:57.570932 BFD session to peer 192.163.6.4 (Internal AS 17) up
```

See Also

- Understanding BFD Authentication for BGP on page 414

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Release History Table

Release	Description
15.1X49-D100	Starting with Junos OS Release 15.1X49-D100, SRX340, SRX345, and SRX1500 devices support dedicated BFD.
15.1X49-D100	Starting with Junos OS Release 15.1X49-D100, SRX300 and SRX320 devices support real-time BFD.
11.2	In Junos OS Release 11.2 and later, BFD supports IPv6 interfaces with BGP.
9.1	In Junos OS Release 9.1 through Junos OS Release 11.1, BFD supports IPv6 interfaces in static routes only.
8.3	In Junos OS Release 8.3 and later, BFD is supported on internal BGP (IBGP) and multihop external BGP (EBGP) sessions as well as on single-hop EBGP sessions.

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Example: Configuring BFD Authentication for BGP

- Understanding BFD Authentication for BGP on page 414
- Example: Configuring BFD Authentication for BGP on page 416

Understanding BFD Authentication for BGP

Bidirectional Forwarding Detection protocol (BFD) enables rapid detection of communication failures between adjacent systems. By default, authentication for BFD sessions is disabled. However, when you run BFD over Network Layer protocols, the risk of service attacks can be significant. We strongly recommend using authentication if you are running BFD over multiple hops or through insecure tunnels. Beginning with Junos OS Release 9.6, Junos OS supports authentication for BFD sessions running over BGP. BFD authentication is not supported on MPLS OAM sessions. BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

You authenticate BFD sessions by specifying an authentication algorithm and keychain, and then associating that configuration information with a security authentication keychain using the keychain name.

The following sections describe the supported authentication algorithms, security keychains, and level of authentication that can be configured:

- BFD Authentication Algorithms on page 415
- Security Authentication Keychains on page 415
- Strict Versus Loose Authentication on page 416

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BFD Authentication Algorithms

Junos OS supports the following algorithms for BFD authentication:

- **simple-password**—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.
- **keyed-md5**—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.
- **meticulous-keyed-md5**—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method might take additional time to authenticate the session.
- **keyed-sha-1**—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.
- **meticulous-keyed-sha-1**—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method might take additional time to authenticate the session.

NOTE: **Nonstop active routing (NSR) is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.**

Security Authentication Keychains

The security authentication keychain defines the authentication attributes used for authentication key updates. When the security authentication keychain is configured and associated with a protocol through the keychain name, authentication key updates can occur without interrupting routing and signaling protocols.

The authentication keychain contains one or more keychains. Each keychain contains one or more keys. Each key holds the secret data and the time at which the key becomes valid. The algorithm and keychain must be configured on both ends of the BFD session,

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and they must match. Any mismatch in configuration prevents the BFD session from being created.

BFD allows multiple clients per session, and each client can have its own keychain and algorithm defined. To avoid confusion, we recommend specifying only one security authentication keychain.

Strict Versus Loose Authentication

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session. This feature is intended for transitional periods only.

See Also

- Example: Configuring BFD Authentication for BGP on page 416
- **bfd-liveness-detection on page 1116** statement
- **authentication-key-chains** statement in the *Junos OS Administration Library*
- **show bfd session** command in the CLI Explorer
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404

Example: Configuring BFD Authentication for BGP

Beginning with Junos OS Release 9.6, you can configure authentication for BFD sessions running over BGP. Only three steps are needed to configure authentication on a BFD session:

1. Specify the BFD authentication algorithm for the BGP protocol.
2. Associate the authentication keychain with the BGP protocol.
3. Configure the related security authentication keychain.

The following sections provide instructions for configuring and viewing BFD authentication on BGP:

- Configuring BFD Authentication Parameters on page 416
- Viewing Authentication Information for BFD Sessions on page 418

Configuring BFD Authentication Parameters

BFD authentication can be configured for the entire BGP protocol, or a specific BGP group, neighbor, or routing instance.

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The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BFD authentication:

1. Specify the algorithm (**keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**) to use.

```
[edit]
user@host# set protocols bgp bfd-liveness-detection authentication algorithm
   keyed-sha-1
user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
   algorithm keyed-sha-1
user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
   authentication algorithm keyed-sha-1
```

NOTE: Nonstop active routing is not supported with meticulous-keyed-md5 and meticulous-keyed-sha-1 authentication algorithms. BFD sessions using these algorithms might go down after a switchover.

2. Specify the keychain to be used to associate BFD sessions on BGP with the unique security authentication keychain attributes.

   The keychain name you specify must match a keychain name configured at the **[edit security authentication key-chains]** hierarchy level.

```
[edit]
user@host# set protocols bgp bfd-liveness-detection authentication keychain bfd-bgp
user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
   keychain bfd-bgp
user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
   authentication keychain bfd-bgp
```

NOTE: The algorithm and keychain must be configured on both ends of the BFD session, and they must match. Any mismatch in configuration prevents the BFD session from being created.

3. Specify the unique security authentication information for BFD sessions:
   - The matching keychain name as specified in Step 2.
   - At least one key, a unique integer between **0** and **63**. Creating multiple keys allows multiple clients to use the BFD session.

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- The secret data used to allow access to the session.
- The time at which the authentication key becomes active, in the format *yyyy-mm-dd.hh:mm:ss*.

```
[edit security]
user@host# set authentication-key-chains key-chain bfd-bgp key 53 secret
  $ABC123$ABC123 start-time 2009-06-14.10:00:00
```

4. (Optional) Specify loose authentication checking if you are transitioning from nonauthenticated sessions to authenticated sessions.

```
[edit]
user@host# set protocols bgp bfd-liveness-detection authentication loose-check
user@host# set protocols bgp group bgp-gr1 bfd-liveness-detection authentication
  loose-check
user@host# set protocols bgp group bgp-gr1 neighbor 10.10.10.7 bfd-liveness-detection
  authentication loose-check
```

5. (Optional) View your configuration using the **show bfd session detail** or **show bfd session extensive** command.

6. Repeat these steps to configure the other end of the BFD session.

NOTE: BFD authentication is only supported in the Canada and United States version of the Junos OS image and is not available in the export version.

Viewing Authentication Information for BFD Sessions

You can view the existing BFD authentication configuration using the **show bfd session detail** and **show bfd session extensive** commands.

The following example shows BFD authentication configured for the **bgp-gr1** BGP group. It specifies the keyed SHA-1 authentication algorithm and a keychain name of **bfd-bgp**. The authentication keychain is configured with two keys. Key **1** contains the secret data "**$ABC123$ABC123**" and a start time of June 1, 2009, at 9:46:02 AM PST. Key **2** contains the secret data "**$ABC123$ABC123**" and a start time of June 1, 2009, at 3:29:20 PM PST.

```
[edit protocols bgp]
group bgp-gr1 {
  bfd-liveness-detection {
    authentication {
      algorithm keyed-sha-1;
      key-chain bfd-bgp;
    }
  }
}
```


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```
[edit security]
authentication key-chains {
  key-chain bfd-bgp {
    key 1 {
      secret "$ABC123$ABC123";
      start-time "2009-6-1.09:46:02 -0700";
    }
    key 2 {
      secret "$ABC123$ABC123";
      start-time "2009-6-1.15:29:20 -0700";
    }
  }
}
```

If you commit these updates to your configuration, you see output similar to the following. In the output for the **show bfd session detail** command, **Authenticate** is displayed to indicate that BFD authentication is configured. For more information about the configuration, use the **show bfd session extensive** command. The output for this command provides the keychain name, the authentication algorithm and mode for each client in the session, and the overall BFD authentication configuration status, keychain name, and authentication algorithm and mode.

show bfd session detail

```
user@host# show bfd session detail

                                                Detect   Transmit
Address                 State     Interface     Time     Interval  Multiplier
192.0.2.2                Up        ge-0/1/5.0     0.900     0.300        3
 Client BGP, TX interval 0.300, RX interval 0.300, Authenticate
 Session up time 3d 00:34
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
```

show bfd session extensive

```
user@host# show bfd session extensive
                                                Detect   Transmit
Address                 State     Interface     Time     Interval  Multiplier
192.0.2.2                Up        ge-0/1/5.0     0.900     0.300        3
 Client BGP, TX interval 0.300, RX interval 0.300, Authenticate
        keychain bfd-bgp, algo keyed-sha-1, mode strict
 Session up time 00:04:42
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
 Min async interval 0.300, min slow interval 1.000
 Adaptive async TX interval 0.300, RX interval 0.300
 Local min TX interval 0.300, minimum RX interval 0.300, multiplier 3
 Remote min TX interval 0.300, min RX interval 0.300, multiplier 3
 Local discriminator 2, remote discriminator 2
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd-bgp, algo keyed-sha-1, mode strict
```

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See Also

- Understanding BFD Authentication for BGP on page 414
- **bfd-liveness-detection on page 1116**
- Example: Configuring BFD for BGP on page 403
- **authentication-key-chains** statement in the *Junos OS Administration Library*
- **show bfd session** command in the CLI Explorer

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

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PART 7

Configuring Load Balancing for BGP

- Enabling Load Balancing for a BGP Session on page 423

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CHAPTER 13

Enabling Load Balancing for a BGP Session

- Understanding BGP Multipath on page 424
- Example: Load Balancing BGP Traffic on page 426
- Understanding Configuration of Up to 512 Equal-Cost Paths With Optional Consistent Load Balancing on page 432
- Example: Configuring Single-Hop EBGP Peers to Accept Remote Next Hops on page 434
- Understanding Load Balancing for BGP Traffic with Unequal Bandwidth Allocated to the Paths on page 446
- Example: Load Balancing BGP Traffic with Unequal Bandwidth Allocated to the Paths on page 447
- Advertising Aggregate Bandwidth Across External BGP Links for Load Balancing Overview on page 457
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- Configuring ECMP Next Hops for RSVP and LDP LSPs for Load Balancing on page 524
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- Use Case for BGP Prefix Independent Convergence for Inet, Inet6, or Labeled Unicast on page 555
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- Example: Configuring BGP Prefix Independent Convergence for Inet on page 560
- FAT Pseudowire Support for BGP L2VPN and VPLS Overview on page 575
- Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 576
- Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 577
- Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 605
- Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 606

Understanding BGP Multipath

BGP multipath allows you to install multiple internal BGP paths and multiple external BGP paths to the forwarding table. Selecting multiple paths enables BGP to load-balance traffic across multiple links.

A path is considered a BGP equal-cost path (and is used for forwarding) if the BGP path selection process performs a tie-break after comparing the IGP cost to the next-hop. By default, all paths with the same neighboring AS, learned by a multipath-enabled BGP neighbor are considered in the multipath selection process.

BGP, typically selects only one best path for each prefix and installs that route in the forwarding table. When BGP multipath is enabled, the device selects multiple equal-cost BGP paths to reach a given destination, and all these paths are installed in the forwarding table. BGP advertises only the active path to its neighbors, unless add-path is in use.

The Junos OS BGP multipath feature supports the following applications:

- Load balancing across multiple links between two routing devices belonging to different autonomous systems (ASs)
- Load balancing across a common subnet or multiple subnets to different routing devices belonging to the same peer AS
- Load balancing across multiple links between two routing devices belonging to different external confederation peers
- Load balancing across a common subnet or multiple subnets to different routing devices belonging to external confederation peers

In a common scenario for load balancing, a customer is multihomed to multiple routers or switches in a point of presence (POP). The default behavior is to send all traffic across only one of the available links. Load balancing causes traffic to use two or more of the links.

BGP multipath does not apply to paths that share the same MED-plus-IGP cost, yet differ in IGP cost. Multipath path selection is based on the IGP cost metric, even if two paths have the same MED-plus-IGP cost.

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Starting in Junos OS Release 18.1R1 BGP multipath is supported globally at **[edit protocols bgp]** hierarchy level. You can selectively disable multipath on some BGP groups and neighbors. Include **disable** at **[edit protocols bgp group *group-name* multipath]** hierarchy level to disable multipath option for a group or a specific BGP neighbor.

Starting in Junos OS Release 18.1R1, you can defer multipath calculation until all BGP routes are received. When multipath is enabled, BGP inserts the route into the multipath queue each time a new route is added or whenever an existing route changes. When multiple paths are received through BGP add-path feature, BGP might calculate one multipath route multiple times. Multipath calculation slows down the RIB (also known as the routing table) learning rate. To speed up RIB learning, multipath calculation can be either deferred until the BGP routes are received or you can lower the priority of the multipath build job as per your requirements until the BGP routes are resolved. To defer the multipath calculation configure **defer-initial-multipath-build** at **[edit protocols bgp]** hierarchy level. Alternatively, you can lower the BGP multipath build job priority using **multipath-build-priority** configuration statement at **[edit protocols bgp]** hierarchy level to speed up RIB learning.

Release History Table

Release	Description
18.1R1	Starting in Junos OS Release 18.1R1 BGP multipath is supported globally at **[edit protocols bgp]** hierarchy level. You can selectively disable multipath on some BGP groups and neighbors. Include **disable** at **[edit protocols bgp group *group-name* multipath]** hierarchy level to disable multipath option for a group or a specific BGP neighbor.
18.1R1	Starting in Junos OS Release 18.1R1, you can defer multipath calculation until all BGP routes are received. When multipath is enabled, BGP inserts the route into the multipath queue each time a new route is added or whenever an existing route changes. When multiple paths are received through BGP add-path feature, BGP might calculate one multipath route multiple times. Multipath calculation slows down the RIB (also known as the routing table) learning rate. To speed up RIB learning, multipath calculation can be either deferred until the BGP routes are received or you can lower the priority of the multipath build job as per your requirements until the BGP routes are resolved. To defer the multipath calculation configure **defer-initial-multipath-build** at **[edit protocols bgp]** hierarchy level. Alternatively, you can lower the BGP multipath build job priority using **multipath-build-priority** configuration statement at **[edit protocols bgp]** hierarchy level to speed up RIB learning.

Related Documentation

- Example: Load Balancing BGP Traffic on page 426
- *Example: Advertising Multiple BGP Paths to a Destination*
- *Understanding Per-Packet Load Balancing*

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Example: Load Balancing BGP Traffic

This example shows how to configure BGP to select multiple equal-cost external BGP (EBGP) or internal BGP (IBGP) paths as active paths.

- Requirements on page 426
- Overview on page 426
- Configuration on page 428
- Verification on page 430

Requirements

Before you begin:

- Configure the device interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure a routing policy that exports routes (such as direct routes or IGP routes) from the routing table into BGP.

Overview

The following steps show how to configure per-packet load balancing:

1. Define a load-balancing routing policy by including one or more **policy-statement** statements at the **[edit policy-options]** hierarchy level, defining an action of **load-balance per-packet**:

```
policy-statement policy-name {
   from {
      match-conditions;
      route-filter destination-prefix match-type <actions>;
      prefix-list name;
   }
   then {
      load-balance per-packet;
   }
}
```

NOTE: To enable load-balancing among multiple EBGP paths and multiple IBGP paths , include the **multipath** statement globally at the **[edit protocols bgp]** hierarchy level. You cannot enable load-balancing of BGP traffic without including the **multipath** statement globally, or for a BGP group at the **[edit protocols bgp** group ***group-name*** hierarchy level, or for specific BGP neighbors at the **[edit protocols bgp group *group-name*** neighbor ***address*****]** hierarchy level.

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2. Apply the policy to routes exported from the routing table to the forwarding table. To do this, include the **forwarding-table** and **export** statements:

```
forwarding-table {
  export policy-name;
}
```

   You cannot apply the export policy to VRF routing instances.

3. Specify all next hops of that route, if more than one exists, when allocating a label corresponding to a route that is being advertised.

4. Configure the forwarding-options hash key for MPLS to include the IP payload.

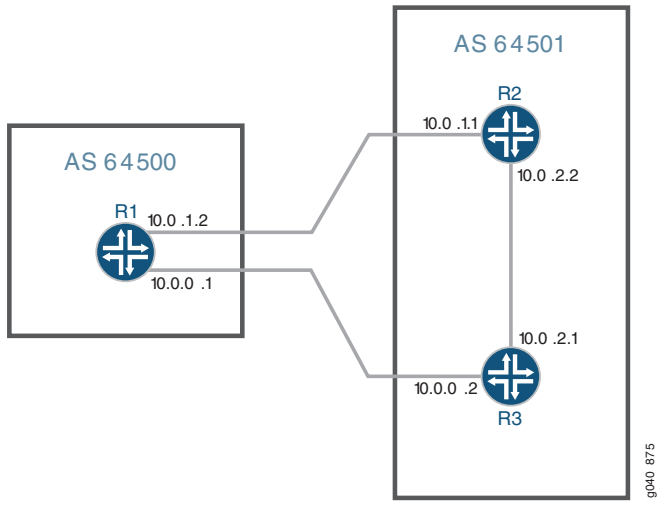
NOTE: On some platforms, you can increase the number of paths that are load balanced by using the **chassis maximum-ecmp** statement. With this statement, you can change the maximum number of equal-cost load-balanced paths to 32, 64, 128, 256, or 512 (the maximum number varies per platform—see *maximum-ecmp*.) Starting with Junos OS Release 19.1R1, you can specify a maximum number of 128 equal-cost paths on QFX10000 switches. Starting with Junos OS Release 19.2R1, you can specify a maximum number of 512 equal-cost paths on QFX10000 switches.—see [Unresolved xref].

In this example, Device R1 is in AS 64500 and is connected to both Device R2 and Device R3, which are in AS 64501. This example shows the configuration on Device R1.

Topology

Figure 42 on page 427 shows the topology used in this example.

Figure 42: BGP Load Balancing



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group external type external
set protocols bgp group external peer-as 64501
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.1
set protocols bgp group external neighbor 10.0.0.2
set policy-options policy-statement loadbal from route-filter 10.0.0.0/16 orlonger
set policy-options policy-statement loadbal then load-balance per-packet
set routing-options forwarding-table export loadbal
set routing-options autonomous-system 64500
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the BGP group.

```
[edit protocols bgp group external]
user@R1# set type external
user@R1# set peer-as 64501
user@R1# set neighbor 10.0.1.1
user@R1# set neighbor 10.0.0.2
```

2. Enable the BGP group to use multiple paths.

NOTE: To disable the default check requiring that paths accepted by BGP multipath must have the same neighboring autonomous system (AS), include the multiple-as option.

```
[edit protocols bgp group external]
user@R1# set multipath
```

3. Configure the load-balancing policy.

```
[edit policy-options policy-statement loadbal]
user@R1# set from route-filter 10.0.0.0/16 orlonger
user@R1# set then load-balance per-packet
```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4. Apply the load-balancing policy.

```
[edit routing-options]
user@R1# set forwarding-table export loadbal
```

5. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 64500
```

Results From configuration mode, confirm your configuration by entering the **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show protocols
bgp {
   group external {
      type external;
      peer-as 64501;
      multipath;
      neighbor 10.0.1.1;
      neighbor 10.0.0.2;
   }
}
```

```
[edit]
user@R1# show policy-options
policy-statement loadbal {
   from {
      route-filter 10.0.0.0/16 orlonger;
   }
   then {
      load-balance per-packet;
   }
}
```

```
[edit]
user@R1# show routing-options
autonomous-system 64500;
forwarding-table {
   export loadbal;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly:

- Verifying Routes on page 430
- Verifying Forwarding on page 431

Verifying Routes

Purpose Verify that routes are learned from both routers in the neighboring AS.

Action From operational mode, run the **show route** command.

```
user@R1> show route 10.0.2.0
```

```
inet.0: 12 destinations, 15 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.2.0/30        *[BGP/170] 03:12:32, localpref 100
                      AS path: 64501 I
                      to 10.0.1.1 via ge-1/2/0.0
                    > to 10.0.0.2 via ge-1/2/1.0
                    [BGP/170] 03:12:32, localpref 100
                      AS path: 64501 I
                    > to 10.0.1.1 via ge-1/2/0.0
```

```
user@R1> show route 10.0.2.0 detail
```

```
inet.0: 12 destinations, 15 routes (12 active, 0 holddown, 0 hidden)
10.0.2.0/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262142
                Next-hop reference count: 3
                Source: 10.0.0.2
                Next hop: 10.0.1.1 via ge-1/2/0.0
                Next hop: 10.0.0.2 via ge-1/2/1.0, selected
                State: <Active Ext>
                Local AS: 64500 Peer AS: 64501
                Age: 3:18:30
                Task: BGP_64501.10.0.0.2+55402
                Announcement bits (1): 2-KRT
                AS path: 64501 I
                Accepted Multipath
                Localpref: 100
                Router ID: 192.168.2.1
         BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 602
                Next-hop reference count: 5
                Source: 10.0.1.1
                Next hop: 10.0.1.1 via ge-1/2/0.0, selected
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Active preferred
                Local AS: 64500 Peer AS: 64501
                Age: 3:18:30
                Task: BGP_64501.10.0.1.1+53135
                AS path: 64501 I
```


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```
                Accepted
                Localpref: 100
                Router ID: 192.168.3.1
```

Meaning The active path, denoted with an asterisk (*), has two next hops: 10.0.1.1 and 10.0.0.2 to the 10.0.2.0 destination. The 10.0.1.1 next hop is copied from the inactive path to the active path.

NOTE: The **show route detail** command output designates one gateway as **selected**. This output is potentially confusing in the context of load balancing. The selected gateway is used for many purposes in addition to deciding which gateway to install into the kernel when Junos OS is not performing per-packet load-balancing. For instance, the **ping mpls** command uses the selected gateway when sending packets. Multicast protocols use the selected gateway in some cases to determine the upstream interface. Therefore, even when Junos OS is performing per-packet load-balancing by way of a forwarding-table policy, the selected gateway information is still required for other purposes. It is useful to display the selected gateway for troubleshooting purposes. Additionally, it is possible to use forwarding-table policy to override what is installed into the kernel (for example, by using the **install-nexthop** action). In this case, the next-hop gateway installed in the forwarding table might be a subset of the total gateways displayed in the **show route** command.

Verifying Forwarding

Purpose Verify that both next hops are installed in the forwarding table.

Action From operational mode, run the **show route forwarding-table** command.

```
user@R1> show route forwarding-table destination 10.0.2.0
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
10.0.2.0/30        user     0                    ulst 262142     2
                              10.0.1.1           ucst   602     5 ge-1/2/0.0
                              10.0.0.2           ucst   522     6 ge-1/2/1.0
```

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Release History Table

Release	Description
19.2R1	Starting with Junos OS Release 19.2R1, you can specify a maximum number of 512 equal-cost paths on QFX10000 switches.
19.1R1	Starting with Junos OS Release 19.1R1, you can specify a maximum number of 128 equal-cost paths on QFX10000 switches.

Related Documentation

- Understanding BGP Multipath on page 424
- Understanding External BGP Peering Sessions on page 23

Understanding Configuration of Up to 512 Equal-Cost Paths With Optional Consistent Load Balancing

You can configure the equal-cost multipath (ECMP) feature with up to 512 paths for external BGP peers. Having the ability to configure up to 512 ECMP next hops allows you to increase the number of direct BGP peer connections with your specified routing device, thus improving latency and optimizing data flow. You can optionally include consistent load balancing in that ECMP configuration. Consistent load balancing ensures that if an ECMP member (that is, a path) fails, only flows flowing through the failed member are redistributed to other active ECMP members. Consistent load balancing also ensures that if an ECMP member is added, redistribution of flows from existing EMCP members to the new ECMP member is minimal.

- Guidelines and Limitations for Configuring from 256 to 512 Equal-Cost Paths, Optionally with Consistent Load Balancing on page 432
- Instructions for Configuring Up to 512 ECMP Next Hops, and Optionally Configuring Consistent Load Balancing on page 433

Guidelines and Limitations for Configuring from 256 to 512 Equal-Cost Paths, Optionally with Consistent Load Balancing

- The feature applies only to single-hop external BGP peers. (This feature does not apply to MPLS routes.)
- The device's routing process (RPD) must support 64-bit mode; 32-bit RPD is not supported.
- The feature applies only to unicast traffic.
- Traffic distribution might not be even across all group members—it depends on the traffic pattern and on the organization of the hashing flow set table in hardware. Consistent hashing *minimizes* remapping of flows to destination links when members are added to or deleted from the group.
- If you configure **set forwarding-options enhanced-hash-key** with one of the options **hash-mode**, **inet**, **inet6**, or **layer2**, some flows might change destination links, because the new hash parameters might generate new hash indexes for the flows, resulting in new destination links.

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- To achieve the best-possible hashing accuracy, this feature uses a *cascaded* topology to implement the next-hop structure for configurations of more than 128 next hops. Hashing accuracy is therefore somewhat lesser than it is for ECMP next-hop configurations of less than 128, which do not require a cascaded topology.
- Existing flows on affected ECMP paths and new flows flowing over those affected ECMP paths might switch paths during local route repair, and traffic skewing might be noticeable. However, any such skewing is corrected during the subsequent global route repair.
- When you increase the **maximum-ecmp** value, consistency hashing is lost during the *next* next-hop-change event for the route prefix.
- If you add a new path to an existing ECMP group, some flows over unaffected paths might move to the newly added path.
- Fast reroute (FRR) might not work with consistent hashing.
- Perfect ECMP-like traffic distribution cannot be achieved. Paths that have more "buckets" than other paths have more traffic flows than paths with fewer buckets (a *bucket* is an entry in the load-balancing table's distribution list that is mapped to an ECMP member index).
- During network topology change events, consistent hashing is lost for network prefixes in some instances because those prefixes point to a new ECMP next hop that does not have all properties of the prefixes' previous ECMP next hops.
- If multiple network prefixes point to the same ECMP next hop and one or more of those prefixes is enabled with the **consistent-hash** statement, *all* network prefixes pointing to that same ECMP next hop display consistent–hashing behavior.
- Consistent hashing is supported on the equal-cost BGP routes–based ECMP group only. When other protocols or static routes are configured that have priority over BGP routes, consistent hashing is not supported.
- Consistent hashing might have limitations when the configuration is combined with configurations for the following features, because these features have tunnel terminations or traffic engineering that does not use hashing for selecting paths—GRE tunneling; BUM traffic; EVPN-VXLAN; and MPLS TE, autobandwidth.

Instructions for Configuring Up to 512 ECMP Next Hops, and Optionally Configuring Consistent Load Balancing

When you are ready to configure up to 512 next hops, use the following configuration instructions:

1. Configure the maximum number of ECMP next hops—for example, configure 512 ECMP next hops:

```
[edit]
  user@host# set chassis maximum-ecmp 512
```

2. Creating a routing policy and enable per-packet load balancing, thus enabling ECMP globally on the system:

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```
[edit]
  user@host# set routing-options forwarding-table export load-balancing-policy
  user@host# set policy-options policy-statement load-balancing-policy then
  load-balance per-packet
```

3. Enable resiliency on selected prefixes by creating a separate routing policy to match incoming routes to one or more destination prefixes—for example:

```
[edit]
  user@host# set policy-options policy-statement c-hash from route-filter 20.0.0.0/24
  orlonger
  user@host# set policy-options policy-statement c-hash then load-balance
  consistent-hash
```

4. Apply an eBGP import policy (for example, “c-hash”) to the BGP group of external peers:

```
[edit]
  user@host# set protocols bgp import c-hash
```

For more detail on configuring equal-cost paths, see “Example: Load Balancing BGP Traffic” on page 426, which appears earlier in this document.

(Optional) For more detail on configuring consistent load balancing (also known as consistent hashing), see “Configuring Consistent Load Balancing for ECMP Groups” on page 527.

Related Documentation

- Understanding BGP Multipath on page 424

Example: Configuring Single-Hop EBGP Peers to Accept Remote Next Hops

This example shows how to configure a single-hop external BGP (EBGP) peer to accept a remote next hop with which it does not share a common subnet.

- Requirements on page 434
- Overview on page 434
- Configuration on page 435
- Verification on page 444

Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

In some situations, it is necessary to configure a single-hop EBGP peer to accept a remote next hop with which it does not share a common subnet. The default behavior is for any next-hop address received from a single-hop EBGP peer that is not recognized as sharing a common subnet to be discarded. The ability to have a single-hop EBGP peer accept a

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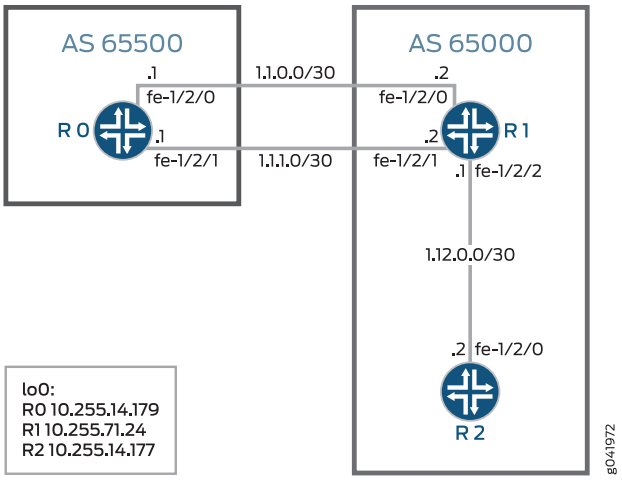
remote next hop to which it is not directly connected also prevents you from having to configure the single-hop EBGP neighbor as a multihop session. When you configure a multihop session in this situation, all next-hop routes learned through this EBGP peer are labeled indirect even when they do share a common subnet. This situation breaks multipath functionality for routes that are recursively resolved over routes that include these next-hop addresses. Configuring the accept-remote-nexthop statement allows a single-hop EBGP peer to accept a remote next hop, which restores multipath functionality for routes that are resolved over these next-hop addresses. You can configure this statement at the global, group, and neighbor hierarchy levels for BGP. The statement is also supported on logical systems and the VPN routing and forwarding (VRF) routing instance type. Both the remote next-hop and the EBGP peer must support BGP route refresh as defined in RFC 2918, *Route Refresh Capability in BGP-4*. If the remote peer does not support BGP route refresh, the session is reset.

When you enable a single-hop EBGP peer to accept a remote next hop, you must also configure an import routing policy on the EBGP peer that specifies the remote next-hop address.

This example includes an import routing policy, **agg_route**, that enables a single-hop external BGP peer (Device R1) to accept the remote next-hop 1.1.10.10 for the route to the 1.1.230.0/23 network. At the **[edit protocols bgp]** hierarchy level, the example includes the **import agg_route** statement to apply the policy to the external BGP peer and includes the **accept-remote-nexthop** statement to enable the single-hop EBGP peer to accept the remote next hop.

Figure 43 on page 435 shows the sample topology.

Figure 43: Topology for Accepting a Remote Next Hop



Configuration

- Device R0 on page 437
- Configuring Device R1 on page 439
- Configuring Device R2 on page 442

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CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R0

```
set interfaces fe-1/2/0 unit 1 family inet address 1.1.0.1/30
set interfaces fe-1/2/1 unit 2 family inet address 1.1.1.1/30
set interfaces lo0 unit 1 family inet address 10.255.14.179/32
set protocols bgp group ext type external
set protocols bgp group ext export test_route
set protocols bgp group ext export agg_route
set protocols bgp group ext peer-as 65000
set protocols bgp group ext multipath
set protocols bgp group ext neighbor 1.1.0.2
set protocols bgp group ext neighbor 1.1.1.2
set policy-options policy-statement agg_route term 1 from protocol static
set policy-options policy-statement agg_route term 1 from route-filter 1.1.230.0/23 exact
set policy-options policy-statement agg_route term 1 then accept
set policy-options policy-statement test_route term 1 from protocol static
set policy-options policy-statement test_route term 1 from route-filter 1.1.10.10/32 exact
set policy-options policy-statement test_route term 1 then accept
set routing-options static route 1.1.10.10/32 reject
set routing-options static route 1.1.230.0/23 reject
set routing-options autonomous-system 65500
```

Device R1

```
set interfaces fe-1/2/0 unit 3 family inet address 1.1.0.2/30
set interfaces fe-1/2/1 unit 4 family inet address 1.1.1.2/30
set interfaces fe-1/2/2 unit 5 family inet address 1.12.0.1/30
set interfaces lo0 unit 2 family inet address 10.255.71.24/32
set protocols bgp accept-remote-nexthop
set protocols bgp group ext type external
set protocols bgp group ext import agg_route
set protocols bgp group ext peer-as 65500
set protocols bgp group ext multipath
set protocols bgp group ext neighbor 1.1.0.1
set protocols bgp group ext neighbor 1.1.1.1
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.71.24
set protocols bgp group int neighbor 10.255.14.177
set protocols ospf area 0.0.0.0 interface fe-1/2/1.4
set protocols ospf area 0.0.0.0 interface 10.255.71.24
set policy-options policy-statement agg_route term 1 from protocol bgp
set policy-options policy-statement agg_route term 1 from route-filter 1.1.230.0/23 exact
set policy-options policy-statement agg_route term 1 then next-hop 1.1.10.10
set policy-options policy-statement agg_route term 1 then accept
set routing-options autonomous-system 65000
```

Device R2

```
set interfaces fe-1/2/0 unit 6 family inet address 1.12.0.2/30
set interfaces lo0 unit 3 family inet address 10.255.14.177/32
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.14.177
```


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```
set protocols bgp group int neighbor 10.255.71.24
set protocols ospf area 0.0.0.0 interface fe-1/2/0.6
set protocols ospf area 0.0.0.0 interface 10.255.14.177
set routing-options autonomous-system 65000
```

Device R0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R0:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 1]
user@R0# set family inet address 1.1.0.1/30
[edit interfaces fe-1/2/1 unit 2]
user@R0# set family inet address 1.1.1.1/30
[edit interfaces lo0 unit 1]
user@R0# set family inet address 10.255.14.179/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@R0# set type external
user@R0# set peer-as 65000
user@R0# set neighbor 1.1.0.2
user@R0# set neighbor 1.1.1.2
```

3. Enable multipath BGP between Device R0 and Device R1.

```
[edit protocols bgp group ext]
user@R0# set multipath
```

4. Configure static routes to remote networks.
   These routes are not part of the topology. The purpose of these routes is to demonstrate the functionality in this example.

```
[edit routing-options]
user@R0# set static route 1.1.10.10/32 reject
user@R0# set static route 1.1.230.0/23 reject
```

5. Configure routing policies that accept the static routes.

```
[edit policy-options policy-statement agg_route term 1]
user@R0# set from protocol static
user@R0# set from route-filter 1.1.230.0/23 exact
user@R0# set then accept
```

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```
[edit policy-options policy-statement test_route term 1]
user@R0# set from protocol static
user@R0# set from route-filter 1.1.10.10/32 exact
user@R0# set then accept
```

6. Export the **agg_route** and **test_route** policies from the routing table into BGP.

```
[edit protocols bgp group ext]
user@R0# set export test_route
user@R0# set export agg_route
```

7. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R0# set autonomous-system 65500
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 1.1.0.1/30;
      }
   }
}
fe-1/2/1 {
   unit 2 {
      family inet {
         address 1.1.1.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 10.255.14.179/32;
      }
   }
}
```

```
user@R0# show policy-options
policy-statement agg_route {
   term 1 {
      from {
         protocol static;
```


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```
        route-filter 1.1.230.0/23 exact;
      }
      then accept;
    }
}
policy-statement test_route {
    term 1 {
      from {
        protocol static;
        route-filter 1.1.10.10/32 exact;
      }
      then accept;
    }
}
```

```
user@R0# show protocols
bgp {
    group ext {
      type external;
      export [ test_route agg_route ];
      peer-as 65000;
      multipath;
      neighbor 1.1.0.2;
      neighbor 1.1.1.2;
    }
}
```

```
user@R0# show routing-options
static {
    route 1.1.10.10/32 reject;
    route 1.1.230.0/23 reject;
}
autonomous-system 65500;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 3]
user@R1# set family inet address 1.1.0.2/30
[edit interfaces fe-1/2/1 unit 4]
user@R1# set family inet address 1.12.0.1/30
[edit interfaces fe-1/2/2 unit 5]
user@R1# set family inet address 1.1.1.2/30
```

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```
[edit interfaces lo0 unit 2]
user@R1# set family inet address 10.255.71.24/32
```

2. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/1.4
user@R1# set interface 10.255.71.24
```

3. Enable Device R1 to accept the remote next hop.

```
[edit protocols bgp]
user@R1# set accept-remote-nexthop
```

4. Configure IBGP.

```
[edit protocols bgp group int]
user@R1# set type internal
user@R1# set local-address 10.255.71.24
user@R1# set neighbor 10.255.14.177
```

5. Configure EBGP.

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set peer-as 65500
user@R1# set neighbor 1.1.0.1
user@R1# set neighbor 1.1.1.1
```

6. Enable multipath BGP between Device R0 and Device R1.

```
[edit protocols bgp group ext]
user@R1# set multipath
```

7. Configure a routing policy that enables a single-hop external BGP peer (Device R1) to accept the remote next-hop 1.1.10.10 for the route to the 1.1.230.0/23 network.

```
[edit policy-options policy-statement agg_route term 1]
user@R1# set from protocol bgp
user@R1# set from route-filter 1.1.230.0/23 exact
user@R1# set then next-hop 1.1.10.10
user@R1# set then accept
```

8. Import the **agg_route** policy into the routing table on Device R1.

```
[edit protocols bgp group ext]
user@R1# set import agg_route
```


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9. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 65000
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 3 {
      family inet {
         address 1.1.0.2/30;
      }
   }
}
fe-1/2/1 {
   unit 4 {
      family inet {
         address 1.12.0.1/30;
      }
   }
}
fe-1/2/2 {
   unit 5 {
      family inet {
         address 1.1.1.2/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 10.255.71.24/32;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement agg_route {
   term 1 {
      from {
         protocol bgp;
         route-filter 1.1.230.0/23 exact;
      }
      then {
         next-hop 1.1.10.10;
         accept;
      }
   }
```

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```
}
```

```
user@R1# show protocols
bgp {
   accept-remote-nexthop;
   group ext {
      type external;
      import agg_route;
      peer-as 65500;
      multipath;
      neighbor 1.1.0.1;
      neighbor 1.1.1.1;
   }
   group int {
      type internal;
      local-address 10.255.71.24;
      neighbor 10.255.14.177;
   }
}
ospf {
   area 0.0.0.0 {
      interface fe-1/2/1.4;
      interface 10.255.71.24;
   }
}
```

```
user@R1# show routing-options
autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

```
[edit interfaces fe-1/2/0 unit 6]
user@R2# set family inet address 1.12.0.2/30
[edit interfaces lo0 unit 3]
user@R2# set family inet address 10.255.14.177/32
```

2. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R2# set interface fe-1/2/0.6
user@R2# set interface 10.255.14.177
```


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3. Configure IBGP.

```
[edit protocols bgp group int]
user@R2# set type internal
user@R2# set local-address 10.255.14.177
user@R2# set neighbor 10.255.71.24
```

4. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 65000
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 6 {
      family inet {
         address 1.12.0.2/30;
      }
   }
}
lo0 {
   unit 3 {
      family inet {
         address 10.255.14.177/32;
      }
   }
}
```

```
user@R2# show protocols
bgp {
   group int {
      type internal;
      local-address 10.255.14.177;
      neighbor 10.255.71.24;
   }
}
ospf {
   area 0.0.0.0 {
      interface fe-1/2/0.6;
      interface 10.255.14.177;
   }
}
```

```
user@R2# show routing-options
autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Verifying That the Multipath Route with the Indirect Next Hop Is in the Routing Table on page 444
- Deactivating and Reactivating the accept-remote-nexthop Statement on page 445

Verifying That the Multipath Route with the Indirect Next Hop Is in the Routing Table

Purpose Verify that Device R1 has a route to the 1.1.230.0/23 network.

Action From operational mode, enter the **show route 1.1.230.0 extensive** command.

```
user@R1> show route 1.1.230.0 extensive
inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
Restart Complete
1.1.230.0/23 (2 entries, 1 announced)
TSI:
KRT in-kernel 1.1.230.0/23 -> {indirect(262142)}
Page 0 idx 1 Type 1 val 9168f6c
    Nexthop: 1.1.10.10
    Localpref: 100
    AS path: [65000] 65500 I
    Communities:
Path 1.1.230.0 from 1.1.0.1 Vector len 4.  Val: 1
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x90c44d8
                Next-hop reference count: 4
                Source: 1.1.0.1
                Next hop type: Router, Next hop index: 262143
                Next hop: 1.1.0.1 via fe-1/2/0.3, selected
                Next hop: 1.1.1.1 via fe-1/2/2.5
                Protocol next hop: 1.1.10.10
                Indirect next hop: 91c0000 262142
                State: <Active Ext>
                Local AS: 65000 Peer AS: 65500
                Age: 2:55:31    Metric2: 0
                Task: BGP_65500.1.1.0.1+64631
                Announcement bits (3): 2-KRT 3-BGP_RT_Background 4-Resolve tree
1
                AS path: 65500 I
                Accepted Multipath
                Localpref: 100
                Router ID: 10.255.14.179
                Indirect next hops: 1
                        Protocol next hop: 1.1.10.10
                        Indirect next hop: 91c0000 262142
                        Indirect path forwarding next hops: 2
                                Next hop type: Router
                                Next hop: 1.1.0.1 via fe-1/2/0.3
                                Next hop: 1.1.1.1 via fe-1/2/2.5
                        1.1.10.10/32 Originating RIB: inet.0
                          Node path count: 1
```


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```
                    Forwarding nexthops: 2
                          Nexthop: 1.1.0.1 via fe-1/2/0.3
                          Nexthop: 1.1.1.1 via fe-1/2/2.5
BGP     Preference: 170/-101
        Next hop type: Indirect
        Address: 0x90c44d8
        Next-hop reference count: 4
        Source: 1.1.1.1
        Next hop type: Router, Next hop index: 262143
        Next hop: 1.1.0.1 via fe-1/2/0.3, selected
        Next hop: 1.1.1.1 via fe-1/2/2.5
        Protocol next hop: 1.1.10.10
        Indirect next hop: 91c0000 262142
        State: <NotBest Ext>
        Inactive reason: Not Best in its group - Update source
        Local AS: 65000 Peer AS: 65500
        Age: 2:55:27    Metric2: 0
        Task: BGP_65500.1.1.1.1+53260
        AS path: 65500 I
        Accepted
        Localpref: 100
        Router ID: 10.255.14.179
        Indirect next hops: 1
                Protocol next hop: 1.1.10.10
                Indirect next hop: 91c0000 262142
                Indirect path forwarding next hops: 2
                        Next hop type: Router
                        Next hop: 1.1.0.1 via fe-1/2/0.3
                        Next hop: 1.1.1.1 via fe-1/2/2.5
                1.1.10.10/32 Originating RIB: inet.0
                  Node path count: 1
                  Forwarding nexthops: 2
                        Nexthop: 1.1.0.1 via fe-1/2/0.3
                        Nexthop: 1.1.1.1 via fe-1/2/2.5
```

Meaning The output shows that Device R1 has a route to the 1.1.230.0 network with the multipath feature enabled (**Accepted Multipath**). The output also shows that the route has an indirect next hop of 1.1.10.10.

Deactivating and Reactivating the accept-remote-nexthop Statement

Purpose Make sure that the multipath route with the indirect next hop is removed from the routing table when you deactivate the **accept-remote-nexthop** statement.

Action

1. From configuration mode, enter the **deactivate protocols bgp accept-remote-nexthop** command.

   ```
   user@R1# deactivate protocols bgp accept-remote-nexthop
   user@R1# commit
   ```

2. From operational mode, enter the **show route 1.1.230.0** command.

   ```
   user@R1> show route 1.1.230.0
   ```

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3. From configuration mode, reactivate the statement by entering the **activate protocols bgp accept-remote-nexthop** command.

```
user@R1# activate protocols bgp accept-remote-nexthop
user@R1# commit
```

4. From operational mode, reenter the **show route 1.1.230.0** command.

```
user@R1> show route 1.1.230.0

inet.0: 11 destinations, 13 routes (11 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

1.1.230.0/23       *[BGP/170] 03:13:19, localpref 100
                      AS path: 65500 I
                    > to 1.1.0.1 via fe-1/2/0.3
                      to 1.1.1.1 via fe-1/2/2.5
                     [BGP/170] 03:13:15, localpref 100, from 1.1.1.1
                      AS path: 65500 I
                    > to 1.1.0.1 via fe-1/2/0.3
                      to 1.1.1.1 via fe-1/2/2.5
```

Meaning When the **accept-remote-nexthop** statement is deactivated, the multipath route to the 1.1.230.0 network is removed from the routing table .

Related Documentation

- Understanding BGP Path Selection on page 14
- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

Understanding Load Balancing for BGP Traffic with Unequal Bandwidth Allocated to the Paths

The multipath option removes the tiebreakers from the active route decision process, thereby allowing otherwise equal cost BGP routes learned from multiple sources to be installed into the forwarding table. However, when the available paths are not equal cost, you may wish to load balance the traffic asymmetrically.

Once multiple next hops are installed in the forwarding table, a specific forwarding next hop is selected by the Junos OS per-prefix load-balancing algorithm. This process hashes against a packet's source and destination addresses to deterministically map the prefix pairing onto one of the available next hops. Per-prefix mapping works best when the hash function is presented with a large number of prefixes, such as might occur on an Internet peering exchange, and it serves to prevent packet reordering among pairs of communicating nodes.

An enterprise network normally wants to alter the default behavior to evoke a *per-packet* load-balancing algorithm. Per-packet is emphasized here because its use is a misnomer

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that stems from the historic behavior of the original Internet Processor ASIC. In reality, current Juniper Networks routers support per-prefix (default) and per-flow load balancing. The latter involves hashing against various Layer 3 and Layer 4 headers, including portions of the source address, destination address, transport protocol, incoming interface, and application ports. The effect is that now individual flows are hashed to a specific next hop, resulting in a more even distribution across available next hops, especially when routing between fewer source and destination pairs.

With per-packet load balancing, packets comprising a communication stream between two endpoints might be resequenced, but packets within individual flows maintain correct sequencing. Whether you opt for per-prefix or per-packet load balancing, asymmetry of access links can present a technical challenge. Either way, the prefixes or flows that are mapped to, for example, a T1 link will exhibit degraded performance when compared to those flows that map to, for example, a Fast Ethernet access link. Worse yet, with heavy traffic loads, any attempt at equal load balancing is likely to result in total saturation of the T1 link and session disruption stemming from packet loss.

Fortunately, the Juniper Networks BGP implementation supports the notion of a bandwidth community. This extended community encodes the bandwidth of a given next hop, and when combined with multipath, the load-balancing algorithm distributes flows across the set of next hops proportional to their relative bandwidths. Put another way, if you have a 10-Mbps and a 1-Mbps next hop, on average nine flows will map to the high-speed next hop for every one that uses the low speed.

Use of BGP bandwidth community is supported only with per-packet load balancing.

The configuration task has two parts:

- Configure the external BGP (EBGP) peering sessions, enable multipath, and define an import policy to tag routes with a bandwidth community that reflects link speed.
- Enable per-packet (really per-flow) load balancing for optimal distribution of traffic.

Related Documentation

- Example: Load Balancing BGP Traffic with Unequal Bandwidth Allocated to the Paths on page 447

Example: Load Balancing BGP Traffic with Unequal Bandwidth Allocated to the Paths

This example shows how to configure BGP to select multiple unequal-cost paths as active paths.

BGP communities can help you control routing policy. An example of a good use for BGP communities is unequal load balancing. When an autonomous system border router (ASBR) receives routes from directly connected external BGP (EBGP) neighbors, the ASBR then advertises those routes to internal neighbors, using IBGP advertisements. In the IBGP adverisements, you can attach the link-bandwidth community to communicate the bandwidth of the advertised external link. This is useful when multiple external links are available, and you want to do unequal load balancing over the links. You configure the link-bandwidth extended community on all ingress links of the AS. The bandwidth information in the link-bandwidth extended community is based on the configured

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bandwidth of the EBGP link. It is not based on the amount of traffic on the link. Junos OS supports BGP link-bandwidth and multipath load balancing, as described in Internet draft draft-ietf-idr-link-bandwidth-06, *BGP Link Bandwidth Extended Community*. Note that even though **draft-ietf-idr-link-bandwidth-06** specifies non-transitive communities, the Junos OS implementation is limited to transitive communities.

- Requirements on page 448
- Overview on page 448
- Configuration on page 450
- Verification on page 455

Requirements

Before you begin:

- Configure the device interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure a routing policy that exports routes (such as direct routes or IGP routes) from the routing table into BGP.

Overview

In this example, Device R1 is in AS 64500 and is connected to both Device R2 and Device R3, which are in AS 64501.

The example uses the bandwidth extended community.

By default, when BGP multipath is used, traffic is distributed equally among the several paths calculated. The bandwidth extended community allows an additional attribute to be added to BGP paths, thus allowing the traffic to be distributed unequally. The primary application is a scenario where multiple external paths exist for a given network with asymmetric bandwidth capabilities. In such a scenario, you can tag routes received with the bandwidth extended community. When BGP multipath (internal or external) operates among routes that contain the bandwidth attribute, the forwarding engine can unequally distribute traffic according to the bandwidth corresponding to each path.

When BGP has several candidate paths available for multipath purposes, BGP does not perform unequal cost load balancing according to the bandwidth community unless all candidate paths have this attribute.

The applicability of the bandwidth extended community is limited by the restrictions under which BGP multipath accepts multiple paths for consideration. Explicitly, the IGP distance, as far as BGP is concerned, between the router performing load balancing and the multiple exit points needs to be the same. This can be achieved by using a full mesh of label-switched paths (LSPs) that do not track the corresponding IGP metric. However, in a network in which the propagation delay of circuits is significant (for example, if long-haul circuits are present), it is often valuable to take into account the delay characteristics of different paths.

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Configure the bandwidth community as follows:

```
[edit policy-options]
user@host# set community members bandwidth:[1-65535]:[0-4294967295]
```

The first 16-bit number represents the local autonomous system. The second 32-bit number represents the link bandwidth in bytes per second.

For example:

```
[edit policy-options]
user@host# show
community bw-t1 members bandwidth:10458:193000;
community bw-t3 members bandwidth:10458:5592000;
community bw-oc3 members bandwidth:10458:19440000;
```

Where 10458 is the local AS number. The values correspond to the bandwidth of the T1, T3, and OC-3 paths in bytes per second. The value specified as the bandwidth value does not need to correspond to the actual bandwidth of a specific interface. The balance factors used are calculated as a function of the total bandwidth specified. To tag a route with this extended community, define a policy statement, as follows:

```
[edit policy-options]
user@host# show
policy-statement link-bw-t1 {
   then {
      community set bw-t1;
   }
   accept;
}
```

Apply this as an import policy on the BGP peering sessions facing the asymmetrical bandwidth links. Although in theory the community attribute can be added or removed at any point in the network, in the scenario described above, applying the community as an import policy in the EBGP peering session facing the external link allows for that attribute to influence the local multipath decision, and is potentially easier to manage.

Topology

Figure 44 on page 450 shows the topology used in this example.

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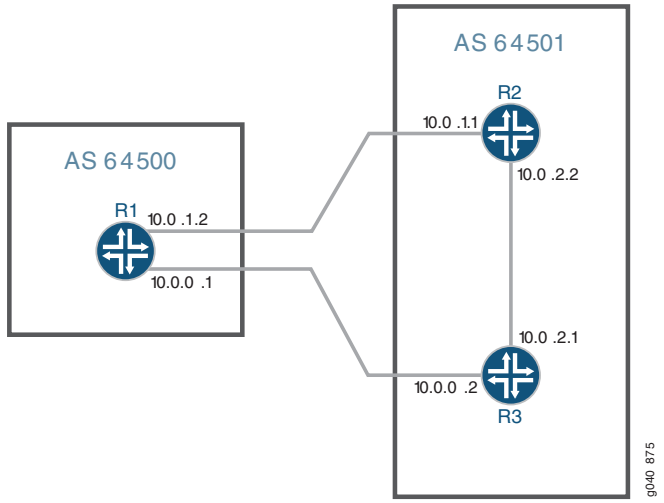
Figure 44: BGP Load Balancing



"CLI Quick Configuration" on page 450 shows the configuration for all of the devices in Figure 44 on page 450. The section"Step-by-Step Procedure" on page 452 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces ge-1/2/0 unit 0 description R1->R3
set interfaces ge-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces ge-1/2/1 unit 0 description R1->R2
set interfaces ge-1/2/1 unit 0 family inet address 10.0.1.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group external type external
set protocols bgp group external import bw-dis
set protocols bgp group external peer-as 64501
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.1
set protocols bgp group external neighbor 10.0.0.2
set policy-options policy-statement bw-dis term a from protocol bgp
set policy-options policy-statement bw-dis term a from neighbor 10.0.1.1
set policy-options policy-statement bw-dis term a then community add bw-high
set policy-options policy-statement bw-dis term a then accept
set policy-options policy-statement bw-dis term b from protocol bgp
set policy-options policy-statement bw-dis term b from neighbor 10.0.0.2
set policy-options policy-statement bw-dis term b then community add bw-low
set policy-options policy-statement bw-dis term b then accept
set policy-options policy-statement loadbal from route-filter 10.0.0.0/16 orlonger
set policy-options policy-statement loadbal then load-balance per-packet
set policy-options community bw-high members bandwidth:65000:60000000
set policy-options community bw-low members bandwidth:65000:40000000
```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```
set routing-options autonomous-system 64500
set routing-options forwarding-table export loadbal
```

Device R2

```
set interfaces ge-1/2/0 unit 0 description R2->R1
set interfaces ge-1/2/0 unit 0 family inet address 10.0.1.1/30
set interfaces ge-1/2/1 unit 0 description R2->R3
set interfaces ge-1/2/1 unit 0 family inet address 10.0.2.2/30
set interfaces ge-1/2/1 unit 0 family iso
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set interfaces lo0 unit 0 family iso address 49.0001.1921.6800.0002.00
set protocols bgp group external type external
set protocols bgp group external export bgp-default
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 64500
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.2
set protocols isis interface ge-1/2/1.0
set protocols isis interface lo0.0
set policy-options policy-statement bgp-default from protocol static
set policy-options policy-statement bgp-default from route-filter 172.16.0.0/16 exact
set policy-options policy-statement bgp-default then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options static route 172.16.0.0/16 discard
set routing-options static route 172.16.0.0/16 no-install
set routing-options autonomous-system 64501
```

Device R3

```
set interfaces ge-1/2/0 unit 0 description R3->R2
set interfaces ge-1/2/0 unit 0 family inet address 10.0.2.1/30
set interfaces ge-1/2/0 unit 0 family iso
set interfaces ge-1/2/1 unit 0 description R3->R1
set interfaces ge-1/2/1 unit 0 family inet address 10.0.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set interfaces lo0 unit 0 family iso address 49.0001.1921.6800.0003.00
set protocols bgp group external type external
set protocols bgp group external export send-direct
set protocols bgp group external export bgp-default
set protocols bgp group external peer-as 64500
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.0.1
set protocols isis interface ge-1/2/0.0
set protocols isis interface lo0.0
set policy-options policy-statement bgp-default from protocol static
set policy-options policy-statement bgp-default from route-filter 172.16.0.0/16 exact
set policy-options policy-statement bgp-default then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set routing-options static route 172.16.0.0/16 discard
set routing-options static route 172.16.0.0/16 no-install
set routing-options autonomous-system 64501
```

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Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the interfaces.

```
user@R1# set ge-1/2/0 unit 0 description R1->R3
user@R1# set ge-1/2/0 unit 0 family inet address 10.0.0.1/30
user@R1# set ge-1/2/1 unit 0 description R1->R2
user@R1# set ge-1/2/1 unit 0 family inet address 10.0.1.2/30
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

2. Configure the BGP group.

```
[edit protocols bgp group external]
user@R1# set type external
user@R1# set import bw-dis
user@R1# set peer-as 64501
user@R1# set neighbor 10.0.1.1
user@R1# set neighbor 10.0.0.2
```

3. Enable the BGP group to use multiple paths.

NOTE: To disable the default check requiring that paths accepted by BGP multipath must have the same neighboring autonomous system (AS), include the multiple-as option. Use the multiple-as option if the neighbors are in different ASs.

```
[edit protocols bgp group external]
user@R1# set multipath
```

4. Configure the load-balancing policy.

```
[edit policy-options policy-statement loadbal]
user@R1# set from route-filter 10.0.0.0/16 orlonger
user@R1# set then load-balance per-packet
```

5. Apply the load-balancing policy.

```
[edit routing-options]
user@R1# set forwarding-table export loadbal
```

6. Configure the BGP community members.

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This example assumes a bandwidth of 1 Gbps and allocates 60 percent to bw-high and 40 percent to bw-low. The reference bandwidth does not need to be the same as the link bandwidth.

```
[editpolicy-options]
user@R1# set community bw-high members bandwidth:65000:60000000
user@R1# set community bw-low members bandwidth:65000:40000000
```

7. Configure the bandwidth distribution policy.

```
[editpolicy-options bw-dis]
user@R1# set term a from protocol bgp
user@R1# set term a from neighbor 10.0.1.1
user@R1# set term a then community add bw-high
user@R1# set term a then accept
user@R1# set term b from protocol bgp
user@R1# set term b from neighbor 10.0.0.2
user@R1# set term b then community add bw-low
user@R1# set term b then accept
```

8. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@R1# set autonomous-system 64500
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
ge-1/2/0 {
   unit 0 {
      description R1->R3;
      family inet {
         address 10.0.0.1/30;
      }
   }
}
ge-1/2/1 {
   unit 0 {
      description R1->R2;
      family inet {
         address 10.0.1.2/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
```

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```
        address 192.168.0.1/32;
      }
    }
}
```

```
user@R1# show protocols
bgp {
  group external {
    type external;
    import bw-dis;
    peer-as 64501;
    multipath;
    neighbor 10.0.1.1;
    neighbor 10.0.0.2;
  }
}
```

```
user@R1# show policy-options
policy-statement bw-dis {
  term a {
    from {
      protocol bgp;
      neighbor 10.0.1.1;
    }
    then {
      community add bw-high;
      accept;
    }
  }
  term b {
    from {
      protocol bgp;
      neighbor 10.0.0.2;
    }
    then {
      community add bw-low;
      accept;
    }
  }
}
policy-statement loadbal {
  from {
    route-filter 10.0.0.0/16 orlonger;
  }
  then {
    load-balance per-packet;
  }
}
community bw-high members bandwidth:65000:60000000;
community bw-low members bandwidth:65000:40000000;
```

```
user@R1# show routing-options
autonomous-system 64500;
```


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```
forwarding-table {
  export loadbal;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly:

Verifying Routes

Purpose Verify that both routes are selected and that the next hops on the routes show a 60%/40% balance.

Action From operational mode, run the **show route protocol bgp detail** command.

```
user@R1> show route 172.16/16 protocol bgp detail
```

```
inet.0: 9 destinations, 13 routes (9 active, 0 holddown, 0 hidden)
172.16.0.0/16 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262143
                Address: 0x93fc078
                Next-hop reference count: 3
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via ge-1/2/0.0 balance 40%
                Next hop: 10.0.1.1 via ge-1/2/1.0 balance 60%, selected
                State: **Active Ext>
                Local AS: 64500 Peer AS: 64501
                Age: 3:22:55
                Task: BGP_64501.10.0.0.2+55344
                Announcement bits (1): 0-KRT
                AS path: 64501 I
                Communities: bandwidth:65000:40000000
                Accepted Multipath
                Localpref: 100
                Router ID: 192.168.0.3
         BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 658
                Address: 0x9260520
                Next-hop reference count: 4
                Source: 10.0.1.1
                Next hop: 10.0.1.1 via ge-1/2/1.0, selected
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Active preferred
                Local AS: 64500 Peer AS: 64501
                Age: 3:22:55
                Task: BGP_65001.10.0.1.1+62586
                AS path: 64501 I
                Communities: bandwidth:65000:60000000
                Accepted MultipathContrib
                Localpref: 100
                Router ID: 192.168.0.2
```

```
user@R1> show route 10.0.2.0 protocol bgp detail
```

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```
inet.0: 9 destinations, 13 routes (9 active, 0 holddown, 0 hidden)
10.0.2.0/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262143
                Address: 0x93fc078
                Next-hop reference count: 3
                Source: 10.0.1.1
                Next hop: 10.0.0.2 via ge-1/2/0.0 balance 40%
                Next hop: 10.0.1.1 via ge-1/2/1.0 balance 60%, selected
                State: <Active Ext>
                Local AS: 64500 Peer AS: 64501
                Age: 3:36:37
                Task: BGP_65001.10.0.1.1+62586
                Announcement bits (1): 0-KRT
                AS path: 64501 I
                Communities: bandwidth:65000:60000000
                Accepted Multipath
                Localpref: 100
                Router ID: 192.168.0.2
         BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 657
                Address: 0x92604d8
                Next-hop reference count: 4
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via ge-1/2/0.0, selected
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Active preferred
                Local AS: 64500 Peer AS: 65001
                Age: 3:36:36
                Task: BGP_65001.10.0.0.2+55344
                AS path: 64501 I
                Communities: bandwidth:65000:40000000
                Accepted MultipathContrib
                Localpref: 100
                Router ID: 192.168.0.3
```

Meaning The active path, denoted with an asterisk (*), has two next hops: 10.0.1.1 and 10.0.0.2 to the 172.16/16 destination.

Likewise, the active path, denoted with an asterisk (*), has two next hops: 10.0.1.1 and 10.0.0.2 to the 10.0.2.0 destination.

In both cases, the 10.0.1.1 next hop is copied from the inactive path to the active path.

The balance of 40 percent and 60 percent is shown in the **show route** output. This indicates that traffic is being distributed between two next hops and that 60 percent of the traffic is following the first path, while 40 percent is following the second path.

Related Documentation

- Understanding BGP Multipath on page 424

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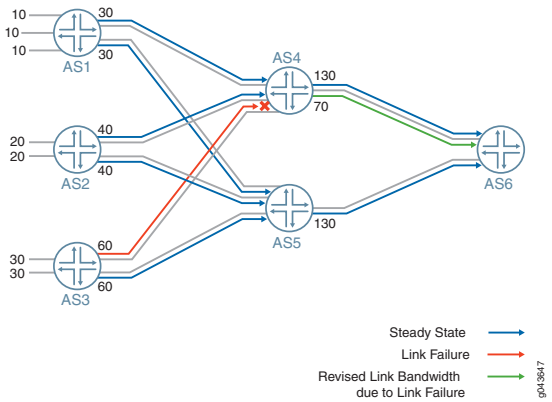
Advertising Aggregate Bandwidth Across External BGP Links for Load Balancing Overview

A BGP peer that receives multiple paths from its internal peers load balances traffic among these paths. In earlier Junos OS releases, a BGP speaker receiving multiple paths from its internal peers advertised only the link bandwidth associated with the active route. BGP uses the link bandwidth extended community, to advertise the aggregated bandwidth of multiple routes across external links. BGP calculates the aggregate bandwidth of multipaths that have unequal bandwidth allocation and advertises the aggregated bandwidth to external BGP peers. A threshold to the aggregate bandwidth can be configured to restrict the bandwidth usage of a BGP group. Both IPv4 and IPv6 routes including anycast addresses support aggregate bandwidth.

To advertise aggregate bandwidth of multipath routes and to set a maximum threshold, configure a policy with **aggregate-bandwidth** and **limit bandwidth** actions at the [edit policy-options policy-statement *name* then] hierarchy level.

Figure 45: Advertising Aggregate Bandwidth Across External BGP Links for Load Balancing



In Figure 45 on page 457, autonomous system 1 (AS1) aggregates the bandwidth of its 3 multipath routes to a remote prefix and advertises it to autonomous system 4 (AS4) with a bandwidth of 30 using the link bandwidth extended community. In case of a link failure between AS3 and AS4, AS4 subtracts 60 from the bandwidth it advertises to AS6 and modifies the bandwidth it was advertising from 130 to 70.

When a BGP peer propagates multipath routes configured with an aggregate bandwidth community, a new link bandwidth community is added with the sum of the bandwidth from the incoming bandwidth communities or that prefix. The available link bandwidth is dynamically derived from interface speed. The link bandwidth is sent as a transitive extended community. However, If the device receives the link bandwidth as a non-transitive link bandwidth extended community, Junos OS ignores this community but propagates it along with the transitive link bandwidth extended community. If the link-bandwidth community is not received for each one of the incoming multipath routes then a link bandwidth community is not advertised to its external peers.

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When one of the multipath links fails, BGP readvertises the route with the bandwidth of the failed link subtracted from the outgoing link bandwidth community. If the aggregate link bandwidth is found to exceed the configured limit, the advertised aggregate bandwidth is truncated to the configured link bandwidth limit between the two peers.

Related Documentation

- Example: Configuring a Policy to Advertise Aggregate Bandwidth Across External BGP Links for Load Balancing on page 458
- *policy-statement*

Example: Configuring a Policy to Advertise Aggregate Bandwidth Across External BGP Links for Load Balancing

This example shows how to configure a policy to advertise aggregate bandwidth across External BGP links for load balancing and to specify a threshold for the configured aggregate bandwidth. BGP adds up the available link bandwidth of multipaths and calculates the aggregated bandwidth. In case of a link failure, the aggregated bandwidth is adjusted to reflect the current status of the available bandwidth.

- Requirements on page 458
- Overview on page 458
- Configuration on page 459
- Verification on page 466

Requirements

This example uses the following hardware and software components:

- Four routers with load balancing capability
- Junos OS Release 17.4 or later running on all the devices

Overview

Starting in Junos OS Release 17.4R1, a BGP speaker that receives multiple paths from its internal peers load balances traffic among these paths. In earlier Junos OS releases, a BGP speaker receiving multiple paths from its internal peers advertised only the link bandwidth associated with the active route. BGP uses a new link bandwidth extended community with the aggregated bandwidth to tag multipaths and advertises the aggregated bandwidth for these multiple routes across its DMZ link. To advertise aggregated multiple routes, configure a policy with **aggregate-bandwidth** and **limit bandwidth** actions at the [edit policy-options policy-statement *name* then] hierarchy level.

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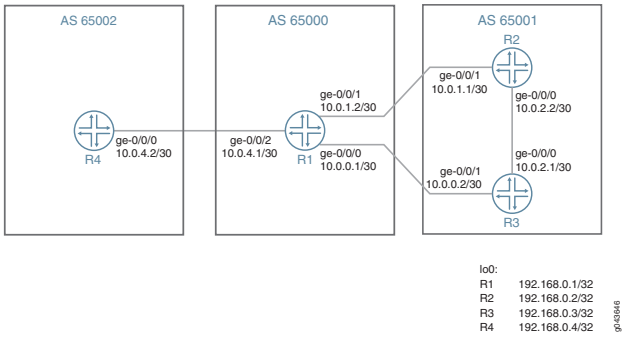
Topology

Figure 46: Configuring a Policy to Advertise Aggregate Bandwidth Across External BGP Links for Load Balancing



In Figure 46 on page 459, Router R1 load balances traffic to a remote destination through next-hop 10.0.1.1 in Router R2 at 60,000,000 bytes per second and through 10.0.0.2 in Router R3 at 40,000,000 bytes per second. Router R1 advertises destination 10.0.2.0 to Router R4. Router R1 calculates the aggregate of the available bandwidth, which is 10000000 bytes per second. However, a policy configured on Router R1 sets the threshold for the aggregate bandwidth to 80,000,000 bytes per second. Therefore, R1 advertises 80,000,000 bytes per second instead of the 10,000,000 bytes per second.

NOTE: If one of the multipath links goes down, then the bandwidth of the failed link is not added to the aggregate bandwidth that is advertised to BGP neighbors.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router R1

```
set interfaces ge-0/0/0 unit 0 description R1->R3
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.1/30
set interfaces ge-0/0/1 unit 0 description R1->R2
set interfaces ge-0/0/1 unit 0 family inet address 10.0.1.2/30
set interfaces ge-0/0/2 unit 0 description R1->R4
set interfaces ge-0/0/2 unit 0 family inet address 10.0.4.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set routing-options autonomous-system 65000
set protocols bgp group external type external
set protocols bgp group external import bw-dis
set protocols bgp group external peer-as 65001
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.1
```

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```
set protocols bgp group external neighbor 10.0.0.2
set protocols bgp group external2 type external
set protocols bgp group external2 peer-as 65002
set policy-options policy-statement bw-dis term a from protocol bgp
set policy-options policy-statement bw-dis term a from neighbor 10.0.1.1
set policy-options policy-statement bw-dis term a then community add bw-high
set policy-options policy-statement bw-dis term a then accept
set policy-options policy-statement bw-dis term b from protocol bgp
set policy-options policy-statement bw-dis term b from neighbor 10.0.0.2
set policy-options policy-statement bw-dis term b then community add bw-low
set policy-options policy-statement bw-dis term b then accept
set policy-options policy-statement aggregate_bw_and_limit_capacity then
  aggregate-bandwidth
set policy-options policy-statement aggregate_bw_and_limit_capacity then
  limit-bandwidth 80000000
set policy-options policy-statement aggregate_bw_and_limit_capacity then accept
set protocols bgp group external2 neighbor 10.0.4.2 export
  aggregate_bw_and_limit_capacity
set policy-options policy-statement loadbal from route-filter 10.0.0.0/16 orlonger
set policy-options policy-statement loadbal then load-balance per-packet
set routing-options forwarding-table export loadbal
set policy-options community bw-high members bandwidth:65000:60000000
set policy-options community bw-low members bandwidth:65000:40000000
```

Router R2

```
set interfaces ge-0/0/0 unit 0 description R2->R3
set interfaces ge-0/0/0 unit 0 family inet address 10.0.2.2/30
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/1 unit 0 description R2->R1
set interfaces ge-0/0/1 unit 0 family inet address 10.0.1.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set interfaces lo0 unit 0 family iso address 49.0001.1921.6800.0002.00
set routing-options static route 172.16.0.0/16 discard
set routing-options static route 172.16.0.0/16 no-install
set routing-options autonomous-system 65001
set protocols bgp group external type external
set protocols bgp group external export bgp-default
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 65000
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.1.2
set protocols isis interface ge-0/0/0.0
set protocols isis interface lo0.0
set policy-options policy-statement bgp-default from protocol static
set policy-options policy-statement bgp-default from route-filter 172.16.0.0/16 exact
set policy-options policy-statement bgp-default then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
```

Router R3

```
set interfaces ge-0/0/0 description R3->R2
set interfaces ge-0/0/0 unit 0 family inet address 10.0.2.1/30
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/1 unit 0 description R3->R1
```


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```
set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set interfaces lo0 unit 0 family iso address 49.0001.1921.6800.0003.00
set routing-options static route 172.16.0.0/16 discard
set routing-options static route 172.16.0.0/16 no-install
set routing-options autonomous-system 65001
set protocols bgp group external type external
set protocols bgp group external export bgp-default
set protocols bgp group external export send-direct
set protocols bgp group external peer-as 65000
set protocols bgp group external multipath
set protocols bgp group external neighbor 10.0.0.1
set protocols isis interface ge-0/0/0.0
set protocols isis interface lo0.0
set policy-options policy-statement bgp-default from protocol static
set policy-options policy-statement bgp-default from route-filter 172.16.0.0/16 exact
set policy-options policy-statement bgp-default then accept
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
```

Router R4

```
set interfaces ge-0/0/0 unit 0 description R4->R1
set interfaces ge-0/0/0 unit 0 family inet address 10.0.4.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.4/32
set routing-options autonomous-system 65002
set protocols bgp group external type external
set protocols bgp group external peer-as 65000
set protocols bgp group external neighbor 10.0.4.1
```

Configuring Routers, Starting with R1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure a policy to advertise an aggregated bandwidth to BGP peers (starting with Router R1):

NOTE: Repeat this procedure on routers R2, R3, and R4 after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 addresses.

```
[edit interfaces]
user@R1# set ge-0/0/0 unit 0 description R1->R3
user@R1# set ge-0/0/0 unit 0 family inet address 10.0.0.1/30

user@R1# set ge-0/0/1 unit 0 description R1->R2
user@R1# set ge-0/0/1 unit 0 family inet address 10.0.1.2/30
```

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```
user@R1# set ge-0/0/2 unit 0 description R1->R4
user@R1# set ge-0/0/2 unit 0 family inet address 10.0.4.1/30
```

2. Configure the loopback address.

```
[edit interfaces]
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

3. Configure the autonomous system for BGP hosts.

```
[edit routing-options]
user@R1# set autonomous-system 65000
```

4. Configure EBGP on the external edge routers.

```
[edit protocols]
user@R1# set bgp group external type external
user@R1# set bgp group external import bw-dis
user@R1# set bgp group external peer-as 65001
user@R1# set bgp group external multipath
user@R1# set bgp group external neighbor 10.0.1.1
user@R1# set bgp group external neighbor 10.0.0.2
user@R1# set bgp group external2 type external
user@R1# set bgp group external2 peer-as 65002
```

5. Define a bandwidth distribution policy to assign a high bandwidth community to traffic destined to Router R3.

```
[edit policy-options]
user@R1# set policy-statement bw-dis term a from protocol bgp
user@R1# set policy-statement bw-dis term a from neighbor 10.0.1.1
user@R1# set policy-statement bw-dis term a then community add bw-high
user@R1# set policy-statement bw-dis term a then accept
```

6. Define a bandwidth distribution policy to assign a low bandwidth community to traffic destined to Router R2.

```
[edit policy-options]
user@R1# set policy-statement bw-dis term b from protocol bgp
user@R1# set policy-statement bw-dis term b from neighbor 10.0.0.2
user@R1# set policy-statement bw-dis term b then community add bw-low
user@R1# set policy-statement bw-dis term b then accept
```

7. Enable the feature to advertise aggregated bandwidth of 80,000,000 bytes to EBGP peer Router R4 over BGP sessions.

```
[edit policy-options]
```


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```
user@R1# set policy-statement aggregate_bw_and_limit_capacity then
  aggregate-bandwidth
user@R1# set policy-statement aggregate_bw_and_limit_capacity then
  limit-bandwidth 80000000
user@R1# set policy-statement aggregate_bw_and_limit_capacity then accept
```

8. Apply the aggregate_bw_and limit_capacity policy to EBGP group **external2**.

```
[edit protocols]
user@R1# set bgp group external2 neighbor 10.0.4.2 export
  aggregate_bw_and_limit_capacity
```

9. Define a load balancing policy.

```
[edit policy-options]
user@R1# set policy-statement loadbal from route-filter 10.0.0.0/16 orlonger
user@R1# set policy-statement loadbal then load-balance per-packet
```

10. Apply the load balancing policy.

```
[edit routing-options]
user@R1# set forwarding-table export loadbal
```

11. Configure the BGP community members. The first 16-bit number represents the local autonomous system. The second 32-bit number represents the link bandwidth in bytes per second. Configure a **bw-high** community with 60 percent of a 1-Gbps link and another community **bw-low** with 40 percent of a 1-Gbps link.

    Configure 60 percent of a 1-Gbps link to bw-high community and 40 percent to bw-low community.

```
[edit policy-options]
user@R1# set community bw-high members bandwidth:65000:60000000
user@R1# set community bw-low members bandwidth:65000:40000000
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show interfaces
interfaces {
   ge-0/0/0 {
      unit 0 {
         description R1->R3;
```

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```
        family inet {
          address 10.0.0.1/30;
        }
      }
    }
    ge-0/0/1 {
      unit 0 {
        description R1->R2;
        family inet {
          address 10.0.1.2/30;
        }
      }
    }
    ge-0/0/2 {
      unit 0 {
        description R1->R4;
        family inet {
          address 10.0.4.1/30;
        }
      }
    }
    lo0 {
      unit 0 {
        family inet {
          address 192.168.0.1/32;
        }
      }
    }
}
```

```
[edit]
user@R1# show protocols
protocols {
    bgp {
        group external {
            type external;
            import bw-dis;
            peer-as 65001;
            multipath;
            neighbor 10.0.1.1;
            neighbor 10.0.0.2;
        }
        group external2 {
            type external;
            peer-as 65002;
            neighbor 10.0.4.2 {
                export aggregate_bw_and_limit_capacity;
            }
        }
    }
}
```

```
[edit]
user@R1# show routing-options
```


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```
routing-options {
  autonomous-system 65000;
  forwarding-table {
    export loadbal;
  }
}
```

```
[edit]
user@R1# show policy-options
policy-options {
  policy-statement bw-dis {
    term a {
      from {
        protocol bgp;
        neighbor 10.0.1.1;
      }
      then {
        community add bw-high;
        accept;
      }
    }
    term b {
      from {
        protocol bgp;
        neighbor 10.0.0.2;
      }
      then {
        community add bw-low;
        accept;
      }
    }
  }
  policy-statement aggregate_bw_and_limit_capacity {
    then {
      aggregate-bandwidth;
      limit-bandwidth 80000000;
      accept;
    }
  }
  policy-statement loadbal {
    from {
      route-filter 10.0.0.0/16 orlonger;
    }
    then {
      load-balance per-packet;
    }
  }
  community bw-high members bandwidth:65000:60000000;
  community bw-low members bandwidth:65000:40000000;
}
```

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Verification

- Verifying BGP Session Is Established on page 466
- Verifying That the Aggregate Bandwidth Is Present in Each Path on page 466
- Verifying That Router R1 Is Advertising the Aggregate Bandwidth to Its Neighbor Router R4 on page 467

Verifying BGP Session Is Established

Purpose To verify that BGP peering is complete and a BGP session is established between the routers,

Action `user@R1>` **show bgp summary**

```
Groups: 2 Peers: 3 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                      12          8          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.2              65001        153        149       0       0     1:07:23
4/6/6/0            0/0/0/0
10.0.1.1              65001        229        226       0       0     1:41:44
4/6/6/0            0/0/0/0
10.0.4.2              65002       1227       1227       0       0     9:10:27
0/0/0/0            0/0/0/0
```

Meaning Router R1 has completed peering with Routers R2, R3, and R4.

Verifying That the Aggregate Bandwidth Is Present in Each Path

Purpose To verify that the extended community is present for each route path.

Action From operational mode, run the **show route protocol bgp detail** command.

`user@R1>` **show route 10.0.2.0 protocol bgp detail**

```
inet.0: 20 destinations, 26 routes (20 active, 0 holddown, 0 hidden)
10.0.2.0/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 0
                Address: 0xb618990
                Next-hop reference count: 3
                Source: 10.0.1.1
                Next hop: 10.0.0.2 via ge-0/0/0.0 balance 40%
                Session Id: 0x0
                Next hop: 10.0.1.1 via ge-0/0/1.0 balance 60%, selected
                Session Id: 0x0
                State: <Active Ext>
                Local AS: 65000 Peer AS: 65001
```


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```
                Age: 20:33
                Validation State: unverified
                Task: BGP_65001.10.0.1.1
                Announcement bits (3): 0-KRT 2-BGP_Listen.0.0.0.0+179
3-BGP_RT_Background
                AS path: 65001 I
                Communities: bandwidth:65000:60000000
                Accepted Multipath
                Localpref: 100
                Router ID: 128.49.121.137
        BGP     Preference: 170/-101
                Next hop type: Router, Next hop index: 595
                Address: 0xb7a1330
                Next-hop reference count: 9
                Source: 10.0.0.2
                Next hop: 10.0.0.2 via ge-0/0/0.0, selected
                Session Id: 0x141
                State: <NotBest Ext>
                Inactive reason: Not Best in its group - Active preferred
                Local AS: 65000 Peer AS: 65001
                Age: 20:33
                Validation State: unverified
                Task: BGP_65001.10.0.0.2
                AS path: 65001 I
                Communities: bandwidth:65000:40000000
                Accepted MultipathContrib
                Localpref: 100
                Router ID: 128.49.121.132
```

Verifying That Router R1 Is Advertising the Aggregate Bandwidth to Its Neighbor Router R4

Purpose To verify that Router R1 is advertising the aggregate bandwidth to its external neighbors.

Action

```
user@R1> show route advertising-protocol bgp 10.0.4.2 10.0.2.0/30 detail

inet.0: 20 destinations, 26 routes (20 active, 0 holddown, 0 hidden)
* 10.0.2.0/30 (2 entries, 1 announced)
 BGP group external2 type External
     Nexthop: Self
     AS path: [65000] 65001 I
     Communities: bandwidth:65000:80000000
```

Meaning Router R1 is advertising the aggregated bandwidth of 80,000,000 bytes to its neighbors.

Related Documentation

- Advertising Aggregate Bandwidth Across External BGP Links for Load Balancing Overview on page 457
- *policy-statement*

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Understanding the Advertisement of Multiple Paths to a Single Destination in BGP

BGP peers advertise routes to each other in update messages. BGP stores its routes in the Junos OS routing table (**inet.0**). For each prefix in the routing table, the routing protocol process selects a single best path, called the active path. Unless you configure BGP to advertise multiple paths to the same destination, BGP advertises only the active path.

Instead of advertising only the active path to a destination, you can configure BGP to advertise multiple paths to the destination. Within an autonomous system (AS), the availability of multiple exit points to reach a destination provides the following benefits:

- Fault tolerance—Path diversity leads to reduction in restoration time after failure. For instance, a border after receiving multiple paths to the same destination can precompute a backup path and have it ready so that when the primary path becomes invalid, the border routing device can use the backup to quickly restore connectivity. Without a backup path, the restoration time depends on BGP reconvergence, which includes withdraw and advertisement messages in the network before a new best path can be learned.
- Load balancing—The availability of multiple paths to reach the same destination enables load balancing of traffic, if the routing within the AS meets certain constraints.
- Maintenance—The availability of alternate exit points allows for graceful maintenance operation of routers.

The following limitations apply to advertising multiple routes in BGP:

- Address families supported:
  - IPv4 unicast (**family inet unicast**)
  - IPv6 unicast (**family inet6 unicast**)
  - IPv4 labeled unicast (**family inet labeled-unicast**)
  - IPv6 labeled unicast (**family inet6 labeled-unicast**)
  - IPv4 VPN unicast (**family inet-vpn unicast**)
  - IPv6 VPN unicast (**family inet6-vpn unicast**)

  The following example shows the configuration of IPv4 VPN unicast and IPv6 VPN unicast families:

```
bgp {
  group <group-name> {
    family inet-vpn unicast {
      add-path {
        send {
          multipath;
            path-count <n>;
          prefix-policy <policy-name>;
        }
      receive;
```


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```
    }
    family inet6-vpn unicast {
      add-path {
        send {
          multipath;
            path-count <n>;
          prefix-policy <policy-name>;
        }
      receive;
    }
  }
}
```

- Internal BGP (IBGP) peers only. No support on external BGP (EBGP) peers.
- Master instance only. No support for routing instances.
- Graceful restart and nonstop active routing (NSR) are supported.
- No BGP Monitoring Protocol (BMP) support.
- No support for EBGP sessions between confederations.
- Prefix policies enable you to filter routes on a router that is configured to advertise multiple paths to a destination. Prefix policies can only match prefixes. They cannot match route attributes, and they cannot change the attributes of routes.

Starting in Junos OS Release 18.4R1, BGP can advertise a maximum of 64 add-path routes and a second best path as a backup in addition to the multiple ECMP paths.

To advertise all add-paths up to 64 add-paths or only equal-cost-paths, include **path-selection-mode** at the **[edit protocols bgp group *group-name* family *name* addpath send]** hierarchy level. You cannot enable both **multipath** and **path-selection-mode** at the same time.

Release History Table

Release	Description
18.4R1	Starting in Junos OS Release 18.4R1, BGP can advertise a maximum of 64 add-path routes and a second best path as a backup in addition to the multiple ECMP paths.

Related Documentation

- Understanding BGP Path Selection on page 14
- Example: Advertising Multiple Paths in BGP on page 470

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Example: Advertising Multiple Paths in BGP

In this example, BGP routers are configured to advertise multiple paths instead of advertising only the active path. Advertising multiple paths in BGP is specified in RFC 7911, *Advertisement of Multiple Paths in BGP*.

- Requirements on page 470
- Overview on page 470
- Configuration on page 471
- Verification on page 491

Requirements

This example uses the following hardware and software components:

- Eight BGP-enabled devices.
- Five of the BGP-enabled devices do not necessarily need to be routers. For example, they can be EX Series Ethernet Switches.
- Three of the BGP-enabled devices are configured to send multiple paths or receive multiple paths (or both send and receive multiple paths). These three BGP-enabled devices must be M Series Multiservice Edge Routers, MX Series 5G Universal Routing Platforms, or T Series Core Routers.
- The three routers must be running Junos OS Release 11.4 or later.

Overview

The following statements are used for configuring multiple paths to a destination:

```
[edit protocols bgp group group-name family family]
add-path {
  receive;
  send {
    path-count number;
    prefix-policy [ policy-names ];
  }
}
```

In this example, Router R5, Router R6, and Router R7 redistribute static routes into BGP. Router R1 and Router R4 are route reflectors. Router R2 and Router R3 are clients to Route Reflector R1. Router R8 is a client to Route Reflector R4.

Route reflection is optional when multiple-path advertisement is enabled in BGP.

With the **add-path send path-count 6** configuration, Router R1 is configured to send up to six paths (per destination) to Router R4.

With the **add-path receive** configuration, Router R4 is configured to receive multiple paths from Router R1.

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With the **add-path send path-count 6** configuration, Router R4 is configured to send up to six paths to Router R8.

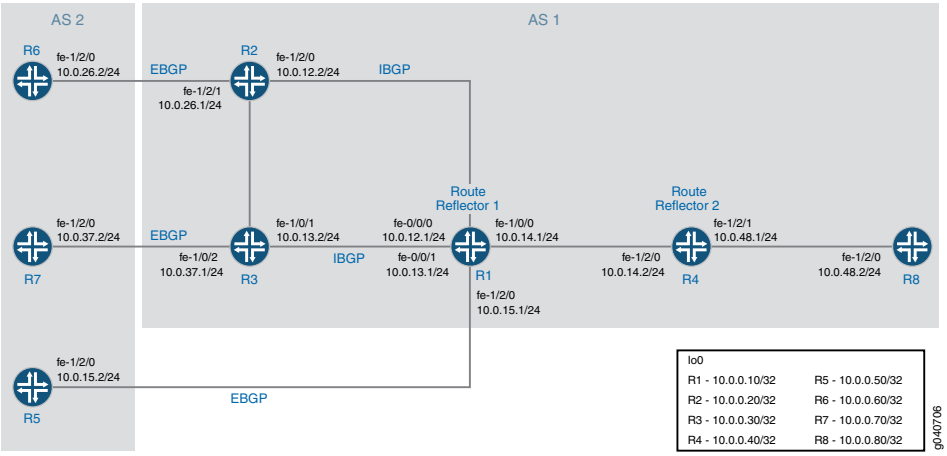
With the **add-path receive** configuration, Router R8 is configured to receive multiple paths from Router R4.

The **add-path send prefix-policy allow_199** policy configuration (along with the corresponding route filter) limits Router R4 to sending multiple paths for only the 172.16.199.1/32 route.

Topology Diagram

Figure 47 on page 471 shows the topology used in this example.

Figure 47: Advertisement of Multiple Paths in BGP



Configuration

- Configuring Router R1 on page 474
- Configuring Router R2 on page 477
- Configuring Router R3 on page 479
- Configuring Router R4 on page 481
- Configuring Router R5 on page 484
- Configuring Router R6 on page 486
- Configuring Router R7 on page 488
- Configuring Router R8 on page 490
- Results on page 490

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

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Router R1

```
set interfaces fe-0/0/0 unit 12 family inet address 10.0.12.1/24
set interfaces fe-0/0/1 unit 13 family inet address 10.0.13.1/24
set interfaces fe-1/0/0 unit 14 family inet address 10.0.14.1/24
set interfaces fe-1/2/0 unit 15 family inet address 10.0.15.1/24
set interfaces lo0 unit 10 family inet address 10.0.0.10/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.10
set protocols bgp group rr cluster 10.0.0.10
set protocols bgp group rr neighbor 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.30
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
set protocols bgp group e1 neighbor 10.0.15.2 peer-as 2
set protocols bgp group rr_rr type internal
set protocols bgp group rr_rr local-address 10.0.0.10
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  path-count 6
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.12
set protocols ospf area 0.0.0.0 interface fe-0/0/1.13
set protocols ospf area 0.0.0.0 interface fe-1/0/0.14
set protocols ospf area 0.0.0.0 interface fe-1/2/0.15
set routing-options router-id 10.0.0.10
set routing-options autonomous-system 1
```

Router R2

```
set interfaces fe-1/2/0 unit 21 family inet address 10.0.12.2/24
set interfaces fe-1/2/1 unit 26 family inet address 10.0.26.1/24
set interfaces lo0 unit 20 family inet address 10.0.0.20/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.20 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.21
set protocols ospf area 0.0.0.0 interface fe-1/2/1.28
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```

Router R3

```
set interfaces fe-1/0/1 unit 31 family inet address 10.0.13.2/24
set interfaces fe-1/0/2 unit 37 family inet address 10.0.37.1/24
set interfaces lo0 unit 30 family inet address 10.0.0.30/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.30
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.2 peer-as 2
set protocols ospf area 0.0.0.0 interface lo0.30 passive
set protocols ospf area 0.0.0.0 interface fe-1/0/1.31
set protocols ospf area 0.0.0.0 interface fe-1/0/2.37
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 1
```


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Router R4

```
set interfaces fe-1/2/0 unit 41 family inet address 10.0.14.2/24
set interfaces fe-1/2/1 unit 48 family inet address 10.0.48.1/24
set interfaces lo0 unit 40 family inet address 10.0.0.40/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.40
set protocols bgp group rr family inet unicast add-path receive
set protocols bgp group rr neighbor 10.0.0.10
set protocols bgp group rr_client type internal
set protocols bgp group rr_client local-address 10.0.0.40
set protocols bgp group rr_client cluster 10.0.0.40
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 6
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  prefix-policy allow_199
set protocols ospf area 0.0.0.0 interface fe-1/2/0.41
set protocols ospf area 0.0.0.0 interface lo0.40 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/1.48
set policy-options policy-statement allow_199 from route-filter 172.16.199.1/32 exact
set policy-options policy-statement allow_199 term match_199 from prefix-list match_199
set policy-options policy-statement allow_199 then add-path send-count 20
set policy-options policy-statement allow_199 then accept
set routing-options autonomous-system 1
```

Router R5

```
set interfaces fe-1/2/0 unit 51 family inet address 10.0.15.2/24
set interfaces lo0 unit 50 family inet address 10.0.0.50/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.1 export s2b
set protocols bgp group e1 neighbor 10.0.15.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then as-path-expand 2
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 172.16.199.1/32 reject
set routing-options static route 172.16.198.1/32 reject
```

Router R6

```
set interfaces fe-1/2/0 unit 62 family inet address 10.0.26.2/24
set interfaces lo0 unit 60 family inet address 10.0.0.60/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.1 export s2b
set protocols bgp group e1 neighbor 10.0.26.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 172.16.199.1/32 reject
set routing-options static route 172.16.198.1/32 reject
```

Router R7

```
set interfaces fe-1/2/0 unit 73 family inet address 10.0.37.2/24
set interfaces lo0 unit 70 family inet address 10.0.0.70/32
```

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```
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.1 export s2b
set protocols bgp group e1 neighbor 10.0.37.1 peer-as 1
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then accept
set routing-options autonomous-system 2
set routing-options static route 172.16.199.1/32 reject
```

Router R8

```
set interfaces fe-1/2/0 unit 84 family inet address 10.0.48.2/24
set interfaces lo0 unit 80 family inet address 10.0.0.80/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.80
set protocols bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
set protocols ospf area 0.0.0.0 interface lo0.80 passive
set protocols ospf area 0.0.0.0 interface fe-1/2/0.84
set routing-options autonomous-system 1
```

Configuring Router R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1:

1. Configure the interfaces to Router R2, Router R3, Router R4, and Router R5, and configure the loopback (lo0) interface.

```
[edit interfaces]
user@R1# set fe-0/0/0 unit 12 family inet address 10.0.12.1/24
user@R1# set fe-0/0/1 unit 13 family inet address 10.0.13.1/24
user@R1# set fe-1/0/0 unit 14 family inet address 10.0.14.1/24
user@R1# set fe-1/2/0 unit 15 family inet address 10.0.15.1/24
user@R1#set lo0 unit 10 family inet address 10.0.0.10/32
```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

```
[edit protocols bgp]
user@R1# set group rr type internal
user@R1# set group rr local-address 10.0.0.10
user@R1# set group rr cluster 10.0.0.10
user@R1# set group rr neighbor 10.0.0.20
user@R1# set group rr neighbor 10.0.0.30
user@R1# set group rr_rr type internal
user@R1# set group rr_rr local-address 10.0.0.10
user@R1# set group e1 type external
user@R1# set group e1 neighbor 10.0.15.2 local-address 10.0.15.1
user@R1# set group e1 neighbor 10.0.15.2 peer-as 2
```


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3. Configure Router R1 to send up to six paths to its neighbor, Router R4.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

```
[edit protocols bgp]
user@R1# set group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
   path-count 6
```

4. Configure OSPF on the interfaces.

```
[edit protocols ospf]
user@R1# set area 0.0.0.0 interface lo0.10 passive
user@R1# set area 0.0.0.0 interface fe-0/0/0.12
user@R1# set area 0.0.0.0 interface fe-0/0/1.13
user@R1# set area 0.0.0.0 interface fe-1/0/0.14
user@R1# set area 0.0.0.0 interface fe-1/2/0.15
```

5. Configure the router ID and the autonomous system number.

```
[edit routing-options]
user@R1# set router-id 10.0.0.10
user@R1# set autonomous-system 1
```

6. If you are done configuring the device, commit the configuration.

```
user@R1# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-0/0/0 {
   unit 12 {
      family inet {
         address 10.0.12.1/24;
      }
   }
}
fe-0/0/1 {
   unit 13 {
      family inet {
         address 10.0.13.1/24;
      }
   }
}
```

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```
fe-1/0/0 {
    unit 14 {
        family inet {
            address 10.0.14.1/24;
        }
    }
}
fe-1/2/0 {
    unit 15 {
        family inet {
            address 10.0.15.1/24;
        }
    }
}
lo0 {
    unit 10 {
        family inet {
            address 10.0.0.10/32;
        }
    }
}
```

```
user@R1# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.10;
        cluster 10.0.0.10;
        neighbor 10.0.0.20;
        neighbor 10.0.0.30;
    }
    group e1 {
        type external;
        neighbor 10.0.15.2 {
            local-address 10.0.15.1;
            peer-as 2;
        }
    }
    group rr_rr {
        type internal;
        local-address 10.0.0.10;
        neighbor 10.0.0.40 {
            family inet {
                unicast {
                    add-path {
                        send {
                            path-count 6;
                        }
                    }
                }
            }
        }
    }
}
```


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```
ospf {
  area 0.0.0.0 {
    interface lo0.10 {
      passive;
    }
    interface fe-0/0/0.12;
    interface fe-0/0/1.13;
    interface fe-1/0/0.14;
    interface fe-1/2/0.15;
  }
}
```

```
user@R1# show routing-options
router-id 10.0.0.10;
autonomous-system 1;
```

Configuring Router R2

Step-by-Step Procedure

To configure Router R2:

1. Configure the loopback (lo0) interface and the interfaces to Router R6 and Router R1.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 21 family inet address 10.0.12.2/24
user@R2# set fe-1/2/1 unit 26 family inet address 10.0.26.1/24
user@R2# set lo0 unit 20 family inet address 10.0.0.20/32
```

2. Configure BGP and OSPF on Router R2's interfaces.

```
[edit protocols]
user@R2# set bgp group rr type internal
user@R2# set bgp group rr local-address 10.0.0.20
user@R2# set bgp group e1 type external
user@R2# set bgp group e1 neighbor 10.0.26.2 peer-as 2
user@R2# set ospf area 0.0.0.0 interface lo0.20 passive
user@R2# set ospf area 0.0.0.0 interface fe-1/2/0.21
user@R2# set ospf area 0.0.0.0 interface fe-1/2/1.28
```

3. For routes sent from Router R2 to Router R1, advertise Router R2 as the next hop, because Router R1 does not have a route to Router R6's address on the 10.0.26.0/24 network.

```
[edit]
user@R2# set policy-options policy-statement set_nh_self then next-hop self
user@R2# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

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4. Configure the autonomous system number.

```
[edit]
user@R2# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R2# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**,and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
    unit 21 {
        family inet {
            address 10.0.12.2/24;
        }
    }
}
fe-1/2/1 {
    unit 26 {
        family inet {
            address 10.0.26.1/24;
        }
    }
}
lo0 {
    unit 20 {
        family inet {
            address 10.0.0.20/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.20;
        neighbor 10.0.0.10 {
            export set_nh_self;
        }
    }
    group e1 {
        type external;
        neighbor 10.0.26.2 {
            peer-as 2;
```


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```
    }
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.20 {
      passive;
    }
    interface fe-1/2/0.21;
    interface fe-1/2/1.28;
  }
}
```

```
user@R2# show policy-options
policy-statement set_nh_self {
  then {
    next-hop self;
  }
}
```

```
user@R2# show routing-options
autonomous-system 1;
```

Configuring Router R3

Step-by-Step Procedure

To configure Router R3:

1. Configure the loopback (lo0) interface and the interfaces to Router R7 and Router R1.

```
[edit interfaces]
user@R3# set fe-1/0/1 unit 31 family inet address 10.0.13.2/24
user@R3# set fe-1/0/2 unit 37 family inet address 10.0.37.1/24
user@R3# set lo0 unit 30 family inet address 10.0.0.30/32
```

2. Configure BGP and OSPF on Router R3's interfaces.

```
[edit protocols]
user@R3# set bgp group rr type internal
user@R3# set bgp group rr local-address 10.0.0.30
user@R3# set bgp group e1 type external
user@R3# set bgp group e1 neighbor 10.0.37.2 peer-as 2
user@R3# set ospf area 0.0.0.0 interface lo0.30 passive
user@R3# set ospf area 0.0.0.0 interface fe-1/0/1.31
user@R3# set ospf area 0.0.0.0 interface fe-1/0/2.37
```

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3. For routes sent from Router R3 to Router R1, advertise Router R3 as the next hop, because Router R1 does not have a route to Router R7's address on the 10.0.37.0/24 network.

```
[edit]
user@R3# set policy-options policy-statement set_nh_self then next-hop self
user@R3# set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
```

4. Configure the autonomous system number.

```
[edit]
user@R3# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R3# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R3# show interfaces
fe-1/0/1 {
    unit 31 {
        family inet {
            address 10.0.13.2/24;
        }
    }
}
fe-1/0/2 {
    unit 37 {
        family inet {
            address 10.0.37.1/24;
        }
    }
}
lo0 {
    unit 30 {
        family inet {
            address 10.0.0.30/32;
        }
    }
}
```

```
user@R3# show protocols
bgp {
    group rr {
        type internal;
```


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```
    local-address 10.0.0.30;
    neighbor 10.0.0.10 {
      export set_nh_self;
    }
  }
  group e1 {
    type external;
    neighbor 10.0.37.2 {
      peer-as 2;
    }
  }
}
ospf {
  area 0.0.0.0 {
    interface lo0.30 {
      passive;
    }
    interface fe-1/0/1.31;
    interface fe-1/0/2.37;
  }
}
user@R3# show policy-options
policy-statement set_nh_self {
  then {
    next-hop self;
  }
}
```

```
user@R3# show routing-options
autonomous-system 1;
```

Configuring Router R4

Step-by-Step Procedure

To configure Router R4:

1. Configure the interfaces to Router R1 and Router R8, and configure the loopback (lo0) interface.

```
[edit interfaces]
user@R4# set fe-1/2/0 unit 41 family inet address 10.0.14.2/24
user@R4# set fe-1/2/1 unit 48 family inet address 10.0.48.1/24
user@R4# set lo0 unit 40 family inet address 10.0.0.40/32
```

2. Configure BGP on the interfaces, and configure IBGP route reflection.

```
[edit protocols bgp]
user@R4# set group rr type internal
user@R4# set group rr local-address 10.0.0.40
user@R4# set group rr neighbor 10.0.0.10
user@R4# set group rr_client type internal
user@R4# set group rr_client local-address 10.0.0.40
user@R4# set group rr_client cluster 10.0.0.40
```

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3. Configure Router R4 to send up to six paths to its neighbor, Router R8.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

   ```
   [edit protocols bgp]
   user@R4# set group rr_client neighbor 10.0.0.80 family inet unicast add-path send
     path-count 6
   ```

4. Configure Router R4 to receive multiple paths from its neighbor, Router R1.

   The destination of the paths can be any destination that Router R1 can reach through multiple paths.

   ```
   [edit protocols bgp group rr family inet unicast]
   user@R4# set add-path receive
   ```

5. Configure OSPF on the interfaces.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R4# set interface fe-1/2/0.41
   user@R4# set interface lo0.40 passive
   user@R4# set interface fe-1/2/1.48
   ```

6. Configure a policy that allows Router R4 to send Router R8 multiple paths to the 172.16.199.1/32 route.

   - Router R4 receives multiple paths for the 172.16.198.1/32 route and the 172.16.199.1/32 route. However, because of this policy, Router R4 only sends multiple paths for the 172.16.199.1/32 route.

     ```
     [edit protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast]
     user@R4# set add-path send prefix-policy allow_199
     [edit policy-options policy-statement allow_199]
     user@R4# set from route-filter 172.16.199.1/32 exact
     user@R4# set then accept
     ```

   - Router R4 can also be configured to send up-to 20 BGP **add-path** routes for a subset of *add-path advertised prefixes*.

     ```
     [edit policy-options policy-statement allow_199]
     user@R4# set term match_199 from prefix-list match_199
     user@R4# set then add-path send-count 20
     ```

7. Configure the autonomous system number.

   ```
   [edit routing-options]
   user@R4# set autonomous-system 1
   ```


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8. If you are done configuring the device, commit the configuration.

```
user@R4# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
fe-1/2/0 {
    unit 41 {
        family inet {
            address 10.0.14.2/24;
        }
    }
}
fe-1/2/1 {
    unit 48 {
        family inet {
            address 10.0.48.1/24;
        }
    }
}
lo0 {
    unit 40 {
        family inet {
            address 10.0.0.40/32;
        }
    }
}
```

```
user@R4# show protocols
bgp {
    group rr {
        type internal;
        local-address 10.0.0.40;
        family inet {
            unicast {
                add-path {
                    receive;
                }
            }
        }
        neighbor 10.0.0.10;
    }
    group rr_client {
        type internal;
        local-address 10.0.0.40;
        cluster 10.0.0.40;
        neighbor 10.0.0.80 {
            family inet {
```

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```
            unicast {
              add-path {
                send {
                  path-count 6;
                  prefix-policy allow_199;
                }
              }
            }
          }
        }
      }
    }
  }
  ospf {
    area 0.0.0.0 {
      interface lo0.40 {
        passive;
      }
      interface fe-1/2/0.41;
      interface fe-1/2/1.48;
    }
  }
```

```
user@R4# show policy-options
policy-statement allow_199 {
  from {
    route-filter 172.16.199.1/32 exact;
  }
  from term match_199 {
    prefix-list match_199;
  }
    then add-path send-count 20;
  then accept;
}
```

```
user@R4# show routing-options
autonomous-system 1;
```

Configuring Router R5

Step-by-Step Procedure

To configure Router R5:

1. Configure the loopback (lo0) interface and the interface to Router R1.

```
[edit interfaces]
user@R5# set fe-1/2/0 unit 51 family inet address 10.0.15.2/24
user@R5# set lo0 unit 50 family inet address 10.0.0.50/32
```

2. Configure BGP on Router R5's interface.

```
[edit protocols bgp group e1]
user@R5# set type external
```


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```
user@R5# set neighbor 10.0.15.1 peer-as 1
```

3. Create static routes for redistribution into BGP.

```
[edit routing-options]
user@R5# set static route 172.16.199.1/32 reject
user@R5# set static route 172.16.198.1/32 reject
```

4. Redistribute static and direct routes into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.15.1]
user@R5# set export s2b
[edit policy-options policy-statement s2b]
user@R5# set from protocol static
user@R5# set from protocol direct
user@R5# set then as-path-expand 2
user@R5# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R5# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R5# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R5# show interfaces
fe-1/2/0 {
   unit 51 {
      family inet {
         address 10.0.15.2/24;
      }
   }
}
lo0 {
   unit 50 {
      family inet {
         address 10.0.0.50/32;
      }
   }
```

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```
}
```

```
user@R5# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.15.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```

```
user@R5# show policy-options
policy-statement s2b {
   from protocol [ static direct ];
   then {
      as-path-expand 2;
      accept;
   }
}
```

```
user@R5# show routing-options
static {
   route 172.16.198.1/32 reject;
   route 172.16.199.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R6

Step-by-Step Procedure

To configure Router R6:

1. Configure the loopback (lo0) interface and the interface to Router R2.

```
[edit interfaces]
user@R6# set fe-1/2/0 unit 62 family inet address 10.0.26.2/24
user@R6# set lo0 unit 60 family inet address 10.0.0.60/32
```

2. Configure BGP on Router R6's interface.

```
[edit protocols]
user@R6# set bgp group e1 type external
user@R6# set bgp group e1 neighbor 10.0.26.1 peer-as 1
```

3. Create static routes for redistribution into BGP.

```
[edit]
user@R6# set routing-options static route 172.16.199.1/32 reject
```


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```
user@R6# set routing-options static route 172.16.198.1/32 reject
```

4. Redistribute static and direct routes from Router R6's routing table into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.26.1]
user@R6# set export s2b
[edit policy-options policy-statement s2b]
user@R6# set from protocol static
user@R6# set from protocol direct
user@R6# set then accept
```

5. Configure the autonomous system number.

```
[edit routing-options]
user@R6# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R6# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R6# show interfaces
fe-1/2/0 {
   unit 62 {
      family inet {
         address 10.0.26.2/24;
      }
   }
}
lo0 {
   unit 60 {
      family inet {
         address 10.0.0.60/32;
      }
   }
}
```

```
user@R6# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.26.1 {
         export s2b;
```

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```
        peer-as 1;
      }
    }
}
```

```
user@R6# show policy-options
policy-statement s2b {
   from protocol [ static direct ];
   then accept;
}
```

```
user@R6# show routing-options
static {
   route 172.16.198.1/32 reject;
   route 172.16.199.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R7

Step-by-Step Procedure

To configure Router R7:

1. Configure the loopback (lo0) interface and the interface to Router R3.

```
[edit interfaces]
user@R7# set fe-1/2/0 unit 73 family inet address 10.0.37.2/24
user@R7# set lo0 unit 70 family inet address 10.0.0.70/32
```

2. Configure BGP on Router R7's interface.

```
[edit protocols bgp group e1]
user@R7# set type external
user@R7# set neighbor 10.0.37.1 peer-as 1
```

3. Create a static route for redistribution into BGP.

```
[edit]
user@R7# set routing-options static route 172.16.199.1/32 reject
```

4. Redistribute static and direct routes from Router R7's routing table into BGP.

```
[edit protocols bgp group e1 neighbor 10.0.37.1]
user@R7# set export s2b
[edit policy-options policy-statement s2b]
user@R7# set from protocol static
user@R7# set from protocol direct
user@R7# set then accept
```


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5. Configure the autonomous system number.

```
[edit routing-options]
user@R7# set autonomous-system 2
```

6. If you are done configuring the device, commit the configuration.

```
user@R7# commit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R7# show interfaces
fe-1/2/0 {
   unit 73 {
      family inet {
         address 10.0.37.2/24;
      }
   }
}
lo0 {
   unit 70 {
      family inet {
         address 10.0.0.70/32;
      }
   }
}
```

```
user@R7# show protocols
bgp {
   group e1 {
      type external;
      neighbor 10.0.37.1 {
         export s2b;
         peer-as 1;
      }
   }
}
```

```
user@R7# show policy-options
policy-statement s2b {
   from protocol [ static direct ];
   then accept;
}
```

```
user@R7# show routing-options
static {
```

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```
    route 172.16.199.1/32 reject;
}
autonomous-system 2;
```

Configuring Router R8

Step-by-Step Procedure

To configure Router R8:

1. Configure the loopback (lo0) interface and the interface to Router R4.

```
[edit interfaces]
user@R8# set fe-1/2/0 unit 84 family inet address 10.0.48.2/24
user@R8# set lo0 unit 80 family inet address 10.0.0.80/32
```

2. Configure BGP and OSPF on Router R8's interface.

```
[edit protocols]
user@R8# set bgp group rr type internal
user@R8# set bgp group rr local-address 10.0.0.80
user@R8# set ospf area 0.0.0.0 interface lo0.80 passive
user@R8# set ospf area 0.0.0.0 interface fe-1/2/0.84
```

3. Configure Router R8 to receive multiple paths from its neighbor, Router R4.

   The destination of the paths can be any destination that Router R4 can reach through multiple paths.

```
[edit protocols]
user@R8# set bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
```

4. Configure the autonomous system number.

```
[edit]
user@R8# set routing-options autonomous-system 1
```

5. If you are done configuring the device, commit the configuration.

```
user@R8# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

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```
user@R8# show interfaces
fe-1/2/0 {
   unit 84 {
      family inet {
         address 10.0.48.2/24;
      }
   }
}
lo0 {
   unit 80 {
      family inet {
         address 10.0.0.80/32;
      }
   }
}
```

```
user@R8# show protocols
bgp {
   group rr {
      type internal;
      local-address 10.0.0.80;
      neighbor 10.0.0.40 {
         family inet {
            unicast {
               add-path {
                  receive;
               }
            }
         }
      }
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.80 {
         passive;
      }
      interface fe-1/2/0.84;
   }
}
```

```
user@R8# show routing-options
autonomous-system 1;
```

Verification

Confirm that the configuration is working properly.

- Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths on page 492
- Verifying That Router R1 Is Advertising Multiple Paths on page 492
- Verifying That Router R4 Is Receiving and Advertising Multiple Paths on page 493

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- Verifying That Router R8 Is Receiving Multiple Paths on page 494
- Checking the Path ID on page 495

Verifying That the BGP Peers Have the Ability to Send and Receive Multiple Paths

Purpose Make sure that one or both of the following strings appear in the output of the **show bgp neighbor** command:

- **NLRI's for which peer can receive multiple paths: inet-unicast**
- **NLRI's for which peer can send multiple paths: inet-unicast**

Action

```
user@R1> show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.10+64227 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...  NLRI's for which peer can receive multiple paths: inet-unicast
...
```

```
user@R4> show bgp neighbor 10.0.0.10
Peer: 10.0.0.10+64227 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established    Flags: <Sync>
...
  NLRI's for which peer can send multiple paths: inet-unicast
...
```

```
user@R4> show bgp neighbor 10.0.0.80
Peer: 10.0.0.80+55416 AS 1     Local: 10.0.0.40+179 AS 1
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  ,,,
  NLRI's for which peer can receive multiple paths: inet-unicast
  ...
```

```
user@R8> show bgp neighbor 10.0.0.40
Peer: 10.0.0.40+179 AS 1       Local: 10.0.0.80+55416 AS 1
  Type: Internal    State: Established    Flags: <Sync>
  ...
  NLRI's for which peer can send multiple paths: inet-unicast
  ...
```

Verifying That Router R1 Is Advertising Multiple Paths

Purpose Make sure that multiple paths to the 172.16.198.1/32 destination and multiple paths to the 172.16.199.1/32 destination are advertised to Router R4.

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Action

```
user@R1> show route advertising-protocol bgp 10.0.0.40

inet.0: 21 destinations, 25 routes (21 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 172.16.198.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 172.16.199.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 172.16.200.0/30            10.0.0.20                    100        2 I
```

Meaning When you see one prefix and more than one next hop, it means that multiple paths are advertised to Router R4.

Verifying That Router R4 Is Receiving and Advertising Multiple Paths

Purpose Make sure that multiple paths to the 172.16.199.1/32 destination are received from Router R1 and advertised to Router R8. Make sure that multiple paths to the 172.16.198.1/32 destination are received from Router R1, but only one path to this destination is advertised to Router R8.

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Action

```
user@R4> show route receive-protocol bgp 10.0.0.10

inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 172.16.198.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 172.16.199.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 172.16.200.0/30            10.0.0.20                    100        2 I
```

```
user@R4> show route advertising-protocol bgp 10.0.0.80

inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 172.16.198.1/32            10.0.0.20                    100        2 I
* 172.16.199.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 172.16.200.0/30            10.0.0.20                    100        2 I
```

Meaning

The **show route receive-protocol** command shows that Router R4 receives two paths to the 172.16.198.1/32 destination and three paths to the 172.16.199.1/32 destination. The **show route advertising-protocol** command shows that Router R4 advertises only one path to the 172.16.198.1/32 destination and advertises all three paths to the 172.16.199.1/32 destination.

Because of the prefix policy that is applied to Router R4, Router R4 does not advertise multiple paths to the 172.16.198.1/32 destination. Router R4 advertises only one path to the 172.16.198.1/32 destination even though it receives multiple paths to this destination.

Verifying That Router R8 Is Receiving Multiple Paths

Purpose

Make sure that Router R8 receives multiple paths to the 172.16.199.1/32 destination through Router R4. Make sure that Router R8 receives only one path to the 172.16.198.1/32 destination through Router R4.

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Action

```
user@R8> show route receive-protocol bgp 10.0.0.40

inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 172.16.198.1/32            10.0.0.20                    100        2 I
* 172.16.199.1/32            10.0.0.20                    100        2 I
                          10.0.0.30                    100        2 I
                          10.0.15.2                    100        2 2 I
* 200.1.1.0/30            10.0.0.20                    100        2 I
```

Checking the Path ID

Purpose On the downstream devices, Router R4 and Router R8, verify that a path ID uniquely identifies the path. Look for the **Addpath Path ID:** string.

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Action `user@R4>` **show route 172.16.199.1/32 detail**

```
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
172.16.199.1/32 (3 entries, 3 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 92041c8 262146
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+64227
                Announcement bits (3): 2-KRT 3-BGP RT Background 4-Resolve tree
1
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 92042ac 262151
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+64227
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 I (Originator) Cluster list:  10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 676
                Next hop: 10.0.14.1 via lt-1/2/0.41, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 92040e4 262150
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 1:44:37    Metric2: 2
                Task: BGP_1.10.0.0.10+64227
                Announcement bits (1): 3-BGP RT Background
                AS path: 2 2 I
```


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```
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 3
```

user@R8> **show route 172.16.199.1/32 detail**

```
inet.0: 17 destinations, 19 routes (17 active, 0 holddown, 0 hidden)
172.16.199.1/32 (3 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 9
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.20
                Indirect next hop: 91fc0e4 262148
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                Announcement bits (2): 2-KRT 4-Resolve tree 1
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.20
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 1
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.0.30
                Indirect next hop: 91fc1c8 262152
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 I (Originator) Cluster list:  10.0.0.40 10.0.0.10
                AS path:  Originator ID: 10.0.0.30
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 2
         BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 4
                Source: 10.0.0.40
                Next hop type: Router, Next hop index: 1045
                Next hop: 10.0.48.1 via lt-1/2/0.84, selected
                Protocol next hop: 10.0.15.2
                Indirect next hop: 91fc2ac 262153
                State: <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
```

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```
                Age: 1:56:51    Metric2: 3
                Task: BGP_1.10.0.0.40+179
                AS path: 2 2 I (Originator) Cluster list:  10.0.0.40
                AS path:  Originator ID: 10.0.0.10
                Accepted
                Localpref: 100
                Router ID: 10.0.0.40
                Addpath Path ID: 3
```

Related Documentation

- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 468
- *Understanding Adding AS Numbers to BGP AS Paths*

Example: Configuring Selective Advertising of BGP Multiple Paths for Load Balancing

This example shows how to configure selective advertising of BGP multiple paths. Advertising all available multiple paths might result in a large overhead of processing on device memory and is a scaling consideration, too. You can configure a BGP route reflector to advertise only contributor multipaths for load balancing.

- Requirements on page 498
- Overview on page 498
- Configuration on page 499
- Verification on page 507

Requirements

No special configuration beyond device initialization is required before configuring this example.

This example uses the following hardware and software components:

- Eight routers that can be a combination of M Series, MX Series, or T Series routers
- Junos OS Release 16.1R2 or later on the device

Overview

Beginning with Junos OS Release 16.1R2, you can restrict BGP **add-path** to advertise contributor multiple paths only. You can limit and configure up to six prefixes that the BGP **multipath** algorithm selects. Selective advertising of multiple paths facilitates Internet service providers and data centers that use route reflector to build in-path diversity in IBGP. You can enable a BGP route reflector to advertise multipaths that are contributor paths for load balancing.

Topology

In Figure 48 on page 499, RR1 and RR4 are route reflectors. Router R2 and R3 are clients to the route reflector RR1. Router R8 is a client to route reflector RR4. The RR1 group with

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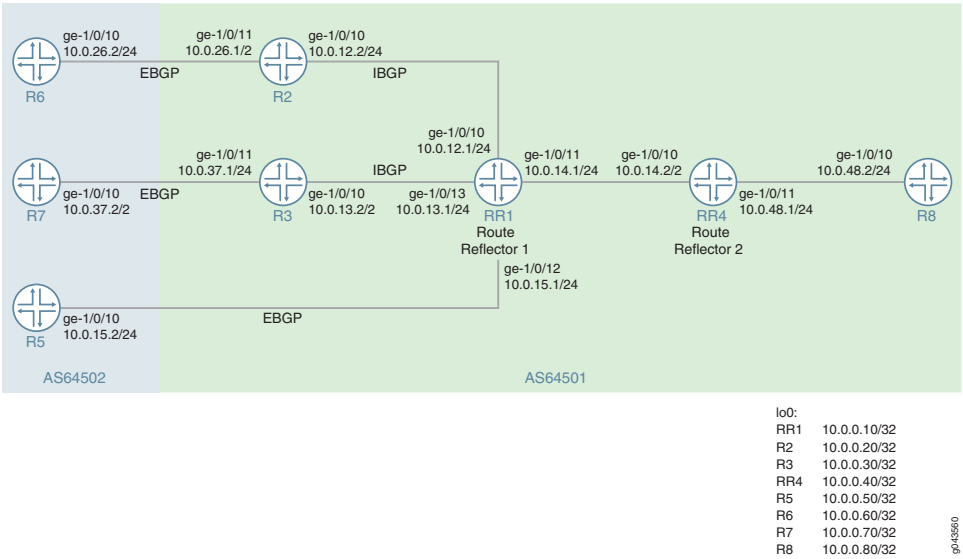
neighbors R2 and R3 is configured for multipath. Routers R5, R6, and Router R7 redistribute static routes 199.1.1.1/32 and 198.1.1.1/32 into BGP.

A load-balancing policy is configured at Router RR1 such that the 199.1.1.1/32 routes have multipath calculated. The multipath feature is configured under add-path for neighbor RR4. However, Router RR4 does not have load-balancing multipath configured. Router RR1 is configured to send Router RR4 up to six add path routes to 199.1.1.1/32 chosen from multipath candidate routes.

Figure 48: Example: Configuring Selective Advertising of BGP Multiple Paths for Load Balancing



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter commit from configuration mode.

Router RR1

```
set interfaces ge-1/0/10 unit 0 description RR1->R2
set interfaces ge-1/0/10 unit 0 family inet address 10.0.12.1/24
set interfaces ge-1/0/11 unit 0 description RR1->RR4
set interfaces ge-1/0/11 unit 0 family inet address 10.0.14.1/24
set interfaces ge-1/0/12 unit 0 description RR1->R5
set interfaces ge-1/0/12 unit 0 family inet address 10.0.15.1/24
set interfaces ge-1/0/13 unit 0 description RR1->R3
set interfaces ge-1/0/13 unit 0 family inet address 10.0.13.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.10/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.10
set protocols bgp group rr cluster 10.0.0.10
set protocols bgp group rr multipath
set protocols bgp group rr neighbor 10.0.0.20
```

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```
set protocols bgp group rr neighbor 10.0.0.30
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
set protocols bgp group e1 neighbor 10.0.15.2 peer-as 64502
set protocols bgp group rr_rr type internal
set protocols bgp group rr_rr local-address 10.0.0.10
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  path-count 6
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  multipath
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/13
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set protocols ospf area 0.0.0.0 interface ge-1/0/12
set policy-options prefix-list match_199 199.1.1.1/32
set policy-options policy-statement loadbal_199 term match_100 from prefix-list
  match_199
set policy-options policy-statement loadbal_199 from route-filter 199.1.1.1/32 exact
set policy-options policy-statement loadbal_199 then load-balance per-packet
set routing-options router-id 10.0.0.10
set routing-options autonomous-system 64501
set routing-options forwarding-table export loadbal_199
```

Router R2

```
set interfaces ge-1/0/10 unit 0 description R2->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.12.2/24
set interfaces ge-1/0/11 unit 0 description R2->R6
set interfaces ge-1/0/11 unit 0 family inet address 10.0.26.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.20/32
set protocols bgp group rr local-address 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.2 peer-as 64502
set protocols ospf area 0.0.0.0 interface lo0.20 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 64501
```

Router R3

```
set interfaces ge-1/0/10 unit 0 description R3->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.13.2/24
set interfaces ge-1/0/11 unit 0 description R3->R7
set interfaces ge-1/0/11 unit 0 family inet address 10.0.37.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.30/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.30
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.2 peer-as 64502
set protocols ospf area 0.0.0.0 interface lo0.30 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/13
```


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```
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 64501
```

Router RR4

```
set interfaces ge-1/0/10 unit 0 description RR4->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.14.2/24
set interfaces ge-1/0/11 unit 0 description RR4->R8
set interfaces ge-1/0/11 unit 0 family inet address 10.0.48.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.40/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.40
set protocols bgp group rr family inet unicast add-path receive
set protocols bgp group rr neighbor 10.0.0.10
set protocols bgp group rr_client type internal
set protocols bgp group rr_client local-address 10.0.0.40
set protocols bgp group rr_client cluster 10.0.0.40
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  prefix-policy addpath-communities-send-4713-100
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 2
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  multipath
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface lo0.40 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set policy-options prefix-list match_199 199.1.1.1/32
set routing-options autonomous-system 64501
```

Router R5

```
set interfaces ge-1/0/10 unit 0 description R5->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.15.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.50/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.1 export s2b
set protocols bgp group e1 neighbor 10.0.15.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then as-path-expand 2
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R6

```
set interfaces ge-1/0/10 unit 0 description R6->R2
set interfaces ge-1/0/10 unit 0 family inet address 10.0.26.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.60/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.1 export s2b
set protocols bgp group e1 neighbor 10.0.26.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
```

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```
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R7

```
set interfaces ge-1/0/10 unit 0 description R7->R3
set interfaces ge-1/0/10 unit 0 family inet address 10.0.37.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.70/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.1 export s2b
set protocols bgp group e1 neighbor 10.0.37.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R8

```
set interfaces ge-1/0/10 unit 0 description R8->RR4
set interfaces ge-1/0/10 unit 0 family inet address 10.0.48.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.80/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.80
set protocols bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10.8
set routing-options autonomous-system 64501
set chassis fpc 1 pic 0 tunnel-services bandwidth 1g
```

Configuring Router RR1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router RR1:

NOTE: Repeat this procedure for other routers after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 addresses.

```
[edit interfaces]
```


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```
user@RR1# set ge-1/0/10 unit 0 description RR1->R2
user@RR1# set ge-1/0/10 unit 0 family inet address 10.0.12.1/24

user@RR1# set ge-1/0/11 unit 0 description RR1->RR4
user@RR1# set ge-1/0/11 unit 0 family inet address 10.0.14.1/24

user@RR1# set ge-1/0/12 unit 0 description RR1->R5
user@RR1# set ge-1/0/12 unit 0 family inet address 10.0.15.1/24

user@RR1# set ge-1/0/13 unit 0 description RR1->R3
user@RR1# set ge-1/0/13 unit 0 family inet address 10.0.13.1/24
```

2. Configure the loopback address.

```
[edit interfaces]
user@RR1# set lo0 unit 0 family inet address 10.0.0.10/32
```

3. Configure interior gateway protocol (IGP) such as OSPF or IS-IS.

```
[edit protocols]
user@RR1# set ospf area 0.0.0.0 interface lo0.10 passive
user@RR1# set ospf area 0.0.0.0 interface ge-1/0/10
user@RR1# set ospf area 0.0.0.0 interface ge-1/0/13
user@RR1# set ospf area 0.0.0.0 interface ge-1/0/11
user@RR1# set ospf area 0.0.0.0 interface ge-1/0/12
```

4. Configure internal group rr for interfaces connecting to internal routers R2 and R3.

```
[edit protocols]
user@RR1# set bgp group rr type internal
user@RR1# set bgp group rr local-address 10.0.0.10
user@RR1# set bgp group rr cluster 10.0.0.10
user@RR1# set bgp group rr neighbor 10.0.0.20
user@RR1# set bgp group rr neighbor 10.0.0.30
```

5. Configure load balancing for internal BGP group rr.

```
[edit protocols]
user@RR1# set bgp group rr multipath
```

6. Configure internal group rr_rr for route reflectors.

```
[edit protocols]
user@RR1# set bgp group rr_rr type internal
user@RR1# set bgp group rr_rr local-address 10.0.0.10
```

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7. Configure the addpath multipath feature to advertise contributor multiple paths only and limit the number of advertised multipaths to 6.

```
[edit protocols]
user@RR1# set bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
   multipath
user@RR1# set bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
   path-count 6
```

8. Configure EBGP on interfaces connecting to the external edge routers.

```
[edit protocols]
user@RR1# set bgp group e1 type external
user@RR1# set bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
user@RR1# set bgp group e1 neighbor 10.0.15.2 peer-as 64502
```

9. Define a policy loadbal_199 for per packet load balancing.

```
[edit policy-options]
user@RR1# set prefix-list match_199 199.1.1.1/32
user@RR1# set policy-statement loadbal_199 term match_100 from prefix-list
   match_199
user@RR1# set policy-statement loadbal_199 from route-filter 199.1.1.1/32 exact
user@RR1# set policy-statement loadbal_199 then load-balance per-packet
```

10. Apply the defined export policy loadbal_199.

```
[edit routing-options]
user@RR1# set forwarding-table export loadbal_199
```

11. Configure the router ID and the autonomous system for BGP hosts.

```
[edit routing-options]
user@RR1# set router-id 10.0.0.10
user@RR1# set autonomous-system 64501
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@RR1# show interfaces
ge-1/0/10 {
   unit 0 {
      description RR1->R2;
```


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```
      family inet {
        address 10.0.12.1/24;
      }
    }
}
ge-1/0/11 {
    unit 0 {
      description RR1->RR4;
      family inet {
        address 10.0.14.1/24;
      }
    }
}
ge-1/0/12 {
    unit 0 {
      description RR1->R5;
      family inet {
        address 10.0.15.1/24;
      }
    }
}
ge-1/0/13 {
    unit 0 {
      description RR1->R3;
      family inet {
        address 10.0.13.1/24;
      }
    }
}
lo0 {
    unit 0 {
      family inet {
        address 10.0.0.10/32;
      }
    }
}
```

```
[edit]
user@RR1# show protocols
bgp {
    group rr {
      type internal;
      local-address 10.0.0.10;
      cluster 10.0.0.10;
      multipath;
      neighbor 10.0.0.20;
      neighbor 10.0.0.30;
    }
    group e1 {
      type external;
      neighbor 10.0.15.2 {
        local-address 10.0.15.1;
        peer-as 64502;
      }
```

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```
    }
    group rr_rr {
      type internal;
      local-address 10.0.0.10;
      neighbor 10.0.0.40 {
        family inet {
          unicast {
            add-path {
              send {
                path-count 6;
                multipath;
              }
            }
          }
        }
      }
    }
}
ospf {
  area 0.0.0.0 {
    interface all;
    interface fxp0.0 {
      disable;
    }
    interface lo0.10 {
      passive;
    }
    interface ge-1/0/10;
    interface ge-1/0/13;
    interface ge-1/0/11;
    interface ge-1/0/12;
  }
}
```

```
[edit]
user@RR1# show routing-options
router-id 10.0.0.10;
autonomous-system 64501;
forwarding-table {
  export load-bal_199;
}
```

```
[edit]
user@RR1# show policy-options
prefix-list match_199 {
  199.1.1.1/32;
}
policy-statement loadbal_199 {
  term match_100 {
    from {
      prefix-list match_199;
    }
  }
  from {
```


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```
    route-filter 199.1.1.1/32 exact;
  }
  then {
    load-balance per-packet;
  }
}
```

If you are done configuring the device, commit the configuration.

```
user@RR1# commit
```

Verification

Confirm that the configuration is working properly.

- Verifying the Multipath Routes for the Static Route 199.1.1.1/32 on page 507
- Verifying That the Multipath Routes are Advertised from Router RR1 to Router RR4 on page 509
- Verifying that Router RR4 Advertises One Route for 199.1.1.1/32 to Router R8 on page 510

Verifying the Multipath Routes for the Static Route 199.1.1.1/32

Purpose Verify the available multipath routes for destination 199.1.1.1/32.

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Action From operational mode, run the **show route 199.1.1.1/32 detail** command on Router RR1.

```
user@RR1> show route 199.1.1.1/32 detail

inet.0: 22 destinations, 26 routes (22 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 2 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xae5cc90
                Next-hop reference count: 1
                Source: 10.0.0.20
                Next hop type: Router, Next hop index: 1118
                Next hop: 10.0.12.2 via lt-1/0/10.1, selected
                Session Id: 0x0
                Next hop type: Router, Next hop index: 1115
                Next hop: 10.0.13.2 via lt-1/0/10.9
                Session Id: 0x0
                Protocol next hop: 10.0.0.20
                Indirect next hop: 0xc409410 1048574 INH Session ID: 0x0
                Protocol next hop: 10.0.0.30
                Indirect next hop: 0xc409520 1048575 INH Session ID: 0x0
                State:  <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 4:03:29  Metric2: 1
                Validation State: unverified
                Task: BGP_1.10.0.0.20
                Announcement bits (3): 2-KRT 3-BGP_RT_Background 4-Resolve tree
2
                AS path: 2 I
                Communities: 4713:100
                Accepted Multipath
                Localpref: 100
                Router ID: 10.0.0.20
         BGP    Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xae0ec10
                Next-hop reference count: 4
                Source: 10.0.0.30
                Next hop type: Router, Next hop index: 1115
                Next hop: 10.0.13.2 via lt-1/0/10.9, selected
                Session Id: 0x0
                Protocol next hop: 10.0.0.30
                Indirect next hop: 0xc409520 1048575 INH Session ID: 0x0
                State: <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:  64501 Peer AS: 64501
                Age: 4:03:29  Metric2: 1
                Validation State: unverified
                Task: BGP_1.10.0.0.30
                Announcement bits (1): 3-BGP_RT_Background
                AS path: 2 I
                Communities: 4713:100
                Accepted MultipathContrib
                Localpref: 100
                Router ID: 10.0.0.30
         BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 1105
                Address: 0xae0e970
                Next-hop reference count: 5
                Source: 10.0.15.2
```


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```
                Next hop: 10.0.15.2 via lt-1/0/10.6, selected
                Session Id: 0x0
                State: <Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     2
                Age: 4:05:01
                Validation State: unverified
                Task: BGP_2.10.0.15.2
                AS path: 2 2 I
                Communities: 4713:100
                Accepted
                Localpref: 100
                Router ID: 10.0.0.50
```

Meaning The selective advertising multipath feature is enabled on Router RR1 and there is more than one nexthop available for route 199.1.1.1/32. The two available next hops for route 199.1.1.1/32 are 10.0.0.20 and 10.0.0.30.

Verifying That the Multipath Routes are Advertised from Router RR1 to Router RR4

Purpose Verify that Router RR1 is advertising the multipath routes.

Action From operational mode, run the **show route advertising-protocol bgp 10.0.0.40** command on Router RR1.

```
user@RR1> show route advertising-protocol bgp 10.0.0.40
```

```
inet.0: 22 destinations, 26 routes (22 active, 0 holddown, 0 hidden)
  Prefix    Nexthop       MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                   100        2 2 I
* 10.0.0.60/32            10.0.0.20                   100        2 I
* 10.0.0.70/32            10.0.0.30                   100        2 I
* 198.1.1.1/32            10.0.0.20                   100        2 I
* 199.1.1.1/32     10.0.0.20        100    2 I
          10.0.0.30        100    2 I
```

```
user@RR1> show route advertising-protocol bgp 10.0.0.40 detail
```

```
inet.0: 22 destinations, 26 routes (22 active, 0 holddown, 0 hidden)
* 10.0.0.50/32 (1 entry, 1 announced)
 BGP group rr_rr type Internal
     Nexthop: 10.0.15.2
     Localpref: 100
     AS path: [1] 2 2 I
     Communities: 4713:100
     Addpath Path ID: 1
….* 199.1.1.1/32 (3 entries, 2 announced)
 BGP group rr_rr type Internal
     Nexthop: 10.0.0.20
     Localpref: 100
     AS path: [1] 2 I
```

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```
    Communities: 4713:100
    Cluster ID: 10.0.0.10
    Originator ID: 10.0.0.20
    Addpath Path ID: 1
 BGP group rr_rr type Internal
    Nexthop: 10.0.0.30
    Localpref: 100
    AS path: [1] 2 I
    Communities: 4713:100
    Cluster ID: 10.0.0.10
    Originator ID: 10.0.0.30
    Addpath Path ID: 2
```

Meaning Router RR1 is advertising two next hops 10.0.0.20 and 10.0.0.30 for route 199.1.1.1/32 to Router RR4.

Verifying that Router RR4 Advertises One Route for 199.1.1.1/32 to Router R8

Purpose Multipath is not configured on Router RR4, therefore route 199.1.1.1/32 is not eligible for add-path. Verify that Router RR4 advertises only one route for 199.1.1.1/32 to Router R8.

Action From operational mode, run the **show route advertising-protocol bgp 10.0.0.80** command on Router RR4.

```
user@RR4> show route advertising-protocol bgp 10.0.0.80 detail
```

```
inet.0: 20 destinations, 21 routes (20 active, 0 holddown, 0 hidden)
* 10.0.0.50/32 (1 entry, 1 announced)
 BGP group rr_client type Internal
     Nexthop: 10.0.15.2
     Localpref: 100
     AS path: [1] 2 2 I
     Communities: 4713:100
     Cluster ID: 10.0.0.40
     Originator ID: 10.0.0.10

     Addpath Path ID: 1
…
* 198.1.1.1/32 (1 entry, 1 announced)
 BGP group rr_client type Internal
     Nexthop: 10.0.0.20
     Localpref: 100
     AS path: [1] 2 I (Originator)
     Cluster list:  10.0.0.10
     Originator ID: 10.0.0.20
     Communities: 4713:100
     Cluster ID: 10.0.0.40
     Addpath Path ID: 1

* 199.1.1.1/32 (2 entries, 1 announced)
 BGP group rr_client type Internal
     Nexthop: 10.0.0.20
     Localpref: 100
     AS path: [1] 2 I (Originator)
```


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```
    Cluster list:  10.0.0.10
    Originator ID: 10.0.0.20
    Communities: 4713:100
    Cluster ID: 10.0.0.40
    Addpath Path ID: 1
```

Meaning Since multipath is not enabled on Router RR4, only one path 10.0.0.20 is advertised to Router R8.

Related Documentation
- multipath on page 1268

Example: Configuring a Routing Policy to Select and Advertise Multipaths Based on BGP Community Value

Advertising all available multiple paths might result in a large overhead of processing on device memory. If you want to advertise a limited subset of prefixes without actually knowing the prefixes in advance, you can use the BGP community value to identify prefix routes that need to be advertised to BGP neighbors. This example shows how to define a routing policy to filter and advertise multiple paths based on a known BGP community value.

- Requirements on page 511
- Overview on page 511
- Configuration on page 512
- Verification on page 519

Requirements

No special configuration beyond device initialization is required before configuring this example.

This example uses the following hardware and software components:

- Eight routers that can be a combination of M Series, MX Series, or T Series routers
- Junos OS Release 16.1R2 or later on the device

Overview

Beginning with Junos OS 16.1R2, you can define a policy to identify eligible multiple path prefixes based on community values. BGP advertises these community-tagged routes in addition to the active path to a given destination. If the community value of a route does not match the community value defined in the policy, then BGP does not advertise that route. This feature allows BGP to advertise not more than 20 paths to a given destination. You can limit and configure the number of prefixes that BGP considers for

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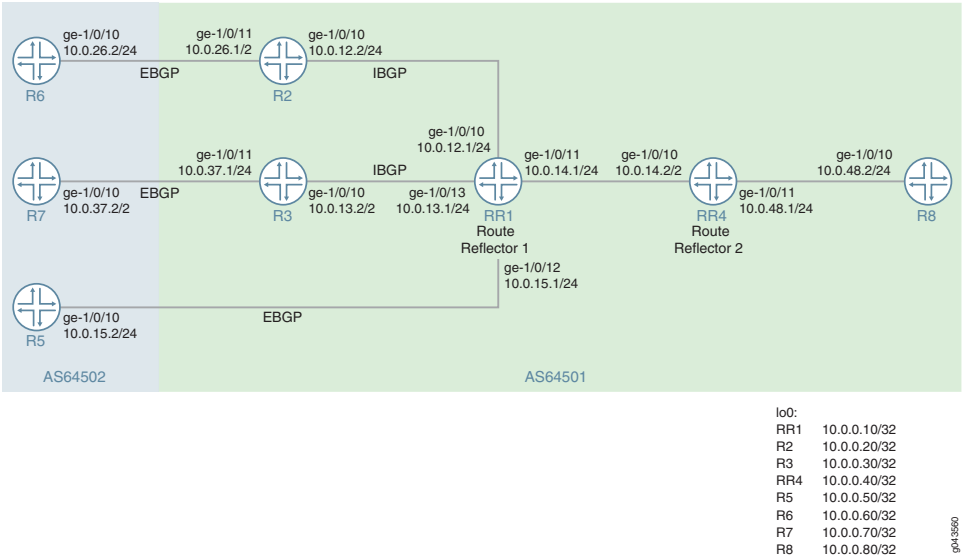
multiple paths without actually knowing the prefixes in advance. Instead, a known BGP community value determines whether or not a prefix is advertised.

Topology

In Figure 49 on page 512, RR1 and RR4 are route reflectors. Router R2 and R3 are clients to the route reflector RR1. Router R8 is a client to route reflector RR4. Routers R5, R6, and Router R7 redistribute static routes into BGP. Router R5 advertises static routes 199.1.1.1/32 and 198.1.1.1/32 with community value 4713:100.

Router RR1 is configured to send up to six paths (per destination) to Router RR4. Router RR4 is configured to send up to six paths to Router R8. Router R8 is configured to receive multiple paths from Router RR4. The add-path community configuration restricts Router RR4 to send multiple paths for routes that contain only the 4713:100 community value. Router RR4 filters and advertises multipaths that contain only 4714:100 community value.

Figure 49: Example: Configuring BGP to Advertise Multipaths Based on Community Value



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter commit from configuration mode.

Router RR1

```
set interfaces ge-1/0/10 unit 0 description RR1->R2
set interfaces ge-1/0/10 unit 0 family inet address 10.0.12.1/24
set interfaces ge-1/0/11 unit 0 description RR1->RR4
set interfaces ge-1/0/11 unit 0 family inet address 10.0.14.1/24
set interfaces ge-1/0/12 unit 0 description RR1->R5
set interfaces ge-1/0/12 unit 0 family inet address 10.0.15.1/24
set interfaces ge-1/0/13 unit 0 description RR1->R3
set interfaces ge-1/0/13 unit 0 family inet address 10.0.13.1/24
```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```
set interfaces lo0 unit 0 family inet address 10.0.0.10/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.10
set protocols bgp group rr cluster 10.0.0.10
set protocols bgp group rr multipath
set protocols bgp group rr neighbor 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.30
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.2 local-address 10.0.15.1
set protocols bgp group e1 neighbor 10.0.15.2 peer-as 64502
set protocols bgp group rr_rr type internal
set protocols bgp group rr_rr local-address 10.0.0.10
set protocols bgp group rr_rr neighbor 10.0.0.40 family inet unicast add-path send
  path-count 6
set protocols ospf area 0.0.0.0 interface lo0.10 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/13
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set protocols ospf area 0.0.0.0 interface ge-1/0/12
set routing-options router-id 10.0.0.10
set routing-options autonomous-system 64501
```

Router R2

```
set interfaces ge-1/0/10 unit 0 description R2->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.12.2/24
set interfaces ge-1/0/11 unit 0 description R2->R6
set interfaces ge-1/0/11 unit 0 family inet address 10.0.26.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.20/32
set protocols bgp group rr local-address 10.0.0.20
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.2 peer-as 64502
set protocols ospf area 0.0.0.0 interface lo0.20 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 64501
```

Router R3

```
set interfaces ge-1/0/10 unit 0 description R3->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.13.2/24
set interfaces ge-1/0/11 unit 0 description R3->R7
set interfaces ge-1/0/11 unit 0 family inet address 10.0.37.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.30/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.30
set protocols bgp group rr neighbor 10.0.0.10 export set_nh_self
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.2 peer-as 64502
set protocols ospf area 0.0.0.0 interface lo0.30 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface ge-1/0/13
set policy-options policy-statement set_nh_self then next-hop self
set routing-options autonomous-system 64501
```

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Router RR4

```
set interfaces ge-1/0/10 unit 0 description RR4->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.14.2/24
set interfaces ge-1/0/11 unit 0 description RR4->R8
set interfaces ge-1/0/11 unit 0 family inet address 10.0.48.1/24
set interfaces lo0 unit 0 family inet address 10.0.0.40/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.40
set protocols bgp group rr family inet unicast add-path receive
set protocols bgp group rr neighbor 10.0.0.10
set protocols bgp group rr_client type internal
set protocols bgp group rr_client local-address 10.0.0.40
set protocols bgp group rr_client cluster 10.0.0.40
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  prefix-policy addpath-communities-send-4713-100
set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path send
  path-count 6
set protocols ospf area 0.0.0.0 interface ge-1/0/10
set protocols ospf area 0.0.0.0 interface lo0.40 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/11
set policy-options community addpath-community-members 4713:100
set policy-options community addpath-communities-send-4713:100
set policy-options policy-statement addpath-communitiesunities-send-4713-100 term
  term1 from protocol bgp
set policy-options policy-statement addpath-communities-send-4713-100 term term1
  from community addpath-4713-100-community
set policy-options policy-statement addpath-communitiesunities-send-4713-100 term
  term1 then add-path send-count 6
set policy-options policy-statement addpath-communities-send-4713-100 term term1
  then add-path accept
set routing-options autonomous-system 64501
```

Router R5

```
set interfaces ge-1/0/10 unit 0 description R5->RR1
set interfaces ge-1/0/10 unit 0 family inet address 10.0.15.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.50/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.15.1 export s2b
set protocols bgp group e1 neighbor 10.0.15.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then as-path-expand 2
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R6

```
set interfaces ge-1/0/10 unit 0 description R6->R2
set interfaces ge-1/0/10 unit 0 family inet address 10.0.26.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.60/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.26.1 export s2b
```


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```
set protocols bgp group e1 neighbor 10.0.26.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R7

```
set interfaces ge-1/0/10 unit 0 description R7->R3
set interfaces ge-1/0/10 unit 0 family inet address 10.0.37.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.70/32
set protocols bgp group e1 type external
set protocols bgp group e1 neighbor 10.0.37.1 export s2b
set protocols bgp group e1 neighbor 10.0.37.1 peer-as 64501
set policy-options policy-statement s2b from protocol static
set policy-options policy-statement s2b from protocol direct
set policy-options policy-statement s2b then community add addpath-community
set policy-options policy-statement s2b then accept
set policy-options community addpath-community members 4713:100
set routing-options static route 199.1.1.1/32 reject
set routing-options autonomous-system 64502
```

Router R8

```
set interfaces ge-1/0/10 unit 0 description R8->RR4
set interfaces ge-1/0/10 unit 0 family inet address 10.0.48.2/24
set interfaces lo0 unit 0 family inet address 10.0.0.80/32
set protocols bgp group rr type internal
set protocols bgp group rr local-address 10.0.0.80
set protocols bgp group rr neighbor 10.0.0.40 family inet unicast add-path receive
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-1/0/10.8
set routing-options autonomous-system 64501
set chassis fpc 1 pic 0 tunnel-services bandwidth 1g
```

Configuring Router RR4

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router RR4:

NOTE: Repeat this procedure for other routers after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 addresses.

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```
[edit interfaces]
user@RR4# set ge-1/0/10 unit 0 description RR4->RR1
user@RR4# set ge-1/0/10 unit 0 family inet address 10.0.14.2/24

user@RR4# set ge-1/0/11 unit 0 description RR4->R8
user@RR4# set ge-1/0/11 unit 0 family inet address 10.0.48.1/24
```

2. Configure the loopback address.

```
[edit interfaces]
user@RR4# set lo0 unit 0 family inet address 10.0.0.40/32
```

3. Configure OSPF or any other interior gateway protocol (IGP).

```
[edit protocols]
user@RR4# set ospf area 0.0.0.0 interface lo0.40 passive
user@RR4# set ospf area 0.0.0.0 interface ge-1/0/10
user@RR4# set ospf area 0.0.0.0 interface ge-1/0/11
```

4. Configure two IBGP groups rr for route reflectors and rr_client for clients of route reflectors.

```
[edit protocols]
user@RR4# set bgp group rr type internal
user@RR4# set bgp group rr local-address 10.0.0.40
user@RR4# set bgp group rr family inet unicast add-path receive
user@RR4# set bgp group rr neighbor 10.0.0.10

user@RR4# set bgp group rr_client type internal
user@RR4# set bgp group rr_client local-address 10.0.0.40
user@RR4# set bgp group rr_client cluster 10.0.0.40
```

5. Configure the feature to send multiple paths that contain 4713:100 community value only and limit the number of advertised multipaths to 6.

```
[edit protocols]
user@RR4# set bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path
   send prefix-policy addpath-communities-send-4713-100
user@RR4# set bgp group rr_client neighbor 10.0.0.80 family inet unicast add-path
   send path-count 6
```

6. Define a policy **addpath-community-members 4713:100** to filter prefixes with the community value 4713:100 and restrict the device to send up to 16 paths to Router R8. This limit overrides the previously configured add-path send path-count of 6 at the BGP group hierarchy level.

```
[edit policy-options]
user@RR4# set community addpath-community-members 4713:100
```


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```
user@RR4# set community addpath-communities-send-4713:100
user@RR4# set policy-statement addpath-communitiesunities-send-4713-100
   term term1 from protocol bgp
user@RR4# set policy-statement addpath-communities-send-4713-100 term term1
   from community addpath-4713-100-community
user@RR4# set policy-statement addpath-communitiesunities-send-4713-100
   term term1 then add-path send-count 16
user@RR4# set policy-statement addpath-communities-send-4713-100 term term1
   then add-path accept
```

7. Configure the router ID and the autonomous system for BGP hosts.

```
[edit routing-options]
user@RR4# set router-id 10.0.0.40
user@RR4# set autonomous-system 64501
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@RR4# show interfaces
ge-1/0/10 {
   unit 0 {
      description RR4->RR1;
      family inet {
         address 10.0.14.2/24;
      }
   }
}
ge-1/0/11 {
   unit 0 {
      description RR4->R8;
      family inet {
         address 10.0.48.1/24;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 10.0.0.10/32;
      }
   }
}
```

```
[edit]
user@RR4# show protocols
```

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```
bgp {
  group rr {
    type internal;
    local-address 10.0.0.40;
    family inet {
      unicast {
        add-path {
          receive;
        }
      }
    }
    neighbor 10.0.0.10;
  }
  group rr_client {
    type internal;
    local-address 10.0.0.40;
    cluster 10.0.0.40;
    neighbor 10.0.0.80 {
      family inet {
        unicast {
          add-path {
            send {
              prefix-policy addpath-communities-send-4713-100;
              path-count 6;
            }
          }
        }
      }
    }
  }
}
ospf {
  area 0.0.0.0 {
    interface ge-1/0/10.0;
    interface lo0.40 {
      passive;
    }
    interface ge-1/0/11.0;
  }
}
```

```
[edit]
user@RR4# show policy-options
policy-options {
  policy-statement addpath-communities-send-4713-100 {
    term term1 {
      from community addpath-4713-100-community;
    }
  }
  policy-statement addpath-communitiesunities-send-4713-100 {
    term term1 {
      from protocol bgp;
      then {
        add-path send-count 16;
```


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```
      }
    }
  }
}
```

```
[edit]
user@RR4# show routing-options
router-id 10.0.0.40;
autonomous-system 64501;
```

If you are done configuring the device, commit the configuration.

```
user@RR4# commit
```

Verification

Confirm that the configuration is working properly.

- Verifying That the Multipath Routes are Advertised from Router RR4 to Router R8 on page 519
- Verifying That Router R8 Receives the Multipath Routes That Router RR4 Advertises on page 520
- Verifying That Router RR4 is Advertising only Multipath Routes with Community Value 4713:100 to Router R8 on page 520

Verifying That the Multipath Routes are Advertised from Router RR4 to Router R8

Purpose Verify that Router RR4 can send multiple paths to Router R8.

Action From operational mode, run the **show route advertising-protocol bgp** *neighbor-address* command on Router RR4.

```
user@RR4> show route advertising-protocol bgp 10.0.0.80
```

```
inet.0: 20 destinations, 23 routes (20 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32     10.0.0.20        100    2 I
          10.0.0.30        100    2 I
          10.0.15.2        100    2 2 I
```

Meaning Router RR4 is advertising multiple paths 10.0.0.20, 10.0.0.30, and 10.0.15.2 to Router R8.

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Verifying That Router R8 Receives the Multipath Routes That Router RR4 Advertises

Purpose Verify that Router R8 is receiving the multipath routes from Router RR4.

Action From operational mode, run the **show route receive-protocol bgp** *neighbor-address* command on Router R8.

```
user@R8> show route receive-protocol bgp 10.0.0.40

inet.0: 19 destinations, 22 routes (19 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 10.0.0.50/32            10.0.15.2                    100        2 2 I
* 10.0.0.60/32            10.0.0.20                    100        2 I
* 10.0.0.70/32            10.0.0.30                    100        2 I
* 198.1.1.1/32            10.0.0.20                    100        2 I
                          10.0.15.2                    100        2 2 I
* 199.1.1.1/32     10.0.0.20        100    2 I
          10.0.0.30        100    2 I
          10.0.15.2        100    2 2 I
```

Meaning Router R8 is receiving multiple next hops 10.0.0.20, 10.0.0.30, and 10.0.15.2 for route 199.1.1.1/32 from Router RR4.

Verifying That Router RR4 is Advertising only Multipath Routes with Community Value 4713:100 to Router R8

Purpose Router RR4 must advertise multipath routes with community value of 4713:100 only to Router R8.

Action From operational mode, run the **show route 199.1.1.1/32 detail** command on Router RR4.

```
user@RR4> show route 199.1.1.1/32 detail

inet.0: 20 destinations, 23 routes (20 active, 0 holddown, 0 hidden)
199.1.1.1/32 (3 entries, 3 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xae0ea90
                Next-hop reference count: 6
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 1115
                Next hop: 10.0.14.1 via ge-1/0/10.4, selected
                Session Id: 0x0
                Protocol next hop: 10.0.0.20
                Indirect next hop: 0xc4091f0 1048581 INH Session ID: 0x0
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 4d 20:56:53        Metric2: 2
                Validation State: unverified
```


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```
                Task: BGP_1.10.0.0.10
                Announcement bits (3): 2-KRT 3-BGP_RT_Background 4-Resolve tree
2
                AS path: 2 I (Originator)
                Cluster list:  10.0.0.10
                Originator ID: 10.0.0.20
                Communities: 4713:100
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 1
        BGP     Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xae0eb50
                Next-hop reference count: 3
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 1115
                Next hop: 10.0.14.1 via lt-1/0/10.4, selected
                Session Id: 0x0
                Protocol next hop: 10.0.0.30
                Indirect next hop: 0xc409300 1048582 INH Session ID: 0x0
                State:  <NotBest Int Ext>
                Inactive reason: Not Best in its group - Router ID
                Local AS:     1 Peer AS:     1
                Age: 4d 20:56:53        Metric2: 2
                Validation State: unverified
                Task: BGP_1.10.0.0.10
                Announcement bits (1): 3-BGP_RT_Background
                AS path: 2 I (Originator)
                Cluster list:  10.0.0.10
                Originator ID: 10.0.0.30
                Communities: 4713:100
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 2
        BGP     Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xae0e9d0
                Next-hop reference count: 4
                Source: 10.0.0.10
                Next hop type: Router, Next hop index: 1115
                Next hop: 10.0.14.1 via lt-1/0/10.4, selected
                Session Id: 0x0
                Protocol next hop: 10.0.15.2
                Indirect next hop: 0xc4090e0 1048580 INH Session ID: 0x0
                State:  <Int Ext>
                Inactive reason: AS path
                Local AS:     1 Peer AS:     1
                Age: 4d 20:56:53        Metric2: 2
                Validation State: unverified
                Task: BGP_1.10.0.0.10
                Announcement bits (1): 3-BGP_RT_Background
                AS path: 2 2 I
                Communities: 4713:100
                Accepted
                Localpref: 100
                Router ID: 10.0.0.10
                Addpath Path ID: 3
```

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Meaning Router RR4, is advertising three paths with community value of 4713:100 to Router R8.

Related Documentation

- multipath on page 1268
- Example: Configuring Selective Advertising of BGP Multiple Paths for Load Balancing on page 498
- Understanding BGP Multipath on page 424

Configuring Recursive Resolution over BGP Multipath

Starting in Junos OS Release 17.3R1, when a BGP prefix that has a single protocol next hop is resolved over another BGP prefix that has multiple resolved paths (unilist), all the paths are selected for protocol next-hop resolution. In earlier Junos OS releases, only one of the paths is picked for protocol next-hop resolution because the resolver did not support load-balancing across all paths of the IBGP multipath route. The resolver in the routing protocol process (rpd) resolves the protocol next-hop address (PNH) into immediate forwarding next hops. The BGP recursive resolution feature enhances the resolver to resolve routes over IBGP multipath route and use all the feasible paths as next hops. This feature benefits densely connected networks where BGP is used to establish infrastructure connectivity such as WAN networks with high equal-cost multipath and seamless MPLS topology.

Before you begin configuring recursive resolution of BGP multipath, you must do the following:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure MPLS and LDP.
4. Configure BGP.

To configure recursive resolution over multipath,

1. Define a policy that includes the **multipath-resolve** action .

```
[edit policy-options policy-statement policy-name then]
user@host# set multipath-resolve
```

2. Import the policy to resolve all the available paths of IBGP multipath route.

```
[edit routing-options resolution rib rib-name]
user@host# set import policy-name
```


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3. Verify that BGP is resolving multipaths recursively and multiple next hops are available for load balancing traffic.

   From operational mode, enter the **show route resolution detail** command:

```
user@host> show route resolution detail 10.1.1.2
Tree Index: 1, Nodes 36, Reference Count 3
Contributing routing tables: inet.0 inet.3
Policy: [ abc ]
10.1.1.2/32 Originating RIB: inet.0
  Node path count: 1
  Next hop subtype: INDIRECT
  Indirect next hops: 2
        Protocol next hop: 10.1.1.1
        Inode flags: 0x206 path flags: 0x08
        Path fnh link: 0xc9321c0 path inh link: 0x0
        Indirect next hop: 0xb2b20f0 1048574 INH Session ID: 0x143
        Indirect path forwarding next hops: 1
                Next hop type: Router
                Next hop: 12.1.1.2 via ge-2/0/1.0
                Session Id: 0x144
                Next hop: 13.1.1.2 via ge-2/0/2.0
                Session Id: 0x145

 10.1.1.1/32 Originating RIB: inet.0
   Node path count: 1
  Node flags: 1
   Forwarding nexthops: 1 (Merged)
  Nexthop: 12.1.1.2 via ge-2/0/1.0

  Nexthop: 13.1.1.2 via ge-2/0/2.0
```

```
user@host> show route 10.1.1.2 extensive
inet.0: 37 destinations, 37 routes (36 active, 0 holddown, 1 hidden)
10.1.1.2/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.1.1.2/32 -> {indirect(1048574)}
        *Static Preference: 5
                Next hop type: Indirect, Next hop index: 0
                Address: 0xb39d1b0
                Next-hop reference count: 2
                Next hop type: Router, Next hop index: 581
                Next hop: 12.1.1.2 via ge-2/0/1.0, selected
                Session Id: 0x144
                Next hop: 13.1.1.2 via ge-2/0/2.0, selected
                Session Id: 0x145
                Protocol next hop: 10.1.1.1
                Indirect next hop: 0xb2b20f0 1048574 INH Session ID: 0x143
                State: <Active Int Ext>
                Age: 2:53  Metric2: 0
                Validation State: unverified
                Task: RT
                Announcement bits (2): 0-KRT 2-Resolve tree 1
                AS path: I
                Indirect next hops: 1
                        Protocol next hop: 10.1.1.1
                        Indirect next hop: 0xb2b20f0 1048574 INH Session ID:
0x143
```

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```
                    Indirect path forwarding next hops: 2
                            Next hop type: Router
                            Next hop: 12.1.1.2 via ge-2/0/1.0
                            Session Id: 0x144
                            Next hop: 13.1.1.2 via ge-2/0/2.0
                            Session Id: 0x145
                 10.1.1.1/32 Originating RIB: inet.0
                    Node path count: 1
                      Node flags: 1
                    Forwarding nexthops: 2 (Merged)
                    Nexthop: 12.1.1.2 via ge-2/0/1.0
                     Nexthop: 13.1.1.2 via ge-2/0/2.0
```

Related Documentation

- *policy-statement*
- *show route resolution*

Configuring ECMP Next Hops for RSVP and LDP LSPs for Load Balancing

The Junos OS supports configurations of 16, 32, or 64 equal-cost multipath (ECMP) next hops for RSVP and LDP LSPs on M10i routers with an Enhanced CFEB, M320, M120, MX Series, and T Series routers, and routing devices. For networks with high-volume traffic, this provides more flexibility to load-balance the traffic over as many as 64 LSPs.

To configure the maximum limit for ECMP next hops, include the **maximum-ecmp *next-hops*** statement at the **[edit chassis]** hierarchy level:

```
[edit chassis]
maximum-ecmp next-hops;
```

You can configure a maximum ECMP next-hop limit of 16, 32, or 64 using this statement. The default limit is 16.

NOTE: MX Series routers with one or more Modular Port Concentrator (MPC) cards and with Junos OS 11.4 or earlier installed, support the configuration of the **maximum-ecmp** statement with only 16 next hops. You should *not* configure the **maximum-ecmp** statement with 32 or 64 next hops. When you commit the configuration with 32 or 64 next hops, the following warning message appears:

Error: Number of members in Unilist NH exceeds the maximum supported 16 on Trio.

The following types of routes support the ECMP maximum next-hop configuration for as many as 64 ECMP gateways:

- Static IPv4 and IPv6 routes with direct and indirect next-hop ECMPs
- LDP ingress and transit routes learned through associated IGP routes

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- RSVP ECMP next hops created for LSPs
- OSPF IPv4 and IPv6 route ECMPs
- ISIS IPv4 and IPv6 route ECMPs
- EBGP IPv4 and IPv6 route ECMPs
- IBGP (resolving over IGP routes) IPv4 and IPv6 route ECMPs

The enhanced ECMP limit of up to 64 ECMP next hops is also applicable for Layer 3 VPNs, Layer 2 VPNs, Layer 2 circuits, and VPLS services that resolve over an MPLS route, because the available ECMP paths in the MPLS route can also be used by such traffic.

NOTE:

The following FPCs on M320, T640, and T1600 routers only support 16 ECMP next hops:

- (M320, T640, and T1600 routers only) Enhanced II FPC1
- (M320, T640, and T1600 routers only) Enhanced II FPC2
- (M320 and T640 routers only) Enhanced II FPC3
- (T640 and T1600 routers only) FPC2
- (T640 and T1600 routers only) FPC3

If a maximum ECMP next-hop limit of 32 or 64 is configured on an M320, T640, or T1600 router with any of these FPCs installed, the Packet Forwarding Engines on these FPCs use only the first 16 ECMP next hops. For Packet Forwarding Engines on FPCs that support only 16 ECMP next hops, the Junos OS generates a system log message if a maximum ECMP next-hop limit of 32 or 64 is configured. However, for Packet Forwarding Engines on other FPCs installed on the router, a maximum configured ECMP limit of 32 or 64 ECMP next hops is applicable.

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NOTE: If RSVP LSPs are configured with bandwidth allocation, for ECMP next hops with more than 16 LSPs, traffic is not distributed optimally based on bandwidths configured. Some LSPs with smaller allocated bandwidths receive more traffic than the ones configured with higher bandwidths. Traffic distribution does not strictly comply with the configured bandwidth allocation. This caveat is applicable to the following routers:

- T1600 and T640 routers with Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, Enhanced Scaling FPC 4, and all Type 4 FPCs
- M320 routers with Enhanced III FPC1, Enhanced III FPC2, and Enhanced III FPC3
- MX Series routers with all types of FPCs and DPCs, excluding MPCs. This caveat is **not** applicable to MX Series routers with line cards based on the Junos Trio chipset.
- M120 routers with Type 1, Type 2, and Type 3 FPCs
- M10i routers with Enhanced CFEB

Next-hop cloning and permutations are disabled on T Series routers with Enhanced Scaling FPCs (Enhanced Scaling FPC1, Enhanced Scaling FPC2, Enhanced Scaling FPC3, and Enhanced Scaling FPC 4) that support enhanced load-balancing capability. As a result, memory utilization is reduced for a highly scaled system with a high number of next hops on ECMP or aggregated interfaces. Next-hop cloning and permutations are also disabled on T Series routers with Type-4 FPCs.

To view the details of the ECMP next hops, issue the **show route** command. The **show route summary command** also shows the current configuration for the maximum ECMP limit. To view details of the ECMP LDP paths, issue the **traceroute mpls ldp** command.

Related Documentation

- *maximum-ecmp*

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Configuring Consistent Load Balancing for ECMP Groups

Per-packet load balancing allows you to spread traffic across multiple equal-cost paths. By default, when a failure occurs in one or more paths, the hashing algorithm recalculates the next hop for all paths, typically resulting in the redistribution of all flows. *Consistent load balancing* enables you to override this behavior so that only flows for links that are inactive are redirected. All existing active flows are maintained without disruption. In a data center environment, the redistribution of all flows when a link fails potentially results in significant traffic loss or a loss of service to servers whose links remain active. Consistent load balancing maintains all active links and instead remaps only those flows affected by one or more link failures. This feature ensures that flows connected to links that remain active continue uninterrupted.

This feature applies to topologies where members of an equal-cost multipath (ECMP) group are external BGP neighbors in a single-hop BGP session. Consistent load balancing does not apply when you add a new ECMP path or modify an existing path in any way. To add a new path with minimal disruption, define a new ECMP group without modifying the existing paths. In this way, clients can be moved to the new group gradually without terminating existing connections.

- (On MX Series) Only Modular Port Concentrators (MPCs) are supported.
- Both IPv4 and IPv6 paths are supported.
- ECMP groups that are part of a virtual routing and forwarding (VRF) instance or other routing instance are also supported.
- Multicast traffic is not supported.
- Aggregated interfaces are supported, but consistent load balancing is not supported among members of the link aggregation (LAG) bundle. Traffic from active members of the LAG bundle might be moved to another active member when one or more member links fail. Flows are rehashed when one or more LAG member links fail.
- We strongly recommend that you apply consistent load balancing to no more than a maximum of 1,000 IP prefixes per router or switch.
- Layer 3 adjacency over integrated routing and bridging (IRB) interfaces is supported.

You can configure the BGP add-path feature to enable replacement of a failed path with a new active path when one or more paths in the ECMP group fail. Configuring replacement of failed paths ensures that traffic flow on the failed paths only are redirected. Traffic flow on active paths will remain unaltered.

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NOTE:

- When you configure consistent load balancing on generic routing encapsulation (GRE) tunnel interfaces, you must specify the inet address of the far end GRE interface so that the Layer 3 adjacencies over the GRE tunnel interfaces are installed correctly in the forwarding table. However, ECMP fast reroute (FRR) over GRE tunnel interfaces is not supported during consistent load balancing. You can specify the destination address on the router configured with consistent load balancing at the **[edit interfaces *interface name* unit *unit name* family inet address *address*]** hierarchy level. For example:

  ```
  [edit interfaces]
  user@host# set interfaces gr-4/0/0 unit 21 family inet address 10.10.31.2/32
    destination 10.10.31.1
  ```

  For more information on generic routing encapsulation see *Configuring Generic Routing Encapsulation Tunneling*.

- Consistent load balancing does not support BGP multihop for EBGP neighbors. Therefore, do not enable the **multihop** option on devices configured with consistent load balancing.

To configure consistent load balancing for ECMP groups:

1. Configure BGP and enable the BGP group of external peers to use multiple paths.

2. Create a routing policy to match incoming routes to one or more destination prefixes.

   ```
   [edit policy-options]
   user@host# set policy-statement policy-statement-name from route-filter
     destination-prefix  orlonger
   ```

3. Apply consistent load balancing to the routing policy so that only traffic flows to one or more destination prefixes that experience a link failure are redirected to an active link.

   ```
   [edit policy-options]
   user@host# set policy-statement policy-statement-name then load-balance
     consistent-hash
   ```

4. Create a separate routing policy and enable per-packet load balancing.

   NOTE: You must configure and apply a per-packet load-balancing policy to install all routes in the forwarding table.

   ```
   [edit policy-options]
   ```


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```
user@host# set policy-statement policy-statement-name then load-balance per-packet
```

5. Apply the routing policy for consistent load balancing to the BGP group of external peers.

NOTE: Consistent load balancing can be applied only to BGP external peers. This policy cannot be applied globally.

```
[edit protocols bgp]
user@host# set group group-name  import policy-statement-name
  #This policy-statement-name refers to the policy created in Step 2.
```

6. (Optional) Enable bidirectional forwarding detection (BFD) for each external BGP neighbor.

```
[edit protocols bgp]
user@host# set group group-name neighbor ip-address bfd-liveness-detection
  milliseconds
```

NOTE: This step shows the minimum BFD configuration required. You can configure additional options for BFD.

7. Apply the per-prefix load-balancing policy globally to install all next-hop routes in the forwarding table.

```
[edit routing-options]
user@host# set forwarding table export policy-statement-name
  #This policy-statement-name refers to the policy created in Step 4.
```

8. (Optional) Enable fast reroute for ECMP routes.

```
[edit routing-options]
user@host# set forwarding-table ecmp-fast-reroute
```

9. Verify the status of one or more ECMP routes for which you enabled consistent load balancing.

```
user@host> show route destination-prefix extensive
```

The output of the command displays the following flag when consistent load balancing is enabled:
State: <Active Ext LoadBalConsistentHash>

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Related Documentation

- *policy-statement*
- *Actions in Routing Policy Terms*
- *Understanding Per-Packet Load Balancing*
- *Examples: Configuring BGP Multipath*

Understanding Entropy Label for BGP Labeled Unicast LSP

What Is an Entropy Label?

An entropy label is a special load-balancing label that enhances the router's ability to load-balance traffic across equal-cost multipath (ECMP) paths or link aggregation groups (LAGs). The entropy label allows routers to efficiently load-balance traffic using just the label stack rather than deep packet inspection (DPI). DPI requires more of the router's processing power and is not a capability shared by all routers.

When an IP packet has multiple paths to reach its destination, Junos OS uses certain fields of the packet headers to hash the packet to a deterministic path. The source or destination addresses and port numbers of the packet are used to hash, in order to avoid packet reordering of a given flow. If a core label-switching router (LSR) is not capable of performing a DPI to identify the flow or can not do so at line rate, the label stack alone is used for ECMP hashing. This requires an entropy label, a special load-balancing label that can carry the flow information. The ingress LSR has more context and information about incoming packets than transit LSRs. Therefore, the ingress label edge router (LER) can inspect the flow information of a packet, map it to an entropy label, and insert it into the label stack. LSRs in the core simply use the entropy label as the key to hash the packet to the right path.

An entropy label can be any label value between 16 to 1048575 (regular 20-bit label range). Since this range overlaps with the existing regular label range, a special label called entropy label indicator (ELI) is inserted before the entropy label. ELI is a special label assigned by IANA with the value of 7.

Figure 50 on page 531 illustrates the entropy label in an RSVP label-switched path (LSP) packet label stack. The label stack consists of the entropy label indicator (ELI), the entropy label, and the IP packet.

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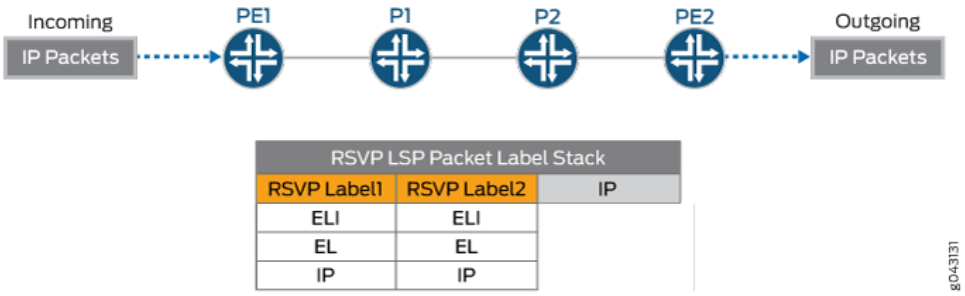
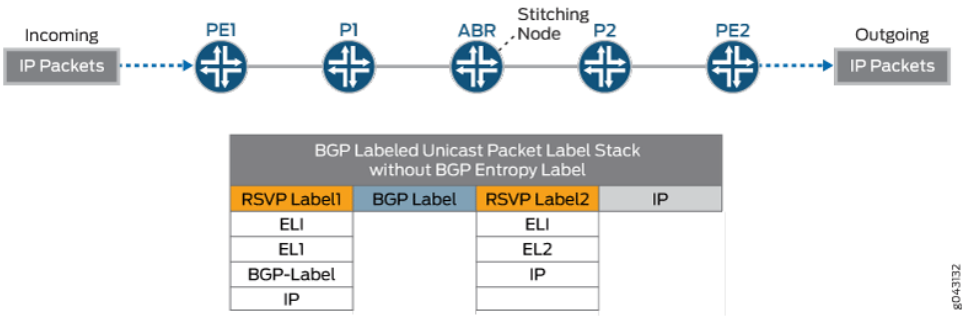
Figure 50: Entropy Label for RSVP LSP



Entropy Label for BGP Labeled Unicast

BGP labeled unicasts concatenate RSVP or LDP LSPs across multiple interior gateway protocol (IGP) areas or multiple autonomous systems (inter-AS LSPs). Inter-area BGP labeled unicast LSPs usually carry VPN and IP traffic when ingress PEs and egress PEs are in different IGP areas. When BGP labeled unicasts concatenate RSVP or LDP LSPs, Junos OS inserts the entropy labels at the BGP labeled unicast LSP ingress to achieve end-to-end entropy label load balancing. This is because RSVP or LDP entropy labels are usually popped at the penultimate hop node, together with the RSVP or LDP label, and there are no entropy labels at the stitching points, that is, the routers between two areas or two ASs. Therefore, in the absence of entropy labels, the router at the stitching point uses the BGP labels to forward packets. Figure 51 on page 531 illustrates the BGP labeled unicast packet label stack with the entropy label in an RSVP label stack. The RSVP label stack consists of the entropy label indicator (ELI), the entropy label, the BGP label, and the IP packet. The RSVP entropy labels are popped at the penultimate hop node.

Figure 51: Inter-Area BGP Labeled Unicast with RSVP Entropy Label



The BGP labeled unicast stitching node cannot use the entropy labels for load balancing unless the stitching node signals the entropy label capability at the BGP egress. If the BGP labeled unicast stitching node signals BGP entropy label capability (ELC) to the provider edge routers, the BGP labeled unicast LSP ingress is aware that the BGP labeled unicast LSP egress can handle entropy labels and inserts an entropy label indicator and entropy label underneath the BGP label. All of the LSRs are able to use the entropy label for load balancing. While BGP labeled unicast LSP might cross many routers in different

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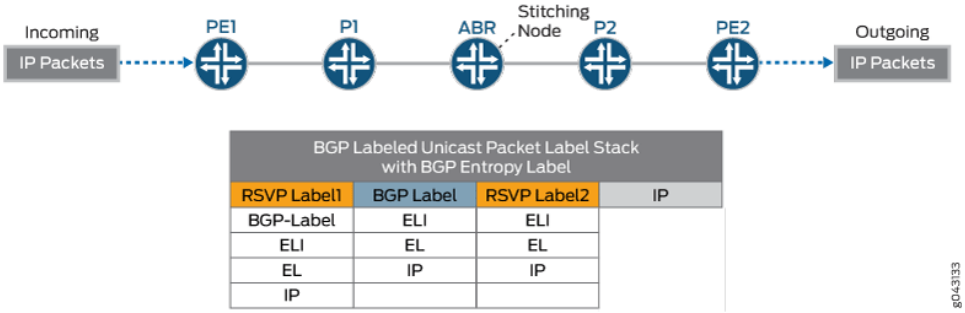
areas and ASs, it is possible that some of the segments might support entropy labels while others might not. Figure 52 on page 532 illustrates the entropy label in the BGP label stack. The label stack at the stitching node consists of the ELI, the entropy label, and the IP packet.

Figure 52: Inter-Area BGP Labeled Unicast with BGP Entropy Label at Stitching Point



NOTE: To disable entropy label capability for BGP labeled unicast at the egress node, define a policy with the option **no-entropy-label-capability** at the **[edit policy-options policy-statement *policy-name* then]** hierarchy level.

```
[edit policy-options policy-statement policy-name then]
user@PE# no-entropy-label-capability
```

By default, routers that support entropy labels are configured with the *load-balance-label-capability* statement at the **[edit forwarding-options]** hierarchy level to signal the labels on a per-LSP basis. If the peer router is not equipped to handle load-balancing labels, you can prevent the signaling of entropy label capability by configuring the **no-load-balance-label-capability** statement at the **[edit forwarding-options]** hierarchy level.

```
[edit forwarding-options]
user@PE# no-load-balance-label-capability
```

Supported and Unsupported Features

Junos OS supports an entropy label for BGP labeled unicast in the following scenarios:

- All the nodes of the LSPs have entropy label capability.
- Some of the nodes of the LSPs have entropy label capability.
- The LSPs tunnel through another carrier's VPN.
- Define an ingress policy to select a subset of BGP labeled unicast LSPs to insert an entropy label at ingress.
- Define an egress policy to disable entropy label capability advertisement.

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Junos OS does not support the following features for an entropy label for BGP labeled unicast:

- When BGP labeled unicast LSPs are tunneling through another carrier's VPN, there is no true end-to-end entropy label because Junos OS does not insert an entropy label indicator or entropy label underneath VPN labels at the carrier-of-carriers network.
- Currently, Junos OS does not support IPv6 BGP labeled unicast LSPs with their own entropy labels. However, IPv6 BGP labeled unicast LSPs might use the entropy labels from the underlying RSVP, LDP, or BGP LSPs.

Related Documentation

- entropy-label on page 1160
- Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 533
- Example: Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 534

Configuring an Entropy Label for a BGP Labeled Unicast LSP

Configure an entropy label for BGP labeled unicast LSP to achieve end-to-end entropy label load balancing. An entropy label is a special load-balancing label that can carry the flow information of the packets. BGP labeled unicasts generally concatenate RSVP or LDP LSPs across multiple IGP areas or multiple autonomous systems (ASs). RSVP or LDP entropy labels are popped at the penultimate hop node, together with the RSVP or LDP label. This feature enables the use of an entropy label at the stitching point, that is, the routers between two areas or ASs, to achieve end-to-end entropy label load balancing for BGP traffic. This feature enables the insertion of entropy labels at the BGP labeled unicast LSP ingress.

An entropy label can be any label value between 16 to 1048575 (regular 20-bit label range). Since this range overlaps with the existing regular label range, a special label called entropy label indicator (ELI) is inserted before the entropy label. ELI is a special label assigned by IANA with the value of 7.

Before you configure an entropy label for BGP labeled unicast, make sure you:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure BGP.
4. Configure LDP.
5. Configure RSVP.
6. Configure MPLS.

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To configure an entropy label for BGP labeled unicast LSP:

1. On the ingress router, include the **entropy-label** statement at the **[edit protocols bgp family inet labeled-unicast]** hierarchy level to enable entropy label capability for BGP labeled unicast at a global level.

   You can also enable the use of an entropy label at a BGP group or a specific BGP neighbor level by including the **entropy-label** statement at the **[edit protocols bgp group *group name* family inet labeled-unicast]** or **[edit protocols bgp group *group name* neighbor *address* labeled-unicast]** hierarchy level.

   ```
   [edit protocols bgp family inet labeled-unicast]
   user@host# entropy-label
   ```

2. (Optional) Specify an additional policy to define the routes that have the entropy label capability.

   Apply the policy at the ingress router.

   ```
   [edit protocols bgp family inet labeled-unicast entropy-label]
   user@host# import policy-name;
   ```

3. (Optional) Include the option **no-next-hop-validation** if you do not want Junos OS to validate the next-hop field in the entropy label capability attribute against the route next hop.

   ```
   [edit protocols bgp family inet labeled-unicast entropy-label]
   user@host# no-next-hop-validation
   ```

4. (Optional) To explicitly disable advertising entropy label capability on the egress router, define a policy with the **no-entropy-label-capability** option for routes specified in the policy, and include the **no-entropy-label-capability** option in the specified policy at the **[edit policy-options policy statement *policy-name* then]** hierarchy level.

   ```
   [edit policy-options policy-statement policy-name then]
   user @ host# no-entropy-label-capability
   ```

Related Documentation

- entropy-label on page 1160
- Example: Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 534
- Understanding Entropy Label for BGP Labeled Unicast LSP on page 530

Example: Configuring an Entropy Label for a BGP Labeled Unicast LSP

This example shows how to configure an entropy label for a BGP labeled unicast to achieve end-to-end load balancing using entropy labels. When an IP packet has multiple paths to reach its destination, Junos OS uses certain fields of the packet headers to hash

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the packet to a deterministic path. This requires an entropy label, a special load-balancing label that can carry the flow information. LSRs in the core simply use the entropy label as the key to hash the packet to the correct path. An entropy label can be any label value between 16 to 1048575 (regular 20-bit label range). Since this range overlaps with the existing regular label range, a special label called entropy label indicator (ELI) is inserted before the entropy label. ELI is a special label assigned by IANA with the value of 7.

BGP labeled unicasts generally concatenate RSVP or LDP LSPs across multiple IGP areas or multiple autonomous systems. RSVP or LDP entropy labels are popped at the penultimate hop node, together with the RSVP or LDP label. This feature enables the use of entropy labels at the stitching points to bridge the gap between the penultimate hop node and the stitching point, in order to achieve end-to-end entropy label load balancing for BGP traffic.

- Requirements on page 535
- Overview on page 535
- Configuration on page 537
- Verification on page 551

Requirements

This example uses the following hardware and software components:

- Seven MX Series routers with MPCs
- Junos OS Release 15.1 or later running on all the devices

Before you configure an entropy label for BGP labeled unicast, make sure you:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure BGP.
4. Configure RSVP.
5. Configure MPLS.

Overview

When BGP labeled unicasts concatenate RSVP or LDP LSPs across multiple IGP areas or multiple autonomous systems, RSVP or LDP entropy labels are popped at the penultimate hop node, together with the RSVP or LDP label. However, there are no entropy labels at the stitching points, that is, the routers between two areas. Therefore, the routers at the stitching points used the BGP labels to forward packets.

Beginning with Junos OS Release 15.1, you can configure an entropy label for BGP labeled unicast to achieve end-to-end entropy label load balancing. This feature enables the

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use of an entropy label at the stitching points in order to achieve end-to-end entropy label load balancing for BGP traffic. Junos OS allows the insertion of entropy labels at the BGP labeled unicast LSP ingress.

By default, routers that support entropy labels are configured with the **load-balance-label-capability** statement at the **[edit forwarding-options]** hierarchy level to signal the labels on a per-LSP basis. If the peer router is not equipped to handle load-balancing labels, you can prevent the signaling of entropy label capability by configuring the **no-load-balance-label-capability** at the **[edit forwarding-options]** hierarchy level.

```
[edit forwarding-options]
user@PE# no-load-balance-label-capability
```

NOTE: You can explicitly disable advertising entropy label capability at egress for routes specified in the policy with the **no-entropy-label-capability** option at the **[edit policy-options policy-statement *policy name* then]** hierarchy level.

```
[edit policy-options policy-statement policy-name then]
user@PE# no-entropy-label-capability
```

Topology

In Figure 53 on page 537 , Router PE1 is the ingress router and Router PE2 is the egress router. Routers P1 and P2 are the transit routers. Router ABR is the area bridge router between Area 0 and Area 1. LAG is configured on the provider routers for load balancing the traffic. Entropy label capability for BGP labeled unicast is enabled on the ingress Router PE1.

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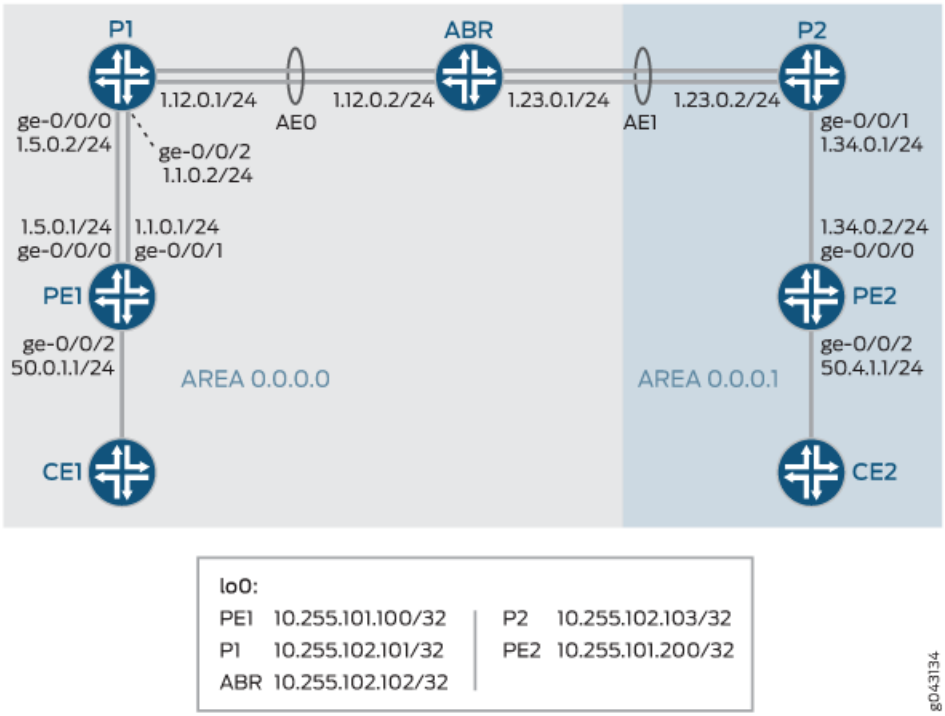
Figure 53: Configuring an Entropy Label for BGP Labeled Unicast



Configuration

- Configuring Router PE1 on page 541
- Configuring Router P1 on page 545
- Configuring Router ABR on page 546
- Results on page 549

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router PE1

```
set interfaces ge-0/0/0 unit 0 family inet address 1.5.0.1/24
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/0 unit 0 family inet6 address 2000::1:5:0:1/120
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 family inet address 1.1.0.1/24
set interfaces ge-0/0/1 unit 0 family iso
set interfaces ge-0/0/1 unit 0 family inet6 address 2000::1:1:0:1/120
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces ge-0/0/2 unit 0 family inet address 50.0.1.1/24
set interfaces ge-0/0/2 unit 0 family inet6 address 2000::1:34:0:2/120
set interfaces ge-0/0/3 vlan-tagging
```

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```
set interfaces ge-0/0/3 unit 0 vlan-id 520
set interfaces ge-0/0/3 unit 0 family inet address 1.0.0.2/16
set interfaces lo0 unit 0 family inet address 10.255.101.100/32 primary
set routing-options router-id 10.255.101.100
set routing-options autonomous-system 1
set protocols rsvp interface all
set protocols mpls icmp-tunneling
set protocols mpls no-cspf
set protocols mpls label-switched-path r0-r2 to 10.255.102.102
set protocols mpls label-switched-path r0-r2 entropy-label
set protocols mpls interface all
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.101.100
set protocols bgp group ibgp family inet labeled-unicast entropy-label
set protocols bgp group ibgp neighbor 10.255.102.102 family inet labeled-unicast rib inet.3
set protocols bgp group ibgp neighbor 10.255.101.200 family inet-vpn unicast
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set policy-options prefix-list el-fec 10.255.101.200/32
set policy-options prefix-list el-fec-2 10.255.102.102/32
set policy-options policy-statement EL from prefix-list el-fec
set policy-options policy-statement EL then accept
set policy-options policy-statement EL-2 from prefix-list el-fec-2
set policy-options policy-statement EL-2 then accept
set policy-options policy-statement bgp-to-ospf from protocol bgp
set policy-options policy-statement bgp-to-ospf then accept
set policy-options policy-statement ospf-to-bgp from protocol ospf
set policy-options policy-statement ospf-to-bgp then accept
set policy-options policy-statement stat-to-bgp from protocol static
set policy-options policy-statement stat-to-bgp then accept
set policy-options community VPN members target:100:1
set routing-instances VPN-l3vpn instance-type vrf
set routing-instances VPN-l3vpn interface ge-0/0/2.0
set routing-instances VPN-l3vpn interface ge-0/0/3.0
set routing-instances VPN-l3vpn route-distinguisher 100.100.100.100:100
set routing-instances VPN-l3vpn vrf-target target:100:1
set routing-instances VPN-l3vpn routing-options static route 5.0.0.0/16 next-hop 1.0.0.1
set routing-instances VPN-l3vpn protocols ospf export bgp-to-ospf
set routing-instances VPN-l3vpn protocols ospf area 0.0.0.0 interface ge-0/0/2.0
```

Router P1

```
set interfaces ge-0/0/0 unit 0 family inet address 1.5.0.2/24
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/0 unit 0 family inet6 address 2000::1:5:0:2/120
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 gigether-options 802.3ad ae0
set interfaces ge-0/0/2 unit 0 family inet address 1.1.0.2/24
set interfaces ge-0/0/2 unit 0 family iso
set interfaces ge-0/0/2 unit 0 family inet6 address 2000::1:1:0:2/120
set interfaces ge-0/0/2 unit 0 family mpls
set interfaces ge-0/0/3 gigether-options 802.3ad ae0
set interfaces ae0 unit 0 family inet address 1.12.0.1/24
```


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```
set interfaces ae0 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.102.101/32 primary
set forwarding-options hash-key family mpls label-1
set forwarding-options hash-key family mpls label-2
set forwarding-options hash-key family mpls label-3
set forwarding-options enhanced-hash-key family mpls no-payload
set routing-options router-id 10.255.102.101
set routing-options autonomous-system 1
set routing-options forwarding-table export pplb
set protocols rsvp interface all
set protocols mpls icmp-tunneling
set protocols mpls interface all
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface ge-0/0/3.0
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
set policy-options policy-statement pplb then load-balance per-packet
```

Router ABR

```
set interfaces ge-0/0/0 gigether-options 802.3ad ae0
set interfaces ge-0/0/1 gigether-options 802.3ad ae1
set interfaces ge-0/0/2 gigether-options 802.3ad ae0
set interfaces ge-0/0/3 gigether-options 802.3ad ae1
set interfaces ae0 unit 0 family inet address 1.12.0.2/24
set interfaces ae0 unit 0 family mpls
set interfaces ae1 unit 0 family inet address 1.23.0.1/24
set interfaces ae1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.102.102/32 primary
set forwarding-options hash-key family mpls label-1
set forwarding-options hash-key family mpls label-2
set forwarding-options hash-key family mpls label-3
set forwarding-options enhanced-hash-key family mpls no-payload
set routing-options router-id 10.255.102.102
set routing-options autonomous-system 1
set routing-options forwarding-table export pplb
set protocols rsvp interface all
set protocols mpls icmp-tunneling
set protocols mpls label-switched-path r2-r0 to 10.255.101.100
set protocols mpls label-switched-path r2-r0 entropy-label
set protocols mpls label-switched-path r2-r4 to 10.255.101.200
set protocols mpls label-switched-path r2-r4 entropy-label
set protocols mpls interface all
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.102.102
set protocols bgp group ibgp family inet labeled-unicast rib inet.3
set protocols bgp group ibgp neighbor 10.255.101.100 export send-inet3-R4
set protocols bgp group ibgp neighbor 10.255.101.200 export send-inet3-R0
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/2.0
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set protocols ospf area 0.0.0.0 interface ae0.0
```

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```
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.1 interface ge-0/0/3.0
set protocols ospf area 0.0.0.1 interface ge-0/0/1.0
set protocols ospf area 0.0.0.1 interface ae1.0
set protocols ldp interface all
set policy-options policy-statement pplb then load-balance per-packet
set policy-options policy-statement send-inet3-R0 from route-filter 10.255.101.100/32
  exact
set policy-options policy-statement send-inet3-R0 then accept
set policy-options policy-statement send-inet3-R4 from route-filter 10.255.101.200/32
  exact
set policy-options policy-statement send-inet3-R4 then accept
```

Router P2

```
set chassis aggregated-devices ethernet device-count 3
set interfaces ge-0/0/0 gigether-options 802.3ad ae0
set interfaces ge-0/0/1 unit 0 family inet address 1.34.0.1/24
set interfaces ge-0/0/1 unit 0 family iso
set interfaces ge-0/0/1 unit 0 family inet6 address 2000::1:34:0:1/120
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces ge-0/0/2 gigether-options 802.3ad ae0
set interfaces ae1 unit 0 family inet address 1.23.0.2/24
set interfaces ae1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.102.103/32 primary
set forwarding-options enhanced-hash-key family mpls no-payload
set routing-options router-id 10.255.102.103
set routing-options autonomous-system 1
set routing-options forwarding-table export pplb
set protocols rsvp interface all
set protocols mpls icmp-tunneling
set protocols mpls interface all
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.1 interface lo0.0 passive
set protocols ospf area 0.0.0.1 interface fxp0.0 disable
set protocols ospf area 0.0.0.1 interface all
set policy-options policy-statement pplb then load-balance per-packet
```

Router PE2

```
set interfaces ge-0/0/0 unit 0 family inet address 1.34.0.2/24
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/0 unit 0 family inet6 address 2000::1:34:0:2/120
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 vlan-tagging
set interfaces ge-0/0/1 unit 0 vlan-id 520
set interfaces ge-0/0/1 unit 0 family inet address 2.0.0.2/16
set interfaces ge-0/0/2 unit 0 family inet address 50.4.1.1/24
set interfaces ge-0/0/2 unit 0 family inet6 address 2000::1:34:0:2/120
set interfaces lo0 unit 0 family inet address 10.255.101.200/32 primary
set routing-options router-id 10.255.101.200
set routing-options autonomous-system 1
set protocols rsvp interface all
set protocols mpls icmp-tunneling
set protocols mpls no-cspf
set protocols mpls label-switched-path r4-r2 to 10.255.102.102
```


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```
set protocols mpls label-switched-path r4-r2 entropy-label
set protocols mpls interface all
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.101.200
set protocols bgp group ibgp neighbor 10.255.102.102 family inet labeled-unicast rib inet.3
set protocols bgp group ibgp neighbor 10.255.101.100 family inet-vpn unicast
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.1 interface all
set protocols ospf area 0.0.0.1 interface fxp0.0 disable
set protocols ospf area 0.0.0.1 interface lo0.0 passive
set policy-options prefix-list el-fec 10.255.101.100/32
set policy-options policy-statement EL term el from prefix-list el-fec
set policy-options policy-statement EL term el then accept
set policy-options policy-statement bgp-to-ospf from protocol bgp
set policy-options policy-statement bgp-to-ospf then accept
set policy-options policy-statement ospf-to-bgp from protocol ospf
set policy-options policy-statement ospf-to-bgp then accept
set policy-options policy-statement stat-to-bgp from protocol static
set policy-options policy-statement stat-to-bgp then accept
set policy-options community VPN members target:100:1
set routing-instances VPN-l3vpn instance-type vrf
set routing-instances VPN-l3vpn interface ge-0/0/1.0
set routing-instances VPN-l3vpn interface ge-0/0/2.0
set routing-instances VPN-l3vpn route-distinguisher 100.100.100.100:104
set routing-instances VPN-l3vpn vrf-target target:100:1
set routing-instances VPN-l3vpn routing-options static route 6.0.0.0/16 next-hop 2.0.0.1
set routing-instances VPN-l3vpn protocols ospf export bgp-to-ospf
set routing-instances VPN-l3vpn protocols ospf area 0.0.0.0 interface ge-0/0/2.0
set routing-instances VPN-l3vpn protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```

Configuring Router PE1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router PE1:

NOTE: Repeat this procedure for Router PE2 after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 and IPv6 addresses.

```
[edit interfaces]
user@PE1# set ge-0/0/0 unit 0 family inet address 1.5.0.1/24
user@PE1# set ge-0/0/0 unit 0 family iso
user@PE1# set ge-0/0/0 unit 0 family inet6 address 2000::1:5:0:1/120
user@PE1# set ge-0/0/0 unit 0 family mpls


user@PE1# set ge-0/0/1 unit 0 family inet address 1.1.0.1/24
```

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```
user@PE1# set ge-0/0/1 unit 0 family iso
user@PE1# set ge-0/0/1 unit 0 family inet6 address 2000::1:1:0:1/120
user@PE1# set ge-0/0/1 unit 0 family mpls

user@PE1# set ge-0/0/2 unit 0 family inet address 50.0.1.1/24
user@PE1# set ge-0/0/2 unit 0 family inet6 address 2000::1:34:0:2/120

user@PE1# set ge-0/0/3 vlan-tagging
user@PE1# set ge-0/0/3 unit 0 vlan-id 520
user@PE1# set ge-0/0/3 unit 0 family inet address 1.0.0.2/16
```

2. Configure the loopback interface.

```
[edit interfaces]
user@PE1# set lo0 unit 0 family inet address 10.255.101.100/32 primary
```

3. Set the router ID and the autonomous system number.

```
[edit routing-options]
user@PE1# set router-id 10.255.101.100
user@PE1# set autonomous-system 1
```

4. Configure RSVP protocol for all interfaces.

```
[edit protocols]
user@PE1# set protocols rsvp interface all
```

5. Enable MPLS on all the interfaces of Router PE1 and specify the LSP.

```
[edit protocols]
user@PE1# set mpls icmp-tunneling
user@PE1# set mpls no-cspf
user@PE1# set mpls label-switched-path r0-r2 to 10.255.102.102
user@PE1# set mpls label-switched-path r0-r2 entropy-label
user@PE1# set mpls interface all
```

6. Configure IBGP on the internal routers.

```
[edit protocols]
user@PE1# set bgp group ibgp type internal
user@PE1# set bgp group ibgp local-address 10.255.101.100
```

7. Enable entropy label capability for BGP labeled unicast for internal BGP group ibgp.

```
user@PE1# set bgp group ibgp family inet labeled-unicast entropy-label
user@PE1# set bgp group ibgp neighbor 10.255.102.102 family inet labeled-unicast
   rib inet.3
```


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```
user@PE1# set bgp group ibgp neighbor 10.255.101.200 family inet-vpn unicast
```

8. Enable the OSPF protocol on all the interfaces of the area border router (ABR).

```
[edit protocols]
user@PE1# set ospf traffic-engineering
user@PE1# set ospf area 0.0.0.0 interface all
user@PE1# set ospf area 0.0.0.0 interface fxp0.0 disable
user@PE1# set ospf area 0.0.0.0 interface lo0.0 passive
```

9. Define prefix lists to specify the routes with entropy label capability.

```
[edit policy-options ]
user@PE1# set policy-options prefix-list el-fec 10.255.101.200/32
user@PE1# set policy-options prefix-list el-fec-2 10.255.102.102/32
```

10. Define a policy EL to specify the routes with entropy label capability.

```
[edit policy-options ]
user@PE1# set policy-statement EL from prefix-list el-fec
user@PE1# set policy-statement EL then accept
```

11. Define another policy EL-2 to specify the routes with entropy label capability.

```
[edit policy-options ]
user@PE1# set policy-statement EL-2 from prefix-list el-fec-2
user@PE1# set policy-statement EL-2 then accept
```

12. Define a policy to export BGP routes to the OSPF routing table.

```
[edit policy-options ]
user@PE1# set policy-statement bgp-to-ospf from protocol bgp
user@PE1# set policy-statement bgp-to-ospf then accept
```

13. Define a policy to export OSPF routes to the BGP routing table.

```
[edit policy-options ]
user@PE1# set policy-statement ospf-to-bgp from protocol ospf
user@PE1# set policy-statement ospf-to-bgp then accept
```

14. Define a policy to export static routes to the BGP routing table.

```
[edit policy-options ]
user@PE1# set policy-statement stat-to-bgp from protocol static
user@PE1# set policy-statement stat-to-bgp then accept
```

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15. Configure a VPN target for the VPN community.

```
[edit policy-options ]
user@PE1# set community VPN members target:100:1
```

16. Configure the Layer 3 VPN routing instance VPN-l3vpn.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn instance-type vrf
```

17. Assign the interfaces for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn interface ge-0/0/2.0
user@PE1# set VPN-l3vpn interface ge-0/0/3.0
```

18. Configure the route distinguisher for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn route-distinguisher 100.100.100.100:100
```

19. Configure a VPN routing and forwarding (VRF) target for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn vrf-target target:100:1
```

20. Configure a static route to Device CE1 using the Layer 3 VPN protocol for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn routing-options static route 5.0.0.0/16 next-hop 1.0.0.1
```

21. Export the BGP routes to the OSPF routing table for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn protocols ospf export bgp-to-ospf
```

22. Assign the OSPF interface for the VPN-l3vpn routing instance.

```
[edit routing-instances]
user@PE1# set VPN-l3vpn protocols ospf area 0.0.0.0 interface ge-0/0/2.0
```


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Configuring Router P1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router P1:

NOTE: Repeat this procedure for Router P2 after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 and IPv6 addresses.

```
[edit interfaces]
user@P1# set ge-0/0/0 unit 0 family inet address 1.5.0.2/24
user@P1# set ge-0/0/0 unit 0 family iso
user@P1# set ge-0/0/0 unit 0 family inet6 address 2000::1:5:0:2/120
user@P1# set ge-0/0/0 unit 0 family mpls

user@P1# set ge-0/0/2 unit 0 family inet address 1.1.0.2/24
user@P1# set ge-0/0/2 unit 0 family iso
user@P1# set ge-0/0/2 unit 0 family inet6 address 2000::1:1:0:2/120
user@P1# set ge-0/0/2 unit 0 family mpls

user@P1# set ge-0/0/1 gigether-options 802.3ad ae0

user@P1# set ge-0/0/3 gigether-options 802.3ad ae0
```

2. Configure link aggregation on the interfaces.

```
user@P1# set ae0 unit 0 family inet address 1.12.0.1/24
user@P1# set ae0 unit 0 family mpls
```

3. Configure the loopback interface.

```
[edit interfaces]
user@P1# set lo0 unit 0 family inet address 10.255.102.101/32 primary
```

4. Configure MPLS labels that the router uses for hashing the packets to its destination for load balancing.

```
[edit forwarding-options]
user@P1# set hash-key family mpls label-1
user@P1# set hash-key family mpls label-2
user@P1# set hash-key family mpls label-3
user@P1# set enhanced-hash-key family mpls no-payload
```

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5. Set the router ID and the autonomous system number.

```
[edit routing-options]
user@P1# set router-id 10.255.102.101
user@P1# set autonomous-system 1
```

6. Enable per packet load balancing.

```
[edit routing-options]
user@P1# set forwarding-table export pplb
```

7. Configure the RSVP protocol for all interfaces.

```
[edit protocols]
user@P1# set protocols rsvp interface all
```

8. Enable MPLS on all the interfaces of Router P1 and specify the LSP.

```
[edit protocols]
user@P1# set protocols mpls icmp-tunneling
user@P1# set protocols mpls interface all
```

9. Enable the OSPF protocol on all the interfaces of Router P1 excluding the management interface.

```
[edit protocols]
user@P1# set protocols ospf traffic-engineering
user@P1# set protocols ospf area 0.0.0.0 interface lo0.0 passive
user@P1# set protocols ospf area 0.0.0.0 interface fxp0.0 disable
user@P1# set protocols ospf area 0.0.0.0 interface all
user@P1# set protocols ospf area 0.0.0.0 interface ge-0/0/3.0
user@P1# set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```

10. Define a policy for per packet load balancing.

```
[edit policy-options]]
user@P1# set policy-statement pplb then load-balance per-packet
```

Configuring Router ABR

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router ABR:

1. Configure the interfaces with IPv4 and IPv6 addresses.

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```
[edit interfaces]
user@ABR# set ge-0/0/0 gigether-options 802.3ad ae0

user@ABR# set ge-0/0/1 gigether-options 802.3ad ae1

user@ABR# set ge-0/0/2 gigether-options 802.3ad ae0

user@ABR# set ge-0/0/3 gigether-options 802.3ad ae1
```

2. Configure the loopback interface.

```
[edit interfaces]
user@ABR# set lo0 unit 0 family inet address 10.255.102.102/32 primary
```

3. Configure link aggregation on the interfaces.

```
[edit interfaces]
user@ABR# set ae0 unit 0 family inet address 1.12.0.2/24
user@ABR# set ae0 unit 0 family mpls
user@ABR# set ae1 unit 0 family inet address 1.23.0.1/24
user@ABR# set ae1 unit 0 family mpls
```

4. Configure MPLS labels that the router uses for hashing the packets to its destination for load balancing.

```
[edit forwarding-options]
user@ABR# set hash-key family mpls label-1
user@ABR# set hash-key family mpls label-2
user@ABR# set hash-key family mpls label-3
user@ABR# set enhanced-hash-key family mpls no-payload
```

5. Set the router ID and the autonomous system number.

```
[edit routing-options]
user@ABR# set router-id 10.255.102.102
user@ABR# set autonomous-system 1
```

6. Enable per packet load balancing.

```
[edit routing-options]
user@ABR# set forwarding-table export pplb
```

7. Configure the RSVP protocol for all interfaces.

```
[edit protocols]
```

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```
user@ABR# set protocols rsvp interface all
```

8. Enable MPLS on all the interfaces of Router P1 and specify the LSP.

```
[edit protocols]
user@ABR# set mpls icmp-tunneling
user@ABR# set mpls label-switched-path r2-r0 to 10.255.101.100
user@ABR# set mpls label-switched-path r2-r0 entropy-label
user@ABR# set mpls label-switched-path r2-r4 to 10.255.101.200
user@ABR# set mpls label-switched-path r2-r4 entropy-label
user@ABR# set mpls interface all
```

9. Configure IBGP on the internal routers.

```
[edit protocols ]
user@ABR# set bgp group ibgp type internal
user@ABR# set bgp group ibgp local-address 10.255.102.102
user@ABR# set bgp group ibgp family inet labeled-unicast rib inet.3
user@ABR# set bgp group ibgp neighbor 10.255.101.100 export send-inet3-R4
user@ABR# set bgp group ibgp neighbor 10.255.101.200 export send-inet3-R0
```

10. Enable the OSPF protocol on all the interfaces of ABR.

```
[edit protocols ]
user@ABR# set ospf traffic-engineering
user@ABR# set ospf area 0.0.0.0 interface lo0.0 passive
user@ABR# set ospf area 0.0.0.0 interface ge-0/0/2.0
user@ABR# set ospf area 0.0.0.0 interface ge-0/0/0.0
user@ABR# set ospf area 0.0.0.0 interface ae0.0
user@ABR# set ospf area 0.0.0.0 interface fxp0.0 disable
user@ABR# set ospf area 0.0.0.1 interface ge-0/0/3.0
user@ABR# set ospf area 0.0.0.1 interface ge-0/0/1.0
user@ABR# set ospf area 0.0.0.1 interface ae1.0
```

11. Define a policy to specify the routes with entropy label capability.

```
[edit policy-options ]
user@ABR# set policy-statement pplb then load-balance per-packet
user@ABR# set policy-statement send-inet3-R0 from route-filter 10.255.101.100/32
  exact
user@ABR# set policy-statement send-inet3-R0 then accept
user@ABR# set policy-statement send-inet3-R4 from route-filter 10.255.101.200/32
  exact
user@ABR# set policy-statement send-inet3-R4 then accept
```


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Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, **show forwarding options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@ABR# show interfaces
ge-0/0/0 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-0/0/1 {
    gigether-options {
        802.3ad ae1;
    }
}
ge-0/0/2 {
    gigether-options {
        802.3ad ae0;
    }
}
ge-0/0/3 {
    gigether-options {
        802.3ad ae1;
    }
}
ae0 {
    unit 0 {
        family inet {
            address 1.12.0.2/24;
        }
        family mpls;
    }
}
ae1 {
    unit 0 {
        family inet {
            address 1.23.0.1/24;
        }
        family mpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.255.102.102/32 {
                primary;
            }
        }
    }
}
```

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```
[edit]
user@ABR# show protocols
rsvp {
    interface all;
}
mpls {
    icmp-tunneling;
    label-switched-path r2-r0 {
        to 10.255.101.100;
        entropy-label;
    }
    label-switched-path r2-r4 {
        to 10.255.101.200;
        entropy-label;
    }
    interface all;
}
bgp {
    group ibgp {
        type internal;
        local-address 10.255.102.102;
        family inet {
            labeled-unicast {
                rib {
                    inet.3;
                }
            }
        }
        neighbor 10.255.101.100 {
            export send-inet3-R4;
        }
        neighbor 10.255.101.200 {
            export send-inet3-R0;
        }
    }
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
        interface lo0.0 {
            passive;
        }
        interface ge-0/0/2.0;
        interface ge-0/0/0.0;
        interface ae0.0;
        interface fxp0.0 {
            disable;
        }
    }
    area 0.0.0.1 {
        interface ge-0/0/3.0;
        interface ge-0/0/1.0;
        interface ae1.0;
    }
}
```


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```
[edit]
user@ABR# show routing-options
router-id 10.255.102.102;
autonomous-system 1;
forwarding-table {
   export pplb;
}
```

```
[edit]
user@ABR# show forwarding-options
hash-key {
   family mpls {
      label-1;
      label-2;
      label-3;
   }
}
enhanced-hash-key {
   family mpls {
      no-payload;
   }
}
```

```
[edit]
user@ABR# show policy-options
policy-statement pplb {
   then {
      load-balance per-packet;
   }
}
policy-statement send-inet3-R0 {
   from {
      route-filter 10.255.101.100/32 exact;
   }
   then accept;
}
policy-statement send-inet3-R4 {
   from {
      route-filter 10.255.101.200/32 exact;
   }
   then accept;
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That the Entropy Label Capability Is Being Advertised from Router PE2 on page 552
- Verifying That Router ABR Receives the Entropy Label Advertisement on page 552
- Verifying That the Entropy Label Flag Is Set on page 554

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Verifying That the Entropy Label Capability Is Being Advertised from Router PE2

Purpose Verify that the entropy label capability path attribute is being advertised from the upstream Router PE2 at egress.

Action From operational mode, run the **show route 10.255.101.200 advertising-protocol bgp 10.255.102.102** command on Router PE2.

```
user@PE2> show route 10.255.101.200 advertising-protocol bgp 10.255.102.102

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
* 10.255.101.200/32 (1 entry, 1 announced)
 BGP group ibgp type Internal
     Route Label: 299920
     Nexthop: Self
     Flags: Nexthop Change
     MED: 2
     Localpref: 4294967294
     AS path: [1] I
     Entropy label capable
```

Meaning The output shows that the host PE2 with the IP address of 10.255.101.200 has the entropy label capability. The host is advertising the entropy label capability to its BGP neighbors.

Verifying That Router ABR Receives the Entropy Label Advertisement

Purpose Verify that Router ABR receives the entropy label advertisement at ingress from Router PE2.

Action From operational mode, run the **show route 10.255.101.200 receiving-protocol bgp 10.255.101.200** command on Router ABR.

```
user@ABR> show route 10.255.101.200 receiving-protocol bgp 10.255.101.200
inet.0: 63 destinations, 63 routes (63 active, 0 holddown, 0 hidden)

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
* 10.255.101.100/32 (1 entry, 1 announced)
     Accepted
     Route Label: 299920
     Nexthop: 10.255.102.102
     MED: 2
     Localpref: 4294967294
     AS path: I
     Entropy label capable

VPN-l3vpn.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)

iso.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```


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```
mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

bgp.l3vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

inet6.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)

VPN-l3vpn.inet6.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

user@PE1> show route protocol bgp detail

inet.0: 64 destinations, 64 routes (64 active, 0 holddown, 0 hidden)

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.255.101.200/32 (1 entry, 1 announced)
        *BGP    Preference: 170/1
                Next hop type: Indirect, Next hop index: 0
                Address: 0xa533c10
                Next-hop reference count: 2
                Source: 10.255.102.102
                Next hop type: Router, Next hop index: 0
                Next hop: 1.1.0.2 via ge-0/0/1.0, selected
                Label-switched-path r0-r2
                Label operation: Push 299904, Push 300096(top)
                Label TTL action: prop-ttl, prop-ttl(top)
               Load balance label: Label 299904: Entropy label; Label 300096: None;

                Label element ptr: 0xa5335a0
                Label parent element ptr: 0xa5338a0
                Label element references: 2
                Label element child references: 1
                Label element lsp id: 0
                Session Id: 0x0
                Protocol next hop: 10.255.102.102
                Label operation: Push 299904
                Label TTL action: prop-ttl
                Load balance label: Label 299904: Entropy label;
                Indirect next hop: 0xaa18540 - INH Session ID: 0x0
                State: <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 12:39      Metric: 2       Metric2: 2
                Validation State: unverified
                Task: BGP_1.10.255.102.102
                Announcement bits (2): 0-Resolve tree 1 3-Resolve_IGP_FRR task

                AS path: I
                Accepted
                Route Label: 299904
                Localpref: 4294967294
                Router ID: 10.255.102.102
VPN-l3vpn.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
```

Meaning Router ABR receives the entropy label capability advertisement from its BGP neighbor PE2.

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Verifying That the Entropy Label Flag Is Set

Purpose Verify that the entropy label flag is set for the label elements at the ingress.

Action From operational mode, run the **show route protocol bgp detail** command on Router PE1.

```
user@PE1> show route protocol bgp detail
inet.0: 64 destinations, 64 routes (64 active, 0 holddown, 0 hidden)

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.255.101.200/32 (1 entry, 1 announced)
        *BGP    Preference: 170/1
                Next hop type: Indirect, Next hop index: 0
                Address: 0xa533c10
                Next-hop reference count: 2
                Source: 10.255.102.102
                Next hop type: Router, Next hop index: 0
                Next hop: 1.1.0.2 via ge-0/0/1.0, selected
                Label-switched-path r0-r2
                Label operation: Push 299904, Push 300096(top)
                Label TTL action: prop-ttl, prop-ttl(top)
              Load balance label: Label 299904: Entropy label; Label 300096: None;

                Label element ptr: 0xa5335a0
                Label parent element ptr: 0xa5338a0
                Label element references: 2
                Label element child references: 1
                Label element lsp id: 0
                Session Id: 0x0
                Protocol next hop: 10.255.102.102
                Label operation: Push 299904
                Label TTL action: prop-ttl
                Load balance label: Label 299904: Entropy label;
                Indirect next hop: 0xaa18540 - INH Session ID: 0x0
                State:    <Active Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 12:39      Metric: 2       Metric2: 2
                Validation State: unverified
                Task: BGP_1.10.255.102.102
                Announcement bits (2): 0-Resolve tree 1 3-Resolve_IGP_FRR task

                AS path: I
                Accepted
                Route Label: 299904
                Localpref: 4294967294
                Router ID: 10.255.102.102
VPN-l3vpn.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
```

Meaning An entropy label is enabled on Router PE1. The output shows that the entropy label is being used for the BGP labeled unicast to achieve end-to-end load balancing.

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Related Documentation

- entropy-label on page 1160
- Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 533
- Understanding Entropy Label for BGP Labeled Unicast LSP on page 530

Use Case for BGP Prefix Independent Convergence for Inet, Inet6, or Labeled Unicast

In the instance of a router failure, a BGP network can take from a few seconds to minutes to recover, depending on parameters such as the size of the network or router performance. When the BGP Prefix Independent Convergence (PIC) feature is enabled on a router, BGP installs to the Packet Forwarding Engine the second best path in addition to the calculated best path to a destination. The router uses this backup path when an egress router fails in a network and drastically reduces the outage time. You can enable this feature to reduce the network downtime if the egress router fails.

When reachability to an egress router in a network fails, the IGP detects this outage, and the link state propagates this information throughout the network and advertises the BGP next hop for that prefix as unreachable. BGP reevaluates alternative paths and if an alternative path is available, reinstalls this alternate next hop into the Packet Forwarding Engine. This kind of egress failure usually impacts multiple prefixes at the same time, and BGP has to update all these prefixes one at a time. On the ingress routers, the IGP completes the shortest path first (SPF) and updates the next hops. Junos OS then determines the prefixes that have become unreachable and signals to the protocol that these need to be updated. BGP gets the notification and updates the next hop for every prefix that is now invalid. This process could impact the connectivity and could take a few minutes to recover from the outage. BGP PIC can reduce this down time as the backup path is already installed in the Packet Forwarding Engine.

Beginning with Junos OS Release 15.1, the BGP PIC feature, which was initially supported for Layer 3 VPN routers, is extended to BGP with multiple routes in the global tables such as inet and inet6 unicast, and inet and inet6 labeled unicast. On a BGP PIC enabled router, Junos OS installs the backup path for the indirect next hop on the Routine Engine and also provides this route to the Packet Forwarding Engine and IGP. When an IGP loses reachability to a prefix with one or more routes, it signals to the Routing Engine with a single message prior to updating the routing tables. The Routing Engine signals to the Packet Forwarding Engine that an indirect next hop has failed, and traffic must be rerouted using the backup path. Routing to the impacted destination prefix continues using the backup path even before BGP starts recalculating the new next hops for the BGP prefixes. The router uses this backup path to reduce traffic loss until the global convergence through the BGP is resolved.

The time at which the outage occurs to the time until the loss of reachability is signaled actually depends on the failure detection time of the nearest router and the IGP convergence time. Once the local router detects the outage, the route convergence without the BGP PIC feature enabled depends heavily on the number of prefixes affected and the performance of the router due to recalculation of each affected prefix. However, with the BGP PIC feature enabled, even before BGP recalculates the best path for those affected prefixes, the Routing Engine signals the data plane to switch to the standby next best path. Hence traffic loss is minimum. The new routes are calculated even while

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the traffic is being forwarded, and these new routes are pushed down to the data plane. Therefore, the number of BGP prefixes affected does not impact the time taken from the time traffic outage occurs to the point of time at which BGP signals the loss of reachability.

Related Documentation

- Configuring BGP Prefix Independent Convergence for Inet on page 556
- *Configuring BGP PIC Edge for MPLS Layer 3 VPNs*
- Example: Configuring BGP Prefix Independent Convergence for Inet on page 560
- *Example: Configuring BGP PIC Edge for MPLS Layer 3 VPNs*

Configuring BGP Prefix Independent Convergence for Inet

On a BGP Prefix Independent Convergence (PIC) enabled router, Junos OS installs the backup path for the indirect next hop on the Routing Engine and also provides this route to the Packet Forwarding Engine and IGP. When an IGP loses reachability to a prefix with one or more routes, it signals to the Routing Engine with a single message prior to updating the routing tables. The Routing Engine signals to the Packet Forwarding Engine that an indirect next hop has failed, and traffic must be rerouted using the backup path. Routing to the impacted destination prefix continues using the backup path even before BGP starts recalculating the new next hops for the BGP prefixes. The router uses this backup path to reduce traffic loss until the global convergence through the BGP is resolved. The BGP PIC feature, which was initially supported for Layer 3 VPN routers, is extended to BGP with multiple routes in the global tables such as inet and inet6 unicast, and inet and inet6 labeled unicast.

NOTE: **The BGP PIC feature is supported only on routers with MPC interfaces.**

Before you begin:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure MPLS and LDP.
4. Configure BGP.

BEST PRACTICE:

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On routers with Modular Port Concentrators (MPCs), enable enhanced IP network services as shown here:

```
[edit chassis network-services]
user@host# set enhanced-ip
```

To configure BGP PIC for inet:

1. Enable BGP PIC for inet.

   ```
   [edit routing-instances routing-instance-name routing-options]
   user@host# set protect core
   ```

   NOTE: The BGP PIC edge feature is supported only on routers with MPC interfaces.

2. Configure per-packet load balancing.

   ```
   [edit policy-options]
   user@host# set policy-statement policy-name then load-balance per-packet
   ```

3. Apply the per-packet load-balancing policy to routes exported from the routing table to the forwarding table.

   ```
   [edit routing-options forwarding-table]
   user@host# set export policy-name
   ```

4. Verify that BGP PIC is working.

   From operational mode, enter the **show route extensive** command:

   ```
   user@host> show route 20.1.1.1 extensive
   inet.0: 236941 destinations, 630411 routes (236940 active, 0 holddown, 1 hidden)
   20.1.1.1/32 (3 entries, 2 announced)
           State: <CalcForwarding>
   TSI:
   KRT in-kernel 20.1.1.1/32 -> {indirect(1048574), indirect(1048575)}
           @BGP    Preference: 170/-101
                   Next hop type: Indirect, Next hop index: 0
                   Address: 0xafd09d0
                   Next-hop reference count: 236886
                   Source: 10.255.183.55
                   Next hop type: Router, Next hop index: 623
                   Next hop: 100.0.1.2 via ge-2/1/2.0, selected

                   Session Id: 0x140
                   Protocol next hop: 10.255.183.55
                   Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144
   ```

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```
           State: <Active Int Ext ProtectionPath ProtectionCand>

           Local AS:   100 Peer AS:   100
           Age: 1:11       Metric2: 2
           Validation State: unverified
           Task: BGP_100.10.255.183.55
           Announcement bits (1): 6-Resolve tree 2
           AS path: 200 400 I
           Accepted MultipathUnequal
           Localpref: 100
           Router ID: 10.255.183.55
           Indirect next hops: 1
        Protocol next hop: 10.255.183.55 Metric: 2

         Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144

        Indirect path forwarding next hops: 1

            Next hop type: Router
            Next hop: 100.0.1.2 via ge-2/1/2.0

            Session Id: 0x140
        10.255.183.55/32 Originating RIB: inet.0

         Metric: 2                      Node path count: 1

         Forwarding nexthops: 1
            Nexthop: 100.0.1.2 via ge-2/1/2.0
BGP     Preference: 170/-101
  Next hop type: Indirect, Next hop index: 0
  Address: 0xafd0970
  Next-hop reference count: 196735
  Source: 10.255.183.56
  Next hop type: Router, Next hop index: 624
  Next hop: 100.0.2.2 via ge-2/0/9.0, selected
  Session Id: 0x141
 Protocol next hop: 10.255.183.56
 Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145

 State: <NotBest Int Ext ProtectionCand>
 Inactive reason: Not Best in its group - IGP metric
 Local AS:   100 Peer AS:   100
 Age: 1:05       Metric2: 1001
 Validation State: unverified
 Task: BGP_100.10.255.183.56
 AS path: 200 400 I
 Accepted
 Localpref: 100
 Router ID: 10.255.183.56
 Indirect next hops: 1
     Protocol next hop: 10.255.183.56 Metric: 1001

     Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145

     Indirect path forwarding next hops: 1

         Next hop type: Router
         Next hop: 100.0.2.2 via ge-2/0/9.0
```


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```
              Session Id: 0x141
           10.255.183.56/32 Originating RIB: inet.0

            Metric: 1001                  Node path count: 1

            Forwarding nexthops: 1
               Nexthop: 100.0.2.2 via ge-2/0/9.0
#Multipath Preference: 255
         Next hop type: Indirect, Next hop index: 0
         Address: 0xd330f90
         Next-hop reference count: 304062
         Next hop type: Router, Next hop index: 623
         Next hop: 100.0.1.2 via ge-2/1/2.0, selected
         Session Id: 0x140
         Next hop type: Router, Next hop index: 624
         Next hop: 100.0.2.2 via ge-2/0/9.0
         Session Id: 0x141
         Protocol next hop: 10.255.183.55
         Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144 Weight 0x1

         Protocol next hop: 10.255.183.56
         Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145 Weight 0x4000

         State:   <ForwardinOnly Int Ext>
         Inactive reason: Forwarding use only
         Local AS:   100
         Age: 1:05       Metric2: 2
         Validation State: unverified
         Task: RT
         Announcement bits (1): 0-KRT
         AS path: 200 400 I
```

```
user@host> show route forwarding-table destination 20.1.1.1 extensive
  Routing table: default.inet [Index 0]
Internet:

Destination:  20.1.1.1/32
  Route type: user
  Route reference: 0                   Route interface-index: 0
  Multicast RPF nh index: 0
  Flags: sent to PFE
  Next-hop type: unilist               Index: 1048576  Reference: 7401
  Next-hop type: indirect              Index: 1048574  Reference: 2
                               Weight: 0x1
  Nexthop: 100.0.1.2
  Next-hop type: unicast               Index: 623      Reference: 8
  Next-hop interface: ge-2/1/2.0    Weight: 0x1
  Next-hop type: indirect              Index: 1048575  Reference: 2
                               Weight: 0x4000
  Nexthop: 100.0.2.2
  Next-hop type: unicast               Index: 624      Reference: 8
  Next-hop interface: ge-2/0/9.0    Weight: 0x4000
```

The output lines that contain **Indirect next hop: weight** follow next hops that the software can use to repair paths where a link failure occurs. The next-hop weight has one of the following values:

- 0x1 indicates active next hops.

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- 0x4000 indicates passive next hops.

Related Documentation

- Example: Configuring BGP Prefix Independent Convergence for Inet on page 560
- Use Case for BGP Prefix Independent Convergence for Inet, Inet6, or Labeled Unicast on page 555

Example: Configuring BGP Prefix Independent Convergence for Inet

This example shows how to configure BGP PIC for inet. In the instance of a router failure, a BGP network can take from a few seconds to minutes to recover, depending on parameters such as the size of the network or router performance. When the BGP Prefix Independent Convergence (PIC) feature is enabled on a router, BGP with multiple routes in the global tables, such as inet and inet6 unicast, and inet and inet6 labeled unicast, installs to the Packet Forwarding Engine the second best path in addition to the calculated best path to a destination. The router uses this backup path when an egress router fails in a network and drastically reduces the outage time.

- Requirements on page 560
- Overview on page 560
- Configuration on page 561
- Verification on page 571

Requirements

No special configuration beyond device initialization is required before configuring this example.

This example uses the following hardware and software components:

- One MX Series router with MPCs to configure the BGP PIC feature
- Seven routers that can be a combination of M Series, MX Series, T Series, or PTX Series routers
- Junos OS Release 15.1 or later on the device with BGP PIC configured

Overview

Beginning with Junos OS Release 15.1, BGP PIC, which was initially supported for Layer 3 VPN routers, is extended to BGP with multiple routes in the global tables such as inet and inet6 unicast, and inet and inet6 labeled unicast. BGP installs to the Packet Forwarding Engine the second best path in addition to the calculated best path to a destination. When an IGP loses reachability to a prefix, the router uses this backup path to reduce traffic loss until the global convergence through the BGP is resolved, thereby reducing the outage duration.

NOTE: **The BGP PIC feature is supported only on routers with MPCs.**

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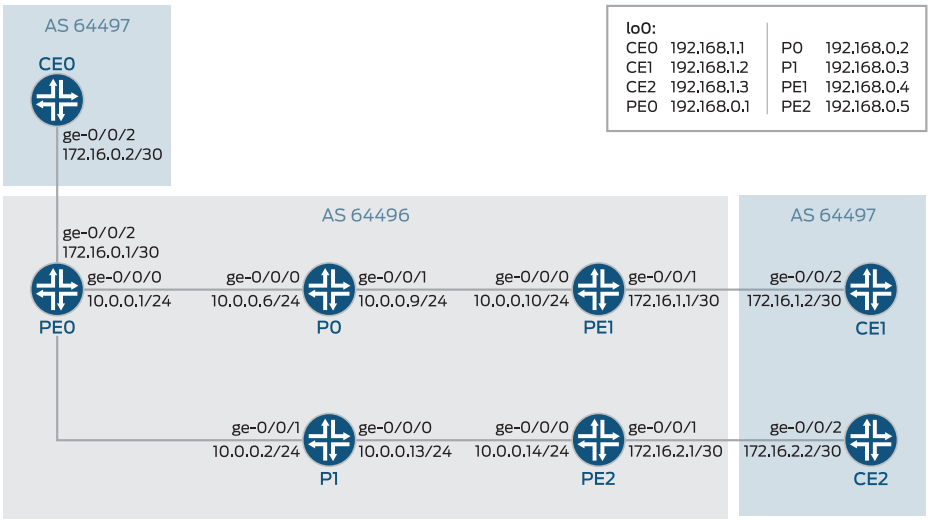
Topology

This example shows three customer edge (CE) routers, Device CE0, CE1, and CE2. Routers PE0, PE1, and PE2 are the provider edge (PE) routers. Router P0 and P1 are the provider core routers. BGP PIC is configured on Router PE0. For testing, the address 192.168.1.5 is added as a second loopback interface address on Device CE1. The address is announced to Routers PE1 and PE2 and is relayed by the internal BGP (IBGP) to Router PE0. On Router PE0, there are two paths to the 192.168.1.5 network. These are the primary path and a backup path. Figure 54 on page 561 shows the sample network.

Figure 54: Configuring BGP PIC for Inet



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter commit from configuration mode.

Router PE0

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/0 unit 0 description PE0->P0
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.5/24
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:db8::1/32
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 description PE0->P1
set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.1/24
set interfaces ge-0/0/1 unit 0 family iso
set interfaces ge-0/0/1 unit 0 family inet6 address 2001:db8::2/32
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set interfaces ge-0/0/2 unit 0 description PE0->CE0
```

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```
set interfaces ge-0/0/2 unit 0 family inet address 172.16.0.1/30
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:db8::10/32
set interfaces ge-0/0/2 unit 0 family mpls
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 192.168.0.1
set protocols bgp group ibgp family inet labeled-unicast per-prefix-label
set protocols bgp group ibgp family inet6 labeled-unicast explicit-null
set protocols bgp group ibgp export nhself
set protocols bgp group ibgp neighbor 192.168.0.4 description PE1
set protocols bgp group ibgp neighbor 192.168.0.5 description PE2
set protocols bgp group ebgp type external
set protocols bgp group ebgp local address 192.168.0.1
set protocols bgp group ebgp family inet labeled-unicast
set protocols bgp group ebgp family inet6 labeled-unicast
set protocols bgp group ebgp peer-as 64497
set protocols bgp group ebgp neighbor 172.16.0.2 description CE0
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0 metric 1000
set protocols ospf3 area 0.0.0.0 interface all
set protocols ospf3 area 0.0.0.0 interface fxp0.0 disable
set protocols ospf3 area 0.0.0.0 interface lo0.0 passive
set protocols ospf3 area 0.0.0.0 interface ge-0/0/1.0 metric 1000
set protocols ldp track-igp-metric
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options policy-statement lb then load-balance per-packet
set policy-options policy-statement nhself then next-hop self
set routing-options protect core
set routing-options forwarding-table export lb
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 64496
```

Router P0

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/0 unit 0 description P0->PE0
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.6/24
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:db8::3/32
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 description P0->PE1
set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.9/24
set interfaces ge-0/0/1 unit 0 family inet6 address 2001:db8::4/32
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local address 192.168.0.1
set protocols bgp group ibgp neighbor 192.168.0.4 description PE1
```


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```
set protocols bgp group ibgp neighbor 192.168.0.5 description PE2
set routing-options router-id 192.168.0.2
set routing-options autonomous-system 64496
```

Router P1

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/1 unit 0 description P1->PE0
set interfaces ge-0/0/1 unit 0 family inet address 10.0.0.2/24
set interfaces ge-0/0/1 unit 0 family inet6 address 2001:db8::5/32
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces ge-0/0/0 unit 0 description P1->PE2
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.13/24
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:db8::6/32
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local address 192.168.0.3
set protocols bgp group ibgp neighbor 192.168.0.1 description PE0
set protocols bgp group ibgp neighbor 192.168.0.5 description PE2
set routing-options router-id 192.168.0.3
set routing-options autonomous-system 64496
```

Router PE1

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/0 unit 0 description PE1->P0
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.10/24
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:db8::7/32
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/1 unit 0 description PE1->CE1
set interfaces ge-0/0/1 unit 0 family inet address 172.16.1.1/30
set interfaces ge-0/0/1 unit 0 family inet6 address 2001:db8::12/32
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.0.4/32
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local address 192.168.0.4
set protocols bgp group ibgp family inet labeled-unicast per-prefix-label
set protocols bgp group ibgp family inet6 labeled-unicast explicit-null
set protocols bgp group ibgp export nhself
set protocols bgp group ibgp neighbor 192.168.0.1 description PE0
set protocols bgp group ibgp neighbor 192.168.0.5 description PE2
set protocols bgp group ebgp type external
set protocols bgp group ebgp local address 192.168.0.4
set protocols bgp group ebgp peer-as 64497
set protocols bgp group ebgp neighbor 172.16.1.2 description CE1
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0 metric 1000
set protocols ospf3 area 0.0.0.0 interface all
set protocols ospf3 area 0.0.0.0 interface fxp0.0 disable
```

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```
set protocols ospf3 area 0.0.0.0 interface lo0.0 passive
set protocols ospf3 area 0.0.0.0 interface ge-0/0/0.0 metric 1000
set protocols ldp track-igp-metric
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options policy-statement PE1-v6-nh_CE1 from family inet6
set policy-options policy-statement PE1-v6-nh_CE1 then next-hop 2001:DB8::13
set policy-options policy-statement nhself then next-hop self
set routing-options router-id 192.168.0.4
set routing-options autonomous-system 64496
set routing-options static route 192.168.1.2 next-hop 172.16.1.2
```

Router PE2

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/0 unit 0 description PE2->P1
set interfaces ge-0/0/0 unit 0 family inet address 10.0.0.14/24
set interfaces ge-0/0/0 unit 0 family inet6 address 2001:db8::8/32
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/0 unit 0 family iso
set interfaces ge-0/0/1 unit 0 description PE2->CE2
set interfaces ge-0/0/1 unit 0 family inet address 172.16.2.1/30
set interfaces ge-0/0/1 unit 0 family inet6 address 2001:db8::14/32
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.0.5/32
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local address 192.168.0.5
set protocols bgp group ibgp family inet labeled-unicast per-prefix-label
set protocols bgp group ibgp family inet6 labeled-unicast explicit-null
set protocols bgp group ibgp export nhself
set protocols bgp group ibgp neighbor 192.168.0.4 description PE1
set protocols bgp group ibgp neighbor 192.168.0.1 description PE0
set protocols bgp group ebgp type external
set protocols bgp group ebgp local address 192.168.0.5
set protocols bgp group ebgp peer-as 64497
set protocols bgp group ebgp family inet labeled-unicast
set protocols bgp group ebgp family inet6 labeled-unicast
set protocols bgp group ebgp neighbor 172.16.2.2 description CE2
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0 metric 1000
set protocols ospf3 area 0.0.0.0 interface all
set protocols ospf3 area 0.0.0.0 interface fxp0.0 disable
set protocols ospf3 area 0.0.0.0 interface lo0.0 passive
set protocols ospf3 area 0.0.0.0 interface ge-0/0/0.0 metric 1000
set protocols ldp track-igp-metric
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options policy-statement nhself then next-hop self
set routing-options router-id 192.168.0.5
set routing-options autonomous-system 64496
```


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```
set routing-options static route 192.168.1.3 next-hop 172.16.2.2
```

Device CE0

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/2 unit 0 description CE0->PE0
set interfaces ge-0/0/2 unit 0 family inet address 172.16.0.2/30
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:db8::11/32
set interfaces lo0 unit 0 family inet address 192.168.1.1/32
set protocols mpls interface all
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp family inet labeled-unicast
set protocols bgp group ebgp family inet6 labeled-unicast
set protocols bgp group ebgp neighbor 172.16.0.1 description PE0
set protocols bgp group ebgp local-address 192.168.1.1
set routing-options autonomous-system 64497
set routing-options router-id 192.168.1.1
```

Device CE1

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/2 unit 0 description CE1->PE1
set interfaces ge-0/0/2 unit 0 family inet address 172.16.1.2/30
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:db8::13/32
set interfaces ge-0/0/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.1.2/32
set interfaces lo0 unit 0 family inet address 192.168.1.5/24
set protocols mpls interface all
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp family inet labeled-unicast
set protocols bgp group ebgp family inet6 labeled-unicast
set protocols bgp group ebgp export send-direct
set protocols bgp group ebgp neighbor 172.16.1.1 description PE1
set policy-options policy statement send-direct from protocol direct then accept
set routing-options autonomous-system 64497
set routing-options router-id 192.168.1.2
```

Device CE2

```
set chassis network-services enhanced-ip
set interfaces ge-0/0/2 unit 0 description CE2->PE2
set interfaces ge-0/0/2 unit 0 family inet address 172.16.2.2/30
set interfaces ge-0/0/2 unit 0 family inet6 address 2001:db8::15/32
set interfaces ge-0/0/2 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 192.168.1.3/32
set protocols mpls interface all
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp family inet labeled-unicast
set protocols bgp group ebgp family inet6 labeled-unicast
set protocols bgp group ebgp export send-direct
set protocols bgp group ebgp neighbor 172.16.2.1 description PE2
set policy-options policy statement send-direct from protocol direct then accept
set routing-options autonomous-system 64497
```

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```
set routing-options router-id 192.168.1.3
```

Configuring Device PE0

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE0:

1. On routers with Modular Port Concentrators (MPCs), enable enhanced IP network services.

```
[edit chassis]
usr@PE0# set network-services enhanced-ip
```

2. Configure the device interfaces.

```
[edit interfaces]
user@PE0# set ge-0/0/0 unit 0 description PE0->P0
user@PE0# set ge-0/0/0 unit 0 family inet address 10.0.0.5/24
user@PE0# set ge-0/0/0 unit 0 family iso
user@PE0# set ge-0/0/0 unit 0 family inet6 address 2001:db8::1/32
user@PE0# set ge-0/0/0 unit 0 family mpls

user@PE0# set ge-0/0/1 unit 0 description PE0->P1
user@PE0# set ge-0/0/1 unit 0 family inet address 10.0.0.1/24
user@PE0# set ge-0/0/1 unit 0 family iso
user@PE0# set ge-0/0/1 unit 0 family inet6 address 2001:db8::2/32
user@PE0# set ge-0/0/1 unit 0 family mpls

user@PE0# set ge-0/0/2 unit 0 description PE0->CE0
user@PE0# set ge-0/0/2 unit 0 family inet address 172.16.0.1/30
user@PE0# set ge-0/0/2 unit 0 family inet6 address 2001:db8::10/32
user@PE0# set ge-0/0/2 unit 0 family mpls
```

3. Configure the loopback interface.

```
[edit interfaces]
user@PE0# set lo0 unit 0 family inet address 192.168.0.1/32
```

4. Configure MPLS and LDP on all interfaces excluding the management interface.

```
[edit protocols]
user@PE0# set mpls ipv6-tunneling
user@PE0# set mpls interface all
user@PE0# set mpls interface fxp0.0 disable

user@PE0# set ldp track-igp-metric
```


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```
user@PE0# set ldp interface all
user@PE0# set ldp interface fxp0.0 disable
```

5. Configure an IGP on the core-facing interfaces.

```
[edit protocols]
user@PE0# set ospf area 0.0.0.0 interface all
user@PE0# set ospf area 0.0.0.0 interface fxp0.0 disable
user@PE0# set ospf area 0.0.0.0 interface lo0.0 passive
user@PE0# set ospf area 0.0.0.0 interface ge-0/0/1.0 metric 1000
user@PE0# set ospf3 area 0.0.0.0 interface all
user@PE0# set ospf3 area 0.0.0.0 interface fxp0.0 disable
user@PE0# set ospf3 area 0.0.0.0 interface lo0.0 passive
user@PE0# set ospf3 area 0.0.0.0 interface ge-0/0/1.0 metric 1000
```

6. Configure IBGP connections with the other PE devices.

```
[edit protocols]
user@PE0# set bgp group ibgp type internal
user@PE0# set bgp group ibgp local-address 192.168.0.1
user@PE0# set bgp group ibgp family inet labeled-unicast per-prefix-label
user@PE0# set bgp group ibgp family inet6 labeled-unicast explicit-null
user@PE0# set bgp group ibgp export nhself
user@PE0# set bgp group ibgp neighbor 192.168.0.4 description PE1
user@PE0# set bgp group ibgp neighbor 192.168.0.5 description PE2
```

7. Configure EBGP connections with the customer devices.

```
[edit protocols]
user@PE0# set bgp group ebgp type external
user@PE0# set bgp group ebgp local address 192.168.0.1
user@PE0# set bgp group ebgp family inet labeled-unicast
user@PE0# set bgp group ebgp family inet6 labeled-unicast
user@PE0# set bgp group ebgp peer-as 64497
user@PE0# set bgp group ebgp neighbor 172.16.0.2 description CE0
```

8. Configure the load-balancing policy.

```
[edit policy-options]
user@PE0# set policy-statement lb then load-balance per-packet
```

9. Configure a next-hop self policy.

```
[edit policy-options]
user@PE0# set policy-statement nhself then next-hop self
```

10. Enable the BGP PIC edge feature.

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```
[edit routing-options]
user@PE0# set protect core
```

11. Apply the load-balancing policy.

```
[edit routing-options]
user@PE0# set forwarding-table export lb
```

12. Assign the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@PE0# set router-id 192.168.0.2
user@PE0# set autonomous-system 64496
```

Results

From configuration mode, confirm your configuration by entering the **show chassis**, **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@PE0# show chassis
network-services enhanced-ip;
```

```
[edit]
user@PE0# show interfaces
ge-0/0/0 {
   unit 0 {
      description PE0->P0;
      family inet {
         address 10.0.0.5/24;
      }
      family iso;
      family inet6 {
         address 2001:db8::1/32;
      }
      family mpls;
   }
}
ge-0/0/1 {
   unit 0 {
      description PE0->P1;
      family inet {
         address 10.0.0.1/24;
      }
      family iso;
      family inet6 {
         address 2001:db8::2/32;
```


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```
    }
    family mpls;
  }
}
ge-0/0/2 {
  unit 0 {
    description PE0->CE0;
    family inet {
      address 172.16.0.1/30;
    }
    family inet6 {
      address 2001:db8::10/32;
    }
    family mpls;
  }
}
lo0 {
  unit 0 {
    family inet {
      address 192.168.0.1/32;
    }
  }
}
```

```
[edit]
user@PE0# show protocols
mpls {
  ipv6-tunneling;
  interface all;
  interface fxp0.0 {
    disable;
  }
}
bgp {
  group ibgp {
    type internal;
    local-address 192.168.0.1;
    family inet {
      labeled-unicast {
        per-prefix-label;
      }
    }
    family inet6 {
      labeled-unicast {
        explicit-null;
      }
    }
    export nhself;
    neighbor 192.168.0.4 {
      description PE1;
    }
    neighbor 192.168.0.5 {
      description PE2;
    }
```

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```
    }
    group ebgp {
      type external;
      local-address 192.168.0.1;
      family inet {
        labeled-unicast;
      }
      family inet6 {
        labeled-unicast;
      }
      peer-as 64497;
      neighbor 172.16.0.2 {
        description CE0;
      }
    }
}
ospf {
    area 0.0.0.0 {
      interface all;
      interface lo0.0 {
        passive;
      }
      interface ge-0/0/1.0 {
        metric 1000;
      }
      interface fxp0.0 {
        disable;
      }
    }
}
ospf3 {
    area 0.0.0.0 {
      interface all;
      interface lo0.0 {
        passive;
      }
      interface ge-0/0/1.0 {
        metric 1000;
      }
      interface fxp0.0 {
        disable;
      }
    }
}
ldp {
    track-igp-metric;
    interface all;
    interface fxp0.0 {
      disable;
    }
}
```

```
[edit]
user@PE1# show policy-options
```


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```
policy-statement lb {
   then {
      load-balance per-packet;
   }
}
policy-statement nhself {
   then {
      next-hop self;
   }
}
```

```
[edit]
user@PE0# show routing-options
protect core;
router-id 192.168.0.1;
autonomous system 64496
forwarding-table {
   export lb;
}
```

Verification

Confirm that the configuration is working properly.

- Displaying Extensive Route Information on page 571
- Displaying the Forwarding Table on page 574

Displaying Extensive Route Information

Purpose Confirm that BGP PIC edge is working.

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Action From Device PE0, run the **show route extensive** command.

```
user@PE0> show route 192.168.1.5 extensive

inet.0: 236941 destinations, 630411 routes (236940 active, 0 holddown, 1 hidden)
20.1.1.1/32 (3 entries, 2 announced)
        State: <CalcForwarding>
TSI:
KRT in-kernel 192.168.1.5/24 -> {indirect(1048574), indirect(1048575)}
        @BGP    Preference: 170/-101
                Next hop type: Indirect, Next hop index: 0
                Address: 0xafd09d0
                Next-hop reference count: 236886
                Source: 192.168.0.4
                Next hop type: Router, Next hop index: 623
                Next hop: 10.0.0.2 via ge-0/0/1.0, selected
                Session Id: 0x140
                Protocol next hop: 192.168.0.4
                Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144

                State: <Active Int Ext ProtectionPath ProtectionCand>

                Local AS:   64496 Peer AS:   64496
                Age: 1:11       Metric2: 2
                Validation State: unverified
                Task: BGP_100.192.168.0.5
                Announcement bits (1): 6-Resolve tree 2
                AS path: 64497 I
                Accepted MultipathUnequal
                Localpref: 100
                Router ID: 192.168.0.5
                Indirect next hops: 1
             Protocol next hop: 192.168.0.5 Metric: 2
              Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144

             Indirect path forwarding next hops: 1

                 Next hop type: Router
                 Next hop: 10.0.0.2 via ge-0/0/1.0

                 Session Id: 0x140
             192.168.0.5/32 Originating RIB: inet.0
              Metric: 2                       Node path count: 1

              Forwarding nexthops: 1
                 Nexthop: 10.0.0.2 via ge-0/0/1.0
      BGP    Preference: 170/-101
        Next hop type: Indirect, Next hop index: 0
        Address: 0xafd0970
        Next-hop reference count: 196735
        Source: 192.168.0.4
        Next hop type: Router, Next hop index: 624
        Next hop: 10.0.0.6 via ge-0/0/0.0, selected
        Session Id: 0x141
       Protocol next hop: 192.168.0.4
       Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145

       State: <NotBest Int Ext ProtectionCand>
       Inactive reason: Not Best in its group - IGP metric
       Local AS:   100 Peer AS:   100
```


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```
      Age: 1:05       Metric2: 1001
      Validation State: unverified
      Task: BGP_100.192.168.0.4
      AS path: 200 400 I
      Accepted
      Localpref: 100
      Router ID: 192.168.0.4
      Indirect next hops: 1
          Protocol next hop:  192.168.0.4 Metric: 1001

          Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145

          Indirect path forwarding next hops: 1

              Next hop type: Router
              Next hop: 10.0.0.6 via ge-0/0/0.0

              Session Id: 0x141
          192.168.0.4/32 Originating RIB: inet.0
           Metric: 1001                    Node path count: 1

           Forwarding nexthops: 1
              Nexthop: 10.0.0.6 via ge-0/0/0.0
#Multipath Preference: 255
         Next hop type: Indirect, Next hop index: 0
         Address: 0xd330f90
         Next-hop reference count: 304062
         Next hop type: Router, Next hop index: 623
         Next hop: 10.0.0.6 via ge-0/0/0.0, selected
         Session Id: 0x140
         Next hop type: Router, Next hop index: 624
         Next hop: 10.0.0.2 via ge-0/0/1.0
         Session Id: 0x141
         Protocol next hop: 192.168.0.4
         Indirect next hop: 0xab3b980 1048574 INH Session ID: 0x144 Weight 0x1

         Protocol next hop: 192.168.0.5
        Indirect next hop: 0xab3c240 1048575 INH Session ID: 0x145 Weight 0x4000

         State:   <ForwardinOnly Int Ext>
         Inactive reason: Forwarding use only
         Local AS:   64496
         Age: 1:05       Metric2: 2
         Validation State: unverified
         Task: RT
         Announcement bits (1): 0-KRT
         AS path: 64497 I
```

Meaning Junos OS uses the next hops and the **weight** values to select a backup path when a link failure occurs. The next-hop weight has one of the following values:

- 0x1 indicates the primary path with active next hops.
- 0x4000 indicates the backup path with passive next hops.

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Displaying the Forwarding Table

Purpose Check the forwarding and kernel routing-table state by using the **show route forwarding-table** command.

Action From Device PE0, run the **show route forwarding-table destination 192.168.1.5 extensive** command.

```
user@PE0> show route forwarding-table destination 192.168.1.5 extensive
  Routing table: default.inet [Index 0]
Internet:

Destination:  192.168.1.5/24
  Route type: user
  Route reference: 0                    Route interface-index: 0
  Multicast RPF nh index: 0
  Flags: sent to PFE
  Next-hop type: unilist                Index: 1048576  Reference: 7401
  Next-hop type: indirect               Index: 1048574  Reference: 2
                            Weight: 0x1
  Nexthop: 10.0.0.6
  Next-hop type: unicast                Index: 623      Reference: 8
  Next-hop interface: ge-0/0/0.0   Weight: 0x1
  Next-hop type: indirect               Index: 1048575  Reference: 2
                            Weight: 0x4000
  Nexthop: 10.0.0.2
  Next-hop type: unicast                Index: 624      Reference: 8
  Next-hop interface: ge-0/0/1.0   Weight: 0x4000
```

Meaning Junos OS uses the next hops and the **weight** values to select a backup path when a link failure occurs. The next-hop weight has one of the following values:

- 0x1 indicates the primary path with active next hops.
- 0x4000 indicates the backup path with passive next hops.

Related Documentation

- Configuring BGP Prefix Independent Convergence for Inet on page 556
- Use Case for BGP Prefix Independent Convergence for Inet, Inet6, or Labeled Unicast on page 555

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FAT Pseudowire Support for BGP L2VPN and VPLS Overview

A pseudowire is a Layer 2 circuit or service that emulates the essential attributes of a telecommunications service, such as a T1 line, over an MPLS packet-switched network (PSN). The pseudowire is intended to provide only the minimum necessary functionality to emulate the wire with the required resiliency requirements for the given service definition.

In an MPLS network, the flow-aware transport (FAT) of pseudowires flow label, as described in *draft-keyupdate-l2vpn-fat-pw-bgp*, is used for load-balancing traffic across BGP-signaled pseudowires for the Layer 2 virtual private network (L2VPN) and virtual private LAN service (VPLS).

FAT flow label is configured only on the label edge routers (LERs). This causes the transit routers or label-switching routers (LSRs) to perform load balancing of MPLS packets across equal-cost multipath (ECMP) paths or link aggregation groups (LAGs) without the need for deep packet inspection of the payload.

FAT flow label can be used for LDP-signaled forwarding equivalence class (FEC 128 and FEC 129) pseudowires for VPWS and VPLS pseudowires. The interface parameter (Sub-TLV) is used both for FEC 128 and FEC 129 pseudowires. The sub-TLV defined for LDP contains the transmit (T) and receive (R) bits. The T bit advertises the ability to push the flow label. The R bit advertises the ability to pop the flow label. By default, the signaling behavior of the provider edge (PE) router for any of these pseudowires is to advertise the T and R bits in the label set to 0.

The **flow-label-transmit** and **flow-label-receive** configuration statements provide the ability to set the T bit and R bit advertisement to 1 in the Sub-TLV field, which is part of the interface parameters of the FEC for the LDP label-mapping message. You can use these statements to control the pushing of the load-balancing label and the advertisement of the label to the routing peers in the control plane for BGP signaled pseudowires like L2VPN and VPLS.

Related Documentation

- Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 576
- Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 605
- Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 606
- Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 577
- *flow-label-receive*
- *flow-label-transmit*

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Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic

The flow-aware transport (FAT) or flow label is supported for BGP-signaled pseudowires such as L2VPN to be configured only on the label edge routers (LERs). This enables the transit routers or the label-switching routers (LSRs) to perform load balancing of MPLS packets across equal-cost multipath paths (ECMP) or link aggregation groups (LAGs) without the need for deep packet inspection of the payload. FAT pseudowires or flow label can be used with LDP-signaled L2VPNs with forwarding equivalence class (FEC128 and FEC129), and the support for flow label is extended for BGP-signaled pseudowires for point-to-point or point–to-multipoint Layer 2 services.

Before you configure FAT pseudowire support for BGP L2VPN to load-balance MPLS traffic:

- Configure the device interfaces and enable MPLS on all the interfaces.
- Configure RSVP.
- Configure MPLS and an LSP to the remote PE router.
- Configure BGP and OSPF.

To configure FAT pseudowire support for BGP L2VPN to load-balance MPLS traffic, you must do the following:

1. Configure the sites connected to the provider equipment for a given routing instance for the L2VPN protocols.

   ```
   [edit routing-instances routing-instance name protocols l2vpn]
   user@host# set site site-name site-identifier site-identifier
   user@host# set site site-name interface interface-name remote-site-id remote-site-id
   ```

2. Configure the L2VPN protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE.

   ```
   [edit routing-instances routing-instance name protocols l2vpn]
   user@host# set flow-label-receive
   ```

3. Configure the L2VPN protocol to provide advertising capability to push the flow label in the transmit direction to the remote PE.

   ```
   [edit routing-instances routing-instance name protocols l2vpn]
   user@host# set flow-label-transmit
   ```

4. Configure the sites connected to the provider equipment for a given routing instance for the VPLS protocol.

   ```
   [edit routing-instances routing-instance name protocols vpls]
   user@host# set site site-name site-identifier site-identifier
   user@host# set site-range site-range
   ```


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5. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE.

```
[edit routing-instances routing-instance name protocols vpls]
user@host# set flow-label-receive
```

6. Configure the VPLS protocol to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances routing-instance name protocols vpls]
user@host# set flow-label-transmit
```

Related Documentation

- FAT Pseudowire Support for BGP L2VPN and VPLS Overview on page 575
- Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 605
- Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 577
- Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 606
- *flow-label-receive*
- *flow-label-transmit*

Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic

This example shows how to implement FAT pseudowire support for BGP L2VPN to help load-balance MPLS traffic.

- Requirements on page 577
- Overview on page 578
- Configuration on page 578
- Configuring PE2 on page 592
- Verification on page 600

Requirements

This example uses the following hardware and software components:

- Five MX Series routers
- Junos OS Release 16.1 or later running on all devices

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Before you configure FAT pseudowire support for BGP L2VPN, be sure you configure the routing and signaling protocols.

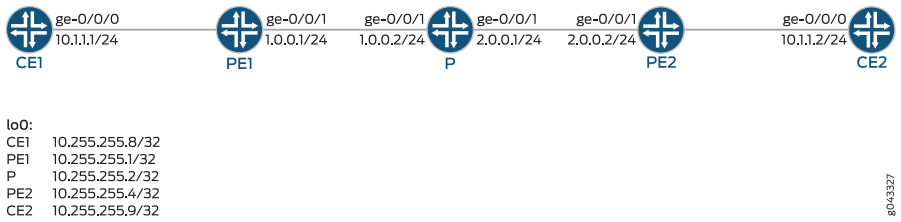
Overview

Junos OS allows the flow-aware transport (FAT) flow label that is supported for BGP-signaled pseudowires such as L2VPN to be configured only on the label edge routers (LERs). This causes the transit routers or the label-switching routers(LSRs) to perform load balancing of MPLS packets across equal-cost multipath (ECMP) paths or link aggregation groups (LAGs) without the need for deep packet inspection of the payload. The FAT flow label can be used for LDP-signaled forwarding equivalence class (FEC 128 and FEC 129) pseudowires for VPWS and VPLS pseudowires.

Topology

Figure 55 on page 578, shows the FAT pseudowire support for BGP L2VPN configured on Device PE1 and Device PE2.

Figure 55: Example FAT Pseudowire Support for BGP L2VPN



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

CE1

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family inet address 10.1.1.1/24
set interfaces lo0 unit 0 family inet address 10.255.255.8/32
```

PE1

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 mtu 1600
set interfaces ge-0/0/0 encapsulation vlan-ccc
set interfaces ge-0/0/0 unit 300 encapsulation vlan-ccc
set interfaces ge-0/0/0 unit 300 vlan-id 600
set interfaces ge-0/0/0 unit 600 encapsulation vlan-vpls
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family vpls
set interfaces ge-0/0/1 unit 0 family inet address 1.0.0.1/24
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.255.1/32
```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```
set routing-options nonstop-routing
set routing-options router-id 10.255.255.1
set routing-options autonomous-system 100
set routing-options forwarding-table export exp-to-frwd
set protocols rsvp interface all
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface lo0.0
set protocols mpls label-switched-path to-pe2 to 10.255.255.4
set protocols mpls interface ge-0/0/1.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.1
set protocols bgp group vpls-pe family l2vpn auto-discovery-only
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.4
set protocols bgp group vpls-pe neighbor 10.255.255.2
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
set policy-options policy-statement exp-to-frwd term 0 from community vpls-com
set policy-options policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe2
set policy-options policy-statement exp-to-frwd term 0 then accept
set policy-options community vpls-com members target:100:100
set routing-instances l2vpn-inst instance-type l2vpn
set routing-instances l2vpn-inst interface ge-0/0/0.300
set routing-instances l2vpn-inst route-distinguisher 10.255.255.1:200
set routing-instances l2vpn-inst vrf-target target:100:100
set routing-instances l2vpn-inst protocols l2vpn encapsulation-type ethernet-vlan
set routing-instances l2vpn-inst protocols l2vpn site pe1 site-identifier 1
set routing-instances l2vpn-inst protocols l2vpn site pe1 interface ge-0/0/0.300
  remote-site-id 2
set routing-instances l2vpn-inst protocols l2vpn flow-label-transmit
set routing-instances l2vpn-inst protocols l2vpn flow-label-receive
set routing-instances vpl1 instance-type vpls
set routing-instances vpl1 interface ge-0/0/0.600
set routing-instances vpl1 route-distinguisher 10.255.255.1:100
set routing-instances vpl1 vrf-target target:100:100
set routing-instances vpl1 protocols vpls site-range 10
set routing-instances vpl1 protocols vpls no-tunnel-services
set routing-instances vpl1 protocols vpls site vpl1PE1 site-identifier 1
set routing-instances vpl1 protocols vpls flow-label-transmit
set routing-instances vpl1 protocols vpls flow-label-receive
```

P

```
set interfaces ge-0/0/0 unit 0 family inet address 1.0.0.2/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 family inet address 2.0.0.1/24
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.255.2/32
set routing-options router-id 10.255.255.2
set routing-options autonomous-system 100
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface ge-0/0/0.0
set protocols rsvp interface lo0.0
set protocols mpls interface ge-0/0/0.0
```

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```
set protocols mpls interface ge-0/0/1.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.2
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.1
set protocols bgp group vpls-pe neighbor 10.255.255.4 deactivate protocols bgp
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```

PE2

```
set interfaces ge-0/0/0 unit 0 family inet address 2.0.0.2/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 vlan-tagging
set interfaces ge-0/0/1 mtu 1600
set interfaces ge-0/0/1 encapsulation vlan-ccc
set interfaces ge-0/0/1 unit 300 encapsulation vlan-ccc
set interfaces ge-0/0/1 unit 300 vlan-id 600
set interfaces ge-0/0/1 unit 600 encapsulation vlan-vpls
set interfaces ge-0/0/1 unit 600 vlan-id 600
set interfaces ge-0/0/1 unit 600 family vpls
set interfaces lo0 unit 0 family inet address 10.255.255.4/32
set routing-options router-id 10.255.255.4
set routing-options autonomous-system 100
set routing-options forwarding-table export exp-to-frwd
set protocols rsvp interface all
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface lo0.0
set protocols mpls label-switched-path to-pe1 to 10.255.255.1
set protocols mpls interface ge-0/0/0.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.4
set protocols bgp group vpls-pe family l2vpn auto-discovery-only
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.1
set protocols bgp group vpls-pe neighbor 10.255.255.2
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set policy-options policy-statement exp-to-frwd term 0 from community vpls-com
set policy-options policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe1
set policy-options policy-statement exp-to-frwd term 0 then accept
set policy-options community vpls-com members target:100:100
set routing-instances l2vpn-inst instance-type l2vpn
set routing-instances l2vpn-inst interface ge-0/0/1.300
set routing-instances l2vpn-inst route-distinguisher 10.255.255.4:200
set routing-instances l2vpn-inst vrf-target target:100:100
set routing-instances l2vpn-inst protocols l2vpn encapsulation-type ethernet-vlan
set routing-instances l2vpn-inst protocols l2vpn site pe2 site-identifier 2
set routing-instances l2vpn-inst protocols l2vpn site pe2 interface ge-0/0/1.300
  remote-site-id 1
set routing-instances l2vpn-inst protocols l2vpn flow-label-transmit
set routing-instances l2vpn-inst protocols l2vpn flow-label-receive
```


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```
set routing-instances vpl1 instance-type vpls
set routing-instances vpl1 interface ge-0/0/1.600
set routing-instances vpl1 route-distinguisher 10.255.255.4:100
set routing-instances vpl1 vrf-target target:100:100
set routing-instances vpl1 protocols vpls site-range 10
set routing-instances vpl1 protocols vpls no-tunnel-services
set routing-instances vpl1 protocols vpls site vpl1PE2 site-identifier 2
set routing-instances vpl1 protocols vpls flow-label-transmit
set routing-instances vpl1 protocols vpls flow-label-receive
deactivate routing-instances vpl1
```

CE2

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family inet address 10.1.1.2/24
set interfaces lo0 unit 0 family inet address 10.255.255.9/32
```

Configuring PE1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE1:

1. Configure the interfaces.

```
[edit interfaces]
user@PE1# set ge-0/0/0 vlan-tagging
user@PE1# set ge-0/0/0 mtu 1600
user@PE1# set ge-0/0/0 encapsulation vlan-ccc
user@PE1# set ge-0/0/0 unit 300 encapsulation vlan-ccc
user@PE1# set ge-0/0/0 unit 300 vlan-id 600
user@PE1# set ge-0/0/0 unit 600 encapsulation vlan-vpls
user@PE1# set ge-0/0/0 unit 600 vlan-id 600
user@PE1# set ge-0/0/0 unit 600 family vpls deactivate interfaces ge-0/0/0 unit
  600

user@PE1# set ge-0/0/1 unit 0 family inet address 1.0.0.1/24
user@PE1# set ge-0/0/1 unit 0 family mpls

user@PE1# set lo0 unit 0 family inet address 10.255.255.1/32
```

2. Configure nonstop routing, and configure the router ID.

```
[edit routing-options]
user@PE1# set nonstop-routing
user@PE1# set router-id 10.255.255.1
```

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3. Configure the autonomous system (AS) number, and apply the policy to the forwarding table of the local router with the export statement.

```
[edit routing-options]
user@PE1# set autonomous-system 100
user@PE1# set forwarding-table export exp-to-frwd
```

4. Configure the RSVP protocol on the interfaces.

```
[edit protocols rsvp]
user@PE1# set interface all
user@PE1# set interface ge-0/0/1.0
user@PE1# set interface lo0.0
```

5. Apply the label-switched path attributes to the MPLS protocol, and configure the interface.

```
[edit protocols mpls]
user@PE1# set label-switched-path to-pe2 to 10.255.255.4
user@PE1# set interface ge-0/0/1.0
```

6. Define a peer group, and configure the address of the local-end address of the BGP session for peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE1# set type internal
user@PE1# set local-address 10.255.255.1
```

7. Configure attributes of the protocol family for NLRIs in updates.

```
[edit protocols bgp group vpls-pe]
user@PE1# set family l2vpn auto-discovery-only
user@PE1# set family l2vpn signaling
```

8. Configure neighbors for the peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE1# set neighbor 10.255.255.4
user@PE1# set neighbor 10.255.255.2
```

9. Configure traffic engineering, and configure the interfaces of OSPF area 0.0.0.0.

```
[edit protocols ospf]
user@PE1# set traffic-engineering
user@PE1# set area 0.0.0.0 interface lo0.0 passive
user@PE1# set area 0.0.0.0 interface ge-0/0/1.0
```


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10. Configure the routing policy and the BGP community information.

```
[edit policy-options]
user@PE1# set policy-statement exp-to-fwd term 0 from community vpls-com
user@PE1# set policy-statement exp-to-fwd term 0 then install-nexthop lsp to-pe2
user@PE1# set policy-statement exp-to-fwd term 0 then accept
user@PE1# set community vpls-com members target:100:100
```

11. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances l2vpn-inst]
user@PE1# set instance-type l2vpn
user@PE1# set interface ge-0/0/0.300
```

12. Configure the route distinguisher for instance **l2vpn-inst**, and configure the VRF target community.

```
[edit routing-instances l2vpn-inst]
user@PE1# set route-distinguisher 10.255.255.1:200
user@PE1# set vrf-target target:100:100
```

13. Configure the type of encapsulation required for the L2VPN protocol.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE1# set encapsulation-type ethernet-vlan
```

14. Configure the sites connected to the provider equipment.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE1# set site pe1 site-identifier 1
user@PE1# set site pe1 interface ge-0/0/0.300 remote-site-id 2
```

15. Configure the L2VPN protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE1# set flow-label-transmit
user@PE1# set flow-label-receive
```

16. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances vpl1]
user@PE1# set instance-type vpls
user@PE1# set interface ge-0/0/0.600
```

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17. Configure the route distinguisher for instance **vpl1**, and configure the VRF target community.

```
[edit routing-instances vpl1]
user@PE1# set route-distinguisher 10.255.255.1:100
user@PE1# set vrf-target target:100:100
```

18. Assign the maximum site identifier for the VPLS domain.

```
[edit routing-instances vpl1 protocols vpls]
user@PE1# set site-range 10
```

19. Configure to not use the tunnel services for the VPLS instance, and assign a site identifier to the site connected to the provider equipment.

```
[edit routing-instances vpl1 protocols vpls]
user@PE1# set no-tunnel-services
user@PE1# set site vpl1PE1 site-identifier 1
```

20. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances vpl1 protocols vpls]
user@PE1# set flow-label-transmit
user@PE1# set flow-label-receive
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show interfaces
ge-0/0/0 {
   vlan-tagging;
   mtu 1600;
   encapsulation vlan-ccc;
   unit 300 {
      encapsulation vlan-ccc;
      vlan-id 600;
   }
   unit 600 {
      encapsulation vlan-vpls;
      vlan-id 600;
      family vpls;
   }
}
ge-0/0/1 {
```


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```
    unit 0 {
      family inet {
        address 1.0.0.1/24;
      }
      family mpls;
    }
}
lo0 {
    unit 0 {
      family inet {
        address 10.255.255.1/32;
      }
    }
}
```

```
user@PE1# show protocols
rsvp {
    interface all;
    interface ge-0/0/1.0;
    interface lo0.0;
}
mpls {
    label-switched-path to-pe2 {
        to 10.255.255.4;
    }
    interface ge-0/0/1.0;
}
bgp {
    group vpls-pe {
        type internal;
        local-address 10.255.255.1;
        family l2vpn {
            auto-discovery-only;
            signaling;
        }
        neighbor 10.255.255.4;
        neighbor 10.255.255.2;
    }
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
        interface lo0.0 {
            passive;
        }
        interface ge-0/0/1.0;
    }
}
```

```
user@PE1# show policy-options
policy-statement exp-to-frwd {
    term 0 {
        from community vpls-com;
        then {
```

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```
        install-nexthop lsp to-pe2;
        accept;
      }
    }
}
community vpls-com members target:100:100;
```

```
user@PE1# show routing-instances
l2vpn-inst {
    instance-type l2vpn;
    interface ge-0/0/0.300;
    route-distinguisher 10.255.255.1:200;
    vrf-target target:100:100;
    protocols {
        l2vpn {
            encapsulation-type ethernet-vlan;
            site pe1 {
                site-identifier 1;
                interface ge-0/0/0.300 {
                    remote-site-id 2;
                }
            }
            flow-label-transmit;
            flow-label-receive;
        }
    }
}
vpl1 {
    instance-type vpls;
    interface ge-0/0/0.600;
    route-distinguisher 10.255.255.1:100;
    vrf-target target:100:100;
    protocols {
        vpls {
            site-range 10;
            no-tunnel-services;
            site vpl1PE1 {
                site-identifier 1;
            }
            flow-label-transmit;
            flow-label-receive;
        }
    }
}
```

```
user@PE1# show routing-options
nonstop-routing;
router-id 10.255.255.1;
autonomous-system 100;
forwarding-table {
    export exp-to-frwd;
}
```


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Verification

Confirm that the configuration is working properly.

- Verifying the BGP Summary Information on page 587
- Verifying the L2VPN Connections Information on page 587
- Verifying the Routes on page 588

Verifying the BGP Summary Information

Purpose Verify the BGP summary information.

Action From operational mode, enter the **show bgp summary** command.

```
user@PE1> show bgp summary

Groups: 1 Peers: 2 Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0
                       1          1          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.255.255.2            100          0          0       0       0 2d 12:54:28
Active
10.255.255.4            100       8121       8093       0       0 2d 12:53:56
Establ
  bgp.l2vpn.0: 1/1/1/0
  l2vpn-inst.l2vpn.0: 1/1/1/0
```

Meaning The output displays the BGP summary information.

Verifying the L2VPN Connections Information

Purpose Verify the Layer 2 VPN connections information.

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Action From operational mode, run the **show l2vpn connections** command to display the Layer 2 VPN connections information.

```
user@PE1> show l2vpn connections

Layer-2 VPN connections:

Legend for connection status (St)
EI -- encapsulation invalid      NC -- interface encapsulation not CCC/TCC/VPLS
EM -- encapsulation mismatch     WE -- interface and instance encaps not same
VC-Dn -- Virtual circuit down    NP -- interface hardware not present
CM -- control-word mismatch      -> -- only outbound connection is up
CN -- circuit not provisioned    <- -- only inbound connection is up
OR -- out of range               Up -- operational
OL -- no outgoing label          Dn -- down
LD -- local site signaled down   CF -- call admission control failure
RD -- remote site signaled down  SC -- local and remote site ID collision
LN -- local site not designated  LM -- local site ID not minimum designated
RN -- remote site not designated RM -- remote site ID not minimum designated
XX -- unknown connection status  IL -- no incoming label
MM -- MTU mismatch               MI -- Mesh-Group ID not available
BK -- Backup connection          ST -- Standby connection
PF -- Profile parse failure      PB -- Profile busy
RS -- remote site standby        SN -- Static Neighbor
LB -- Local site not best-site   RB -- Remote site not best-site
VM -- VLAN ID mismatch

Legend for interface status
Up -- operational
Dn -- down

Instance: l2vpn-inst
Edge protection: Not-Primary
  Local site: pe1 (1)
    connection-site           Type  St     Time last up          # Up trans
    2                         rmt   Up     Jun 22 14:46:50 2015           1
      Remote PE: 10.255.255.4, Negotiated control-word: Yes (Null)
      Incoming label: 800003, Outgoing label: 800002
      Local interface: ge-0/0/0.300, Status: Up, Encapsulation: VLAN
      Flow Label Transmit: Yes, Flow Label Receive: Yes
```

Meaning The output displays the Layer 2 VPN connections information along with the flow label transmit and flow label receive information.

Verifying the Routes

Purpose Verify that the expected routes are learned.

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Action From operational mode, run the **show route** command to display the routes in the routing table.

```
user@PE1> show route

inet.0: 51 destinations, 51 routes (51 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.0.0.0/24          *[Direct/0] 2d 12:48:34
                     > via ge-0/0/1.0
1.0.0.1/32          *[Local/0] 2d 12:48:34
                       Local via ge-0/0/1.0
2.0.0.0/24          *[OSPF/10] 2d 12:48:24, metric 2
                     > to 1.0.0.2 via ge-0/0/1.0
10.4.0.0/16         *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.5.0.0/16         *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.6.128.0/17       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.9.0.0/16         *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.10.0.0/16        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.13.4.0/23        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.13.10.0/23       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.82.0.0/15        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.84.0.0/16        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.85.12.0/22       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.92.0.0/16        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.94.0.0/16        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.99.0.0/16        *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.102.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.102.160.0/19     *[Direct/0] 2d 12:48:34
                     > via fxp0.0
10.102.169.99/32    *[Local/0] 2d 12:48:34
                       Local via fxp0.0
10.150.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.155.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.157.64.0/19      *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.160.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.204.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.205.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
10.206.0.0/16       *[Static/5] 2d 12:48:34
                     > to 10.102.191.254 via fxp0.0
```

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```
10.207.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.209.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.212.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.213.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.214.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.215.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.216.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.218.13.0/24     *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.218.14.0/24     *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.218.16.0/20     *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.218.32.0/20     *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.227.0.0/16      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
10.255.255.1/32    *[Direct/0] 2d 12:48:34
                    > via lo0.0
10.255.255.2/32    *[OSPF/10] 2d 12:48:24, metric 1
                    > to 1.0.0.2 via ge-0/0/1.0
10.255.255.4/32    *[OSPF/10] 2d 12:48:24, metric 2
                    > to 1.0.0.2 via ge-0/0/1.0
128.102.161.191/32 *[OSPF/10] 2d 12:48:24, metric 1
                    > to 1.0.0.2 via ge-0/0/1.0
128.102.169.99/32  *[Direct/0] 2d 12:48:34
                    > via lo0.0
128.102.171.41/32  *[OSPF/10] 2d 12:48:24, metric 2
                    > to 1.0.0.2 via ge-0/0/1.0
172.16.0.0/12      *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
192.168.0.0/16     *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
192.168.102.0/23   *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
207.17.136.0/24    *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
207.17.136.192/32  *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
207.17.137.0/24    *[Static/5] 2d 12:48:34
                    > to 10.102.191.254 via fxp0.0
224.0.0.5/32       *[OSPF/10] 2d 12:48:34, metric 1
                       MultiRecv

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.4/32    *[RSVP/7/1] 2d 12:48:04, metric 2
                    > to 1.0.0.2 via ge-0/0/1.0, label-switched-path to-pe2

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
47.0005.80ff.f800.0000.0108.0001.1281.0216.9099/152
                   *[Direct/0] 2d 12:48:34
                    > via lo0.0

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 2d 12:48:34, metric 1
                      Receive
1                  *[MPLS/0] 2d 12:48:34, metric 1
                      Receive
2                  *[MPLS/0] 2d 12:48:34, metric 1
                      Receive
13                 *[MPLS/0] 2d 12:48:34, metric 1
                      Receive
800003             *[L2VPN/7] 2d 12:41:29
                    > via ge-0/0/0.300, Pop       Offset: 4
ge-0/0/0.300       *[L2VPN/7] 2d 12:41:29, metric2 2
                    > to 1.0.0.2 via ge-0/0/1.0, label-switched-path to-pe2

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

abcd::128:102:169:99/128
                   *[Direct/0] 2d 12:48:34
                    > via lo0.0
fe80::5668:a60f:fc6b:eb97/128
                   *[Direct/0] 2d 12:48:34
                    > via lo0.0

bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.4:200:2:1/96
                   *[BGP/170] 2d 12:41:35, localpref 100, from 10.255.255.4
                      AS path: I, validation-state: unverified
                    > to 1.0.0.2 via ge-0/0/1.0, label-switched-path to-pe2

l2vpn-inst.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.1:200:1:1/96
                   *[L2VPN/170/-101] 2d 12:41:29, metric2 1
                      Indirect
10.255.255.4:200:2:1/96
                   *[BGP/170] 2d 12:41:35, localpref 100, from 10.255.255.4
                      AS path: I, validation-state: unverified
                    > to 1.0.0.2 via ge-0/0/1.0, label-switched-path to-pe2

l2vpn-inst.l2id.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1                  *[L2VPN/170/-101] 2d 12:41:29, metric2 1
                      Indirect
                    [L2VPN/175] 2d 12:41:29
                    > via ge-0/0/0.300, Pop       Offset: 4
2                  *[BGP/170] 2d 12:41:35, localpref 100, from 10.255.255.4
                      AS path: I, validation-state: unverified
                    > to 1.0.0.2 via ge-0/0/1.0, label-switched-path to-pe2
```

Meaning The output shows all the routes in the routing table.

Configuring PE2

Step-by-Step Procedure The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE2:

1. Configure the interfaces.

```
[edit interfaces]
user@PE2# set ge-0/0/0 unit 0 family inet address 2.0.0.2/24
user@PE2# set ge-0/0/0 unit 0 family mpls


user@PE2# set ge-0/0/1 vlan-tagging
user@PE2# set ge-0/0/1 mtu 1600
user@PE2# set ge-0/0/1 encapsulation vlan-ccc
user@PE2# set ge-0/0/1 unit 300 encapsulation vlan-ccc
user@PE2# set ge-0/0/1 unit 300 vlan-id 600
user@PE2# set ge-0/0/1 unit 600 encapsulation vlan-vpls
user@PE2# set ge-0/0/1 unit 600 vlan-id 600
user@PE2# set ge-0/0/1 unit 600 family vpls deactivate interfaces ge-0/0/1 unit
  600


user@PE2# set lo0 unit 0 family inet address 10.255.255.4/32
```

2. Configure the router ID.

```
[edit routing-options]
user@PE2# set router-id 10.255.255.4
```

3. Configure the autonomous system (AS) number, and apply the policy to the forwarding table of the local router with the export statement.

```
[edit routing-options]
user@PE2# set autonomous-system 100
user@PE2# set forwarding-table export exp-to-frwd
```

4. Configure the RSVP protocol on the interfaces.

```
[edit protocols rsvp]
user@PE2# set interface all
user@PE2# set interface ge-0/0/1.0
user@PE2# set interface lo0.0
```


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5. Apply the label-switched path attributes to the MPLS protocol, and configure the interface.

```
[edit protocols mpls]
user@PE2# set label-switched-path to-pe1 to 10.255.255.1
user@PE2# set interface ge-0/0/0.0
```

6. Define a peer group, and configure the local-end address of the BGP session for the peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE2# set type internal
user@PE2# set local-address 10.255.255.4
```

7. Configure the attributes of the protocol family for NLRIs in updates.

```
[edit protocols bgp group vpls-pe]
user@PE2# set family l2vpn auto-discovery-only
user@PE2# set family l2vpn signaling
```

8. Configure the neighbors for peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE2# set neighbor 10.255.255.1
user@PE2# set neighbor 10.255.255.2
```

9. Configure traffic engineering, and configure the interfaces of OSPF area 0.0.0.0.

```
[edit protocols ospf]
user@PE2# set traffic-engineering
user@PE2# set area 0.0.0.0 interface lo0.0 passive
user@PE2# set area 0.0.0.0 interface ge-0/0/0.0
```

10. Configure the routing policy and the BGP community information.

```
[edit policy-options]
user@PE2# set policy-statement exp-to-frwd term 0 from community vpls-com
user@PE2# set policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe1
user@PE2# set policy-statement exp-to-frwd term 0 then accept
user@PE2# set community vpls-com members target:100:100
```

11. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances l2vpn-inst]
user@PE2# set instance-type l2vpn
user@PE2# set interface ge-0/0/1.300
```

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12. Configure the route distinguisher for instance **l2vpn-inst**, and configure the VRF target community.

```
[edit routing-instances l2vpn-inst]
user@PE2# set route-distinguisher 10.255.255.4:200
user@PE2# set vrf-target target:100:100
```

13. Configure the type of encapsulation required for the L2VPN protocol.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE2# set encapsulation-type ethernet-vlan
```

14. Configure the sites connected to the provider equipment.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE2# set site pe2 site-identifier 2
user@PE2# set site pe2 interface ge-0/0/1.300 remote-site-id 1
```

15. Configure the L2VPN protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances l2vpn-inst protocols l2vpn]
user@PE2# set flow-label-transmit
user@PE2# set flow-label-receive
```

16. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances vpl1]
user@PE2# set instance-type vpls
user@PE2# set interface ge-0/0/1.600
```

17. Configure the route distinguisher for instance **vpl1**, and configure the VRF target community.

```
[edit routing-instances vpl1]
user@PE2# set route-distinguisher 10.255.255.4:100
user@PE2# set vrf-target target:100:100
```

18. Assign the maximum site identifier for the VPLS domain.

```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set site-range 10
```

19. Configure to not use the tunnel services for the VPLS instance, and assign a site identifier to the site connected to the provider equipment.

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```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set no-tunnel-services
user@PE2# set site vpl1PE2 site-identifier 2
```

20. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to the push flow label in the transmit direction to the remote PE.

```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set flow-label-transmit
user@PE2# set flow-label-receive
```

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Results

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From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
ge-0/0/0 {
   unit 0 {
      family inet {
         address 2.0.0.2/24;
      }
      family mpls;
   }
}
ge-0/0/1 {
   vlan-tagging;
   mtu 1600;
   encapsulation vlan-ccc;
   unit 300 {
      encapsulation vlan-ccc;
      vlan-id 600;
   }
   unit 600 {
      encapsulation vlan-vpls;
      vlan-id 600;
      family vpls;
   }
}
lo0 {
   unit 0 {
      family inet {
         address 10.255.255.4/32;
      }
   }
}
```

```
user@PE2# show protocols
rsvp {
   interface all;
   interface ge-0/0/1.0;
   interface lo0.0;
}
mpls {
   label-switched-path to-pe1 {
      to 10.255.255.1;
   }
   interface ge-0/0/0.0;
}
bgp {
   group vpls-pe {
      type internal;
      local-address 10.255.255.4;
      family l2vpn {
         auto-discovery-only;
```

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```
        signaling;
      }
      neighbor 10.255.255.1;
      neighbor 10.255.255.2;
    }
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
      interface lo0.0 {
        passive;
      }
      interface ge-0/0/0.0;
    }
}
```

```
user@PE2# show policy-options
policy-statement exp-to-frwd {
    term 0 {
      from community vpls-com;
      then {
        install-nexthop lsp to-pe1;
        accept;
      }
    }
}
community vpls-com members target:100:100;
```


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```
user@PE2# show routing-instances
l2vpn-inst {
   instance-type l2vpn;
   interface ge-0/0/1.300;
   route-distinguisher 10.255.255.4:200;
   vrf-target target:100:100;
   protocols {
      l2vpn {
         encapsulation-type ethernet-vlan;
         site pe2 {
            site-identifier 2;
            interface ge-0/0/1.300 {
               remote-site-id 1;
            }
         }
         flow-label-transmit;
         flow-label-receive;
      }
   }
}
vpl1 {
   instance-type vpls;
   interface ge-0/0/1.600;
   route-distinguisher 10.255.255.4:100;
   vrf-target target:100:100;
   protocols {
      vpls {
         site-range 10;
         no-tunnel-services;
         site vpl1PE2 {
            site-identifier 2;
         }
         flow-label-transmit;
         flow-label-receive;
      }
   }
}
```

```
user@PE2# show routing-options
router-id 10.255.255.4;
autonomous-system 100;
forwarding-table {
   export exp-to-frwd;
}
```

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Verification

Confirm that the configuration is working properly.

- Verifying the BGP Summary Information on page 600
- Verifying the L2VPN Connections Information on page 600
- Verifying the Routes on page 601

Verifying the BGP Summary Information

Purpose Verify the BGP summary information.

Action From operational mode, enter the **show bgp summary** command.

```
user@PE2> show bgp summary

Groups: 1 Peers: 2 Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0
                       1          1          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.255.255.1            100       8090       8119       0       1 2d 12:53:15
Establ
  bgp.l2vpn.0: 1/1/1/0
  l2vpn-inst.l2vpn.0: 1/1/1/0
10.255.255.2            100          0          0       0       0 2d 14:14:49
Active
```

Meaning The output displays the BGP summary information.

Verifying the L2VPN Connections Information

Purpose Verify the Layer 2 VPN connections information.

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Action From operational mode, run the **show l2vpn connections** command to display the Layer 2 VPN connections information.

```
user@PE2> show l2vpn connections

Layer-2 VPN connections:

Legend for connection status (St)
EI -- encapsulation invalid      NC -- interface encapsulation not CCC/TCC/VPLS
EM -- encapsulation mismatch     WE -- interface and instance encaps not same
VC-Dn -- Virtual circuit down    NP -- interface hardware not present
CM -- control-word mismatch      -> -- only outbound connection is up
CN -- circuit not provisioned    <- -- only inbound connection is up
OR -- out of range               Up -- operational
OL -- no outgoing label          Dn -- down
LD -- local site signaled down   CF -- call admission control failure
RD -- remote site signaled down  SC -- local and remote site ID collision
LN -- local site not designated  LM -- local site ID not minimum designated
RN -- remote site not designated RM -- remote site ID not minimum designated
XX -- unknown connection status  IL -- no incoming label
MM -- MTU mismatch               MI -- Mesh-Group ID not available
BK -- Backup connection          ST -- Standby connection
PF -- Profile parse failure      PB -- Profile busy
RS -- remote site standby        SN -- Static Neighbor
LB -- Local site not best-site   RB -- Remote site not best-site
VM -- VLAN ID mismatch

Legend for interface status
Up -- operational
Dn -- down

Instance: l2vpn-inst
Edge protection: Not-Primary
  Local site: pe2 (2)
    connection-site           Type  St     Time last up          # Up trans
    1                         rmt   Up     Jun 22 14:46:50 2015           1
      Remote PE: 10.255.255.1, Negotiated control-word: Yes (Null)
      Incoming label: 800002, Outgoing label: 800003
      Local interface: ge-0/0/1.300, Status: Up, Encapsulation: VLAN
      Flow Label Transmit: Yes, Flow Label Receive: Yes
```

Meaning The output displays the Layer 2 VPN connections information along with the flow label transmit and flow label receive information.

Verifying the Routes

Purpose Verify that the expected routes are learned.

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Action From operational mode, run the **show route** command to display the routes in the routing table.

```
user@PE2> show route

inet.0: 51 destinations, 51 routes (51 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.0.0.0/24          *[OSPF/10] 2d 14:09:33, metric 2
                     > to 2.0.0.1 via ge-0/0/0.0
2.0.0.0/24          *[Direct/0] 2d 14:10:18
                     > via ge-0/0/0.0
2.0.0.2/32          *[Local/0] 2d 14:10:20
                       Local via ge-0/0/0.0
10.4.0.0/16         *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.5.0.0/16         *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.6.128.0/17       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.9.0.0/16         *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.10.0.0/16        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.13.4.0/23        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.13.10.0/23       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.82.0.0/15        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.84.0.0/16        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.85.12.0/22       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.92.0.0/16        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.94.0.0/16        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.99.0.0/16        *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.102.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.102.160.0/19     *[Direct/0] 2d 14:12:18
                     > via fxp0.0
10.102.171.41/32    *[Local/0] 2d 14:12:18
                       Local via fxp0.0
10.150.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.155.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.157.64.0/19      *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.160.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.204.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.205.0.0/16       *[Static/5] 2d 14:12:18
                     > to 10.102.191.254 via fxp0.0
10.206.0.0/16       *[Static/5] 2d 14:12:18
```


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```
                    > to 10.102.191.254 via fxp0.0
10.207.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.209.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.212.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.213.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.214.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.215.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.216.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.218.13.0/24     *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.218.14.0/24     *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.218.16.0/20     *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.218.32.0/20     *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.227.0.0/16      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
10.255.255.1/32    *[OSPF/10] 2d 12:50:36, metric 2
                    > to 2.0.0.1 via ge-0/0/0.0
10.255.255.2/32    *[OSPF/10] 2d 14:09:33, metric 1
                    > to 2.0.0.1 via ge-0/0/0.0
10.255.255.4/32    *[Direct/0] 2d 14:11:51
                    > via lo0.0
128.102.161.191/32 *[OSPF/10] 2d 14:09:33, metric 1
                    > to 2.0.0.1 via ge-0/0/0.0
128.102.169.99/32  *[OSPF/10] 2d 12:50:36, metric 2
                    > to 2.0.0.1 via ge-0/0/0.0
128.102.171.41/32  *[Direct/0] 2d 14:12:18
                    > via lo0.0
172.16.0.0/12      *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
192.168.0.0/16     *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
192.168.102.0/23   *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
207.17.136.0/24    *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
207.17.136.192/32  *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
207.17.137.0/24    *[Static/5] 2d 14:12:18
                    > to 10.102.191.254 via fxp0.0
224.0.0.5/32       *[OSPF/10] 2d 14:11:51, metric 1
                       MultiRecv

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.1/32    *[RSVP/7/1] 2d 12:50:24, metric 2
                    > to 2.0.0.1 via ge-0/0/0.0, label-switched-path to-pe1

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```

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```
47.0005.80ff.f800.0000.0108.0001.1281.0217.1041/152
                   *[Direct/0] 2d 14:12:18
                    > via lo0.0

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 2d 14:11:51, metric 1
                      Receive
1                  *[MPLS/0] 2d 14:11:51, metric 1
                      Receive
2                  *[MPLS/0] 2d 14:11:51, metric 1
                      Receive
13                 *[MPLS/0] 2d 14:11:51, metric 1
                      Receive
800002             *[L2VPN/7] 2d 12:43:43
                    > via ge-0/0/1.300, Pop       Offset: 4
ge-0/0/1.300       *[L2VPN/7] 2d 12:43:43, metric2 2
                    > to 2.0.0.1 via ge-0/0/0.0, label-switched-path to-pe1

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

abcd::128:102:171:41/128
                   *[Direct/0] 2d 14:12:18
                    > via lo0.0
fe80::5668:a60f:fc6b:ee28/128
                   *[Direct/0] 2d 14:12:18
                    > via lo0.0

bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.1:200:1:1/96
                   *[BGP/170] 2d 12:43:43, localpref 100, from 10.255.255.1
                      AS path: I, validation-state: unverified
                    > to 2.0.0.1 via ge-0/0/0.0, label-switched-path to-pe1

l2vpn-inst.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.255.1:200:1:1/96
                   *[BGP/170] 2d 12:43:43, localpref 100, from 10.255.255.1
                      AS path: I, validation-state: unverified
                    > to 2.0.0.1 via ge-0/0/0.0, label-switched-path to-pe1
10.255.255.4:200:2:1/96
                   *[L2VPN/170/-101] 2d 12:43:50, metric2 1
                      Indirect

l2vpn-inst.l2id.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1                  *[BGP/170] 2d 12:43:43, localpref 100, from 10.255.255.1
                      AS path: I, validation-state: unverified
                    > to 2.0.0.1 via ge-0/0/0.0, label-switched-path to-pe1
2                  *[L2VPN/170/-101] 2d 12:43:50, metric2 1
                      Indirect
                    [L2VPN/175] 2d 12:43:43
                    > via ge-0/0/1.300, Pop       Offset: 4
```


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Meaning The output shows all the routes in the routing table.

Related Documentation

- Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 576
- Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 605
- Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 606
- FAT Pseudowire Support for BGP L2VPN and VPLS Overview on page 575
- *flow-label-receive*
- *flow-label-transmit*

Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic

The flow-aware transport (FAT) or flow label is supported for BGP-signaled pseudowires such as VPLS and is to be configured only on the label edge routers (LERs). This enables the transit routers or the label-switching routers (LSRs) to perform load balancing of MPLS packets across equal-cost multipath (ECMP) or link aggregation groups (LAGs) without the need for deep packet inspection of the payload. FAT pseudowires or flow label can be used with LDP-signaled VPLS with forwarding equivalence class (FEC128 and FEC129), and the support for flow label is extended for BGP-signaled pseudowires for point-to-point or point-to-multipoint Layer 2 services.

Before you configure FAT pseudowire support for BGP VPLS to load-balance MPLS traffic:

- Configure the device interfaces and enable MPLS on all the interfaces.
- Configure RSVP.
- Configure MPLS and an LSP to the remote PE router.
- Configure BGP and OSPF.

To configure FAT pseudowire support for BGP VPLS to load-balance MPLS traffic, you must do the following:

1. Configure the sites connected to the provider equipment for a given routing instance for the VPLS protocols.

```
[edit routing-instances routing-instance name protocols vpls]
user@host# set site site-name site-identifier site-identifier
user@host# set site-range site-range
```

2. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE.

```
[edit routing-instances routing-instance name protocols vpls]
user@host# set flow-label-receive
```

3. Configure the VPLS protocol to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances routing-instance name protocols vpls]
user@host# set flow-label-transmit
```

Related Documentation

- FAT Pseudowire Support for BGP L2VPN and VPLS Overview on page 575
- Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 576
- Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 577
- Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 606
- *flow-label-receive*
- *flow-label-transmit*

Example: Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic

This example shows how to implement FAT pseudowire support for BGP VPLS to help load-balance MPLS traffic.

- Requirements on page 606
- Overview on page 607
- Configuration on page 607
- Verification on page 620

Requirements

This example uses the following hardware and software components:

- Five MX Series routers
- Junos OS Release 16.1 or later running on all devices

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Before you configure FAT pseudowire support for BGP VPLS, be sure you configure the routing and signaling protocols.

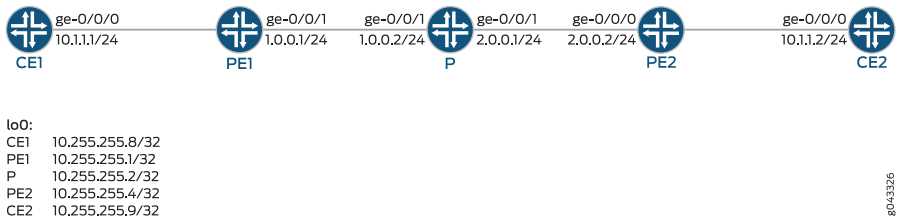
Overview

Junos OS allows the flow-aware transport (FAT) flow label that is supported for BGP-signaled pseudowires such as VPLS to be configured only on the label edge routers (LERs). This causes the transit routers or the label-switching routers (LSRs) to perform load balancing of MPLS packets across equal-cost multipath (ECMP) paths or link aggregation groups (LAGs) without the need for deep packet inspection of the payload. The FAT flow label can be used for LDP-signaled forwarding equivalence class (FEC 128 and FEC 129) pseudowires for VPWS and VPLS pseudowires.

Topology

Figure 56 on page 607 shows the FAT pseudowire support for BGP VPLS configured on Device PE1 and Device PE2.

Figure 56: Example FAT Pseudowire Support for BGP VPLS



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

CE1

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family inet address 10.1.1.1/24
set interfaces lo0 unit 0 family inet address 10.255.255.8/32
```

PE1

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 mtu 1600
set interfaces ge-0/0/0 encapsulation vlan-vpls
set interfaces ge-0/0/0 unit 600 encapsulation vlan-vpls
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family vpls
set interfaces ge-0/0/1 unit 0 family inet address 1.0.0.1/24
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.255.1/32
set routing-options nonstop-routing
set routing-options router-id 10.255.255.1
```

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```
set routing-options autonomous-system 100
set routing-options forwarding-table export exp-to-frwd
set protocols rsvp interface all
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface lo0.0
set protocols mpls label-switched-path to-pe2 to 10.255.255.4
set protocols mpls interface ge-0/0/1.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.1
set protocols bgp group vpls-pe family l2vpn auto-discovery-only
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.4
set protocols bgp group vpls-pe neighbor 10.255.255.2
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
set policy-options policy-statement exp-to-frwd term 0 from community vpls-com
set policy-options policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe2
set policy-options policy-statement exp-to-frwd term 0 then accept
set policy-options community vpls-com members target:100:100
set routing-instances vpl1 instance-type vpls
set routing-instances vpl1 interface ge-0/0/0.600
set routing-instances vpl1 route-distinguisher 10.255.255.1:100
set routing-instances vpl1 vrf-target target:100:100
set routing-instances vpl1 protocols vpls site-range 10
set routing-instances vpl1 protocols vpls no-tunnel-services
set routing-instances vpl1 protocols vpls site vpl1PE1 site-identifier 1
set routing-instances vpl1 protocols vpls flow-label-transmit
set routing-instances vpl1 protocols vpls flow-label-receive
```

P

```
set interfaces ge-0/0/0 unit 0 family inet address 1.0.0.2/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 unit 0 family inet address 2.0.0.1/24
set interfaces ge-0/0/1 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 10.255.255.2/32
set routing-options router-id 10.255.255.2
set routing-options autonomous-system 100
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface ge-0/0/0.0
set protocols rsvp interface lo0.0
set protocols mpls interface ge-0/0/0.0
set protocols mpls interface ge-0/0/1.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.2
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.1
set protocols bgp group vpls-pe neighbor 10.255.255.4 deactivate protocols bgp
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/1.0
```


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PE2

```
set interfaces ge-0/0/0 unit 0 family inet address 2.0.0.2/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-0/0/1 vlan-tagging
set interfaces ge-0/0/1 mtu 1600
set interfaces ge-0/0/1 encapsulation vlan-vpls
set interfaces ge-0/0/1 unit 600 encapsulation vlan-vpls
set interfaces ge-0/0/1 unit 600 vlan-id 600
set interfaces ge-0/0/1 unit 600 family vpls
set interfaces lo0 unit 0 family inet address 10.255.255.4/32
set routing-options router-id 10.255.255.4
set routing-options autonomous-system 100
set routing-options forwarding-table export exp-to-frwd
set protocols rsvp interface all
set protocols rsvp interface ge-0/0/1.0
set protocols rsvp interface lo0.0
set protocols mpls label-switched-path to-pe1 to 10.255.255.1
set protocols mpls interface ge-0/0/0.0
set protocols bgp group vpls-pe type internal
set protocols bgp group vpls-pe local-address 10.255.255.4
set protocols bgp group vpls-pe family l2vpn auto-discovery-only
set protocols bgp group vpls-pe family l2vpn signaling
set protocols bgp group vpls-pe neighbor 10.255.255.1
set protocols bgp group vpls-pe neighbor 10.255.255.2
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set policy-options policy-statement exp-to-frwd term 0 from community vpls-com
set policy-options policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe1
set policy-options policy-statement exp-to-frwd term 0 then accept
set policy-options community vpls-com members target:100:100
set routing-instances vpl1 instance-type vpls
set routing-instances vpl1 interface ge-0/0/1.600
set routing-instances vpl1 route-distinguisher 10.255.255.4:100
set routing-instances vpl1 vrf-target target:100:100
set routing-instances vpl1 protocols vpls site-range 10
set routing-instances vpl1 protocols vpls no-tunnel-services
set routing-instances vpl1 protocols vpls site vpl1PE2 site-identifier 2
set routing-instances vpl1 protocols vpls flow-label-transmit
set routing-instances vpl1 protocols vpls flow-label-receive
```

CE2

```
set interfaces ge-0/0/0 vlan-tagging
set interfaces ge-0/0/0 unit 600 vlan-id 600
set interfaces ge-0/0/0 unit 600 family inet address 10.1.1.2/24
set interfaces lo0 unit 0 family inet address 10.255.255.9/32
```

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Configuring PE1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE1:

1. Configure the interfaces.

```
[edit interfaces]
user@PE1# set ge-0/0/0 vlan-tagging
user@PE1# set ge-0/0/0 mtu 1600
user@PE1# set ge-0/0/0 encapsulation vlan-vpls
user@PE1# set ge-0/0/0 unit 600 encapsulation vlan-vpls
user@PE1# set ge-0/0/0 unit 600 vlan-id 600
user@PE1# set ge-0/0/0 unit 600 family vpls

user@PE1# set ge-0/0/1 unit 0 family inet address 1.0.0.1/24
user@PE1# set ge-0/0/1 unit 0 family mpls

user@PE1# set lo0 unit 0 family inet address 10.255.255.1/32
```

2. Configure nonstop routing, and configure the router ID.

```
[edit routing-options]
user@PE1# set nonstop-routing
user@PE1# set router-id 10.255.255.1
```

3. Configure the autonomous system (AS) number, and apply the policy to the forwarding table of the local router with the export statement.

```
[edit routing-options]
user@PE1# set autonomous-system 100
user@PE1# set forwarding-table export exp-to-frwd
```

4. Configure the RSVP protocol on the interfaces.

```
[edit protocols rsvp]
user@PE1# set interface all
user@PE1# set interface ge-0/0/1.0
user@PE1# set interface lo0.0
```

5. Apply the label-switched path attributes to the MPLS protocol, and configure the interface.

```
[edit protocols mpls]
user@PE1# set label-switched-path to-pe2 to 10.255.255.4
```


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```
user@PE1# set interface ge-0/0/1.0
```

6. Define a peer group, and configure the address of the local end of the BGP session for peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE1# set type internal
user@PE1# set local-address 10.255.255.1
```

7. Configure attributes of the protocol family for NLRIs in updates.

```
[edit protocols bgp group vpls-pe family l2vpn]
user@PE1# set auto-discovery-only
user@PE1# set signaling
```

8. Configure neighbors for the peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE1# set neighbor 10.255.255.4
user@PE1# set neighbor 10.255.255.2
```

9. Configure traffic engineering, and configure the interfaces of OSPF area 0.0.0.0.

```
[edit protocols ospf]
user@PE1# set traffic-engineering
user@PE1# set area 0.0.0.0 interface lo0.0 passive
user@PE1# set area 0.0.0.0 interface ge-0/0/1.0
```

10. Configure the routing policy and the BGP community information.

```
[edit policy-options ]
user@PE1# set policy-statement exp-to-frwd term 0 from community vpls-com
user@PE1# set policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe2
user@PE1# set policy-statement exp-to-frwd term 0 then accept
user@PE1# set community vpls-com members target:100:100
```

11. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances vpl1]
user@PE1# set instance-type vpls
user@PE1# set interface ge-0/0/0.600
```

12. Configure the route distinguisher for instance **vpl1**, and configure the VRF target community.

```
[edit routing-instances vpl1]
```

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```
user@PE1# set route-distinguisher 10.255.255.1:100
user@PE1# set vrf-target target:100:100
```

13. Assign the maximum site identifier for the VPLS domain.

```
[edit routing-instances vp1 protocols vpls]
user@PE1# set site-range 10
```

14. Configure the VPLS protocol to not use the tunnel services for the VPLS instance, and assign the site identifier to the site connected to the provider equipment.

```
[edit routing-instances vp1 protocols vpls]
user@PE1# set no-tunnel-services
user@PE1# set site vpl1PE1 site-identifier 1
```

15. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances vp1 protocols vpls]
user@PE1# set flow-label-receive
user@PE1# set flow-label-transmit
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show interfaces
ge-0/0/0 {
   vlan-tagging;
   mtu 1600;
   encapsulation vlan-vpls;
   unit 600 {
      encapsulation vlan-vpls;
      vlan-id 600;
      family vpls;
   }
}
ge-0/0/1 {
   unit 0 {
      family inet {
         address 1.0.0.1/24;
      }
      family mpls;
   }
```


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```
}
lo0 {
   unit 0 {
      family inet {
         address 10.255.255.1/32;
      }
   }
}
```

```
user@PE1# show protocols
rsvp {
   interface all;
   interface ge-0/0/1.0;
   interface lo0.0;
}
mpls {
   label-switched-path to-pe2 {
      to 10.255.255.4;
   }
   interface ge-0/0/1.0;
}
bgp {
   group vpls-pe {
      type internal;
      local-address 10.255.255.1;
      family l2vpn {
         auto-discovery-only;
         signaling;
      }
      neighbor 10.255.255.4;
      neighbor 10.255.255.2;
   }
}
ospf {
   traffic-engineering;
   area 0.0.0.0 {
      interface lo0.0 {
         passive;
      }
      interface ge-0/0/1.0;
   }
}
```

```
user@PE1# show policy-options
policy-statement exp-to-frwd {
   term 0 {
      from community vpls-com;
      then {
         install-nexthop lsp to-pe2;
         accept;
      }
   }
}
community vpls-com members target:100:100;
```

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```
user@PE1# show routing-instances
vpl1 {
   instance-type vpls;
   interface ge-0/0/0.600;
   route-distinguisher 10.255.255.1:100;
   vrf-target target:100:100;
   protocols {
      vpls {
         site-range 10;
         no-tunnel-services;
         site vpl1PE1 {
            site-identifier 1;
         }
         flow-label-transmit;
         flow-label-receive;
      }
   }
}
```

```
user@PE1# show routing-options
nonstop-routing;
router-id 10.255.255.1;
autonomous-system 100;
forwarding-table {
   export exp-to-frwd;
}
```

Verification

Confirm that the configuration is working properly.

Verifying the VPLS Connection Information

Purpose Verify the VPLS connection information.

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Action From operational mode, run the **show vpls connections** command to display the VPLS connections information.

```
user@PE1> show vpls connections
Layer-2 VPN connections:

Legend for connection status (St)
EI -- encapsulation invalid      NC -- interface encapsulation not CCC/TCC/VPLS
EM -- encapsulation mismatch     WE -- interface and instance encaps not same
VC-Dn -- Virtual circuit down    NP -- interface hardware not present
CM -- control-word mismatch      -> -- only outbound connection is up
CN -- circuit not provisioned    <- -- only inbound connection is up
OR -- out of range               Up -- operational
OL -- no outgoing label          Dn -- down
LD -- local site signaled down   CF -- call admission control failure
RD -- remote site signaled down  SC -- local and remote site ID collision
LN -- local site not designated  LM -- local site ID not minimum designated
RN -- remote site not designated RM -- remote site ID not minimum designated
XX -- unknown connection status  IL -- no incoming label
MM -- MTU mismatch               MI -- Mesh-Group ID not available
BK -- Backup connection          ST -- Standby connection
PF -- Profile parse failure      PB -- Profile busy
RS -- remote site standby        SN -- Static Neighbor
LB -- Local site not best-site   RB -- Remote site not best-site
VM -- VLAN ID mismatch

Legend for interface status
Up -- operational
Dn -- down

Instance: vpl1
Edge protection: Not-Primary
  Local site: vpl1PE1 (1)
    connection-site           Type  St     Time last up          # Up trans
    2                         rmt   Up     Jun 17 11:38:14 2015           1
      Remote PE: 10.255.255.4, Negotiated control-word: No
      Incoming label: 262146, Outgoing label: 262145
      Local interface: lsi.1048576, Status: Up, Encapsulation: VPLS
        Description: Intf - vpls vpl1 local site 1 remote site 2
      Flow Label Transmit: Yes, Flow Label Receive: Yes
```

Meaning The output displays the VPLS connection information along with the flow label receive and flow label transmit information.

Configuring PE2

Step-by-Step Procedure The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device PE2:

1. Configure the interfaces.

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```
[edit interfaces]
user@PE2# set ge-0/0/0 unit 0 family inet address 2.0.0.2/24
user@PE2# set ge-0/0/0 unit 0 family mpls

user@PE2# set ge-0/0/1 vlan-tagging
user@PE2# set ge-0/0/1 mtu 1600
user@PE2# set ge-0/0/1 encapsulation vlan-vpls
user@PE2# set ge-0/0/1 unit 600 encapsulation vlan-vpls
user@PE2# set ge-0/0/1 unit 600 vlan-id 600
user@PE2# set ge-0/0/1 unit 600 family vpls

user@PE2# set lo0 unit 0 family inet address 10.255.255.4/32
```

2. Configure the router ID.

```
[edit routing-options]
user@PE2# set router-id 10.255.255.4
```

3. Configure the autonomous system (AS) number, and apply the policy to the forwarding table of the local router with the export statement.

```
[edit routing-options]
user@PE2# set autonomous-system 100
user@PE2# set forwarding-table export exp-to-frwd
```

4. Configure the RSVP protocol on the interfaces.

```
[edit protocols rsvp]
user@PE2# set interface all
user@PE2# set interface ge-0/0/1.0
user@PE2# set interface lo0.0
```

5. Apply the label-switched path attributes to the MPLS protocol, and configure the interface.

```
[edit protocols mpls]
user@PE2# set label-switched-path to-pe1 to 10.255.255.1
user@PE2# set interface ge-0/0/0.0
```

6. Define a peer group, and configure the local-end address of the BGP session for peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE2# set type internal
user@PE2# set local-address 10.255.255.4
```

7. Configure attributes of the protocol family for NLRIs in updates.

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```
[edit protocols bgp group vpls-pe]
user@PE2# set family l2vpn auto-discovery-only
user@PE2# set family l2vpn signaling
```

8. Configure neighbors for the peer group **vpls-pe**.

```
[edit protocols bgp group vpls-pe]
user@PE2# set neighbor 10.255.255.1
user@PE2# set neighbor 10.255.255.2
```

9. Configure traffic engineering, and configure the interfaces of OSPF area 0.0.0.0.

```
[edit protocols ospf]
user@PE2# set traffic-engineering
user@PE2# set area 0.0.0.0 interface lo0.0 passive
user@PE2# set area 0.0.0.0 interface ge-0/0/0.0
```

10. Configure the routing policy and the BGP community information.

```
[edit policy-options ]
user@PE2# set policy-statement exp-to-frwd term 0 from community vpls-com
user@PE2# set policy-statement exp-to-frwd term 0 then install-nexthop lsp to-pe1
user@PE2# set policy-statement exp-to-frwd term 0 then accept
user@PE2# set community vpls-com members target:100:100
```

11. Configure the type of routing instance, and configure the interface.

```
[edit routing-instances vpl1]
user@PE2# set instance-type vpls
user@PE2# set interface ge-0/0/1.600
```

12. Configure the route distinguisher for instance **vp11**, and configure the VRF target community.

```
[edit routing-instances vpl1]
user@PE2# set route-distinguisher 10.255.255.4:100
user@PE2# set vrf-target target:100:100
```

13. Assign the maximum site identifier for the VPLS domain.

```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set site-range 10
```

14. Configure the VPLS protocol to not use the tunnel services for the VPLS instance, and assign the site identifier to the site connected to the provider equipment.

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```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set no-tunnel-services
user@PE2# set site vpl1PE2 site-identifier 2
```

15. Configure the VPLS protocol for the routing instance to provide advertising capability to pop the flow label in the receive direction to the remote PE and to provide advertising capability to push the flow label in the transmit direction to the remote PE.

```
[edit routing-instances vpl1 protocols vpls]
user@PE2# set flow-label-transmit
user@PE2# set flow-label-receive
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE2# show interfaces
ge-0/0/0 {
    unit 0 {
        family inet {
            address 2.0.0.2/24;
        }
        family mpls;
    }
}
ge-0/0/1 {
    vlan-tagging;
    mtu 1600;
    encapsulation vlan-vpls;
    unit 600 {
        encapsulation vlan-vpls;
        vlan-id 600;
        family vpls;
    }
}
lo0 {
    unit 0 {
        family inet {
            address 10.255.255.4/32;
        }
    }
}
```

```
user@PE2# show protocols
rsvp {
```


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```
    interface all;
    interface ge-0/0/1.0;
    interface lo0.0;
}
mpls {
    label-switched-path to-pe1 {
        to 10.255.255.1;
    }
    interface ge-0/0/0.0;
}
bgp {
    group vpls-pe {
        type internal;
        local-address 10.255.255.4;
        family l2vpn {
            auto-discovery-only;
            signaling;
        }
        neighbor 10.255.255.1;
        neighbor 10.255.255.2;
    }
}
ospf {
    traffic-engineering;
    area 0.0.0.0 {
        interface lo0.0 {
            passive;
        }
        interface ge-0/0/0.0;
    }
}
```

```
user@PE2# show policy-options
policy-statement exp-to-frwd {
    term 0 {
        from community vpls-com;
        then {
            install-nexthop lsp to-pe1;
            accept;
        }
    }
}
community vpls-com members target:100:100;
```

```
user@PE2# show routing-instances
vpl1 {
    instance-type vpls;
    interface ge-0/0/1.600;
    route-distinguisher 10.255.255.4:100;
    vrf-target target:100:100;
    protocols {
        vpls {
            site-range 10;
            no-tunnel-services;
```

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```
        site vpl1PE2 {
          site-identifier 2;
        }
        flow-label-transmit;
        flow-label-receive;
      }
    }
}
```

```
user@PE2# show routing-options
router-id 10.255.255.4;
autonomous-system 100;
forwarding-table {
  export exp-to-frwd;
}
```

Verification

Confirm that the configuration is working properly.

Verifying the VPLS Connection Information

Purpose Verify the VPLS connection information.

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Action From operational mode, run the **show vpls connections** command to display the VPLS connections information.

```
user@PE2> show vpls connections
Layer-2 VPN connections:

Legend for connection status (St)
EI -- encapsulation invalid      NC -- interface encapsulation not CCC/TCC/VPLS
EM -- encapsulation mismatch     WE -- interface and instance encaps not same
VC-Dn -- Virtual circuit down    NP -- interface hardware not present
CM -- control-word mismatch      -> -- only outbound connection is up
CN -- circuit not provisioned    <- -- only inbound connection is up
OR -- out of range               Up -- operational
OL -- no outgoing label          Dn -- down
LD -- local site signaled down   CF -- call admission control failure
RD -- remote site signaled down  SC -- local and remote site ID collision
LN -- local site not designated  LM -- local site ID not minimum designated
RN -- remote site not designated RM -- remote site ID not minimum designated
XX -- unknown connection status  IL -- no incoming label
MM -- MTU mismatch               MI -- Mesh-Group ID not available
BK -- Backup connection          ST -- Standby connection
PF -- Profile parse failure      PB -- Profile busy
RS -- remote site standby        SN -- Static Neighbor
LB -- Local site not best-site   RB -- Remote site not best-site
VM -- VLAN ID mismatch

Legend for interface status
Up -- operational
Dn -- down

Instance: vpl1
Edge protection: Not-Primary
  Local site: vpl1PE2 (2)
    connection-site           Type  St     Time last up          # Up trans
    1                         rmt   Up     Jun 17 11:38:14 2015           1
      Remote PE: 10.255.255.1, Negotiated control-word: No
      Incoming label: 262145, Outgoing label: 262146
      Local interface: lsi.1048576, Status: Up, Encapsulation: VPLS
        Description: Intf - vpls vpl1 local site 2 remote site 1
      Flow Label Transmit: Yes, Flow Label Receive: Yes
```

Meaning The output displays the VPLS connection information along with the flow label receive and flow label transmit information.

Related Documentation

- Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 576
- Configuring FAT Pseudowire Support for BGP VPLS to Load-Balance MPLS Traffic on page 605
- Example: Configuring FAT Pseudowire Support for BGP L2VPN to Load-Balance MPLS Traffic on page 577
- *flow-label-receive*

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- *flow-label-transmit*

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PART 8

Configuring Long-Lived Graceful Restart for BGP

- Maintaining BGP Routing Details for Stale Sessions for a Longer Period During Graceful Restart on page 625

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CHAPTER 14

Maintaining BGP Routing Details for Stale Sessions for a Longer Period During Graceful Restart

- Understanding the Long-Lived BGP Graceful Restart Capability on page 626
- Understanding Maximum Period Configuration for Automatic Generation of BGP Keepalives by Kernel Timers After Switchover on page 627
- Interoperation of Functionalities With BGP Long-Lived Graceful Restart on page 628
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- Configuring BGP Long-Lived Graceful Restart Communities in Routing Policies on page 636
- Configuring Long-Lived Graceful Restarter Mode Negotiation for a Specific Address Family in Logical Systems and Routing Instances on page 638
- Informing the BGP Helper Router or Peer About Retaining Routes By Configuring the Forwarding State Bit for All Address Families and for a Specific Address Family on page 642
- Example: Preserving Route Details for Slow and Latent BGP Peers By Using BGP Long-Lived Graceful Restart on page 647

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Understanding the Long-Lived BGP Graceful Restart Capability

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

Historically, routing protocols and BGP, in particular, have been designed with a focus on correctness, where a significant aspect of the "correctness" is for each network element's forwarding state to converge toward the current state of the network as quickly as possible. For this reason, the protocol was designed to remove state advertised by routers which went down (from a BGP perspective) as promptly as possible. Using BGP Graceful Restart defined in RFC 4724, the fast convergence functionality has been an attempt to rapidly remove "stale" state from the network.

Over a period of time, two contributing factors have caused this method of rapid removal of stale states to be modified and enhanced. The first is the widespread adoption of tunneled forwarding infrastructures, for example MPLS. Such infrastructures eliminate the risk of some types of forwarding loops that can arise in hop-by-hop forwarding, and thereby reduce one of the motivations for strong consistency between forwarding elements. The second is the increasing use of BGP as a transport for data less closely associated with packet forwarding than was originally the case. Examples include the use of BGP for autodiscovery (VPLS [RFC4761]) and filter programming (FLOWSPEC [RFC5575]). In these cases, BGP data assumes a characteristic that is not in line with traditional routing.

It was important to offer network operators the ability to choose to retain BGP data for a longer period when the BGP control plane fails for some reason. Although the properties of BGP Graceful Restart are close to this desired requirement to preserve BGP information for a longer duration, several gaps exist, most notably in maximum time for which "stale" information can be retained—graceful restart imposes a 4095-second upper-bound limitation. Junos OS supports a BGP capability called long-lived graceful restart capability so that stale information can be retained for a longer time across a session reset. It also supports a new BGP community, "LLGR_STALE", to mark such information. Such stale information is to be treated as least-preferred, and its advertisement limited to BGP speakers that support the new capability.

BGP long-lived graceful restart (LLGR) allows a network operator to choose to maintain stale routing information from a failed BGP peer much longer than the existing BGP Graceful Restart facility. This functionality to maintain the BGP routes for a longer time period is in accordance with the IETF draft, *Support for Long-lived BGP Graceful Restart—draft-uttaro-idr-bgp-persistence-03*. According to this draft, long-lived graceful restart (LLGR) must be explicitly configured per NLRI, and it includes provisions to prevent the spread of stale information to other peers that do not recognize and validate LLGR. The following benefits and operations are caused by LLGR:

- Routes from failed nodes are retained for a configured time period (on the order of days).
- You can examine per-NLRI LLGR negotiation states using appropriate show commands.

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- You can view whether LLGR is currently in effect for a peer, and if it is effective, the period after which it expires.
- Stale routes retained by LLGR are explicitly marked in the output of the **show bgp neighbor** command.
- Stale routes learned from other neighbors are explicitly marked in the output of the **show bgp neighbor** command (using well-defined communities).

Although the LLGR methodology can be applied to a number of different scenarios, one specific scenario is the salient objective of this feature. In a scenario in which a loss of connectivity between a route reflector and a client occurs, including intermittent connectivity which can cause a connection to be reset before the entire RIB can be transmitted, such a failure does not result in a restart. Also, such a phenomenon does not imply that any sort of connectivity problem between the clients and the next-hops advertised by the route reflector exists. It is anticipated that a typical long-lived restart time is in the order of 12 hours.

All of the behavioral guidelines and operational points described in the IETF draft, *draft-uttaro-idr-bgp-persistence-03*, for LLGR are supported. Also, backward compatibility with existing Junos OS features in releases earlier than Release 15.1, specifically graceful restart and nonstop routing (NSR), is supported. When LLGR is configured, graceful restart operates in the existing manner, except as explicitly illustrated in the Internet draft. You can also configure both LLGR and NSR at the same time, and achieve the complete LLGR functionality. As a prerequisite for LLGR, support for the IETF draft, *Notification Message support for BGP Graceful Restart—draft-ietf- idr-bgp-gr-notification-01*, is implemented. This draft extends the behavior of ordinary GR to allow it to protect against communications interruptions and protocol errors.

Related Documentation

-

Understanding Maximum Period Configuration for Automatic Generation of BGP Keepalives by Kernel Timers After Switchover

In Junos OS, nonstop active routing (NSR) uses the same infrastructure as graceful Routing Engine switchover (GRES) to preserve interface and kernel information. However, NSR also saves routing protocol information by running the routing protocol process (rpd) on the backup Routing Engine. By saving this additional information, NSR is self-contained and does not rely on helper routers (or switches) to assist the routing platform in restoring routing protocol information. NSR is advantageous in networks where neighbor routers (or switches) do not support graceful restart protocol extensions. As a result of this enhanced functionality, NSR is a natural replacement for graceful restart.

Nonstop active routing automerge is one of the kernel components of the socket replication. On switchover, this component merges the socket pairs automatically from the backup to the master Routing Engine. NSR switchover from backup to master happens when rpd issues a merge call for each secondary socket pair to merge them to a single socket, which could result in a delay. To avoid this delay, an automerge module in the

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kernel decouples the secondary socket merge from rpd and automatically merges secondary sockets on switchover so that the rpd high priority thread takes advantage of this and generates faster keepalive to sustain TCP connections on switchover.

By default, BGP does not register for the automatic keepalive generation service provided by the kernel right after the switchover event from backup to master. For this, you need to enable the **nonstop-routing-options** statement at [**edit routing-options**] hierarchy level and configure precision timers in BGP. Configuring precision timers in BGP allows BGP to register all of its sessions with the automatic keepalive generation service provided by the kernel. Once registered, the kernel automatically generates keepalives using its timers on behalf of BGP for its control sessions just after the switchover event from backup to master. This allows generation of more reliable keepalives for control sessions with very small timers during the switchover event.

Related Documentation

- nonstop-routing-options on page 1276

Interoperation of Functionalities With BGP Long-Lived Graceful Restart

This topic contains the following sections that describe the working behavior of different functionalities with BGP long-lived graceful restart and the various system conditions:

Starting in Junos OS Release 15.1, Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

Limitations on Supported NLRIs

LLGR configuration and capability negotiation is supported for the following BGP network layer reachability information (NLRI) families:

- l2vpn
- inet labeled-unicast
- inet flow
- route-target
- inet-vpn unicast
- inet-vpn flow
- inet6-vpn unicast

LLGR configuration and capability negotiation is prevented for the following families:

- inet-mvpn
- inet6-mvpn
- inet-mdt

For the NLRI families for which LLGR capability is prevented, it indicates that an attempt to commit a configuration that includes an LLGR configuration for these families is

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rejected, and such settings are not saved. The NLRIs associated with these families are not included in an LLGR capabilities advertisement, and are disregarded in a received LLGR capabilities advertisement.

LLGR configuration and capability negotiation is permitted, but hidden, for other families.

LLGR Restarter Mode Under NSR

When NSR and LLGR are configured together, the router negotiates the LLGR capability in the usual, regular manner, including a long-lived stale time to trigger LLGR receiver mode in its peers. However, full LLGR restarter functionality (delaying the transmission of End of RIB markers until EoRs are received from all peers) does not function under NSR. During a full system (both Routing Engines) restart, the routing protocol daemon (rpd) does not wait for EoRs from other peers before sending its own EoR. It transmits the EoR as soon as it has transmitted the current RIB contents. This condition can cause transient outages when the network reconverges. NSR is considered to be adequate to handle all single-Routing Engine restart scenarios. The restarter mode restriction effects only scenarios where both Routing Engines (or both copies of rpd) restart simultaneously. Ordinary restarter mode configuration is not enabled with NSR.

Ordinary graceful-restart restarter mode configuration continues to be not supported with NSR.

LLGR Capability At Global, BGP Group, and BGP Neighbor Levels

Long-lived graceful restart receiver mode is enabled by default, unless ordinary graceful restart receiver mode is disabled. To enable the BGP long-lived graceful restart (LLGR) capability, include the **long-lived receiver enable** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. Apart from enabling BGP LLGR at the global or system-wide level, you can also include the long-lived receiver enable statement at the **[edit protocols bgp group *group-name* graceful- restart]** hierarchy level to configure LLGR for a particular BGP group and at the **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level to configure LLGR for a particular BGP neighbor. To disable the BGP LLGR mechanism, include the **long-lived receiver disable** option the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or [edit protocols bgp group-group-name neighbor neighbor-address graceful-restart] hierarchy level. Disabling LLGR deactivates all of the LLGR capabilities (both receiver and restarter modes) for all NLRI families. This property is inherited by groups from the global configuration, and by neighbors from the group configuration.

Related Documentation

-

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Monitoring and Administering BGP Long-Lived Graceful Restart

This topic describes the operational commands and their significance to enable you analyze and view the parameters related to BGP long-lived graceful restart. You can analyze the statistical counters and metrics related to any traffic loss and take an appropriate corrective measure. The fields displayed in the output of the show commands help in diagnosing and debugging network performance and traffic-handling efficiency problems.

The **clear bgp neighbor** *neighbor-address* **stale-routes** causes any stale routes currently being held for the specified neighbor because of graceful restart (GR) or long-lived graceful restart (LLGR) receiver mode operations. The **clear bgp neighbor** *neighbor-address* **gracefully** command is the same as **clear bgp neighbor hard** (the default for **clear bgp neighbor**), but it does not use the new Hard Reset subcode on the Notify and Cease messages that are sent. This allows the neighbor to enter GR or LLGR helper mode, if negotiated. The session is still cleared on this router, and this router does not enter GR or LLGR helper mode.

A hidden **clear** command is available added for the BGP long-lived graceful restart capability for debugging purposes:

clear bgp neighbor *neighbor-address* **socket**.

This command breaks the TCP connection for an established peering session. This is the only direct implication of the command and all other implications are side effects of the connection being broken. The resultant effect is that (unless GR notification extensions have been disabled) both sides of the connection will enter GR or LLGR helper mode, if negotiated, and the TCP connection will be reestablished.

The output of the **show bgp neighbor** command is enhanced to display the following additional information:

- The long-lived graceful restart option
- The LLGR parameters that the peer has negotiated
- The LLGR parameters that the restart router has negotiated
- Times are displayed using the routing protocol daemon (rpd) %#0T format:

  <weeks>w<days>d <hours>:<minutes>:<seconds>

  Zero leading elements are omitted, for example, a value less than one week do not include the weeks.

If long-lived graceful restart is completely disabled for a neighbor, the following is displayed:

```
user@router> show bgp neighbor
  Peer: 10.6.128.225+45824 AS 100 Local: 10.255.255.14+44542 AS 100
    Type: Internal    State: Established    Flags: <Sync>
    Last State: OpenConfirm   Last Event: RecvKeepAlive
    Last Error: None
```


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```
    Options: <Preference LocalAddress AddressFamily Rib-group Refresh>
    Options: <LLGRHelperDisabled> {The LLGRHelperDisabled value for the Options
field denotes that long-lived BGP graceful restart is completely disabled for a
neighbor}
```

If a neighbor does not support LLGR entirely, the following is displayed:

```
user@router> show bgp neighbor
  ...
    Peer does not support LLGR Restarter or Receiver functionality {BGP neighor
or peer does not support long-lived BGP graceful restart restarter or receiver
functionality}
```

While LLGR receiver mode is active (a peer that negotiated LLGR has disconnected and not yet reconnected), the output of the **show bgp neighbor** command displays the amount of time left until the LLGR expires, the time remaining on the GR stale timer, and RIB details:

```
  user@router> show bgp neighbor
  Peer: 10.4.12.11 AS 100        Local: 10.6.128.225 AS 100
    Type: Internal    State: Active         Flags: <>
    Last State: Idle          Last Event: Start
    Last Error: None
    Export: [ foo ]
    Options: <Preference LocalAddress Refresh GracefulRestart>
    Options: <LLGR>
    Local Address: 10.6.128.225 Holdtime: 90 Preference: 170
    Number of flaps: 3
    Last flap event: Restart
    Error: 'Cease' Sent: 0 Recv: 1
    Time until long-lived stale routes deleted: inet-vpn-unicast 10:00:22
route-target 10:00:22
    Table bgp.l3vpn.0
      RIB State: BGP restart is complete
      RIB State: VPN restart is complete
      Send state: not advertising
      Active prefixes:              0
      Received prefixes:            7
      Accepted prefixes:            7
      Suppressed due to damping:    0
    Table foo.inet.0 Bit: 30000
      RIB State: BGP restart is complete
      RIB State: VPN restart is complete
      Send state: not in sync
      Active prefixes:              0
      Received prefixes:            7
      Accepted prefixes:            7
      Suppressed due to damping:    0
```

When BGP graceful restart receiver mode is active for a neighbor, additional information is displayed in the output of the **show bgp neighbor** command. These details include the list of NLRIs that stale routes are held for (NLRI we are holding stale routes for field), the time remaining on the restart timer (Time until stale routes are deleted or become

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long-lived stale field), the time remaining on the stale timer (Time until end-of-rib is assumed for stale routes), and the RIB details. Time is displayed in Coordinated Universal Time (UTC) format (YYYY-MM-DD-HH:MM:SS). Note that the stale timer display ('Time until end-of-rib is assumed') is also present when a session is active, but the neighbor as not yet sent all of the end-of-rib indications.

When graceful restart or LLGR helper mode is active, the RIB information is now displayed by the **show bgp summary** command. If a BGP session is established on the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the inet.0 (main) and inet.2 (multicast) routing tables. For example, 8/10/10/2 and 2/4/4/0 indicate the following:

- 8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the inet.0 routing table.
- 2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the inet.2 routing table.

The **show route detail** command (with and without the **receive-protocol bgp** option) is enhanced to identify routes that are held in the long-lived stale state. The **LongLivedStale** flag indicates that the route was marked LLGR-stale by this router, as part of the operation of LLGR receiver mode. The **LongLivedStaleImport** flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy. One or both of these flags may be displayed for a route. Neither of these flags will be displayed at the same time as the Stale (ordinary GR stale) flag. When a route is de-preferenced because it is long-lived stale, the Inactive reason field in the output of the show route detail command displays LLGR stale. The new LLGR stale inactive reason fits into the route selection hierarchy between Preference and Local preference.

```
user@router> show route receive-protocol bgp 10.4.12.11 detail

  bgp.l2vpn.0: 38 destinations, 39 routes (37 active, 0 holddown, 1 hidden)
  * 1.1.1.4:100:1.1.1.4/96 AD (1 entry, 1 announced)
    Accepted LongLivedStale LongLivedStaleImport
    Nexthop: 10.4.12.11
    Localpref: 100
    AS path: I
```

TIP: According to the Juniper Technical Assistance Center (JTAC), one helpful command to help troubleshoot issues related to BGP long-lived graceful restart is the **show route table bgp.l2vpn.0 detail hidden** command. The output of the command helps you detect if the BGP routes still exist after the BGP session has ended. Use of the **hidden** option enables you to see the routes during and after an incident, and discover information that explains why the routes are hidden. Other clues that help you troubleshoot this scenario include the appearance of stale BGP log entries (such as **bgp_mark_route_stale**), and hidden routes showing up in the output of the **show bgp summary** command.

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Related Documentation
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Increasing the Duration for Preserving BGP Routes Across Slowly-Restarting Peers By BGP Long-Lived Graceful Restart

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

Long-lived graceful restart receiver mode is enabled by default, unless ordinary graceful restart receiver mode is disabled. To enable the BGP long-lived graceful restart (LLGR) capability, include the **long-lived receiver enable** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. Apart from enabling BGP LLGR at the global or system-wide level, you can also include the long-lived receiver enable statement at the **[edit protocols bgp group *group-name* graceful-restart]** hierarchy level to configure LLGR for a particular BGP group and at the **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level to configure LLGR for a particular BGP neighbor. To disable the BGP LLGR mechanism, include the **long-lived receiver disable** option the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or [edit protocols bgp group-group-name neighbor neighbor-address graceful-restart] hierarchy level. Disabling LLGR deactivates all of the LLGR capabilities (both receiver and restarter modes) for all NLRI families. This property is inherited by groups from the global configuration, and by neighbors from the group configuration.

BGP neighbors can be configured at the following hierarchy levels:

- **[edit protocols bgp group *group-name*]**—Default logical system and default routing instance.
- **[edit routing-instances *instance-name* protocols bgp group *group-name*]**—Default logical system with a specified routing instance.
- **[edit logical-systems *logical-system-name* protocols bgp group *group-name*]**—Configured logical system and default routing instance.
- **[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name*]**—Configured logical system with a specified routing instance.

The **long-lived receiver enable** overrides a disable option inherited from a higher level in the configuration. It does not enable long-lived graceful restart restarter mode for all families—restarter mode must be configured explicitly for each family.

To enable LLGR-stale routes to be advertised to neighbors that do not advertise the LLGR capability, include the **advertise-to-non-llgr-neighbor** statement at the **[edit protocols bgp graceful-restart long-lived]**, **[edit protocols bgp group *group-name* graceful-restart long-lived]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart long-lived]** hierarchy level. This setting applies to both routes that were marked LLGR-stale by this router, and LLGR-stale routes received from neighbors. Ideally, all routers in an autonomous system support the IETF draft specification before it was enabled. However, to facilitate incremental deployment, stale routes might be required

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to be advertised to neighbors that have not advertised the long-lived graceful restart capability under the following conditions: The neighbors must be internal (IBGP or Confederation) neighbors. The NO_EXPORT community must be attached to the stale routes. The stale routes must have their LOCAL_PREF attribute set to zero. If this technique for partial deployment is used, you must set LOCAL_PREF to zero for all LLGR routes throughout the autonomous system. This configuration trades off a small reduction in flexibility (ordering may not be preserved between competing LLGR routes) for consistency between routers that support and do not support this specification. Because consistency of route selection can be important for preventing forwarding loops, the latter consideration of routers that do not support this specification precedes.

To avoid the no-export BGP community from being automatically added to routes advertised to external BGP neighbors (presumed to be CE routers), include the **omit-no-export** statement at the **[edit protocols bgp graceful-restart long-lived]**, **[edit protocols bgp group *group-name* graceful-restart long-lived]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart long-lived]** hierarchy level. In VPN deployments, for example, BGP is often used as a PE-CE protocol. It might be a practical necessity in such deployments to accommodate interoperation with CEs that cannot easily be upgraded to support specifications such as this one. This requirement causes a problem while ensuring that "stale" routing information does not leak beyond the perimeter of routers that support these procedures where one or more IBGP routers are not upgraded. In the VPN PE-CE case, the protocol in use is EBGP, and the LOCAL_PREF, an IBGP-only path attribute, is used. The principal motivation for restricting the propagation of "stale" routing information is the reason to prevent it from spreading without limit once it exits the BGP confederation boundary. VPN deployments are typically topologically constrained, removing this concern. For this reason, an implementation might advertise stale routes over a PE-CE session, when explicitly configured. In such a scenario, the implementation must attach the NO_EXPORT community to the routes in question by default, as an additional protection against stale routes spreading without limit. Attachment of the NO_EXPORT community can be disabled explicitly to accommodate exceptional cases. It might be necessary to advertise stale routes to a CE in some VPN deployments, even if the CE does not support this specification. In that case, if you configure the PE routers to advertise such routes, you must notify the operator of the CE receiving the routes, and the CE must be configured to depreference the routes. Typical BGP implementations perform this operation by matching on the LLGR_STALE community, and setting the LOCAL_PREF for matching routes to zero.

When the LLGR receiver mode is enabled or disabled, the session is reset. This behavior enables the new capability value to be sent to the neighbor. When the **advertise-to-non-llgr-neighbor** option is enabled or disabled, export policy is reevaluated, and LLGR stale routes might be advertised or withdrawn. When the **omit-no-export** option is added or removed, the session is reset. This rest of a session enables LLGR stale routes to be readvertised with or without the no- export community (which is added outside of the export policy).

To enable the BGP long-lived graceful restart capability at the system or global level and configure its properties:

```
[edit]
```


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```
protocols {
  bgp {
    graceful-restart {
      long-lived {
        receiver {
          enable:
          disable;
        }
        advertise-to-non-llgr-neighbor {
          omit-no-export;
        }
      }
    }
  }
}
```

To enable the BGP long-lived graceful restart capability at the BGP group level and configure its properties:

```
[edit]
protocols {
  bgp {
    group group-name {
      graceful-restart {
        long-lived {
          receiver {
            enable:
            disable;
          }
          advertise-to-non-llgr-neighbor {
            omit-no-export;
          }
        }
      }
    }
  }
}
```

To enable the BGP long-lived graceful restart capability at the neighbor or peer group level and configure its properties:

```
[edit]
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          long-lived {
            receiver {
              enable:
              disable;
            }
            advertise-to-non-llgr-neighbor {
              omit-no-export;
```

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```
            }
          }
        }
      }
    }
  }
}
```

Related Documentation

-

Configuring BGP Long-Lived Graceful Restart Communities in Routing Policies

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

Two new well-known communities are introduced. These new BGP communities can be used in any of the configuration hierarchy levels as other symbolic well-known communities (such as no-advertise, no-export, and no-export-subconfed) in the community attribute of static route definitions or in a policy-options community definition. The two new communities are as follows:

- **llgr-stale**—Adds a community to a long-lived stale route when it is readvertised.
- **no-llgr**—Marks routes which a BGP speaker does not want to be retained by LLGR. The Notification message feature does not have any associated configuration parameters.

You can include the **llgr-stale** and **no-llgr** options with the **community *name* members** statement to associate BGP community information with a static, aggregate, or generated route at the following hierarchy levels:

```
[edit dynamic policy-options],
[edit logical-systems logical-system-name policy-options],
[edit policy-options]
```

To configure the BGP long-lived graceful restart communities for use in a routing policy match condition:

```
[edit policy-options]
community name {
   members [ llgr-stale | nollgr];
}
```

Configuring LLGR does not require that BGP graceful restart also be configured. The values for the llgr-stale and no-llgr well-known communities are 0xFFFF0006 and 0xFFFF0007 respectively. The privileges are the same as for protocols bgp. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

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Junos OS also provides support for configuring a BGP export policy that matches the state of a route for BGP long-lived graceful restart. You can associate the community that you previously defined and a list of address prefixes in a routing policy to selectively accept or reject the routes for long-lived graceful restart for the specified prefixes, as follows:

```
policy-options {
  prefix-list name;
  community name members [ llgr-stale | nollgr];
  policy-statement name{
    from {
      prefix-list name;
      community name;
    }
    then {
      (accept | reject)
    }
  }
}
```

Two hidden configuration statements are added under the **[edit protocols bgp graceful-restart**] hierarchy level for global, group-level, and neighbor group-level configuration.

The **disable-notification-flag** statement at the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level disables the transmission of the N flag in the graceful restart capability negotiation. The **disable-notification-extensions** statement at the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level also disables the transmission of the N flag in the graceful restart capability negotiation, but in addition, it disables the new rules for invoking graceful restart receiver mode as specified in the IETF bgp-gr-notification draft, and disables the transmission of the Hard Reset subcode. The Hard Reset subcode is continued to be observed when received in a Notify or a Cease message.

To disable the transmission of N flags and to disable rules for triggering graceful restart at the global or system-wide level:

```
[edit]
protocols {
  bgp {
    graceful-restart {
      disable-notification-flag;
      disable-notification-extensions;
    }
  }
}
```

To disable the transmission of N flags and to disable rules for triggering graceful restart at the group level:

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```
[edit]
protocols {
  bgp {
    group group-name {
      graceful-restart {
        disable-notification-flag;
        disable-notification-extensions;
      }
    }
  }
}
```

To disable the transmission of N flags and to disable rules for triggering graceful restart at the neighbor or peer level:

```
[edit]
protocols {
  bgp {
    group group-name {
      graceful-restart {
        disable-notification-flag;
        disable-notification-extensions;
      }
    }
  }
}
```

Related Documentation

-

Configuring Long-Lived Graceful Restarter Mode Negotiation for a Specific Address Family in Logical Systems and Routing Instances

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

You can also configure the BGP long-lived graceful restarter mode negotiation mechanism for a particular address family instead of configuring this capability for all address families in a system, logical system, or routing instance. To enable BGP LLGR for a specific address family, include the **graceful-restart long-lived restarter stale-time *interval*** statement at one of the following hierarchy levels.

Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast,

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inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

[edit logical-systems *logical-system-name* protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast)],
[edit routing-instances *routing-instance-name* protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast)]
[edit routing-instances *routing-instance-name* protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast)],

The stanzas in the per-family graceful-restart long-lived restarter configuration section enables LLGR restarter mode negotiation for BGP globally, or for a group or neighbor. The values are inherited by groups from the global configuration, and by neighbors from the group configuration. The disable attribute is used to override configuration inherited from a higher level. It does not disable LLGR receiver mode; you must disable LLGR receiver mode explicitly for all families as necessary. A hidden **enable** attribute can be used to override an inherited disable attribute. Configuring graceful-restart long-lived restarter at the neighbor level (when it is not configured at the containing group level or globally) causes an internal group to be split. When LLGR restarter is enabled or disabled for a family or the stale- time is changed, the session is reset so that the new capability can be sent to the neighbor.

The range of values for stale-time is from 1 to 16777215 (2^24 – 1) seconds. The value is a simple integer giving the number of seconds by default, but it can also be specified using the following notation:

[<weeks>w][<days>d][<hours>h][<minutes>m][<seconds>s] For example, you can specify 27 days as 27d, 648h, 38880m or 2332800s. 90 minutes can be configured as 1h30m, 90m or 5400s. The specified number of days is multiplied by 86400, the number of hours by 3600 and the number of minutes by 60; these are added to the seconds to get the total. A combined format of days and hours, in different time period units, such as 1d36h are permitted, as long as the specified total does not exceed the maximum stale time.

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In addition, times can also be configured using the following notation: <hours>:<minutes>:<seconds> For example, 12:00:00 specifies twelve hours. The hours and minutes are optional.

The two notations can be combined, for example, 2w1d 12:00:02 specifies two weeks, one day, twelve hours and two seconds (1339202 seconds). (Note that the CLI requires double-quotes around a value like this with spaces in it.) Expressed in this notation, the maximum stale time is 27w5d 04:20:15 (27 weeks, 5 days, 4 hours, 20 minutes and 15 seconds). While the show configuration command displays the actually configured values, when the associated timers are displayed in run-time show commands such as **show bgp neighbor**, the values are normalized, such as 1d36h becoming 2d 12:00:00. The full rules for displaying normalized LLGR times depend on the **clear bgp neighbor neighbor-address gracefully** command configuration.

To configure the BGP long-lived graceful restart characteristics per-address family and per-subsequent address family at the global level for a logical system or a routing instance:

Configuring BGP Long-Lived Graceful Restart Per Address Family At the Global Level for Logical Systems

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
  bgp {
    graceful-restart {
      long-lived {
        restarter {
          disable;
          stale-time interval;
        }
      }
    }
  }
}
```

Configuring BGP Long-Lived Graceful Restart Per Address Family At the Global Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    graceful-restart {
      long-lived {
        restarter {
          disable;
          stale-time interval;
        }
      }
    }
  }
}
```

To configure the BGP long-lived graceful restart characteristics per-address family and per-subsequent address family at the BGP group level for a logical system or a routing instance:

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Configuring BGP Long-Lived Graceful Restart Per Address Family At the BGP Group Level for Logical Systems

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
  bgp {
    group group-name {
      graceful-restart {
        long-lived {
          restarter {
            disable;
            stale-time interval;
          }
        }
      }
    }
  }
}
```

Configuring BGP Long-Lived Graceful Restart Per Address Family At the BGP Group Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    group group-name {
      graceful-restart {
        long-lived {
          restarter {
            disable;
            stale-time interval;
          }
        }
      }
    }
  }
}
```

To configure the BGP long-lived graceful restart characteristics per-address family and per-subsequent address family at the BGP neighbor group level for a logical system or a routing instance:

Configuring BGP Long-Lived Graceful Restart Per Address Family At the BGP Neighbor Group Level for Logical Systems

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          long-lived {
            restarter {
              disable;
              stale-time interval;
            }
          }
        }
```

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```
        }
      }
    }
  }
```

Configuring BGP Long-Lived Graceful Restart Per Address Family At the BGP Neighbor Group Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          long-lived {
            restarter {
              disable;
              stale-time interval;
            }
          }
        }
      }
    }
  }
}
```

Related Documentation

-

Informing the BGP Helper Router or Peer About Retaining Routes By Configuring the Forwarding State Bit for All Address Families and for a Specific Address Family

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

After a BGP session goes down and before the session is reestablished, stale routes might be retained for up to two consecutive periods, controlled by the restart time and long-lived stale time parameters, respectively. During the first period routing modifications are prevented but with potential blackholing of traffic. During the second period, possible blackholing of traffic might be reduced but routing changes ares visible throughout the network. In your network environment, the setting of the relevant parameters for a particular application must consider the tradeoffs, the network dynamics and potential failure scenarios. If necessary, the first period can be bypassed either by local configuration or by setting the restart time in the graceful restart capability to zero, not listing the address family indicators (AFI) and a subsequent address family identifiers (SAFI) in that capability.

The setting of the F bit (and the "Forwarding State" bit of the accompanying GR capability) depends in part on deployment considerations. The F bit can be interpreted to indicate the helper router needs to flush associated routes (if the bit is left clear). An

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important scenario in which LLGR is used is for routes that are more similar to configuration than to traditional routing (hop-by-hop forwarding instead of tunnel-based routing). For such routes, it might be useful to always set the F bit, regardless of other considerations. Similarly, for control-plane-only entities such as dedicated route reflectors, that do not participate in the forwarding plane, it is preferred that the F bit be always set. Overall, the guideline to be adopted is that if loss of state on the restarting router can reasonably be expected to cause a forwarding loop or black hole, the F bit must be set judiciously, depending on whether state has been retained. You can determine whether the F bit needs to be set or not, based on your deployment needs and configured settings. It might be necessary to advertise stale routes to a CE in some VPN deployments, even if the CE does not support this specification. In such a scenario, the network operator configuring their PE to advertise such routes must notify the operator of the CE receiving the routes, and the CE must be configured to depreference the routes. Typically, BGP implementations perform this behavior by matching on the LLGR_STALE community, and setting the LOCAL_PREF for matching routes to zero.

You can specify the Forwarding State bit, which is a BGP configuration option that can be defined at the global, group and neighbor levels, for any logical system or routing instance. To specify the Forwarding State bit at the global, BGP group, or BGP neighbor level, include the **forwarding-state-bit (as-rr-client | from-fib)** statement at the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group-group-name graceful-restart]**, or **[edit protocols bgp group-group-name neighbor neighbor-address graceful-restart]** hierarchy level. The forwarding-state-bit attribute controls how the Forwarding State bit is set in both graceful restart and long-lived graceful restart capability advertisements. By default, the value depends on whether the neighbor is a route reflector client. If the neighbor is not a route reflector client, the value is set according to the state of the associated FIB in compliance with RFC 4724. If the neighbor is a route reflector client, the value is set to 1 for all families except inet unicast and inet6 unicast, which use the state of the associated FIB. The **as-rr-client** option sets the behavior for all address families to be the same as the functionality for a route reflector client. The **from-fib** option forces the behavior for all address families to be as they would be for a non-route-reflector client.

To configure the forwarding-state flag negotiation at the global level:

```
[edit]
protocols {
  bgp {
    graceful-restart {
      forwarding-state-bit (as-rr-client | from-fib);
    }
  }
}
```

To configure the forwarding-state flag negotiation at the group level:

```
[edit]
protocols {
  bgp {
    group group-name {
```

```
        graceful-restart {
          forwarding-state-bit (as-rr-client | from-fib);
        }
      }
    }
  }
```

To configure the forwarding-state flag negotiation at the neighbor or peer group level:

```
[edit]
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          forwarding-state-bit (as-rr-client | from-fib);
        }
      }
    }
  }
}
```

In addition to the global setting for the Forwarding State bit, the Forwarding State bit behavior can be specified for individual families. Changing the forwarding-state-bit setting has no effect on any existing sessions. To specify the Forwarding State bit for a particular address family, include the **forwarding-state-bit (set | from-fib)** statement at the **[edit protocols bgp graceful-restart family *address-family subsequent-address-family*]**, **[edit protocols bgp group-group-name graceful-restart family *address-family subsequent-address-family*]**, or **[edit protocols bgp group-group-name neighbor neighbor-address graceful-restart family *address-family subsequent-address-family*]** hierarchy level on a logical system and a routing instance. Per-family BGP configuration options are added to control the Forwarding State bit in graceful restart and long-lived graceful restart capability advertisements. They can be specified for the default logical system or for a specific logical system, and for the master routing instance or a specific routing instance. The **per-family forwarding-state-bit** attribute overrides the default rules or the global configuration for setting the Forwarding State bit. The **set** option forces the Forwarding State bit to be set to 1. The **from-fib** option causes the value to be set according to the state of the associated FIB. Changing the per-family forwarding-state-bit setting has no effect on any existing sessions.

The following are the complete configuration hierarchy levels at which you can include the **forwarding-state-bit (set | from-fib)** statement to configure the forwarding state bit per address family:

```
[edit logical-systems logical-system-name protocols bgp family inet (labeled-unicast |
  unicast | multicast)],
[edit logical-systems logical-system-name protocols bgp group group-name family inet
  (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor
  address family inet (labeled-unicast | unicast | multicast)],
```


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```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp group group-name family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp group group-name neighbor address family inet (labeled-unicast | unicast
  | multicast)],
[edit routing-instances routing-instance-name protocols bgp family inet (labeled-unicast
  | unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name family
  inet (labeled-unicast | unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family inet (labeled-unicast | unicast | multicast)]
[edit routing-instances routing-instance-name protocols bgp family inet (labeled-unicast
  | unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name family
  inet (labeled-unicast | unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family inet (labeled-unicast | unicast | multicast)],
```

To configure the forwarding state bit for BGP long-lived graceful restart per-address family and per-subsequent address family at the global level for a logical system or a routing instance:

Configuring the Forwarding State Bit Per Address Family At the Global Level for Logical Systems

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
  bgp {
    graceful-restart {
      forwarding-state-bit (set | from-fib);
    }
  }
}
```

Configuring the Forwarding State Bit Per Address Family At the Global Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    graceful-restart {
      forwarding-state-bit (set | from-fib);
    }
  }
}
```

To configure the forwarding state bit for BGP long-lived graceful restart per-address family and per-subsequent address family at the BGP group level for a logical system or a routing instance:

Configuring the Forwarding State Bit Per Address Family At

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
```

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the BGP Group Level for Logical Systems

```
  bgp {
    group group-name {
      graceful-restart {
        forwarding-state-bit (set | from-fib);
      }
    }
  }
}
```

Configuring the Forwarding State Bit Per Address Family At the BGP Group Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    group group-name {
      graceful-restart {
        forwarding-state-bit (set | from-fib);
      }
    }
  }
}
```

To configure the forwarding state bit for BGP long-lived graceful restart per-address family and per-subsequent address family at the BGP neighbor group level for a logical system or a routing instance:

Configuring the Forwarding State Bit Per Address Family At the BGP Neighbor Group Level for Logical Systems

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp family address-family subsequent-address-family
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          forwarding-state-bit (set | from-fib);
        }
      }
    }
  }
}
```

Configuring the Forwarding State Bit Per Address Family At the BGP Neighbor Group Level for Routing Instances

```
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family
protocols {
  bgp {
    group group-name {
      neighbor neighbor-address {
        graceful-restart {
          forwarding-state-bit (set | from-fib);
        }
      }
    }
  }
```


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```
}
```

Related Documentation

-

Example: Preserving Route Details for Slow and Latent BGP Peers By Using BGP Long-Lived Graceful Restart

Junos OS supports the mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality.

Historically, routing protocols and BGP, in particular, have been designed with a focus on correctness, where a significant aspect of the "correctness" is for each network element's forwarding state to converge toward the current state of the network as quickly as possible. For this reason, the protocol was designed to remove state advertised by routers which went down (from a BGP perspective) as promptly as possible. Using BGP Graceful Restart defined in RFC 4724, the fast convergence functionality has been an attempt to rapidly remove "stale" state from the network.

BGP long-lived graceful restart (LLGR) allows a network operator to choose to maintain stale routing information from a failed BGP peer much longer than the existing BGP Graceful Restart facility. This functionality to maintain the BGP routes for a longer time period is in accordance with the IETF draft, *Support for Long-lived BGP Graceful Restart—draft-uttaro-idr-bgp-persistence-03*. According to this draft, long-lived graceful restart (LLGR) must be explicitly configured per NLRI, and it includes provisions to prevent the spread of stale information to other peers that do not recognize and validate LLGR.

This example describes how to configure BGP long-lived graceful restart functionality on MX Series routers, and contains the following sections:

- Requirements on page 647
- Overview on page 648
- Configuration on page 649
- Verification on page 651

Requirements

This example uses the following hardware and software components:

- One MX Series router with an MPC.
- Junos OS Release 15.1R1 or later for MX Series routers

Before you configure BGP long-lived graceful restart, make sure you:

1. Configure the device interfaces.
2. Configure BGP.

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Overview

Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. During a graceful restart, the restarting device and its neighbors continue forwarding packets without disrupting network performance. Because neighboring devices assist in the restart (these neighbors are called *helper routers*), the restarting device can quickly resume full operation without recalculating algorithms.

Long-lived graceful restart receiver mode is enabled by default, unless ordinary graceful restart receiver mode is disabled. To enable the BGP long-lived graceful restart (LLGR) capability, include the **long-lived receiver enable** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. Apart from enabling BGP LLGR at the global or system-wide level, you can also include the long-lived receiver enable statement at the **[edit protocols bgp group *group-name* graceful-restart]** hierarchy level to configure LLGR for a particular BGP group and at the **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level to configure LLGR for a particular BGP neighbor. To disable the BGP LLGR mechanism, include the **long-lived receiver disable** option the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or [edit protocols bgp group-group-name neighbor neighbor-address graceful-restart] hierarchy level. Disabling LLGR deactivates all of the LLGR capabilities (both receiver and restarter modes) for all NLRI families. This property is inherited by groups from the global configuration, and by neighbors from the group configuration.

Topology

Consider a sample scenario in which you want to increase the time period for which stale routes are maintained for a BGP peer or neighbor with the address of 1.2.3.4. Besides specifying the duration for which the routes must be retained for stale sessions and when a graceful restart of a peer occurs, you can also configure BGP routers from certain address prefixes to be disregarded when you define the long-lived graceful restart mechanism. You can define a list of IPv4 or IPv6 address prefixes for use in a routing policy statement and a BGP community to be included in the routing policy. If you set the action modifier to reject routes from a particular prefix, such BGP routes are not maintained for the increased time period.

You can also configure the BGP long-lived graceful restarter mode negotiation mechanism for a particular address family instead of configuring this capability for all address families in a system, logical system, or routing instance. To enable BGP LLGR for a specific address family, include the **graceful-restart long-lived restarter stale-time *interval*** statement at one of the following hierarchy levels.

Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast,

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inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

Configuration

- Configuring Long-Lived Graceful Restart for Restarter Mode on page 649
- Results on page 650

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Configuring the Address Prefix List, BGP Community, and BGP Routing Policy

```
set policy-options prefix-list special 44.44.44.44/32
set policy-options community llgr-community llgr-stale
set policy-options policy-statement llgr-import from prefix-list special
set policy-options policy-statement llgr-import from community llgr-community
set policy-options policy-statement llgr-import then reject
```

Configuring the BGP Group, NLRI, and Long-Lived Graceful Restart

```
set protocols bgp group ibgp-group type internal
set protocols bgp group ibgp-group import llgr-import
set protocols bgp group ibgp-group family inet unicast
set protocols bgp group ibgp-group family inet unicast graceful-restart long-lived restarter
  stale-time 12h
```

Configuring the BGP Neighbor Group

```
set protocols bgp group ibgp-group neighbor 1.2.3.4
```

Configuring Long-Lived Graceful Restart for Restarter Mode

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

1. Configure the address prefix list, BGP community, and the match condition and action modifier for the BGP routing policy.

```
[edit]
user@ host# set policy-options prefix-list special 44.44.44.44/32
user@ host# set policy-options community llgr-community llgr-stale
user@ host# set policy-options policy-statement llgr-import from prefix-list special
user@ host# set policy-options policy-statement llgr-import from community
  llgr-community
user@ host# set policy-options policy-statement llgr-import then reject
```

2. Configure the BGP group, address family, and long-lived graceful restart functionality for restarter mode with the stale time for flows.

```
[edit]
```

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```
user@ host# set protocols bgp group ibgp-group type internal
user@ host# set protocols bgp group ibgp-group import llgr-import
user@ host# set protocols bgp group ibgp-group family inet unicast
user@ host# set protocols bgp group ibgp-group family inet unicast graceful-restart
  long-lived restarter stale-time 12h
```

3. Configure the BGP neighbor group.

```
[edit]
user@ host# set protocols bgp group ibgp-group neighbor 1.2.3.4
```

Results

From configuration mode, confirm your configuration by entering the **show policy-options** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
```

```
user@host# show policy-options
policy-options {
    prefix-list special 44.44.44.44/32;
    community llgr-community llgr-stale;
    policy-statement llgr-import {
        from {
            prefix-list special;
            community llgr-community;
        }
        then {
            reject;
        }
    }
}
```

```
user@host# show protocols
protocols {
    bgp {
        group ibgp-group {
            type internal;
            import llgr-import;
            family inet unicast {
                graceful-restart {
                    long-lived {
                        restarter {
                            stale-time 12h;
                        }
                    }
                }
            }
            neighbor 1.2.3.4;
        }
```


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```
    }
}
```

Verification

Confirm that the configuration is working properly.

- Verifying That the Long-Lived Graceful Restart Capability is Enabled on page 651

Verifying That the Long-Lived Graceful Restart Capability is Enabled

Purpose Verify the BGP long-lived graceful restart capability configured for BGP neighbor level

Action While LLGR receiver mode is active (a peer that negotiated LLGR has disconnected and not yet reconnected), the output of the **show bgp neighbor** command displays the amount of time left until the LLGR expires, the time remaining on the GR stale timer, and RIB details:

```
 user@router> show bgp neighbor
 Peer: 10.4.12.11 AS 100        Local: 10.6.128.225 AS 100
   Type: Internal    State: Active         Flags: <>
   Last State: Idle          Last Event: Start
   Last Error: None
   Export: [ foo ]
   Options: <Preference LocalAddress Refresh GracefulRestart>
   Options: <LLGR>
   Local Address: 10.6.128.225 Holdtime: 90 Preference: 170
   Number of flaps: 3
   Last flap event: Restart
   Error: 'Cease' Sent: 0 Recv: 1
   Time until long-lived stale routes deleted: inet-vpn-unicast 10:00:22
route-target 10:00:22
    Table bgp.l3vpn.0
      RIB State: BGP restart is complete
      RIB State: VPN restart is complete
      Send state: not advertising
      Active prefixes:              0
      Received prefixes:            7
      Accepted prefixes:            7
      Suppressed due to damping:    0
    Table foo.inet.0 Bit: 30000
      RIB State: BGP restart is complete
      RIB State: VPN restart is complete
      Send state: not in sync
      Active prefixes:              0
      Received prefixes:            7
      Accepted prefixes:            7
      Suppressed due to damping:    0
```

Meaning The output shows information about BGP neighbors.

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PART 9

Configuring Multiprotocol for BGP

- Configuring Multiprotocol for a BGP Session on page 655

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CHAPTER 15

Configuring Multiprotocol for a BGP Session

- Understanding Multiprotocol BGP on page 655
- Example: Configuring IPv6 BGP Routes over IPv4 Transport on page 661
- Advertising IPv4 Routes over BGP IPv6 Sessions Overview on page 668
- Example: Advertising IPv4 Routes over IPv6 BGP Sessions on page 669
- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676
- Configuring BGP to Redistribute IPv4 Routes with IPv6 Next-Hop Addresses on page 680
- Enabling Layer 2 VPN and VPLS Signaling on page 682
- Understanding BGP Flow Routes for Traffic Filtering on page 683
- Example: Enabling BGP to Carry Flow-Specification Routes on page 688
- Example: Configuring BGP to Carry IPv6 Flow Specification Routes on page 704
- Configuring BGP Flow Specification Action Redirect to IP to Filter DDoS Traffic on page 714

Understanding Multiprotocol BGP

Multiprotocol BGP (MP-BGP) is an extension to BGP that enables BGP to carry routing information for multiple network layers and address families. MP-BGP can carry the unicast routes used for multicast routing separately from the routes used for unicast IP forwarding.

To enable MP-BGP, you configure BGP to carry network layer reachability information (NLRI) for address families other than unicast IPv4 by including the **family inet** statement:

```
family inet {
   (any | flow | labeled-unicast | multicast | unicast) {
      accepted-prefix-limit {
         maximum number;
         teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      <loops number>;
      prefix-limit {
         maximum number;
```

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```
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      rib-group group-name;
      topology name {
        community {
          target identifier;
        }
      }
    }
  }
```

To enable MP-BGP to carry NLRI for the IPv6 address family, include the **family inet6** statement:

```
family inet6 {
  (any | labeled-unicast | multicast | unicast) {
    accepted-prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    <loops number>;
    prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    rib-group group-name;
  }
}
```

On routers only, to enable MP-BGP to carry Layer 3 virtual private network (VPN) NLRI for the IPv4 address family, include the **family inet-vpn** statement:

```
family inet-vpn {
  (any | flow | multicast | unicast) {
    accepted-prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    <loops number>;
    prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    rib-group group-name;
  }
}
```

On routers only, to enable MP-BGP to carry Layer 3 VPN NLRI for the IPv6 address family, include the **family inet6-vpn** statement:

```
family inet6-vpn {
  (any | multicast | unicast) {
    accepted-prefix-limit {
```


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```
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      <loops number>;
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      rib-group group-name;
    }
  }
```

On routers only, to enable MP-BGP to carry multicast VPN NLRI for the IPv4 address family and to enable VPN signaling, include the **family inet-mvpn** statement:

```
family inet-mvpn {
  signaling {
    accepted-prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    <loops number>;
    prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
  }
}
```

To enable MP-BGP to carry multicast VPN NLRI for the IPv6 address family and to enable VPN signaling, include the **family inet6-mvpn** statement:

```
family inet6-mvpn {
  signaling {
    accepted-prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    <loops number>;
    prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout <forever | minutes>;
    }
  }
}
```

For more information about multiprotocol BGP-based multicast VPNs, see the *Multicast Protocols Feature Guide* .

For a list of hierarchy levels at which you can include these statements, see the statement summary sections for these statements.

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NOTE: If you change the address family specified in the **[edit protocols bgp family]** hierarchy level, all current BGP sessions on the routing device are dropped and then reestablished.

In Junos OS Release 9.6 and later, you can specify a loops value for a specific BGP address family.

By default, BGP peers carry only unicast routes used for unicast forwarding purposes. To configure BGP peers to carry only multicast routes, specify the **multicast** option. To configure BGP peers to carry both unicast and multicast routes, specify the **any** option.

When MP-BGP is configured, BGP installs the MP-BGP routes into different routing tables. Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI).

The following list shows all possible AFI and SAFI combinations:

- AFI=1, SAFI=1, IPv4 unicast
- AFI=1, SAFI=2, IPv4 multicast
- AFI=1, SAFI=128, L3VPN IPv4 unicast
- AFI=1, SAFI=129, L3VPN IPv4 multicast
- AFI=2, SAFI=1, IPv6 unicast
- AFI=2, SAFI=2, IPv6 multicast
- AFI=25, SAFI=65, BGP-VPLS/BGP-L2VPN
- AFI=2, SAFI=128, L3VPN IPv6 unicast
- AFI=2, SAFI=129, L3VPN IPv6 multicast
- AFI=1, SAFI=132, RT-Constrain
- AFI=1, SAFI=133, Flow-spec
- AFI=1, SAFI=134, Flow-spec
- AFI=3, SAFI=128, CLNS VPN
- AFI=1, SAFI=5, NG-MVPN IPv4
- AFI=2, SAFI=5, NG-MVPN IPv6
- AFI=1, SAFI=66, MDT-SAFI
- AFI=1, SAFI=4, labeled IPv4
- AFI=2, SAFI=4, labeled IPv6 (6PE)

Routes installed in the inet.2 routing table can only be exported to MP-BGP peers because they use the SAFI, identifying them as routes to multicast sources. Routes installed in the inet.0 routing table can only be exported to standard BGP peers.

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The inet.2 routing table should be a subset of the routes that you have in inet.0, since it is unlikely that you would have a route to a multicast source to which you could not send unicast traffic. The inet.2 routing table stores the unicast routes that are used for multicast reverse-path-forwarding checks and the additional reachability information learned by MP-BGP from the NLRI multicast updates. An inet.2 routing table is automatically created when you configure MP-BGP (by setting NLRI to **any**).

When you enable MP-BGP, you can do the following:

- Limiting the Number of Prefixes Received on a BGP Peer Session on page 659
- Limiting the Number of Prefixes Accepted on a BGP Peer Session on page 660
- Configuring BGP Routing Table Groups on page 660
- Resolving Routes to PE Routing Devices Located in Other ASs on page 661
- Allowing Labeled and Unlabeled Routes on page 661

Limiting the Number of Prefixes Received on a BGP Peer Session

You can limit the number of prefixes received on a BGP peer session, and log rate-limited messages when the number of injected prefixes exceeds a set limit. You can also tear down the peering when the number of prefixes exceeds the limit.

To configure a limit to the number of prefixes that can be received on a BGP session, include the **prefix-limit** statement:

```
prefix-limit {
  maximum number;
  teardown <percentage> <idle-timeout (forever | minutes)>;
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

For **maximum** *number*, specify a value in the range from 1 through 4,294,967,295. When the specified maximum number of prefixes is exceeded, a system log message is sent.

If you include the **teardown** statement, the session is torn down when the maximum number of prefixes is exceeded. If you specify a percentage, messages are logged when the number of prefixes exceeds that percentage of the specified maximum limit. After the session is torn down, it is reestablished in a short time (unless you include the **idle-timeout** statement). If you include the **idle-timeout** statement, the session can be kept down for a specified amount of time, or forever. If you specify **forever**, the session is reestablished only after the you issue a **clear bgp neighbor** command.

NOTE: In Junos OS Release 9.2 and later, you can alternatively configure a limit to the number of prefixes that can be accepted on a BGP peer session. For more information, see "Understanding Multiprotocol BGP" on page 655.

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Limiting the Number of Prefixes Accepted on a BGP Peer Session

In Junos OS Release 9.2 and later, you can limit the number of prefixes that can be accepted on a BGP peer session. When that specified limit is exceeded, a system log message is sent. You can also specify to reset the BGP session if the limit to the number of specified prefixes is exceeded.

To configure a limit to the number of prefixes that can be accepted on a BGP peer session, include the **accepted-prefix-limit** statement:

```
accepted-prefix-limit {
  maximum number;
  teardown <percentage> <idle-timeout (forever | minutes)>;
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

For **maximum** *number*, specify a value in the range from 1 through 4,294,967,295.

Include the **teardown** statement to reset the BGP peer session when the number of accepted prefixes exceeds the configured limit. You can also include a percentage value from 1 through 100 to have a system log message sent when the number of accepted prefixes exceeds that percentage of the maximum limit. By default, a BGP session that is reset is reestablished within a short time. Include the **idle-timeout** statement to prevent the BGP session from being reestablished for a specified period of time. You can configure a timeout value from 1 through 2400 minutes. Include the **forever** option to prevent the BGP session from being reestablished until you issue the **clear bgp neighbor** command.

NOTE: When nonstop active routing (NSR) is enabled and a switchover to a backup Routing Engine occurs, BGP peers that are down are automatically restarted. The peers are restarted even if the **idle-timeout forever** statement is configured.

NOTE: Alternatively, you can configure a limit to the number of prefixes that can be *received* (as opposed to accepted) on a BGP peer session. For more information, see "Limiting the Number of Prefixes Received on a BGP Peer Session" on page 659.

Configuring BGP Routing Table Groups

When a BGP session receives a unicast or multicast NLRI, it installs the route in the appropriate table (**inet.0** or **inet6.0** for unicast, and **inet.2** or **inet6.2** for multicast). To add unicast prefixes to both the unicast and multicast tables, you can configure BGP routing table groups. This is useful if you cannot perform multicast NLRI negotiation.

To configure BGP routing table groups, include the **rib-group** statement:

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```
rib-group group-name;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Resolving Routes to PE Routing Devices Located in Other ASs

You can allow labeled routes to be placed in the **inet.3** routing table for route resolution. These routes are then resolved for provider edge (PE) routing device connections where the remote PE is located across another autonomous system (AS). For a PE routing device to install a route in the VPN routing and forwarding (VRF) routing instance, the next hop must resolve to a route stored within the **inet.3** table.

To resolve routes into the **inet.3** routing table, include the **resolve-vpn** statement:

```
resolve-vpn group-name;
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Allowing Labeled and Unlabeled Routes

You can allow both labeled and unlabeled routes to be exchanged in a single session. The labeled routes are placed in the inet.3 or inet6.3 routing table, and both labeled and unlabeled unicast routes can be sent to or received by the routing device.

To allow both labeled and unlabeled routes to be exchanged, include the **rib** statement:

```
rib (inet.3 | inet6.3);
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Example: Configuring IPv6 BGP Routes over IPv4 Transport

This example demonstrates how to export both IPv6 and IPv4 prefixes over an IPv4 connection where both sides are configured with an IPv4 interface.

- Requirements on page 661
- Overview on page 662
- Configuration on page 662
- Verification on page 666

Requirements

No special configuration beyond device initialization is required before you configure this example.

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Overview

Keep the following in mind when exporting IPv6 BGP prefixes:

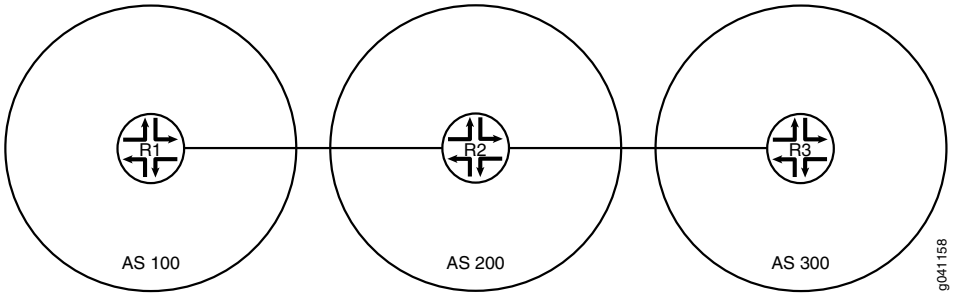
- BGP derives next-hop prefixes using the IPv4-mapped IPv6 prefix. For example, the IPv4 next-hop prefix **10.19.1.1** translates to the IPv6 next-hop prefix ::ffff:10.19.1.1.

  NOTE: **There must be an active route to the IPv4-mapped IPv6 next hop to export IPv6 BGP prefixes.**

- An IPv6 connection must be configured over the link. The connection must be either an IPv6 tunnel or a dual-stack configuration. Dual stacking is used in this example.
- When configuring IPv4-mapped IPv6 prefixes, use a mask that is longer than 96 bits.
- Configure a static route if you want to use normal IPv6 prefixes. This example uses static routes.

Figure 57 on page 662 shows the sample topology.

Figure 57: Topology for Configuring IPv6 BGP Routes over IPv4 Transport



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 1 family inet address 192.168.10.1/24
set interfaces fe-1/2/0 unit 1 family inet6 address ::ffff:192.168.10.1/120
set interfaces lo0 unit 1 family inet address 10.10.10.1/32
set protocols bgp group ext type external
set protocols bgp group ext family inet unicast
set protocols bgp group ext family inet6 unicast
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 192.168.10.10
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
```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```
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options rib inet6.0 static route ::ffff:192.168.20.0/120 next-hop
    ::ffff:192.168.10.10
set routing-options static route 192.168.20.0/24 next-hop 192.168.10.10
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 2 family inet address 192.168.10.10/24
set interfaces fe-1/2/0 unit 2 family inet6 address ::ffff:192.168.10.10/120
set interfaces fe-1/2/1 unit 3 family inet address 192.168.20.21/24
set interfaces fe-1/2/1 unit 3 family inet6 address ::ffff:192.168.20.21/120
set interfaces lo0 unit 2 family inet address 10.10.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext family inet unicast
set protocols bgp group ext family inet6 unicast
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext neighbor 192.168.10.1 peer-as 100
set protocols bgp group ext neighbor 192.168.20.1 peer-as 300
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/0 unit 4 family inet address 192.168.20.1/24
set interfaces fe-1/2/0 unit 4 family inet6 address ::ffff:192.168.20.1/120
set interfaces lo0 unit 3 family inet address 10.10.20.1/32
set protocols bgp group ext type external
set protocols bgp group ext family inet unicast
set protocols bgp group ext family inet6 unicast
set protocols bgp group ext export send-direct
set protocols bgp group ext export send-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 192.168.20.21
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options policy-statement send-static term 1 from protocol static
set policy-options policy-statement send-static term 1 then accept
set routing-options rib inet6.0 static route ::ffff:192.168.10.0/120 next-hop
    ::ffff:192.168.20.21
set routing-options static route 192.168.10.0/24 next-hop 192.168.20.21
set routing-options autonomous-system 300
```

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Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces, including both an IPv4 address and an IPv6 address.

```
[edit interfaces]
user@R1# set fe-1/2/0 unit 1 family inet address 192.168.10.1/24
user@R1# set fe-1/2/0 unit 1 family inet6 address ::ffff:192.168.10.1/120
user@R1# set lo0 unit 1 family inet address 10.10.10.1/32
```

2. Configure EBGP.

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set export send-direct
user@R1# set export send-static
user@R1# set peer-as 200
user@R1# set neighbor 192.168.10.10
```

3. Enable BGP to carry IPv4 unicast and IPv6 unicast routes. .

```
[edit protocols bgp group ext]
user@R1# set family inet unicast
user@R1# set family inet6 unicast
```

IPv4 unicast routes are enabled by default. The configuration is shown here for completeness.

4. Configure the routing policy.

```
[edit policy-options]
user@R1# set policy-statement send-direct term 1 from protocol direct
user@R1# set policy-statement send-direct term 1 then accept
user@R1# set policy-statement send-static term 1 from protocol static
user@R1# set policy-statement send-static term 1 then accept
```

5. Configure some static routes.

```
[edit routing-options]
user@R1# set rib inet6.0 static route ::ffff:192.168.20.0/120 next-hop
   ::ffff:192.168.10.10
user@R1# set static route 192.168.20.0/24 next-hop 192.168.10.10
```

6. Configure the autonomous system (AS) number.

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```
[edit routing-options]
user@R1# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
    unit 1 {
        family inet {
            address 192.168.10.1/24;
        }
        family inet6 {
            address ::ffff:192.168.10.1/120;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 10.10.10.1/32;
        }
    }
}
```

```
user@R1# show policy-options
policy-statement send-direct {
    term 1 {
        from protocol direct;
        then accept;
    }
}
policy-statement send-static {
    term 1 {
        from protocol static;
        then accept;
    }
}
```

```
user@R1# show protocols
bgp {
    group ext {
        type external;
        family inet {
            unicast;
        }
        family inet6 {
            unicast;
        }
```

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```
    export [ send-direct send-static ];
    peer-as 200;
    neighbor 192.168.10.10;
  }
}
```

```
user@R1# show routing-options
rib inet6.0 {
  static {
    route ::ffff:192.168.20.0/120 next-hop ::ffff:192.168.10.10;
  }
}
static {
  route 192.168.20.0/24 next-hop 192.168.10.10;
}
autonomous-system 100;
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on Device R2 and Device R3, changing the interface names and IP addresses, as needed.

Verification

Confirm that the configuration is working properly.

- Checking the Neighbor Status on page 666
- Checking the Routing Table on page 668

Checking the Neighbor Status

Purpose Make sure that BGP is enabled to carry IPv6 unicast routes.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@R2> show bgp neighbor
Peer: 192.168.10.1+179 AS 100  Local: 192.168.10.10+54226 AS 200
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct send-static ]
  Options: <Preference AddressFamily PeerAS Refresh>
  Address families configured: inet-unicast inet6-unicast
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.10.1      Local ID: 10.10.0.1         Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  Local Interface: fe-1/2/0.2
  NLRI for restart configured on peer: inet-unicast inet6-unicast
  NLRI advertised by peer: inet-unicast inet6-unicast
  NLRI for this session: inet-unicast inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
```


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```
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast inet6-unicast
  NLRI of received end-of-rib markers: inet-unicast inet6-unicast
  NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
  Peer supports 4 byte AS extension (peer-as 100)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          4
  Table inet6.0 Bit: 20000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            1
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 24   Sent 12   Checked 60
  Input messages:  Total 132    Updates 6       Refreshes 0     Octets 2700
  Output messages: Total 133    Updates 3       Refreshes 0     Octets 2772
  Output Queue[0]: 0
  Output Queue[1]: 0

Peer: 192.168.20.1+179 AS 300  Local: 192.168.20.21+54706 AS 200
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-direct send-static ]
  Options: <Preference AddressFamily PeerAS Refresh>
  Address families configured: inet-unicast inet6-unicast
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.10.20.1      Local ID: 10.10.0.1         Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
  Local Interface: fe-1/2/1.3
  NLRI for restart configured on peer: inet-unicast inet6-unicast
  NLRI advertised by peer: inet-unicast inet6-unicast
  NLRI for this session: inet-unicast inet6-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast inet6-unicast
  NLRI of received end-of-rib markers: inet-unicast inet6-unicast
  NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
  Peer supports 4 byte AS extension (peer-as 300)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            3
    Accepted prefixes:            2
    Suppressed due to damping:    0
    Advertised prefixes:          4
```

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```
Table inet6.0 Bit: 20000
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              0
  Received prefixes:            1
  Accepted prefixes:            1
  Suppressed due to damping:    0
  Advertised prefixes:          2
Last traffic (seconds): Received 1    Sent 15   Checked 75
Input messages:  Total 133    Updates 6       Refreshes 0     Octets 2719
Output messages: Total 131    Updates 3       Refreshes 0     Octets 2734
Output Queue[0]: 0
Output Queue[1]: 0
```

Meaning The various occurrences of **inet6-unicast** in the output shows that BGP is enabled to carry IPv6 unicast routes.

Checking the Routing Table

Purpose Make sure that Device R2 has BGP routes in its inet6.0 routing table.

Action From operational mode, enter the **show route protocol bgp inet6.0** command.

```
user@R2> show route protocol bgp table inet6.0
```

```
inet6.0: 7 destinations, 10 routes (7 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

::ffff:192.168.10.0/120  [BGP/170] 01:03:49, localpref 100, from 192.168.20.1
                           AS path: 300 I
                         > to ::ffff:192.168.20.21 via fe-1/2/1.3
::ffff:192.168.20.0/120  [BGP/170] 01:03:53, localpref 100, from 192.168.10.1
                           AS path: 100 I
                         > to ::ffff:192.168.10.10 via fe-1/2/0.2
```

Related Documentation

- Understanding Multiprotocol BGP on page 655

Advertising IPv4 Routes over BGP IPv6 Sessions Overview

In an IPv6 network, BGP typically advertises IPv6 network layer reachability information over an IPv6 session between BGP peers. In earlier releases, Junos OS supported the exchange of inet6 unicast, inet6 multicast, or inet6 labeled-unicast address families only. This feature allows the exchange of all BGP address families. In a dual-stack environment that has IPv6 in its core. this feature enables BGP to advertise IPv4 unicast reachability with IPv4 next hop over an IPv6 BGP session.

This feature is for BGP IPv6 sessions only, where IPv4 is configured at both endpoints. The **local-ipv4-address** can be a loopback address or any ipv4 address for an IBGP or

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multiple-hop EBGP session. For single-hop external BGP speakers that are not part of BGP confederations, if the configured local IPv4 address is not directly connected, the BGP session is closed and remains idle and an error is generated, which is displayed in the output of the **show bgp neighbor** command.

To enable IPv4 route advertising over IPv6 session, configure **local-ipv4-address** as follows:

```
[edit protocols bgp family inet unicast]
local-ipv4-address local ipv4 address;
```

NOTE: You cannot configure this feature for the inet6 unicast, inet6 multicast, or inet6 labeled-unicast address families because BGP already has the capability to advertise these address families over an IPv6 BGP session.

The configured **local-ipv4-address** is used only when BGP advertises routes with self-next hop. When IBGP advertises routes learned from EBGP peers or the route reflector advertises BGP routes to its clients, BGP does not change the route next hop, ignores the configured **local-ipv4-address**, and uses the original IPv4 next hop.

Related Documentation

- Example: Advertising IPv4 Routes over IPv6 BGP Sessions on page 669
- **local-ipv4-address on page 1238**

Example: Advertising IPv4 Routes over IPv6 BGP Sessions

This example shows how to advertise IPv4 routes over IPv6 BGP session.In a dual-stack environment that has IPv6 in its core, there is a need to reach remote IPv4 hosts. Therefore, BGP advertises IPv4 routes with IPv4 next hops to BGP peers over BGP sessions using IPv6 source and destination addresses. This feature enables BGP to advertise IPv4 unicast reachability with IPv4 next hop over IPv6 BGP sessions.

- Requirements on page 669
- Overview on page 670
- Configuration on page 670
- Verification on page 674

Requirements

This example uses the following hardware and software components:

- Three routers with dual stacking capability
- Junos OS Release 16.1 or later running on all the devices

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Before you enable IPv4 advertisements over IPv6 BGP sessions, be sure to:

1. Configure the device interfaces.

2. Configure dual stacking on all devices.

Overview

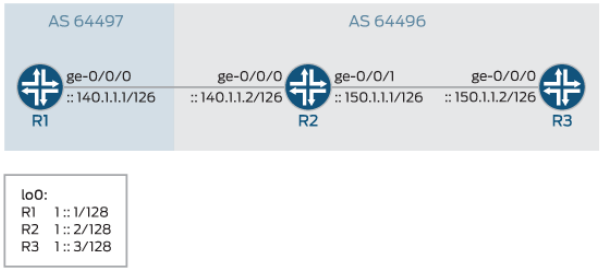
Beginning with Release 16.1, Junos OS allows BGP to advertise IPv4 unicast reachability with IPv4 next hop over an IPv6 BGP session. In earlier Junos OS releases, BGP could advertise only inet6 unicast, inet6 multicast and inet6 labeled unicast address families over IPv6 BGP sessions. This feature allows BGP to exchange all BGP address families over an IPv6 session. You can enable BGP to advertise IPv4 routes with IPv4 next hops to BGP peers over IPv6 session. The configured **local-ipv4-address** is used only when BGP advertises routes with self-next hop.

NOTE: **You cannot configure this feature for the inet6 unicast, inet6 multicast, or inet6 labeled-unicast address families because BGP already has the capability to advertise these address families over an IPv6 BGP session.**

Topology

In Figure 58 on page 670, an IPv6 external BGP session is running between Routers R1 and R2. An IPv6 IBGP session is established between Router R2 and Router R3. IPv4 static routes are redistributed to the BGP on R1. To redistribute the IPv4 routes over the IPv6 BGP session, the new feature must be enabled on all routers at the **[edit protocols bgp address family]** hierarchy level.

Figure 58: Advertising IPv4 Routes over IPv6 BGP Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router R1

```
set interfaces ge-0/0/0 unit 0 description R1->R2
```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```
set interfaces ge-0/0/0 unit 0 family inet address 140.1.1.1/24
set interfaces ge-0/0/0 unit 0 family inet6 address ::140.1.1.1/126
set interfaces lo0 unit 0 family inet6 address 1::1/128
set routing-options static route 11.1.1.1/32 discard
set routing-options static route 11.1.1.2/32 discard
set routing-options autonomous-system 64497
set protocols bgp group ebgp-v6 type external
set protocols bgp group ebgp-v6 export p1
set protocols bgp group ebgp-v6 peer-as 64496
set protocols bgp group ebgp-v6 neighbor ::140.1.1.2 description R2
set protocols bgp group ebgp-v6 neighbor ::140.1.1.2 family inet unicast local-ipv4-address
  140.1.1.1
set policy-options policy-statement p1 from protocol static
set policy-options policy-statement p1 then accept
```

Router R2

```
set interfaces ge-0/0/0 unit 0 description R2->R1
set interfaces ge-0/0/0 unit 0 family inet address 140.1.1.2/24
set interfaces ge-0/0/0 unit 0 family inet6 address ::140.1.1.2/126
set interfaces ge-0/0/1 unit 0 description R2->R3
set interfaces ge-0/0/1 unit 0 family inet address 150.1.1.1/24
set interfaces ge-0/0/1 unit 0 family inet6 address ::150.1.1.1/126
set interfaces lo0 unit 0 family inet6 address 1::2/128
set routing-options autonomous-system 64496
set protocols bgp group ibgp-v6 type internal
set protocols bgp group ibgp-v6 export change-nh
set protocols bgp group ibgp-v6 neighbor ::150.1.1.2 description R3
set protocols bgp group ibgp-v6 neighbor ::150.1.1.2 family inet unicast local-ipv4-address
  150.1.1.1
set protocols bgp group ebgp-v6 type external
set protocols bgp group ebgp-v6 peer-as 64497
set protocols bgp group ebgp-v6 neighbor ::140.1.1.1 description R1
set protocols bgp group ebgp-v6 neighbor ::140.1.1.1 family inet unicast local-ipv4-address
  140.1.1.2
set policy-options policy-statement change-nh from protocol bgp
set policy-options policy-statement change-nh then next-hop self
set policy-options policy-statement change-nh then accept
```

Router R3

```
set interfaces ge-0/0/0 unit 0 description R3->R2
set interfaces ge-0/0/0 unit 0 family inet address 150.1.1.2/24
set interfaces ge-0/0/0 unit 0 family inet6 address ::150.1.1.2/126
set interfaces lo0 unit 0 family inet6 address 1::3/128
set routing-options autonomous-system 64496
set protocols bgp group ibgp-v6 type internal
set protocols bgp group ibgp-v6 neighbor ::150.1.1.1 description R2
set protocols bgp group ibgp-v6 neighbor ::150.1.1.1 family inet unicast local-ipv4-address
  150.1.1.2
```

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Configuring Router R1

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1:

NOTE: Repeat this procedure for other routers after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 and IPv6 addresses.

```
[edit interfaces]
user@R1# set ge-0/0/0 unit 0 description R1->R2
user@R1# set ge-0/0/0 unit 0 family inet address 140.1.1.1/24
user@R1# set ge-0/0/0 unit 0 family inet6 address ::140.1.1.1/126
```

2. Configure the loopback address.

```
[edit interfaces]
user@R1# set lo0 unit 0 family inet6 address 1::1/128
```

3. Configure an IPv4 static route that needs to be advertised.

```
[edit routing-options]
user@R1# set static route 11.1.1.1/32 discard
user@R1# set static route 11.1.1.2/32 discard
```

4. Configure the autonomous system for BGP hosts.

```
[edit routing-options]
user@R1# set autonomous-system 64497
```

5. Configure EBGP on the external edge routers.

```
[edit protocols]
user@R1# set bgp group ebgp-v6 type external
user@R1# set bgp group ebgp-v6 peer-as 64496user@R1# set bgp group ebgp-v6
   neighbor ::140.1.1.2 description R2
```

6. Enable the feature to advertise IPv4 adddress 140.1.1.1 over BGP IPv6 sessions.

```
[edit protocols]
```


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```
user@R1# set bgp group ebgp-v6 neighbor ::140.1.1.2 family inet unicast
  local-ipv4-address 140.1.1.1
```

7. Define a policy p1 to accept all static routes.

```
[edit policy-options]
user@R1# set policy-statement p1 from protocol static
user@R1# set policy-statement p1 then accept
```

8. Apply the policy p1 on EBGP group ebgp-v6.

```
[edit protocols]
user@R1# set bgp group ebgp-v6 export p1
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R1# show interfaces
ge-0/0/0 {
   unit 0 {
      description R1->R2;
      family inet {
         address 140.1.1.1/24;
      }
      family inet6 {
         address ::140.1.1.1/126;
      }
   }
   lo0 {
      unit 0 {
         family inet {
            address 1::1/128;
         }
      }
   }
}
```

```
[edit]
user@R1# show protocols
bgp {
   group ebgp-v6 {
      type external;
      export p1;
      peer-as 64496;
      neighbor ::140.1.1.2 {
```

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```
        description R2;
        family inet {
          unicast {
            local-ipv4-address 140.1.1.1;
          }
        }
      }
    }
}
```

```
[edit]
user@R1# show routing-options
static {
  route 11.1.1.1/32 discard;
  route 11.1.1.2/32 discard;
}
autonomous-system 64497;
```

```
[edit]
user@R1# show policy-options
policy-statement p1 {
  from {
    protocol static;
  }
  then accept;
}
```

If you are done configuring the device, commit the configuration.

```
user@R1# commit
```

Verification

Confirm that the configuration is working properly.

- Verifying That the BGP Session Is Up on page 674
- Verifying That the IPv4 address Is Being Advertised on page 675
- Verifying That the BGP Neighbor Router R2 Receives the Advertised IPv4 Address on page 675

Verifying That the BGP Session Is Up

Purpose Verify that BGP is running on the configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp summary** command on Router R1.

```
user@R1> show bgp summary
```

```
Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
```


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```
inet.0
                     0          0          0          0          0          0
Peer                   AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
::140.1.1.2             64496       4140       4158       0       0  1d 7:10:36
0/0/0/0              0/0/0/0
```

Meaning The BGP session is up and running, and BGP peering is established.

Verifying That the IPv4 address Is Being Advertised

Purpose Verify that the configured IPv4 address is being advertised by Router R1 to the configured BGP neighbors.

Action From operational mode, run the **show route advertising-protocol bgp ::150.1.1.2** command on Router R1.

```
user@R1> show route advertising-protocol bgp ::150.1.1.2

inet.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
  Prefix    Nexthop        MED     Lclpref    AS path
* 11.1.1.1/32       Self                          64497        64497 I
* 11.1.1.2/32       Self                          64497        64497 I
```

Meaning The IPv4 static route is being advertised to the BGP neighbor Router R2.

Verifying That the BGP Neighbor Router R2 Receives the Advertised IPv4 Address

Purpose Verify that Router R2 receives the IPv4 address that Router R1 is advertising to the BGP neighbor over IPv6.

Action

```
user@R2> show route receive-protocol bgp ::140.1.1.1

inet.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
  Prefix    Nexthop        MED     Lclpref    AS path
* 11.1.1.1/32        140.1.1.1                               64497 I
* 11.1.1.2/32        140.1.1.1                               64497 I

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

inet6.0: 9 destinations, 10 routes (9 active, 0 holddown, 0 hidden)
```

Meaning The presence of the static IPv4 route in Router R2's routing table indicates that it is receiving the advertised IPv4 routes from Router R1.

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Related Documentation
- local-ipv4-address on page 1238
- Advertising IPv4 Routes over BGP IPv6 Sessions Overview on page 668

Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP

In a network that predominantly transports IPv6 traffic there is a need to route IPv4 routes when required. For example, an Internet Service Provider that has an IPv6-only network, but has customers who still route IPv4 traffic. In this case, it is necessary to cater to such customers and forward IPv4 traffic over an IPv6 network. As described in RFC 5549, *Advertising IPv4 Network Layer Reachability Information with an IPv6 Next Hop* IPv4 traffic is tunneled from customer premises equipment (CPE) devices to IPv4-over-IPv6 gateways. These gateways are announced to CPE devices through anycast addresses. The gateway devices then create dynamic IPv4-over-IPv6 tunnels to remote CPE devices and advertise IPv4 aggregate routes to steer traffic.

NOTE: **Dynamic IPv4-over-IPv6 tunnel feature does not support unified ISSU in Junos OS Release 17.3R1.**

Route reflectors (RRs) with a programmable interface are connected through IBGP to the gateway routers and host routes with IPv6 address as the next hop. These RRs advertise the IPv4 /32 addresses to inject the tunnel information into the network. The gateway routers create dynamic IPv4-over-IPv6 tunnels to the remote customer provider edge. The gateway router also advertises the IPv4 aggregate routes to steer traffic. The RR then advertises the tunnel source routes to the ISP. When the RR removes the tunnel route, BGP also withdraws the route causing the tunnel to be torn down and the CPE to be unreachable. The gateway router also withdraws the IPv4 aggregate routes and IPv6 tunnel source routes when all the aggregate routes contributor routes are removed. The gateway router sends route withdraw when the anchor Packet Forwarding Engine line card goes down, so that it will redirect traffic to other gateway routers.

The following extensions are introduced to support IPv4 routes with an IPv6 next hop:

BGP Next Hop Encoding

BGP is extended with next hop encoding capability that is used to send IPv4 routes with IPv6 next hops. If this capability is not available on the remote peer, BGP groups the peers based on this encoding capability and removes BGP family without encoding capability from the negotiated network layer reachability information (NLRI) list. Junos OS allows only one resolution table such as inet.0. To permit IPv4 BGP routes with IPv6 next hops BGP creates a new resolution tree. This feature allows a Junos OS routing table to have multiple resolution trees.

Besides RFC 5549, *Advertising IPv4 Network Layer Reachability Information with an IPv6 Next Hop* a new encapsulation community specified in RFC 5512, *The BGP Encapsulation Subsequent Address Family Identifier (SAFI) and the BGP Tunnel Encapsulation Attribute* is introduced to determine the address family of the next-hop address. The encapsulation community indicates the type of tunnels that the ingress node needs to create. When

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BGP receives IPv4 routes with IPv6 next hop address and the V4oV6 encapsulation community, then BGP creates IPv4-over-IPv6 dynamic tunnels. When BGP receives routes without the encapsulation community, BGP routes are resolved without creating the V4oV6 tunnel.

A new policy action **dynamic-tunnel-attributes *dyan-attribute*** is available at the **[edit policy-statement *policy name* term then]** hierarchy level to support the new extended encapsulation.

Tunnel Localization

The dynamic tunnel infrastructure is enhanced with tunnel localization to support a larger number of tunnels. There is a need for tunnel localization to provide resiliency to handle traffic when the anchor fails. One or more chassis back up one another and let the routing protocol process (rpd) steer traffic away from the failure point to the backup chassis. The chassis advertises only these aggregate prefixes instead of the individual loopback addresses into the network.

Tunnel Handling

IPv4 over IPv6 tunnels use the dynamic tunnel infrastructure along with tunnel anchoring to support the required chassis wide scale. The tunnel state is localized to a Packet Forwarding Engine and the other Packet Forwarding Engines steer the traffic to the tunnel anchor.

Tunnel Ingress

Tunnel ingress or tunnel encapsulation forwards the network traffic towards the customer site. When the tunnel state is present on the Packet Forwarding Engine on which traffic entered the chassis, the routing protocol process (rpd) uses the following procedure to redistribute IPv4 routes over IPv6 tunnels:

Figure 59: Tunnel Ingress Handling when the Tunnel State is Available on the same PFE

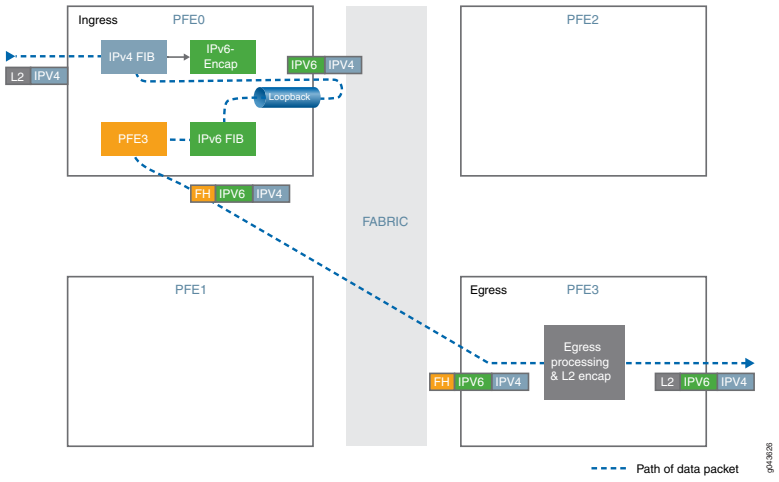
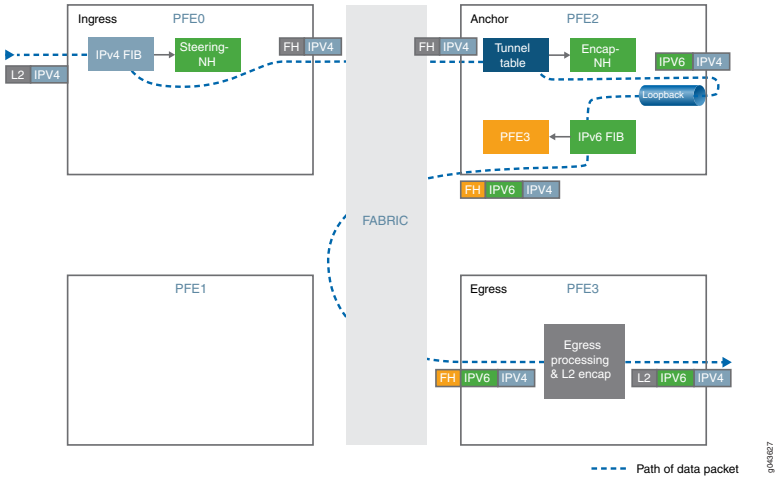


Figure 60: Tunnel Ingress Handling when the Tunnel State is on a Different PFE



1. Encapsulates IPv4 traffic inside the IPv6 header.

   Maximum transmission unit (MTU) enforcement is performed before encapsulation. If the encapsulated packet size exceeds the tunnel MTU and the IPv4 packet's **DF-bit** is not set then the packet is fragmented and these fragments are encapsulated.

2. Uses hash-based traffic load balancing on inner packet headers.

3. Forwards traffic to the destination IPv6 address. The IPv6 address is taken from the IPv6 header.

Tunnel Egress

Tunnel egress forwards traffic from the customer premises equipment to the network side.

Figure 61: Tunnel Egress Handling when the Tunnel State is Available on the same PFE

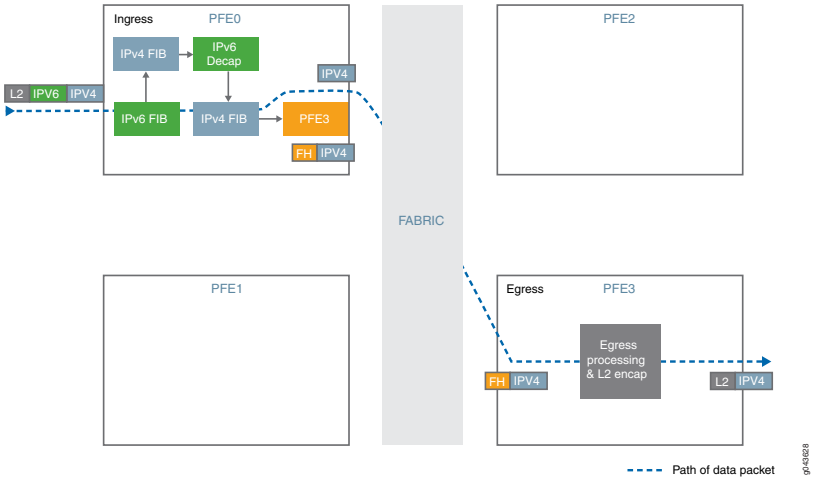


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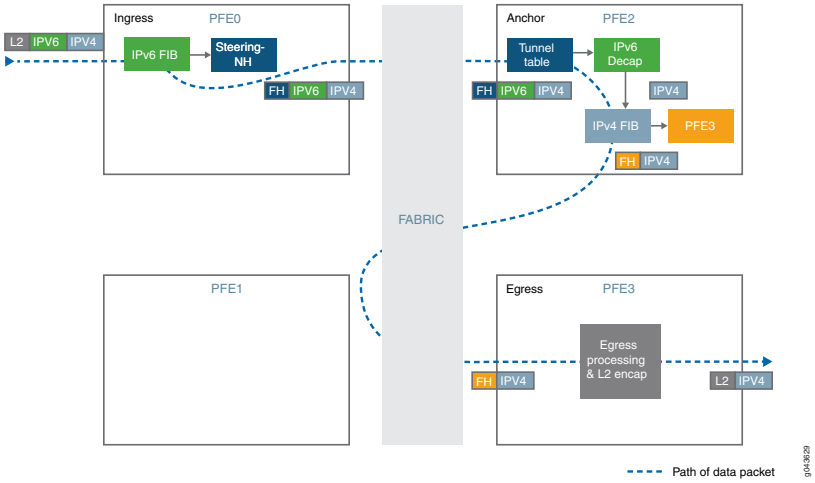
Figure 62: Tunnel Egress Handling when the Tunnel State is Available on a Remote PFE



1. Decapsulates the IPv4 packet present inside the IPv6 packet.

2. Performs anti-spoof checking to ensure that the IPv6, IPv4 pair matches with the information that was used for setting up the tunnel.

3. Looks up the IPv4 destination address from the decapsulated packet's IPv4 header and forwards the packet to the specified IPv4 address.

Tunnel Load Balancing and Anchor Packet Forwarding Engine Failure Handling

The Packet Forwarding Engine failure needs to be handled promptly to avoid black holing of tunnel traffic anchored on the Packet Forwarding Engine. Tunnel localization involves the use of BGP advertisements to repair the failure globally. The tunnel traffic is diverted away from the failure point to other backup chassis that contains the identical tunnel state. For traffic load balancing, the chassis is configured to advertise different multiple exit discriminator (MED) values for each of the prefix sets so that only the traffic for one fourth of the tunnels goes through each chassis. CPE traffic is also handled in a similar manner by configuring the same set of anycast addresses on each chassis and steering only one fourth of traffic towards each chassis.

Anchor Packet Forwarding Engine is the single entity that does all processing for a tunnel. The anchor Packet Forwarding Engine selection is through static provisioning and tied to the Packet Forwarding Engine physical interfaces. When one of the Packet Forwarding Engines goes down, the daemon marks all the Packet Forwarding Engines down on the line card and communicates this information to routing protocol process routing protocol process and other daemons. The routing protocol process sends out BGP withdrawals for the prefixes that are anchored on the failed Packet Forwarding Engine and the IPv6 addresses assigned to the Packet Forwarding Engine that is down. These advertisements reroute traffic to other backup chassis. When the failed Packet Forwarding Engine is up again, the chassis marks the Packet Forwarding Engine as **up** and updates routing protocol process. The routing protocol process triggers BGP updates to its peers that tunnels anchored to the specific Packet Forwarding Engine are now available for routing traffic.

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This process might take minutes for large scale tunnel configuration. Therefore, the **Ack** mechanism is built into the system to ensure minimal traffic loss while switching traffic back to the original chassis.

Tunnel Loopback Stream Statistics

Dynamic tunnel infrastructure uses loopback streams in Packet Forwarding Engine for looping the packet after encapsulation. Since the bandwidth of this loopback stream is limited there is a need to monitor the performance of tunnel loopback streams.

To monitor the statistics of the loopback stream, use the operational command **show pfe statistics traffic detail** that displays the aggregated loopback stream statistics including forwarding rate, drop packet rate and the byte rate.

Related Documentation

- *dynamic-tunnels*
- extended-nexthop on page 1164
- tunnel-attributes on page 1386
- Configuring BGP to Redistribute IPv4 Routes with IPv6 Next-Hop Addresses on page 680

Configuring BGP to Redistribute IPv4 Routes with IPv6 Next-Hop Addresses

Starting in Release 17.3R1, Junos OS devices can forward IPv4 traffic over an IPv6-only network, which generally cannot forward IPv4 traffic. As described in RFC 5549, IPv4 traffic is tunneled from CPE devices to IPv4-over-IPv6 gateways. These gateways are announced to CPE devices through anycast addresses. The gateway devices then create dynamic IPv4-over-IPv6 tunnels to remote customer premises equipment and advertise IPv4 aggregate routes to steer traffic. Route reflectors with programmable interfaces inject the tunnel information into the network. The route reflectors are connected through IBGP to gateway routers, which advertise the IPv4 addresses of host routes with IPv6 addresses as the next hop.

NOTE: Dynamic IPv4-over-IPv6 tunnel feature does not support unified ISSU in Junos OS Release 17.3R1.

Before you begin configuring BGP to distribute IPv4 routes with IPv6 next-hop addresses, do the following:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure MPLS and LDP.
4. Configure BGP.

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To configure BGP to distribute IPv4 routes with IPv6 next-hop addresses:

1. Configure the extended next-hop encoding option for BGP groups with IPv6 peers to route IPv4 address families over an IPv6 session.

```
[edit protocols bgp family inet unicast]
user@host# set extended-nexthop
```

2. Configure dynamic IPv4-over-IPv6 tunnels and define their attributes to forward IPv4 traffic over an IPv6-only network. IPv4 traffic is tunneled from CPE devices to IPv4-over-IPv6 gateways.

```
[edit routing-options]
user@host# set dynamic-tunnels
```

3. Configure the tunnel attributes.

```
[edit routing-options dynamic-tunnels tunnel-attributes]
user@host# set tunnel-attributes name
user@host# set dynamic-tunnel-source-prefix dynamic-tunnel-source-prefix
user@host# set dynamic-tunnel-type V4oV6
user@host# set dynamic-tunnel-mtu dynamic-tunnel-mtu
user@host# set dynamic-tunnel-anchor-pfe dynamic-tunnel-anchor-pfe
user@host# set dynamic-tunnel-anti-spoof (off | on)
```

   For example, configure a dynamic tunnel, **first_tunnel** with the following attributes:

```
[edit routing-options dynamic-tunnels tunnel-attributes]
user@host# set tunnel-attributes first_tunnel{
user@host# set dynamic-tunnel-source-prefix 10.1.1.0
user@host# set dynamic-tunnel-type V4oV6
user@host# set dynamic-tunnel-mtu 300
user@host# set dynamic-tunnel-anchor-pfe pfe-1/2/0
user@host# set dynamic-tunnel-anti-spoof on
```

4. Define a policy to associate the configured dynamic tunnel attribute profile to a prefix list or a route filter.

```
[edit policy-options policy-statement policy-name from then]
user@host# set dynamic-tunnel-attributes name
```

   For example, define *dynamic_tunnel_policy* policy to associate the dynamic tunnel *first_tunnel* attributes only to traffic heading to a specific route 2.2.2.2/32.

```
[edit policy-options policy-statement dynamic_tunnel_policy from route-filter 2.2.2.2/32
  exact then]
user@host# set dynamic-tunnel-attributes first_tunnel
```

5. Export the defined policy.

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```
[edit routing options]
user@host# set forwarding-table export policy-name
```

For example, export the configured *dynamic_tunnel_policy* policy.

```
[edit routing options]
user@host# set forwarding-table export dynamic_tunnel_policy
```

Related Documentation

- *dynamic-tunnels*
- extended-nexthop on page 1164
- tunnel-attributes on page 1386
- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676

Enabling Layer 2 VPN and VPLS Signaling

You can enable BGP to carry Layer 2 VPN and VPLS NLRI messages.

To enable VPN and VPLS signaling, include the **family** statement:

```
family {
  l2vpn {
    signaling {
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
    }
  }
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

To configure a maximum number of prefixes, include the **prefix-limit** statement:

```
prefix-limit {
  maximum number;
  teardown <percentage> <idle-timeout (forever | minutes)>;
}
```

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

When you set the maximum number of prefixes, a message is logged when that number is reached. If you include the **teardown** statement, the session is torn down when the maximum number of prefixes is reached. If you specify a percentage, messages are logged when the number of prefixes reaches that percentage. Once the session is torn down, it is reestablished in a short time. Include the **idle-timeout** statement to keep the session

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down for a specified amount of time, or forever. If you specify **forever**, the session is reestablished only after you use the **clear bgp neighbor** command.

Related Documentation

- *Junos OS VPNs Library for Routing Devices*

Understanding BGP Flow Routes for Traffic Filtering

A flow route is an aggregation of match conditions for IP packets. Flow routes are propagated through the network using flow-specification network-layer reachability information (NLRI) messages and installed into the flow routing table ***instance-name*.inetflow.0**. Packets can travel through flow routes only if specific match conditions are met.

Flow routes and firewall filters are similar in that they filter packets based on their components and perform an action on the packets that match. Flow routes provide traffic filtering and rate-limiting capabilities much like firewall filters. In addition, you can propagate flow routes across different autonomous systems.

Flow routes are propagated by BGP through flow-specification NLRI messages. You must enable BGP to propagate these NLRIs.

Beginning with Junos OS Release 15.1, changes are implemented to extend nonstop active routing (NSR) support for existing inet-flow and inetvpn-flow families and extend route validation for BGP flowspec per draft-ietf-idr-bgp-flowspec-oid-01. Two new statements are introduced as part of this enhancement. See enforce-first-as and no-install.

NOTE: **Beginning with Junos OS Release 16.1, IPv6 support is extended to BGP flow specification that allows propagation of traffic flow specification rules for IPv6 and VPN-IPv6 packets. BGP flow specification automates coordination of traffic filtering rules in order to mitigate distributed denial-of-service attack during nonstop active routing (NSR).**

Starting with Junos OS Release 16.1R1, BGP flow specification supports traffic-marking **extended-community** filtering action. For IPv4 traffic, Junos OS modifies the DiffServ code point (DSCP) bits of a transiting IPv4 packet to the corresponding value of the extended community. For IPv6 packets, Junos OS modifies the first six bits of the **traffic class** field of the transmitting IPv6 packet to the corresponding value of the extended community.

- Match Conditions for Flow Routes on page 683
- Actions for Flow Routes on page 686
- Validating Flow Routes on page 686
- Support for BGP Flow-Specification Algorithm Version 7 and Later on page 687

Match Conditions for Flow Routes

You specify conditions that the packet must match before the action in the **then** statement is taken for a flow route. All conditions in the **from** statement must match for the action

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to be taken. The order in which you specify match conditions is not important, because a packet must match all the conditions in a term for a match to occur.

To configure a match condition, include the **match** statement at the **[edit routing-options flow]** hierarchy level.

Table 8 on page 684 describes the flow route match conditions.

Table 8: Flow Route Match Conditions

Match Condition	Description
destination *prefix* **prefix-offset** *number*	IP destination address field. You can use the **prefix-offset** optional field, which is available only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode, to specify the number of bits that must be skipped before Junos OS starts matching an IPv6 prefix.
destination-port *number*	TCP or User Datagram Protocol (UDP) destination port field. You cannot specify both the **port** and **destination-port** match conditions in the same term. In place of the numeric value, you can specify one of the following text synonyms (the port numbers are also listed): **afs** (1483), **bgp** (179), **biff** (512), **bootpc** (68), **bootps** (67), **cmd** (514), **cvspserver** (2401), **dhcp** (67), **domain** (53), **eklogin** (2105), **ekshell** (2106), **exec** (512), **finger** (79), **ftp** (21), **ftp-data** (20), **http** (80), **https** (443), **ident** (113), **imap** (143), **kerberos-sec** (88), **klogin** (543), **kpasswd** (761), **krb-prop** (754), **krbupdate** (760), **kshell** (544), **ldap** (389), **login** (513), **mobileip-agent** (434), **mobilip-mn** (435), **msdp** (639), **netbios-dgm** (138), **netbios-ns** (137), **netbios-ssn** (139), **nfsd** (2049), **nntp** (119), **ntalk** (518), **ntp** (123), **pop3** (110), **pptp** (1723), **printer** (515), **radacct** (1813), **radius** (1812), **rip** (520), **rkinit** (2108), **smtp** (25), **snmp** (161), **snmptrap** (162), **snpp** (444), **socks** (1080), **ssh** (22), **sunrpc** (111), **syslog** (514), **tacacs-ds** (65), **talk** (517), **telnet** (23), **tftp** (69), **timed** (525), **who** (513), **xdmcp** (177), **zephyr-clt** (2103), or **zephyr-hm** (2104).
dscp *number*	Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most significant six bits of this byte form the DSCP. You can specify DSCP in hexadecimal or decimal form.
flow-label *numeric-expression*	Match the flow label value. The value of this field ranges from 0 through 1048575. This match condition is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode. This match condition is not supported for IPv4.
fragment *type*	Fragment type field. The keywords are grouped by the fragment type with which they are associated: • **dont-fragment** NOTE: This option is not supported for IPv6. • **first-fragment** • **is-fragment** • **last-fragment** • **not-a-fragment** This match condition is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode. .

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Table 8: Flow Route Match Conditions (continued)

Match Condition	Description
icmp-code *number* **icmp6-code** *icmp6-code-value*;	ICMP code field. This value or keyword provides more specific information than **icmp-type**. Because the value's meaning depends upon the associated **icmp-type** value, you must specify **icmp-type** along with **icmp-code**. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed). The keywords are grouped by the ICMP type with which they are associated: • parameter-problem: **ip-header-bad** (0), **required-option-missing** (1) • redirect: **redirect-for-host** (1), **redirect-for-network** (0), **redirect-for-tos-and-host** (3), **redirect-for-tos-and-net** (2) • time-exceeded: **ttl-eq-zero-during-reassembly** (1), **ttl-eq-zero-during-transit** (0) • unreachable: **communication-prohibited-by-filtering** (13), **destination-host-prohibited** (10), **destination-host-unknown** (7), **destination-network-prohibited** (9), **destination-network-unknown** (6), **fragmentation-needed** (4), **host-precedence-violation** (14), **host-unreachable** (1), **host-unreachable-for-TOS** (12), **network-unreachable** (0), **network-unreachable-for-TOS** (11), **port-unreachable** (3), **precedence-cutoff-in-effect** (15), **protocol-unreachable** (2), **source-host-isolated** (8), **source-route-failed** (5)
icmp-type *number* **icmp6-type** *icmp6-type-value*	ICMP packet type field. Normally, you specify this match in conjunction with the **protocol** match statement to determine which protocol is being used on the port. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): **echo-reply** (0), **echo-request** (8), **info-reply** (16), **info-request** (15), **mask-request** (17), **mask-reply** (18), **parameter-problem** (12), **redirect** (5), **router-advertisement** (9), **router-solicit** (10), **source-quench** (4), **time-exceeded** (11), **timestamp** (13), **timestamp-reply** (14), or **unreachable** (3).
packet-length *number*	Total IP packet length.
port *number*	TCP or UDP source or destination port field. You cannot specify both the **port** match and either the **destination-port** or **source-port** match condition in the same term. In place of the numeric value, you can specify one of the text synonyms listed under **destination-port**.
protocol *number*	IP protocol field. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): **ah, egp** (8), **esp** (50), **gre** (47), **icmp** (1), **igmp** (2), **ipip** (4), **ipv6** (41), **ospf** (89), **pim** (103), **rsvp** (46), **tcp** (6), or **udp** (17). This match condition is supported for IPv6 only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.
source *prefix***prefix-offset** *number*	IP source address field. You can use the **prefix-offset** optional field, which is available only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode, to specify the number of bits that must be skipped before Junos OS starts matching an IPv6 prefix.
source-port *number*	TCP or UDP source port field. You cannot specify the **port** and **source-port** match conditions in the same term. In place of the numeric field, you can specify one of the text synonyms listed under **destination-port**.
tcp-flag type	TCP header format.

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Actions for Flow Routes

You can specify the action to take if the packet matches the conditions you have configured in the flow route. To configure an action, include the **then** statement at the **[edit routing-options flow]** hierarchy level.

Table 9 on page 686 describes the flow route actions.

Table 9: Flow Route Action Modifiers

Action or Action Modifier	Description
Actions	
accept	Accept a packet. This is the default.
discard	Discard a packet silently, without sending an Internet Control Message Protocol (ICMP) message.
community	Replace any communities in the route with the specified communities.
mark *value*	Set a DSCP value for traffic that matches this flow. Specify a value from 0 through 63. This action is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.
next term	Continue to the next match condition for evaluation.
routing-instance *extended-community*	Specify a routing instance to which packets are forwarded.
rate-limit *bits-per-second*	Limit the bandwidth on the flow route. Express the limit in bits per second (bps). Beginning with Junos OS Release 16.1R4, the rate-limit range is [0 through 1000000000000].
sample	Sample the traffic on the flow route.

Validating Flow Routes

The Junos OS installs flow routes into the flow routing table only if they have been validated using the validation procedure. The Routing Engine does the validation before the installing routes into the flow routing table.

Flow routes received using the BGP network layer reachability information (NLRI) messages are validated before they are installed into the flow primary instance routing table **instance.inetflow.0**. The validation procedure is described in the draft-ietf-idr-flow-spec-09.txt, *Dissemination of Flow Specification Rules*. You can bypass the validation process for flow routes using BGP NLRI messages and use your own specific import policy.

To trace validation operations, include the **validation** statement at the **[edit routing-options flow]** hierarchy level.

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Support for BGP Flow-Specification Algorithm Version 7 and Later

By default, the Junos OS uses the term-ordering algorithm defined in version 6 of the BGP flow specification draft. In Junos OS Release 10.0 and later, you can configure the router to comply with the term-ordering algorithm first defined in version 7 of the BGP flow specification and supported through RFC 5575, *Dissemination of Flow Specification Routes*.

BEST PRACTICE: We recommend that you configure the Junos OS to use the term-ordering algorithm first defined in version 7 of the BGP flow specification draft. We also recommend that you configure the Junos OS to use the same term-ordering algorithm on all routing instances configured on a router.

To configure BGP to use the flow-specification algorithm first defined in version 7 of the Internet draft, include the **standard** statement at the **[edit routing-options flow term-order]** hierarchy level.

To revert to using the term-ordering algorithm defined in version 6, include the **legacy** statement at the **[edit routing-options flow term-order]** hierarchy level.

NOTE: The configured term order has only local significance. That is, the term order does not propagate with flow routes sent to the remote BGP peers, whose term order is completely determined by their own term order configuration. Therefore, you should be careful when configuring the order-dependent action **next term** when you are not aware of the term order configuration of the remote peers. The local **next term** might differ from the **next term** configured on the remote peer.

NOTE: On Junos OS Evolved, **next term** cannot appear as the last term of the action. A filter term where **next term** is specified as an action but without any match conditions configured is not supported.

Starting in Release 16.1, Junos OS excludes applying the **flowspec** filter to traffic received on specific interfaces. A new term is added at the beginning of the **flowspec** filter that accepts any packet received on these specific interfaces. The new term is a variable that creates an exclusion list of terms attached to the forwarding table filter as a part of the flow specification filter.

To exclude the **flowspec** filter from being applied to traffic received on specific interfaces, you must first configure a **group-id** on such interfaces by including the family **inet** filter group **group-id** statement at the **[edit interfaces]** hierarchy level and then attach the **flowspec** filter with the interface group by including the **flow interface-group group-id exclude** statement at the **[edit routing-options]** hiearchy level. You can configure only one **group-id** per routing instance with the **set routing-options flow interface-group group-id** statement.

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Release History Table

Release	Description
16.1R4	Beginning with Junos OS Release 16.1R4, the rate-limit range is [0 through 1000000000000].
16.1	Beginning with Junos OS Release 16.1, IPv6 support is extended to BGP flow specification that allows propagation of traffic flow specification rules for IPv6 and VPN-IPv6 packets.
16.1	Starting with Junos OS Release 16.1R1, BGP flow specification supports traffic-marking **extended-community** filtering action.
16.1	Starting in Release 16.1, Junos OS excludes applying the **flowspec** filter to traffic received on specific interfaces.
15.1	Beginning with Junos OS Release 15.1, changes are implemented to extend nonstop active routing (NSR) support for existing inet-flow and inetvpn-flow families and extend route validation for BGP flowspec per draft-ietf-idr-bgp-flowspec-oid-01.

Related Documentation

- Example: Enabling BGP to Carry Flow-Specification Routes on page 688
- **interface-group group-id exclude on page 1217**
- **flow (IPv6) on page 1174**

Example: Enabling BGP to Carry Flow-Specification Routes

This example shows how to allow BGP to carry flow-specification network layer reachability information (NLRI) messages.

- Requirements on page 688
- Overview on page 689
- Configuration on page 691
- Verification on page 699

Requirements

Before you begin:

- Configure the device interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure a routing policy that exports routes (such as direct routes or IGP routes) from the routing table into BGP.

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Overview

Propagating firewall filter information as part of BGP enables you to propagate firewall filters against denial-of-service (DOS) attacks dynamically across autonomous systems. Flow routes are encapsulated into the flow-specification NLRI and propagated through a network or virtual private networks (VPNs), sharing filter-like information. Flow routes are an aggregation of match conditions and resulting actions for packets. They provide you with traffic filtering and rate-limiting capabilities much like firewall filters. Unicast flow routes are supported for the default instance, VPN routing and forwarding (VRF) instances, and virtual-router instances.

Import and export policies can be applied to the family **inet flow** or family **inet-vpn flow** NLRI, affecting the flow routes accepted or advertised, similar to the way import and export policies are applied to other BGP families. The only difference is that the flow policy configuration must include the from **rib inetflow.0** statement. This statement causes the policy to be applied to the flow routes. An exception to this rule occurs if the policy has only the **then reject** or the **then accept** statement and no **from** statement. Then, the policy affects all routes, including IP unicast and IP flow.

The flow route filters are first configured on a router statically, with a set of matching criteria followed by the actions to be taken. Then, in addition to **family inet unicast**, **family inet flow** (or **family inet-vpn flow**) is configured between this BGP-enabled device and its peers.

By default, statically configured flow routes (firewall filters) are advertised to other BGP-enabled devices that support the **family inet flow** or **family inet-vpn flow** NLRI.

The receiving BGP-enabled device performs a validation process before installing the firewall filter into the flow routing table ***instance-name*.inetflow.0**. The validation procedure is described in RFC 5575, *Dissemination of Flow Specification Rules*.

The receiving BGP-enabled device accepts a flow route if it passes the following criteria:

- The originator of a flow route matches the originator of the best match unicast route for the destination address that is embedded in the route.
- There are no more specific unicast routes, when compared to the destination address of the flow route, for which the active route has been received from a different next-hop autonomous system.

The first criterion ensures that the filter is being advertised by the next-hop used by unicast forwarding for the destination address embedded in the flow route. For example, if a flow route is given as 10.1.1.1, proto=6, port=80, the receiving BGP-enabled device selects the more specific unicast route in the unicast routing table that matches the destination prefix 10.1.1.1/32. On a unicast routing table containing 10.1/16 and 10.1.1/24, the latter is chosen as the unicast route to compare against. Only the active unicast route entry is considered. This follows the concept that a flow route is valid if advertised by the originator of the best unicast route.

The second criterion addresses situations in which a given address block is allocated to different entities. Flows that resolve to a best-match unicast route that is an aggregate

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route are only accepted if they do not cover more specific routes that are being routed to different next-hop autonomous systems.

You can bypass the validation process for flow routes using BGP NLRI messages and use your own specific import policy. When BGP is carrying flow-specification NLRI messages, the **no-validate** statement at the **[edit protocols bgp group *group-name* family inet flow]** hierarchy level omits the flow route validation procedure after packets are accepted by a policy. You can configure the import policy to match on destination address and path attributes such as community, next-hop, and AS path. You can specify the action to take if the packet matches the conditions you have configured in the flow route. To configure an action, include the statement at the **[edit routing-options flow]** hierarchy level. The flow specification NLRI type includes components such as destination prefix, source prefix, protocol, and ports as defined in the RFC 5575. The import policy can filter an inbound route using path attributes and destination address in the flow specification NLRI. The import policy cannot filter any other components in the RFC 5575.

The flow specification defines required protocol extensions to address most common applications of IPv4 unicast and VPN unicast filtering. The same mechanism can be reused and new match criteria added to address similar filtering for other BGP address families (for example, IPv6 unicast).

After a flow route is installed in the **inetflow.0** table, it is also added to the list of firewall filters in the kernel.

On routers only, flow-specification NLRI messages are supported in VPNs. The VPN compares the route target extended community in the NLRI to the import policy. If there is a match, the VPN can start using the flow routes to filter and rate-limit packet traffic. Received flow routes are installed into the flow routing table ***instance-name*.inetflow.0**. Flow routes can also be propagated throughout a VPN network and shared among VPNs. To enable multiprotocol BGP (MP-BGP) to carry flow-specification NLRI for the **inet-vpn** address family, include the **flow** statement at the **[edit protocols bgp group *group-name* family inet-vpn]** hierarchy level. VPN flow routes are supported for the default instance only. Flow routes configured for VPNs with family **inet-vpn** are not automatically validated, so the **no-validate** statement is not supported at the **[edit protocols bgp group *group-name* family inet-vpn]** hierarchy level. No validation is needed if the flow routes are configured locally between devices in a single AS.

Import and export policies can be applied to the **family inet flow** or **family inet-vpn flow** NLRI, affecting the flow routes accepted or advertised, similar to the way import and export policies are applied to other BGP families. The only difference is that the flow policy configuration must include the **from rib inetflow.0** statement. This statement causes the policy to be applied to the flow routes. An exception to this rule occurs if the policy has only the **then reject** or the **then accept** statement and no **from** statement. Then, the policy affects all routes, including IP unicast and IP flow.

This example shows how to configure the following export policies:

- A policy that allows the advertisement of flow routes specified by a route-filter. Only the flow routes covered by the 10.13/16 block are advertised. This policy does not affect unicast routes.

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- A policy that allows all unicast and flow routes to be advertised to the neighbor.
- A policy that disallows all routes (unicast or flow) to be advertised to the neighbor.

Configuration

- Configuring a Static Flow Route on page 691
- Advertising Flow Routes Specified by a Route Filter on page 692
- Advertising All Unicast and Flow Routes on page 694
- Advertising No Unicast or Flow Routes on page 695
- Limiting the Number of Flow Routes Installed in a Routing Table on page 697
- Limiting the Number of Prefixes Received on a BGP Peering Session on page 698

Configuring a Static Flow Route

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set routing-options flow route block-10.131.1.1 match destination 10.131.1.1/32
set routing-options flow route block-10.131.1.1 match protocol icmp
set routing-options flow route block-10.131.1.1 match icmp-type echo-request
set routing-options flow route block-10.131.1.1 then discard
set routing-options flow term-order standard
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the match conditions.

   ```
   [edit routing-options flow route block-10.131.1.1]
   user@host# set match destination 10.131.1.1/32
   user@host# set match protocol icmp
   user@host# set match icmp-type echo-request
   ```

2. Configure the action.

   ```
   [edit routing-options flow route block-10.131.1.1]
   user@host# set then discard
   ```

3. (Recommended) For the flow specification algorithm, configure the standard-based term order.

   ```
   [edit routing-options flow]
   ```

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```
user@host# set term-order standard
```

In the default term ordering algorithm, as specified in the flowspec RFC draft Version 6, a term with less specific matching conditions is always evaluated before a term with more specific matching conditions. This causes the term with more specific matching conditions to never be evaluated. Version 7 of RFC 5575 made a revision to the algorithm so that the more specific matching conditions are evaluated before the less specific matching conditions. For backward compatibility, the default behavior is not altered in Junos OS, even though the newer algorithm makes more sense. To use the newer algorithm, include the **term-order standard** statement in the configuration. This statement is supported in Junos OS Release 10.0 and later.

Results From configuration mode, confirm your configuration by entering the **show routing-options** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show routing-options
flow {
   term-order standard;
   route block-10.131.1.1 {
      match {
         destination 10.131.1.1/32;
         protocol icmp;
         icmp-type echo-request;
      }
      then discard;
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Advertising Flow Routes Specified by a Route Filter

CLI Quick Configuration To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group core family inet unicast
set protocols bgp group core family inet flow
set protocols bgp group core export p1
set protocols bgp group core peer-as 65000
set protocols bgp group core neighbor 10.12.99.5
set policy-options policy-statement p1 term a from rib inetflow.0
set policy-options policy-statement p1 term a from route-filter 10.13.0.0/16 orlonger
set policy-options policy-statement p1 term a then accept
set policy-options policy-statement p1 term b then reject
set routing-options autonomous-system 65001
```


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Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the BGP group.

```
[edit protocols bgp group core]
user@host# set family inet unicast
user@host# set family inet flow
user@host# set export p1
user@host# set peer-as 65000
user@host# set neighbor 10.12.99.5
```

2. Configure the flow policy.

```
[edit policy-options policy-statement p1]
user@host# set term a from rib inetflow.0
user@host# set term a from route-filter 10.13.0.0/16 orlonger
user@host# set term a then accept
user@host# set term b then reject
```

3. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@host# set autonomous-system 65001
```

Results

From configuration mode, confirm your configuration by entering the **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show protocols
bgp {
   group core {
      family inet {
         unicast;
         flow;
      }
      export p1;
      peer-as 65000;
      neighbor 10.12.99.5;
   }
}
```

```
[edit]
user@host# show policy-options
```

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```
policy-statement p1 {
  term a {
    from {
      rib inetflow.0;
      route-filter 10.13.0.0/16 orlonger;
    }
    then accept;
  }
  term b {
    then reject;
  }
}
```

```
[edit]
user@host# show routing-options
autonomous-system 65001;
```

If you are done configuring the device, enter **commit** from configuration mode.

Advertising All Unicast and Flow Routes

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group core family inet unicast
set protocols bgp group core family inet flow
set protocols bgp group core export p1
set protocols bgp group core peer-as 65000
set protocols bgp group core neighbor 10.12.99.5
set policy-options policy-statement p1 term a then accept
set routing-options autonomous-system 65001
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the BGP group.

```
[edit protocols bgp group core]
user@host# set family inet unicast
user@host# set family inet flow
user@host# set export p1
user@host# set peer-as 65000
user@host# set neighbor 10.12.99.5
```

2. Configure the flow policy.

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```
[edit policy-options policy-statement p1]
user@host# set term a then accept
```

3. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@host# set autonomous-system 65001
```

Results From configuration mode, confirm your configuration by entering the **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show protocols
bgp {
   group core {
      family inet {
         unicast;
         flow;
      }
      export p1;
      peer-as 65000;
      neighbor 10.12.99.5;
   }
}
```

```
[edit]
user@host# show policy-options
policy-statement p1 {
   term a {
      prefix-list inetflow;
      }
      then accept;
   }
}
```

```
[edit]
user@host# show routing-options
autonomous-system 65001;
```

If you are done configuring the device, enter **commit** from configuration mode.

Advertising No Unicast or Flow Routes

CLI Quick Configuration To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

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```
set protocols bgp group core family inet unicast
set protocols bgp group core family inet flow
set protocols bgp group core export p1
set protocols bgp group core peer-as 65000
set protocols bgp group core neighbor 10.12.99.5
set policy-options policy-statement p1 term a then reject
set routing-options autonomous-system 65001
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP peer sessions:

1. Configure the BGP group.

```
[edit protocols bgp group core]
user@host# set family inet unicast
user@host# set family inet flow
user@host# set export p1
user@host# set peer-as 65000
user@host# set neighbor 10.12.99.5
```

2. Configure the flow policy.

```
[edit policy-options policy-statement p1]
user@host# set term a then reject
```

3. Configure the local autonomous system (AS) number.

```
[edit routing-options]
user@host# set autonomous-system 65001
```

Results

From configuration mode, confirm your configuration by entering the **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show protocols
bgp {
  group core {
    family inet {
      unicast;
      flow;
    }
    export p1;
    peer-as 65000;
```


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```
    neighbor 10.12.99.5;
  }
}
```

```
[edit]
user@host# show policy-options
policy-statement p1 {
  term a {
    then reject;
  }
}
```

```
[edit]
user@host# show routing-options
autonomous-system 65001;
```

If you are done configuring the device, enter **commit** from configuration mode.

Limiting the Number of Flow Routes Installed in a Routing Table

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set routing-options rib inetflow.0 maximum-prefixes 1000
set routing-options rib inetflow.0 maximum-prefixes threshold 50
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

NOTE: Application of a route limit might result in unpredictable dynamic route protocol behavior. For example, once the limit is reached and routes are being rejected, BGP does not necessarily attempt to reinstall the rejected routes after the number of routes drops below the limit. BGP sessions might need to be cleared to resolve this issue.

To limit the flow routes:

1. Set an upper limit for the number of prefixes installed in **inetflow.0** table.

```
[edit routing-options rib inetflow.0]
user@host# set maximum-prefixes 1000
```

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2. Set a threshold value of 50 percent, where when 500 routes are installed, a warning is logged in the system log.

```
[edit routing-options rib inetflow.0]
user@host# set maximum-prefixes threshold 50
```

Results From configuration mode, confirm your configuration by entering the **show routing-options** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show routing-options
rib inetflow.0 {
   maximum-prefixes 1000 threshold 50;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Limiting the Number of Prefixes Received on a BGP Peering Session

CLI Quick Configuration To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group x1 neighbor 10.12.99.2 family inet flow prefix-limit maximum 1000
set protocols bgp group x1 neighbor 10.12.99.2 family inet flow prefix-limit teardown 50
```

Step-by-Step Procedure The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

Configuring a prefix limit for a specific neighbor provides more predictable control over which peer can advertise how many flow routes.

To limit the number of prefixes:

1. Set a limit of 1000 BGP routes from neighbor 10.12.99.2.

```
[edit protocols bgp group x1]
user@host# set neighbor 10.12.99.2 family inet flow prefix-limit maximum 1000
```

2. Configure the neighbor session to be brought down when the maximum number of prefixes is reached.

```
[edit routing-options rib inetflow.0]
user@host# set neighbor 10.12.99.2 family inet flow prefix-limit teardown 50
```


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If you specify a percentage, as shown here, messages are logged when the number of prefixes reaches that percentage.

After the session is brought down, the session reestablishes in a short time unless you include the **idle-timeout** statement.

Results From configuration mode, confirm your configuration by entering the **show protocols** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@host# show protocols
bgp {
   group x1 {
      neighbor 10.12.99.2 {
            flow {
               prefix-limit {
                  maximum 1000;
                  teardown 50;
               }
            }
         }
      }
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying the NLRI on page 699
- Verifying Routes on page 700
- Verifying Flow Validation on page 702
- Verifying Firewall Filters on page 703
- Verifying System Logging When Exceeding the Number of Allowed Flow Routes on page 703
- Verifying System Logging When Exceeding the Number of Prefixes Received on a BGP Peering Session on page 703

Verifying the NLRI

Purpose Look at the NLRI enabled for the neighbor.

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Action From operational mode, run the **show bgp neighbor 10.12.99.5** command. Look for **inet-flow** in the output.

```
user@host> show bgp neighbor 10.12.99.5
Peer: 10.12.99.5+3792 AS 65000 Local: 10.12.99.6+179 AS 65002
Type: External State: Established Flags: <Sync>
Last State: OpenConfirm Last Event: RecvKeepAlive
Last Error: None
Export: [ direct ]
Options: <Preference HoldTime AddressFamily PeerAS Refresh>
Address families configured: inet-unicast inet-multicast inet-flow
Holdtime: 90 Preference: 170
Number of flaps: 1
Error: 'Cease' Sent: 0 Recv: 1
Peer ID: 10.255.71.161 Local ID: 10.255.124.107 Active Holdtime: 90
Keepalive Interval: 30 Peer index: 0
Local Interface: e1-3/0/0.0
NLRI advertised by peer: inet-unicast inet-multicast inet-flow
NLRI for this session: inet-unicast inet-multicast inet-flow
Peer supports Refresh capability (2)
Table inet.0 Bit: 10000
RIB State: BGP restart is complete
Send state: in sync
Active prefixes: 2
Received prefixes: 2
Suppressed due to damping: 0
Advertised prefixes: 3
Table inet.2 Bit: 20000
RIB State: BGP restart is complete
Send state: in sync
Active prefixes: 0
Received prefixes: 0
Suppressed due to damping: 0
Advertised prefixes: 0
Table inetflow.0 Bit: 30000
RIB State: BGP restart is complete
Send state: in sync
Active prefixes: 0
Received prefixes: 0
Suppressed due to damping: 0
Advertised prefixes: 0
Last traffic (seconds): Received 29 Sent 15 Checked 15
Input messages: Total 5549 Updates 2618 Refreshes 0 Octets 416486
Output messages: Total 2943 Updates 1 Refreshes 0 Octets 55995
Output Queue[0]: 0
Output Queue[1]: 0
Output Queue[2]: 0
```

Verifying Routes

Purpose Look at the flow routes. The sample output shows a flow route learned from BGP and a statically configured flow route.

For locally configured flow routes (configured at the **[edit routing-options flow]** hierarchy level), the routes are installed by the flow protocol. Therefore, you can display the flow routes by specifying the table, as in **show route table inetflow.0** or **show route table**

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instance-name.inetflow.0, where *instance-name* is the routing instance name. Or, you can display all locally configured flow routes across multiple routing instances by running the **show route protocol flow** command.

If a flow route is not locally configured, but received from the router's BGP peer, this flow route is installed in the routing table by BGP. You can display the flow routes by specifying the table or by running **show route protocol bgp**, which displays all BGP routes (flow and non-flow).

Action From operational mode, run the **show route table inetflow.0** command.

```
user@host> show route table inetflow.0
```

```
inetflow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100.100.100.100,*,proto=1,icmp-type=8/term:1
                   *[BGP/170] 00:00:18, localpref 100, from 100.0.12.2
                      AS path: 2000 I, validation-state: unverified
                      Fictitious
200.200.200.200,*,proto=6,port=80/term:2
                   *[BGP/170] 00:00:18, localpref 100, from 100.0.12.2
                      AS path: 2000 I, validation-state: unverified
                      Fictitious
```

```
user@host> show route table inetflow.0 extensive
```

```
inetflow.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
7.7.7.7,8.8.8.8/term:1 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Action(s): accept,count
        *Flow   Preference: 5
                Next hop type: Fictitious
                Address: 0x8d383a4
                Next-hop reference count: 3
                State: <Active>
                Local AS: 65000
                Age: 9:50
                Task: RT Flow
                Announcement bits (1): 0-Flow
                AS path: I
```

```
user@host> show route hidden
```

```
inetflow.0: 2 destinations, 2 routes (0 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

100.100.100.100,*,proto=1,icmp-type=8/term:N/A
                    [BGP ] 00:00:17, localpref 100, from 100.0.12.2
                      AS path: 2000 I, validation-state: unverified
                      Fictitious
200.200.200.200,*,proto=6,port=80/term:N/A
                    [BGP ] 00:00:17, localpref 100, from 100.0.12.2
```

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```
                    AS path: 2000 I, validation-state: unverified
                    Fictitious
```

Meaning A flow route represents a term of a firewall filter. When you configure a flow route, you specify the match conditions and the actions. In the match attributes, you can match a source address, a destination address, and other qualifiers such as the port and the protocol. For a single flow route that contains multiple match conditions, all the match conditions are encapsulated in the prefix field of the route. When you issue the **show route** command on a flow route, the prefix field of the route is displayed with all of the match conditions. **10.12.44.1,*** means that the matching condition is **match destination 10.12.44.1/32**. If the prefix in the output were ***,10.12.44.1**, this would mean that the match condition was **match source 10.12.44.1/32**. If the matching conditions contain both a source and a destination, the asterisk is replaced with the address.

The term-order numbers indicate the sequence of the terms (flow routes) being evaluated in the firewall filter. The **show route extensive** command displays the actions for each term (route).

Verifying Flow Validation

Purpose Display flow route information.

Action From operational mode, run the show route flow validation **detail** command.

```
user@host> show route flow validation detail
```

```
inet.0:
0.0.0.0/0
                Internal node: best match, inconsistent
10.0.0.0/8
                Internal node: no match, inconsistent
10.12.42.0/24
                Internal node: no match, consistent, next-as: 65003
                Active unicast route
                    Dependent flow destinations: 1
                    Origin: 10.255.124.106, Neighbor AS: 65003
10.12.42.1/32
                Flow destination (1 entries, 1 match origin)
                    Unicast best match: 10.12.42.0/24
                    Flags: Consistent
10.131.0.0/16
                Internal node: no match, consistent, next-as: 65001
                Active unicast route
                    Dependent flow destinations: 5000
                    Origin: 10.12.99.2, Neighbor AS: 65001
10.131.0.0/19
                Internal node: best match
10.131.0.0/20
```


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```
                Internal node: best match
10.131.0.0/21
```

Verifying Firewall Filters

Purpose Display the firewall filters that are installed in the kernel.

Action From operational mode, run the **show firewall** command.

```
user@host> show firewall
```

```
Filter: __default_bpdu_filter__
Filter: __flowspec_default_inet__
Counters:
Name                                                Bytes              Packets
10.12.42.1,*                                            0                    0
196.1.28/23,*                                           0                    0
196.1.30/24,*                                           0                    0
196.1.31/24,*                                           0                    0
196.1.32/24,*                                           0                    0
196.1.56/21,*                                           0                    0
196.1.68/24,*                                           0                    0
196.1.69/24,*                                           0                    0
196.1.70/24,*                                           0                    0
196.1.75/24,*                                           0                    0
196.1.76/24,*                                           0                    0
```

Verifying System Logging When Exceeding the Number of Allowed Flow Routes

Purpose If you configure a limit on the number of flow routes installed, as described in "Limiting the Number of Flow Routes Installed in a Routing Table" on page 697, view the system log message when the threshold is reached.

Action From operational mode, run the **show log <log-filename>** command.

```
user@host> show log flow-routes-log-file
```

```
Jul 12 08:19:01  host rpd[2748]: RPD_RT_MAXROUTES_WARN: Number of routes (1000)
in
table inetflow.0 exceeded warning threshold (50 percent of configured maximum
1000)
```

Verifying System Logging When Exceeding the Number of Prefixes Received on a BGP Peering Session

Purpose If you configure a limit on the number of flow routes installed, as described in "Limiting the Number of Prefixes Received on a BGP Peering Session" on page 698, view the system log message when the threshold is reached.

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Action From operational mode, run the **show log <log-filename>** command.

```
user@host> show log flow-routes-log-file
Jul 12 08:44:47  host rpd[2748]: 10.12.99.2 (External AS 65001): Shutting down
peer due to
exceeding configured maximum  prefix-limit(1000) for inet-flow nlri: 1001
```

Related Documentation

- Understanding BGP Flow Routes for Traffic Filtering on page 683

Example: Configuring BGP to Carry IPv6 Flow Specification Routes

This example shows how to configure IPv6 flow specification for traffic filtering. BGP flow specification can be used to automate inter-domain and intra-domain coordination of traffic filtering rules in order to mitigate denial-of-service attacks.

- Requirements on page 704
- Overview on page 704
- Configuration on page 705
- Verification on page 709

Requirements

This example uses the following hardware and software components:

- Two MX Series routers
- Junos OS Release 16.1 or later

Before you enable BGP to carry IPv6 flow specification routes:

1. Configure IP addresses on the device interfaces.
2. Configure BGP.
3. Configure a routing policy that exports routes (such as static routes, direct routes, or IGP routes) from the routing table into BGP.

Overview

Flow specification provides protection against denial-of-service attacks and restricts bad traffic that consumes the bandwidth and stops it near the source. In earlier Junos OS releases, flow specification rules were propagated for IPv4 over BGP as network layer reachability information. Beginning with Junos OS Release 16.1, the flow specification feature is supported on the IPv6 family and allows propagation of traffic flow specification rules for IPv6 and IPv6 VPN.

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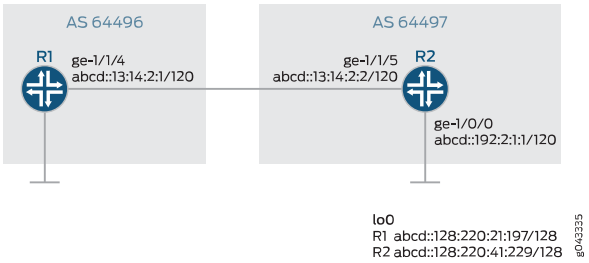
Topology

Figure 63 on page 705 shows the sample topology. Router R1 and Router R2 belong to different autonomous systems. IPv6 flow specification is configured on Router R2. All incoming traffic is filtered based on the flow specification conditions, and the traffic is treated differently depending on the specified action. In this example, all traffic heading to abcd::11:11:11:10/128 that matches the flow specification conditions is discarded; whereas, traffic destined to abcd::11:11:11:30/128 and matching the flow specification conditions is accepted.

Figure 63: Configuring BGP to Carry IPv6 Flow Routes



Configuration

- Configuring Router R2 on page 706
- Results on page 708

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router R1

```
set interfaces ge-1/1/4 unit 0 family inet6 address abcd::13:14:2:1/120
set interfaces lo0 unit 0 family inet6 address abcd::128:220:21:197/128
set routing-options router-id 128.220.21.197
set routing-options autonomous-system 64496
set protocols bgp group ebgp type external
set protocols bgp group ebgp family inet6 unicast
set protocols bgp group ebgp family inet6 flow
set protocols bgp group ebgp peer-as 64497
set protocols bgp group ebgp neighbor abcd::13:14:2:2
```

Router R2

```
set interfaces ge-1/0/0 unit 0 family inet6 address abcd::192:2:1:1/120
set interfaces ge-1/1/5 unit 0 family inet6 address abcd::13:14:2:2/120
set interfaces lo0 unit 0 family inet6 address abcd::128:220:41:229/128
set routing-options rib inet6.0 static route abcd::11:11:11:0/120 next-hop abcd::192:2:1:2
set routing-options rib inet6.0 flow route route-1 match destination abcd::11:11:11:10/128
set routing-options rib inet6.0 flow route route-1 match protocol tcp
set routing-options rib inet6.0 flow route route-1 match destination-port http
set routing-options rib inet6.0 flow route route-1 match source-port 65535
```

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```
set routing-options rib inet6.0 flow route route-1 then discard
set routing-options rib inet6.0 flow route route-2 match destination abcd::11:11:11:30/128
set routing-options rib inet6.0 flow route route-2 match icmp6-type echo-request
set routing-options rib inet6.0 flow route route-2 match packet-length 100
set routing-options rib inet6.0 flow route route-2 match dscp 10
set routing-options rib inet6.0 flow route route-2 then accept
set routing-options router-id 128.220.41.229
set routing-options autonomous-system 64497
set protocols bgp group ebgp type external
set protocols bgp group ebgp family inet6 unicast
set protocols bgp group ebgp family inet6 flow
set protocols bgp group ebgp export redis
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp neighbor abcd::13:14:2:1
set policy-options policy-statement redis from protocol static
set policy-options policy-statement redis then accept
```

Configuring Router R2

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R2:

NOTE: Repeat this procedure for Router R1 after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv6 addresses.

```
[edit interfaces]
user@R2# set ge-1/0/0 unit 0 family inet6 address abcd::192:2:1:1/120
user@R2# set ge-1/1/5 unit 0 family inet6 address abcd::13:14:2:2/120
```

2. Configure the IPv6 loopback address.

```
[edit interfaces]
user@R2# set lo0 unit 0 family inet6 address abcd::128:220:41:229/128
```

3. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R2# set router-id 128.220.41.229
user@R2# set autonomous-system 64497
```

4. Configure an EBGP peering session between Router R1 and Router R2.

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```
[edit protocols]
user@R2# set bgp group ebgp type external
user@R2# set bgp group ebgp family inet6 unicast
user@R2# set bgp group ebgp family inet6 flow
user@R2# set bgp group ebgp export redis
user@R2# set bgp group ebgp peer-as 64496
user@R2# set bgp group ebgp neighbor abcd::13:14:2:1
```

5. Configure a static route and a next hop. Thus a route is added to the routing table to verify the feature in this example.

```
[edit routing-options]
user@R2# set rib inet6.0 static route abcd::11:11:11:0/120 next-hop abcd::192:2:1:2
```

6. Specify flow specification conditions.

```
[edit routing-options]
user@R2# set rib inet6.0 flow route route-1 match destination abcd::11:11:11:10/128
user@R2# set rib inet6.0 flow route route-1 match protocol tcp
user@R2# set rib inet6.0 flow route route-1 match destination-port http
user@R2# set rib inet6.0 flow route route-1 match source-port 65535
```

7. Configure a **discard** action to discard packets that match the specified match conditions.

```
[edit routing-options]
user@R2# set rib inet6.0 flow route route-1 then discard
```

8. Specify flow specification conditions.

```
[edit routing-options]
user@R2# set rib inet6.0 flow route route-2 match destination abcd::11:11:11:30/128
user@R2# set rib inet6.0 flow route route-2 match icmp6-type echo-request
user@R2# set rib inet6.0 flow route route-2 match packet-length 100
user@R2# set rib inet6.0 flow route route-2 match dscp 10
```

9. Configure an **accept** action to accept packets that match the specified match conditions

```
[edit routing-options]
user@R2# set rib inet6.0 flow route route-2 then accept
```

10. Define a policy that allows BGP to accept static routes.

```
[edit policy-options]
user@R2# set policy-statement redis from protocol static
user@R2# set policy-statement redis then accept
```

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Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R2# show interfaces
ge-1/0/0 {
   unit 0 {
      family inet6 {
         address abcd::192:2:1:1/120;
      }
   }
}
ge-1/1/5 {
   unit 0 {
      family inet6 {
         address abcd::13:14:2:2/120;
      }
   }
}
lo0 {
   unit 0 {
      family inet6 {
         address abcd::128:220:41:229/128;
      }
   }
}
```

```
[edit]
user@R2# show protocols
bgp {
   group ebgp {
      type external;
      family inet6 {
         unicast;
         flow;
      }
      export redis;
      peer-as 64496;
      neighbor abcd::13:14:2:1;
   }
}
```

```
[edit]
user@R2# show routing-options
rib inet6.0 {
   static {
      route abcd::11:11:11:0/120 next-hop abcd::192:2:1:2;
   }
```


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```
    flow {
      route route-1 {
        match {
          destination abcd::11:11:11:10/128;
          protocol tcp;
          destination-port http;
          source-port 65535;
        }
        then discard;
      }
      route route-2 {
        match {
          destination abcd::11:11:11:30/128;
          icmp6-type echo-request;
          packet-length 100;
          dscp 10;
        }
        then accept;
      }
    }
}
router-id 128.220.41.229;
autonomous-system 64497;
```

```
[edit]
user@R2# show policy-options
policy-statement redis {
   from protocol static;
   then accept;
}
```

Verification

Confirm that the configuration is working properly.

- Verifying the Presence of IPv6 Flow Specification Routes in the inet6flow Table on page 709
- Verifying BGP Summary Information on page 711
- Verifying Flow Validation on page 712
- Verifying the Flow Specification of IPv6 Routes on page 713

Verifying the Presence of IPv6 Flow Specification Routes in the inet6flow Table

Purpose Display the routes in the **inet6flow** table in Router R1 and R2, and verify that BGP has learned the flow routes.

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Action From operational mode, run the **show route table inet6flow.0 extensive** command on Router R1.

```
user@R1> show route table inet6flow.0 extensive
```

```
inet6flow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
abcd::11:11:11:10/128,*,proto=6,dstport=80,srcport=65535/term:1 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Action(s): discard,count
        *BGP    Preference: 170/-101
                Next hop type: Fictitious, Next hop index: 0
                Address: 0x9b24064
                Next-hop reference count: 2
                State:<Active Ext>
                Local AS:   64496 Peer AS:  64497
                Age: 20:55
                Validation State: unverified
                Task: BGP_64497.abcd::13:14:2:2
                Announcement bits (1): 0-Flow
                AS path: 64497 I
                Communities: traffic-rate:64497:0
                Accepted
                Validation state: Accept, Originator: abcd::13:14:2:2, Nbr AS:
64497
                Via: abcd::11:11:11:0/120, Active
                Localpref: 100
                Router ID: 128.220.41.229
```

```
abcd::11:11:11:30/128,*,icmp6-type=128,len=100,dscp=10/term:2 (1 entry, 1 announced)

TSI:
KRT in dfwd;
Action(s): accept,count
        *BGP    Preference: 170/-101
                Next hop type: Fictitious, Next hop index: 0
                Address: 0x9b24064
                Next-hop reference count: 2
                State:  <Active Ext>
                Local AS:   64496 Peer AS:  64497
                Age: 12:51
                Validation State: unverified
                Task: BGP_64497.abcd::13:14:2:2
                Announcement bits (1): 0-Flow
                AS path: 64497 I
                Accepted
                Validation state: Accept, Originator: abcd::13:14:2:2, Nbr AS:
64497
                Via: abcd::11:11:11:0/120, Active
                Localpref: 100
                Router ID: 128.220.41.229
```

From operational mode, run the **show route table inet6flow.0 extensive** command on Router R2.

```
user@R2> show route table inet6flow.0 extensive
```


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```
inet6flow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
abcd::11:11:11:10/128,*,proto=6,dstport=80,srcport=65535/term:1 (1 entry, 1 announced)

TSI:
KRT in dfwd;
Action(s): discard,count
Page 0 idx 0, (group pe-v6 type External) Type 1 val 0xaec8850 (adv_entry)
   Advertised metrics:
     Nexthop: Self
     AS path: [64497]
     Communities: traffic-rate:64497:0
Path abcd::11:11:11:10/128,*,proto=6,dstport=80,srcport=65535 Vector len 4.  Val:
 0
        *Flow   Preference: 5
                Next hop type: Fictitious, Next hop index: 0
                Address: 0x9b24064
                Next-hop reference count: 3
                State:  <Active>
                Local AS:  64497
                Age: 14:21
                Validation State: unverified
                Task: RT Flow
                Announcement bits (2): 0-Flow 1-BGP_RT_Background
                AS path: I
                Communities: traffic-rate:64497:0
```

```
abcd::11:11:11:30/128,*,proto=17,port=65535/term:2 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Action(s): accept,count
Page 0 idx 0, (group pe-v6 type External) Type 1 val 0xaec8930 (adv_entry)
 Advertised metrics:
  Nexthop: Self
  AS path: [64497]
  Communities:
Path abcd::11:11:11:30/128,*,proto=17,port=65535 Vector len 4.  Val: 0
*Flow   Preference: 5
    Next hop type: Fictitious, Next hop index: 0
    Address: 0x9b24064
    Next-hop reference count: 3
    State: <Active>
    Local AS:  64497
    Age: 14:21
    Validation State: unverified
    Task: RT Flow
    Announcement bits (2): 0-Flow 1-BGP_RT_Background
    AS path: I
```

Meaning The presence of routes abcd::11:11:11:10/128 and abcd::11:11:11:30/128 in the **inet6flow** table confirms that BGP has learned the flow routes.

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

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Action From operational mode, run the **show bgp summary** command on Router R1 and R2.

```
user@R1> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0
                       1          1          0          0          0          0
inet6flow.0
                       2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
abcd::13:14:2:2        2000         58         58       0       2       19:48
Establ
  inet6.0: 1/1/1/0
  inet6flow.0: 2/2/2/0
```

```
user@R2> show bgp summary

 Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet6.0
                       0          0          0          0          0          0
inet6flow.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
abcd::13:14:2:1         64496         51         52       0       0       23:03
Establ
  inet6.0: 0/0/0/0
  inet6flow.0: 0/0/0/0
```

Meaning Verify that the **inet6.0** table contains the BGP neighbor address and a peering session has been established with its BGP neighbor.

Verifying Flow Validation

Purpose Display flow route information.

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Action From operational mode, run the **show route flow validation** command on Router R1.

```
user@R1> show route flow validation
inet6.0:
abcd::11:11:11:0/120
                Active unicast route
                    Dependent flow destinations: 2
                    Origin: abcd::13:14:2:2, Neighbor AS: 64497
abcd::11:11:11:10/128
                Flow destination (1 entries, 1 match origin, next-as)
                    Unicast best match: abcd::11:11:11:0/120
                    Flags: Consistent
abcd::11:11:11:30/128
                Flow destination (1 entries, 1 match origin, next-as)
                    Unicast best match: abcd::11:11:11:0/120
                    Flags: Consistent
```

Meaning The output displays the flow routes in the **inet6.0** table.

Verifying the Flow Specification of IPv6 Routes

Purpose Display the number of packets that are discarded and accepted based on the specified flow specification routes.

Action From operational mode, run the **show firewall filter_flowspec_default_inet6_** command on Router R2.

```
user@R2> show firewall filter __flowspec_default_inet6__
Filter: __flowspec_default_inet6__
Counters:
Name                                                                  Bytes
       Packets
abcd::11:11:11:10/128,*,proto=6,dstport=80,srcport=65535            0
     0
abcd::11:11:11:30/128,*,proto=17,port=65535                    6395472
 88826
```

Meaning The output indicates that packets destined to abcd::11:11:11:10/128 are discarded and 88826 packets have been accepted for the route abcd::11:11:11:11:30/128.

Related Documentation

- flow on page 1174

Configuring BGP Flow Specification Action Redirect to IP to Filter DDoS Traffic

Starting in Junos OS Release 18.4R1, BGP flow specification as described in BGP Flow-Spec Internet draft draft-ietf-idr-flowspec-redirect-ip-02.txt, *Redirect to IP Action* is supported. Redirect to IP action uses extended BGP community to provide traffic filtering options for DDoS mitigation in service provider networks. Legacy flow specification redirect to IP uses the BGP nexthop attribute. Junos OS advertises redirect to IP flow specification action using the extended community by default. This feature is required to support service chaining in virtual service control gateway (vSCG). Redirect to IP action allows to divert matching flow specification traffic to a globally reachable address that could be connected to a filtering device that can filter the DDoS traffic and send the clean traffic to the egress device.

Before you begin redirecting traffic to IP for BGP flow specification routes, do the following:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure MPLS and LDP.
4. Configure BGP.

Configure the redirect to IP feature using the BGP extended community.

1. Configure redirect to IP action for static IPv4 flow specification routes as specified in the BGP Flow-Spec Internet draft draft-ietf-idr-flowspec-redirect-ip-02.txt, *Redirect to IP Action* .

   Junos OS advertises redirect to IP flow specification action using the extended community redirect to IP by default. The ingress device detects and sends the DDoS traffic to the specified IP address.

   ```
   [edit routing-options flow route then]
   user@host# set redirect ipv4-address
   ```

   For example, redirect the DDoS traffic to IPv4 address 10.1.1.1.

   ```
   [edit routing-options flow route then]
   user@host# set redirect 10.1.1.1.1
   ```

2. Configure redirect to IP action for static IPv6 flow specification routes.

   ```
   [edit routing-options flow route then]
   user@host# set redirect ipv6-address
   ```

   For example, redirect the DDoS traffic to IPv6 address 1002:db8::

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```
[edit routing-options flow route then]
user@host# set redirect 2001:db8::
```

3. Define a policy to filter traffic from a specific BGP community.

```
[edit policy-options]
user@host# policy-statement policy-name
user@host# from community community-ids
user@host# community community-ids members
  extended-community-type:administrator:assigned number
```

For example, define a policy p1 to filter traffic from BGP community redirip.

```
[edit policy-options]
user@host# policy-statement p1
user@host# from community redirip
user@host# community redirip members redirect-to-ip :10.1.1.1:0
```

4. Define a policy to set, add, or delete a BGP community and specify the extended community.

```
[edit policy-options]
user@host# policy-statement policy-name
user@host# then community set community-ids
user@host# then community add community-ids
user@host# then community deletecommunity-ids
user@host# community community-ids members
  extended-community-type:administrator:assigned number
```

For example, define a policy p1 to set, add, or delete a community reidirip and an extended community to redirect traffic to IP address 10.1.1.1.

```
[edit policy-options]
user@host# policy-statement p1
user@host# then community set redirip
user@host# then community add redirip
user@host# then community deleteredirip
user@host# community redirip members redirect-to-ip:10.1.1.1:0
```

5. Configure BGP to use VRF.inet.0 table to resolve VRF flow specification routes include statement at the hierarchy level.

```
[edit protocols bgp neighbor family flow]
user@host# set secondary-independent-resolution
```

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Configure the legacy flow specification redirect to IP feature using the nexthop attribute.

NOTE: You cannot configure policies to redirect traffic to an IP address using BGP extended community and the legacy redirect to next hop IP address together.

1. Configure legacy flow specification redirect to IP specified in the internet draft draft-ietf-idr-flowspec-redirect-ip-00.txt , *BGP Flow-Spec Extended Community for Traffic Redirect to IP Next Hop* include at the hierarchy level.

   ```
   [edit group bgp-group neighbor bgp neighbor family inet flow]
   user@host# set legacy-redirect-ip-action
   ```

2. Define a policy to match the next hop attribute.

   ```
   [edit policy options]
   user@host#policy statement policy_name
   user@host#from community community-name
   user@host#from next-hop ip-address
   ```

   For example, define a policy p1 to redirect traffic to next hop IP address 10.1.1.1.

   ```
   [edit policy options]
   user@host#policy statement p1
   user@host#from community redirnh
   user@host#from next-hop 10.1.1.1
   ```

3. Define a policy to set, add, or delete the BGP community using the legacy flow specification next hop attribute redirect to IP action.

   ```
   [edit policy-options]
   user@host# policy-statement policy_name
   user@host# then community set community-name
   user@host# then community add community-name
   user@host# then community delete community-name
   user@host# then next-hop next-hop-address
   ```

   For example, define a policy p1 and set, add, or delete a BGP community redirnh to redirect the DDoS traffic to the the next hop IP address 10.1.1.1.

   ```
   [edit policy-options policy-statement p1]
   user@host# then community set redirnh
   user@host# then community add redirnh
   user@host# then community delete redirnh
   user@host# then next-hop 10.1.1.1
   ```

Related Documentation

- Understanding BGP Flow Routes for Traffic Filtering on page 683
- show route table on page 1687

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PART 10

Configuring BGP CLNS

- Enabling CLNS for BGP Sessions on page 719

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CHAPTER 16

Enabling CLNS for BGP Sessions

- Understanding BGP for CLNS VPNs on page 719
- Example: Configuring BGP for CLNS VPNs on page 720
- Enabling BGP to Carry CLNS Routes on page 722

Understanding BGP for CLNS VPNs

BGP extensions allow BGP to carry Connectionless Network Service (CLNS) virtual private network (VPN) network layer reachability information (NLRI) between provider edge (PE) routers. Each CLNS route is encapsulated into a CLNS VPN NLRI and propagated between remote sites in a VPN.

CLNS is a Layer 3 protocol similar to IP version 4 (IPv4). CLNS uses network service access points (NSAPs) to address end systems. This allows for a seamless autonomous system (AS) based on International Organization for Standardization (ISO) NSAPs.

A single routing domain consisting of ISO NSAP devices are considered to be CLNS islands. CLNS islands are connected together by VPNs.

You can configure BGP to exchange ISO CLNS routes between PE routers connecting various CLNS islands in a VPN using multiprotocol BGP extensions. These extensions are the ISO VPN NLRIs.

Each CLNS network island is treated as a separate VPN routing and forwarding instance (VRF) instance on the PE router.

You can configure CLNS on the global level, group level, and neighbor level.

Related Documentation

- *CLNS Overview*
- Example: Configuring BGP for CLNS VPNs on page 720

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Example: Configuring BGP for CLNS VPNs

This example shows how to create a BGP group for CLNS VPNs, define the BGP peer neighbor address for the group, and define the family.

- Requirements on page 720
- Overview on page 720
- Configuration on page 720
- Verification on page 721

Requirements

Before you begin, configure the network interfaces. See the *Interfaces Feature Guide for Security Devices*.

Overview

In this example, you create the BGP group called pedge-pedge, define the BGP peer neighbor address for the group as 10.255.245.215, and define the BGP family.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

```
set protocols bgp group pedge-pedge neighbor 10.255.245.213
set protocols bgp family iso-vpn unicast
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode*.

To configure BGP for CLNS VPNs:

1. Configure the BGP group and define the BGP peer neighbor address.

   ```
   [edit protocols bgp]
   user@host# set group pedge-pedge neighbor 10.255.245.213
   ```

2. Define the family.

   ```
   [edit protocols bgp]
   user@host# set family iso-vpn unicast
   ```

3. If you are done configuring the device, commit the configuration.

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```
[edit]
user@host# commit
```

Verification

Verifying the Neighbor Status

Purpose Display information about the BGP peer.

Action From operational mode, run the **show bgp neighbor 10.255.245.213** command. Look for **iso-vpn-unicast** in the output.

```
user@host> show bgp neighbor 10.255.245.213
Peer: 10.255.245.213+179 AS 200 Local: 10.255.245.214+3770 AS 100
Type: External State: Established Flags: <ImportEval Sync>
Last State: OpenConfirm Last Event: RecvKeepAlive
Last Error: None
Options: <Multihop Preference LocalAddress HoldTime AddressFamily PeerAS
Rib-group Refresh>
Address families configured: iso-vpn-unicast
Local Address: 10.255.245.214 Holdtime: 90 Preference: 170
Number of flaps: 0
Peer ID: 10.255.245.213 Local ID: 10.255.245.214 Active Holdtime: 90
Keepalive Interval: 30 Peer index: 0
NLRI advertised by peer: iso-vpn-unicast
NLRI for this session: iso-vpn-unicast
Peer supports Refresh capability (2)
Table bgp.isovpn.0 Bit: 10000
RIB State: BGP restart is complete
RIB State: VPN restart is complete
Send state: in sync
Active prefixes: 3
Received prefixes: 3
Suppressed due to damping: 0
Advertised prefixes: 3
Table aaaa.iso.0
RIB State: BGP restart is complete
RIB State: VPN restart is complete
Send state: not advertising
Active prefixes: 3
Received prefixes: 3
Suppressed due to damping: 0
Last traffic (seconds): Received 6 Sent 5 Checked 5
Input messages: Total 1736 Updates 4 Refreshes 0 Octets 33385
Output messages: Total 1738 Updates 3 Refreshes 0 Octets 33305
Output Queue[0]: 0
Output Queue[1]: 0
```

Related Documentation

- *CLNS Configuration Overview*
- Understanding BGP for CLNS VPNs on page 719
- *Verifying a CLNS VPN Configuration*

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Enabling BGP to Carry CLNS Routes

Connectionless Network Service (CLNS) is a Layer 3 protocol similar to IP version 4 (IPv4). CLNS uses network service access points (NSAPs) to address end systems. This allows for a seamless autonomous system (AS) based on International Organization for Standardization (ISO) NSAPs.

Platform support for CLNS depends on the Junos OS release in your installation.

A single routing domain consisting of ISO NSAP devices are considered to be CLNS islands. CLNS islands are connected together by VPNs.

You can configure BGP to exchange ISO CLNS routes between provider edge (PE) routers connecting various CLNS islands in a virtual private network (VPN) using multiprotocol BGP extensions. These extensions are the ISO VPN NLRIs.

To enable multiprotocol BGP (MP-BGP) to carry CLNS VPN NLRIs, include the **iso-vpn** statement:

```
iso-vpn {
  unicast {
    prefix-limit number;
    rib-group group-name;
  }
}
```

To limit the number of prefixes from a peer, include the **prefix-limit** statement. To specify a routing table group, include the **rib-group** statement.

For a list of hierarchy levels at which you can include this statement, see the statement summary section for this statement.

Each CLNS network island is treated as a separate VRF instance on the PE router.

You can configure CLNS on the global level, group level, and neighbor level.

For sample configurations, see the following sections:

- Example: Enabling CLNS Between Two Routers on page 722
- Example: Configuring CLNS Within a VPN on page 724

Example: Enabling CLNS Between Two Routers

Configure CLNS between two routers through a route reflector:

```
On Router 1:
protocols {
  bgp {
    local-address 10.255.245.195;
    group pe-pe {
      type internal;
      neighbor 10.255.245.194 {
```


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```
            family iso-vpn {
               unicast;
            }
         }
      }
   }
}
routing-instances {
   aaaa {
      instance-type vrf;
      interface fe-0/0/0.0;
      interface so-1/1/0.0;
      interface lo0.1;
      route-distinguisher 10.255.245.194:1;
      vrf-target target:11111:1;
      protocols {
         isis {
            export dist-bgp;
            no-ipv4-routing;
            no-ipv6-routing;
            clns-routing;
            interface all;
         }
      }
   }
}
```

On Router 2:

```
protocols {
   bgp {
      group pe-pe {
         type internal;
         local-address 10.255.245.198;
         family route-target;
         neighbor 10.255.245.194 {
            family iso-vpn {
               unicast;
            }
         }
      }
   }
}
routing-instances {
   aaaa {
      instance-type vrf;
      interface lo0.1;
      interface so-0/1/2.0;
      interface so-0/1/3.0;
      route-distinguisher 10.255.245.194:1;
      vrf-target target:11111:1;
      routing-options {
         rib aaaa.iso.0 {
            static {
               iso-route 47.0005.80ff.f800.0000.bbbb.1022/104 next-hop
                  47.0005.80ff.f800.0000.aaaa.1000.1921.6800.4196.00;
            }
```

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```
        }
      }
      protocols {
        isis {
          export dist-bgp;
          no-ipv4-routing;
          no-ipv6-routing;
          clns-routing;
          interface all;
        }
      }
    }
}
On Route Reflector:
protocols {
    bgp {
      group pe-pe {
        type internal;
        local-address 10.255.245.194;
        family route-target;
        neighbor 10.255.245.195 {
          cluster 0.0.0.1;
        }
        neighbor 10.255.245.198 {
          cluster 0.0.0.1;
        }
      }
    }
}
```

Example: Configuring CLNS Within a VPN

Configure CLNS on three PE routers within a VPN:

```
On PE Router 1:
protocols {
    mpls {
      interface all;
    }
    bgp {
      group asbr {
        type external;
        local-address 10.245.245.3;
        neighbor 10.245.245.1 {
          multihop;
          family iso-vpn {
            unicast;
          }
          peer-as 200;
        }
      }
    }
}
routing-instances {
```


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```
    aaaa {
      instance-type vrf;
      interface lo0.1;
      interface t1-3/0/0.0;
      interface fe-5/0/1.0;
      route-distinguisher 10.245.245.1:1;
      vrf-target target:11111:1;
      protocols {
        isis {
          export dist-bgp;
          no-ipv4-routing;
          no-ipv6-routing;
          clns-routing;
          interface all;
        }
      }
    }
}
```

On PE Router 2:

```
protocols {
    bgp {
      group asbr {
        type external;
        multihop;
        family iso-vpn {
          unicast;
        }
        neighbor 10.245.245.2 {
          peer-as 300;
        }
        neighbor 10.245.245.3 {
          peer-as 100;
        }
      }
    }
}
routing-instances {
    aaaa {
      instance-type vrf;
      interface lo0.1;
      route-distinguisher 10.245.245.1:1;
      vrf-target target:11111:1;
    }
}
```

On PE Router 3:

```
protocols {
    bgp {
      group asbr {
        type external;
        multihop;
        local-address 10.245.245.2;
        neighbor 10.245.245.1 {
          family iso-vpn {
            unicast;
          }
```

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```
            peer-as 200;
        }
    }
  }
}
routing-instances {
  aaaa {
    instance-type vrf;
    interface lo0.1;
    interface fe-0/0/1.0;
    interface t1-3/0/0.0;
    route-distinguisher 10.245.245.1:1;
    vrf-target target:11111:1;
    protocols {
      isis {
        export dist-bgp;
        no-ipv6-routing;
        clns-routing;
        interface all;
      }
    }
  }
}
```

Related Documentation

- Example: Configuring BGP for CLNS VPNs on page 720

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PART 11

Configuring IBGP Scaling

- Using Route Reflectors for BGP Networks on page 729
- Configuring BGP Route Server on page 765

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CHAPTER 17

Using Route Reflectors for BGP Networks

- Understanding BGP Route Reflectors on page 729
- Example: Configuring a Route Reflector on page 732
- Understanding a Route Reflector That Belongs to Two Different Clusters on page 748
- Example: Configuring a Route Reflector That Belongs to Two Different Clusters on page 750
- Understanding BGP Confederations on page 754
- Example: Configuring BGP Confederations on page 755
- Understanding BGP Optimal Route Reflection on page 761
- Configuring BGP Optimal Route Reflection on a Route Reflector to Advertise the Best Path on page 762

Understanding BGP Route Reflectors

This topic discusses using route reflectors to simplify configuration and aid in scaling. A further way to reduce the workload on a route reflector that is not in the traffic-forwarding path is to use the **no-install** statement at the **[edit protocols bgp family *family-name*]** hierarchy level. Starting in Junos OS Release 15.1, the **no-install** statement eliminates interaction between the routing protocols daemon (rpd) and other components in the Junos system such as the kernel or the distributed firewall daemon (dfwd). This interaction is eliminated by prohibiting any routes in the associated rpd routing information bases (RIBs), also known as routing tables, from being published to those components.

NOTE: **In releases previous to Junos OS Release 15.1, you can reduce the workload on a route reflector that is not in the traffic-forwarding path by using a forwarding-table export policy that rejects routes learned from BGP.**

Because of the internal BGP (IBGP) full-mesh requirement, most networks use route reflectors to simplify configuration. The formula to compute the number of sessions required for a full mesh is v * (v - 1)/2, where v is the number of BGP-enabled devices. The full-mesh model does not scale well. Using a route reflector, you group routers into clusters, which are identified by numeric identifiers unique to the autonomous system (AS). Within the cluster, you must configure a BGP session from a single router (the route

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reflector) to each internal peer. With this configuration, the IBGP full-mesh requirement is met.

To use route reflection in an AS, you designate one or more routers as a route reflector—typically, one per point of presence (POP). Route reflectors have the special BGP ability to readvertise routes learned from an internal peer to other internal peers. So rather than requiring all internal peers to be fully meshed with each other, route reflection requires only that the route reflector be fully meshed with all internal peers. The route reflector and all of its internal peers form a cluster, as shown in Figure 64 on page 730.

NOTE: For some Juniper Networks devices, you must have an Advanced BGP Feature license installed on each device that uses a route reflector. For license details, see the *Software Installation and Upgrade Guide*.

Figure 64: Simple Route Reflector Topology (One Cluster)

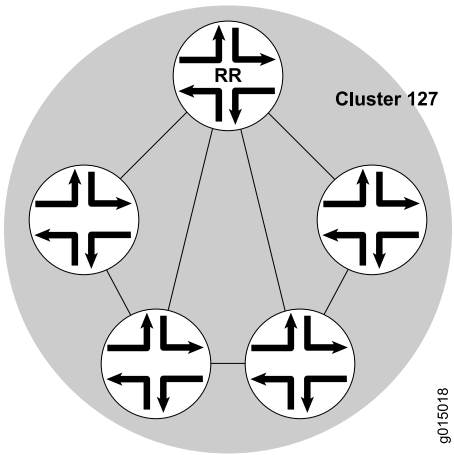

Figure 64 on page 730 shows Router RR configured as the route reflector for Cluster 127. The other routers are designated internal peers within the cluster. BGP routes are advertised to Router RR by any of the internal peers. RR then readvertises those routes to all other peers within the cluster.

You can configure multiple clusters and link them by configuring a full mesh of route reflectors (see Figure 65 on page 731).

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Figure 65: Basic Route Reflection (Multiple Clusters)

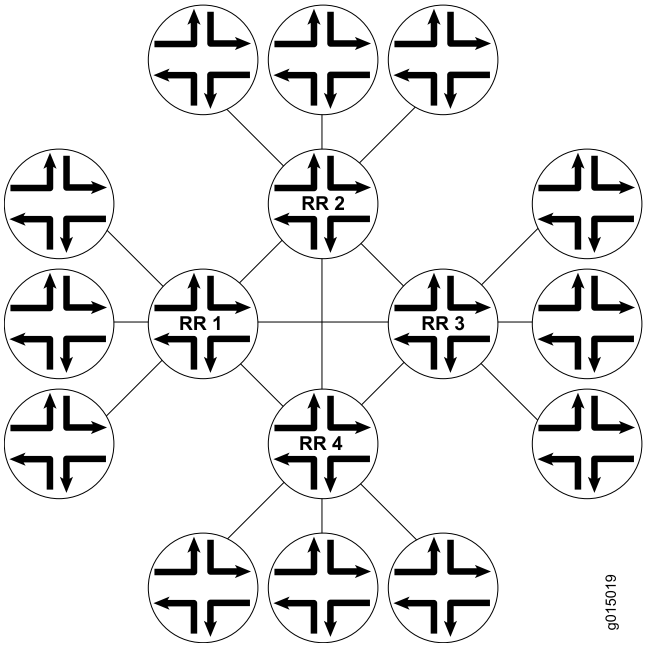

Figure 65 on page 731 shows Route Reflectors RR 1, RR 2, RR 3, and RR 4 as fully meshed internal peers. When a router advertises a route to RR 1, RR 1 readvertises the route to the other route reflectors, which, in turn, readvertise the route to the remaining routers within the AS. Route reflection allows the route to be propagated throughout the AS without the scaling problems created by the full mesh requirement.

NOTE: A route reflector that supports multiple clusters does not accept a route with the same cluster ID from a non-client router. Therefore, you must configure a different cluster ID for a redundant RR to reflect the route to other clusters.

However, as clusters become large, a full mesh with a route reflector becomes difficult to scale, as does a full mesh between route reflectors. To help offset this problem, you can group clusters of routers together into clusters of clusters for hierarchical route reflection (see Figure 66 on page 732).

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Figure 66: Hierarchical Route Reflection (Clusters of Clusters)

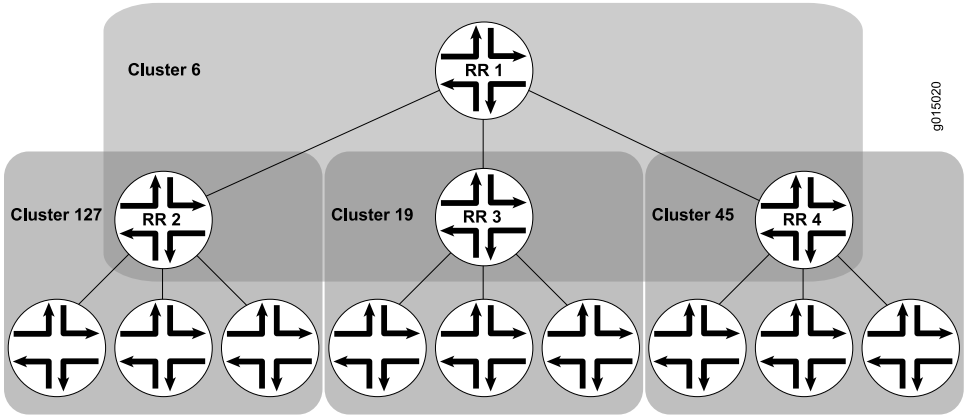

Figure 66 on page 732 shows RR 2, RR 3, and RR 4 as the route reflectors for Clusters 127, 19, and 45, respectively. Rather than fully mesh those route reflectors, the network administrator has configured them as part of another cluster (Cluster 6) for which RR 1 is the route reflector. When a router advertises a route to RR 2, RR 2 readvertises the route to all the routers within its own cluster, and then readvertises the route to RR 1. RR 1 readvertises the route to the routers in its cluster, and those routers propagate the route down through their clusters.

Release History Table

Release	Description
15.1	Starting in Junos OS Release 15.1, the **no-install** statement eliminates interaction between the routing protocols daemon (rpd) and other components in the Junos system such as the kernel or the distributed firewall daemon (dfwd).
15.1	In releases previous to Junos OS Release 15.1, you can reduce the workload on a route reflector that is not in the traffic-forwarding path by using a forwarding-table export policy that rejects routes learned from BGP.

Related Documentation

- Understanding BGP on page 4
- Example: Configuring a Route Reflector on page 732
- Installing Virtual Route Reflectors

Example: Configuring a Route Reflector

This example shows how to configure a route reflector.

- Requirements on page 733
- Overview on page 733
- Configuration on page 734
- Verification on page 743

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Requirements

No special configuration beyond device initialization is required before you configure this example.

Overview

Generally, internal BGP (IBGP)-enabled devices need to be fully meshed, because IBGP does not readvertise updates to other IBGP-enabled devices. The full mesh is a logical mesh achieved through configuration of multiple **neighbor** statements on each IBGP-enabled device. The full mesh is not necessarily a physical full mesh. Maintaining a full mesh (logical or physical) does not scale well in large deployments.

Figure 67 on page 734 shows an IBGP network with Device A acting as a route reflector. Device B and Device C are clients of the route reflector. Device D and Device E are outside the cluster, so they are nonclients of the route reflector.

On Device A (the route reflector), you must form peer relationships with all of the IBGP-enabled devices by including the **neighbor** statement for the clients (Device B and Device C) and the nonclients (Device D and Device E). You must also include the **cluster** statement and a cluster identifier. The cluster identifier can be any 32-bit value. This example uses the loopback interface IP address of the route reflector.

On Device B and Device C, the route reflector clients, you only need one **neighbor** statement that forms a peer relationship with the route reflector, Device A.

On Device D and Device E, the nonclients, you need a **neighbor** statement for each nonclient device (D-to-E and E-to-D). You also need a **neighbor** statement for the route reflector (D-to-A and E-to-A). Device D and Device E do not need **neighbor** statements for the client devices (Device B and Device C).

TIP: Device D and Device E are considered to be nonclients because they have explicitly configured peer relationships with each other. To make them RRroute reflector clients, remove the neighbor 192.168.5.5 statement from the configuration on Device D, and remove the neighbor 192.168.0.1 statement from the configuration on Device E.

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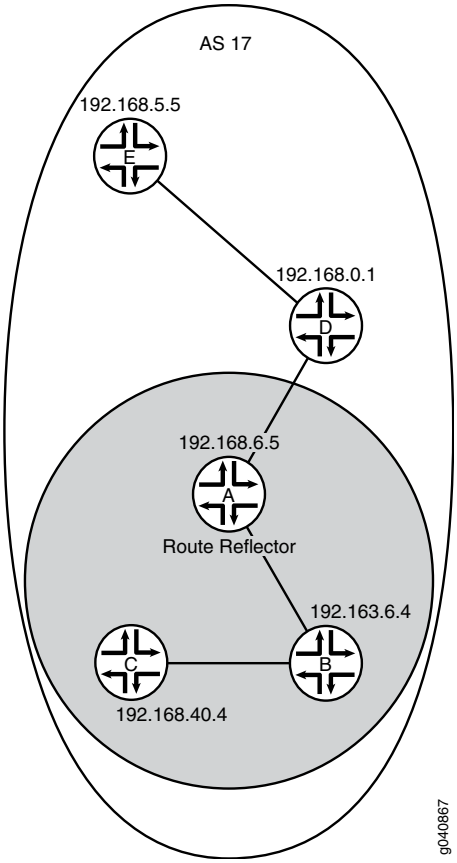
Figure 67: IBGP Network Using a Route Reflector



Configuration

- [xref target has no title]
- Configuring the Route Reflector on page 736
- Configuring Client Peers on page 739
- Configuring Nonclient Peers on page 741

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device A

```
set interfaces fe-0/0/0 unit 1 description to-B
set interfaces fe-0/0/0 unit 1 family inet address 10.10.10.1/30
set interfaces fe-0/0/1 unit 3 description to-D
set interfaces fe-0/0/1 unit 3 family inet address 10.10.10.9/30
set interfaces lo0 unit 1 family inet address 192.168.6.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.6.5
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers cluster 192.168.6.5
```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```
set protocols bgp group internal-peers neighbor 192.163.6.4
set protocols bgp group internal-peers neighbor 192.168.40.4
set protocols bgp group internal-peers neighbor 192.168.0.1
set protocols bgp group internal-peers neighbor 192.168.5.5
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.1
set protocols ospf area 0.0.0.0 interface fe-0/0/1.3
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.6.5
set routing-options autonomous-system 17
```

Device B

```
set interfaces fe-0/0/0 unit 2 description to-A
set interfaces fe-0/0/0 unit 2 family inet address 10.10.10.2/30
set interfaces fe-0/0/1 unit 5 description to-C
set interfaces fe-0/0/1 unit 5 family inet address 10.10.10.5/30
set interfaces lo0 unit 2 family inet address 192.163.6.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.163.6.4
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.2
set protocols ospf area 0.0.0.0 interface fe-0/0/1.5
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.163.6.4
set routing-options autonomous-system 17
```

Device C

```
set interfaces fe-0/0/0 unit 6 description to-B
set interfaces fe-0/0/0 unit 6 family inet address 10.10.10.6/30
set interfaces lo0 unit 3 family inet address 192.168.40.4/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.40.4
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.6
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.40.4
set routing-options autonomous-system 17
```

Device D

```
set interfaces fe-0/0/0 unit 4 description to-A
set interfaces fe-0/0/0 unit 4 family inet address 10.10.10.10/30
set interfaces fe-0/0/1 unit 7 description to-E
set interfaces fe-0/0/1 unit 7 family inet address 10.10.10.13/30
set interfaces lo0 unit 4 family inet address 192.168.0.1/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.0.1
```

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```
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols bgp group internal-peers neighbor 192.168.5.5
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.4
set protocols ospf area 0.0.0.0 interface fe-0/0/1.7
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.0.1
set routing-options autonomous-system 17
```

Device E

```
set interfaces fe-0/0/0 unit 8 description to-D
set interfaces fe-0/0/0 unit 8 family inet address 10.10.10.14/30
set interfaces lo0 unit 5 family inet address 192.168.5.5/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.5.5
set protocols bgp group internal-peers export send-ospf
set protocols bgp group internal-peers neighbor 192.168.0.1
set protocols bgp group internal-peers neighbor 192.168.6.5
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set protocols ospf area 0.0.0.0 interface fe-0/0/0.8
set policy-options policy-statement send-ospf term 2 from protocol ospf
set policy-options policy-statement send-ospf term 2 then accept
set routing-options router-id 192.168.5.5
set routing-options autonomous-system 17
```

Configuring the Route Reflector

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure IBGP in the network using Juniper Networks Device A as a route reflector:

1. Configure the interfaces.

```
[edit interfaces]
user@A# set fe-0/0/0 unit 1 description to-B
user@A# set fe-0/0/0 unit 1 family inet address 10.10.10.1/30
user@A# set fe-0/0/1 unit 3 description to-D
user@A# set fe-0/0/1 unit 3 family inet address 10.10.10.9/30
user@A# set lo0 unit 1 family inet address 192.168.6.5/32
```

2. Configure BGP, including the cluster identifier and neighbor relationships with all IBGP-enabled devices in the autonomous system (AS).

   Also apply the policy that redistributes OSPF routes into BGP.

```
[edit protocols bgp group internal-peers]
user@A# set type internal
user@A# set local-address 192.168.6.5
```


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```
user@A# set export send-ospf
user@A# set cluster 192.168.6.5
user@A# set neighbor192.163.6.4
user@A# set neighbor 192.168.40.4
user@A# set neighbor 192.168.0.1
user@A# set neighbor 192.168.5.5
```

3. Configure static routing or an interior gateway protocol (IGP).

   This example uses OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@A# set interface lo0.1 passive
user@A# set interface fe-0/0/0.1
user@A# set interface fe-0/0/1.3
```

4. Configure the policy that redistributes OSPF routes into BGP.

```
[edit policy-options policy-statement send-ospf term 2]
user@A# set from protocol ospf
user@A# set then accept
```

5. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@A# set router-id 192.168.6.5
user@A# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@A# show interfaces
fe-0/0/0 {
   unit 1 {
      description to-B;
      family inet {
         address 10.10.10.1/30;
      }
   }
}
fe-0/0/1 {
   unit 3 {
      description to-D;
      family inet {
         address 10.10.10.9/30;
      }
   }
```

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```
}
lo0 {
   unit 1 {
      family inet {
         address 192.168.6.5/32;
      }
   }
}
```

```
user@A# show protocols
bgp {
   group internal-peers {
      type internal;
      local-address 192.168.6.5;
      export send-ospf;
      cluster 192.168.6.5;
      neighbor 192.163.6.4;
      neighbor 192.168.40.4;
      neighbor 192.168.0.1;
      neighbor 192.168.5.5;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.1 {
         passive;
      }
      interface fe-0/0/0.1;
      interface fe-0/0/1.3;
   }
}
```

```
user@A# show policy-options
policy-statement send-ospf {
   term 2 {
      from protocol ospf;
      then accept;
   }
}
```

```
user@A# show routing-options
router-id 192.168.6.5;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each nonclient BGP peer within the cluster that you are configuring, if the other nonclient devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

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Configuring Client Peers

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure client peers:

1. Configure the interfaces.

```
[edit interfaces]
user@B# set fe-0/0/0 unit 2 description to-A
user@B# set fe-0/0/0 unit 2 family inet address 10.10.10.2/30
user@B# set fe-0/0/1 unit 5 description to-C
user@B# set fe-0/0/1 unit 5 family inet address 10.10.10.5/30
user@B# set lo0 unit 2 family inet address 192.163.6.4/32
```

2. Configure the BGP neighbor relationship with the route reflector.

   Also apply the policy that redistributes OSPF routes into BGP.

```
[edit protocols bgp group internal-peers]
user@B# set type internal
user@B# set local-address 192.163.6.4
user@B# set export send-ospf
user@B# set neighbor 192.168.6.5
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@B# set interface lo0.2 passive
user@B# set interface fe-0/0/0.2
user@B# set interface fe-0/0/1.5
```

4. Configure the policy that redistributes OSPF routes into BGP.

```
[edit policy-options policy-statement send-ospf term 2]
user@B# set from protocol ospf
user@B# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@B# set router-id 192.163.6.4
user@B# set autonomous-system 17
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output

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does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@B# show interfaces
fe-0/0/0 {
   unit 2 {
      description to-A;
      family inet {
         address 10.10.10.2/30;
      }
   }
}
fe-0/0/1 {
   unit 5 {
      description to-C;
      family inet {
         address 10.10.10.5/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 192.163.6.4/32;
      }
   }
}
```

```
user@B# show protocols
bgp {
   group internal-peers {
      type internal;
      local-address 192.163.6.4;
      export send-ospf;
      neighbor 192.168.6.5;
   }
}
ospf {
   area 0.0.0.0 {
      interface lo0.2 {
         passive;
      }
      interface fe-0/0/0.2;
      interface fe-0/0/1.5;
   }
}
```

```
user@B# show policy-options
policy-statement send-ospf {
   term 2 {
      from protocol ospf;
      then accept;
   }
}
```


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```
user@B# show routing-options
router-id 192.163.6.4;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each client BGP peer within the cluster that you are configuring if the other client devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

Configuring Nonclient Peers

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure nonclient peers:

1. Configure the interfaces.

```
[edit interfaces]
user@D# set fe-0/0/0 unit 4 description to-A
user@D# set fe-0/0/0 unit 4 family inet address 10.10.10.10/30
user@D# set fe-0/0/1 unit 7 description to-E
user@D# set fe-0/0/1 unit 7 family inet address 10.10.10.13/30
user@D# set lo0 unit 4 family inet address 192.168.0.1/32
```

2. Configure the BGP neighbor relationships with the RRroute reflector and with the other nonclient peers.

   Also apply the policy that redistributes OSPF routes into BGP.

```
[edit protocols bgp group internal-peers]
user@D# set type internal
user@D# set local-address 192.168.0.1
user@D# set export send-ospf
user@D# set neighbor 192.168.6.5
user@D# set neighbor 192.168.5.5
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@D# set interface lo0.4 passive
user@D# set interface fe-0/0/0.4
user@D# set interface fe-0/0/1.7
```

4. Configure the policy that redistributes OSPF routes into BGP.

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```
[edit policy-options policy-statement send-ospf term 2]
user@D# set from protocol ospf
user@D# set then accept
```

5. Configure the router ID and the AS number.

```
[edit routing-options]
user@D# set router-id 192.168.0.1
user@D# set autonomous-system 17
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@D# show interfaces
fe-0/0/0 {
   unit 4 {
      description to-A;
      family inet {
         address 10.10.10.10/30;
      }
   }
}
fe-0/0/1 {
   unit 7 {
      description to-E;
      family inet {
         address 10.10.10.13/30;
      }
   }
}
lo0 {
   unit 4 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@D# show protocols
bgp {
   group internal-peers {
      type internal;
      local-address 192.168.0.1;
      export send-ospf;
      neighbor 192.168.6.5;
      neighbor 192.168.5.5;
   }
}
```


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```
ospf {
  area 0.0.0.0 {
    interface lo0.4 {
      passive;
    }
    interface fe-0/0/0.4;
    interface fe-0/0/1.7;
  }
}
```

```
user@D# show policy-options
policy-statement send-ospf {
  term 2 {
    from protocol ospf;
    then accept;
  }
}
```

```
user@D# show routing-options
router-id 192.168.0.1;
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

NOTE: Repeat these steps for each nonclient BGP peer within the cluster that you are configuring if the other nonclient devices are from Juniper Networks. Otherwise, consult the device's documentation for instructions.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 743
- Verifying BGP Groups on page 746
- Verifying BGP Summary Information on page 746
- Verifying Routing Table Information on page 747

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is established for each neighbor address.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@A> show bgp neighbor
```

```
Peer: 192.163.6.4+179 AS 17    Local: 192.168.6.5+62857 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
```

```
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.163.6.4     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            6
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 5    Sent 3    Checked 19
  Input messages:  Total 2961   Updates 7       Refreshes 0     Octets 56480
  Output messages: Total 2945   Updates 6       Refreshes 0     Octets 56235
  Output Queue[0]: 0

Peer: 192.168.0.1+179 AS 17    Local: 192.168.6.5+60068 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.0.1     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 3
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
```


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```
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            6
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 18   Sent 20   Checked 12
  Input messages:  Total 15     Updates 5       Refreshes 0     Octets 447
  Output messages: Total 554    Updates 4       Refreshes 0     Octets 32307
  Output Queue[0]: 0

Peer: 192.168.5.5+57458 AS 17  Local: 192.168.6.5+179 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.5.5     Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 2
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 17   Sent 3    Checked 9
  Input messages:  Total 2967   Updates 7       Refreshes 0     Octets 56629
  Output messages: Total 2943   Updates 6       Refreshes 0     Octets 56197
  Output Queue[0]: 0

Peer: 192.168.40.4+53990 AS 17 Local: 192.168.6.5+179 AS 17
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ send-ospf ]
  Options: <Preference LocalAddress Cluster Refresh>
  Local Address: 192.168.6.5 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 192.168.40.4    Local ID: 192.168.6.5       Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 1
  BFD: disabled, down
```

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```
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-unicast
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 17)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
    Advertised prefixes:          6
  Last traffic (seconds): Received 5    Sent 23   Checked 52
  Input messages:  Total 2960   Updates 7       Refreshes 0     Octets 56496
  Output messages: Total 2943   Updates 6       Refreshes 0     Octets 56197
  Output Queue[0]: 0
```

Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From operational mode, enter the **show bgp group** command.

```
user@A> show bgp group
```

```
Group Type: Internal    AS: 17                     Local AS: 17
  Name: internal-peers  Index: 0                   Flags: <>
  Export: [ send-ospf ]
  Options: <Cluster>
  Holdtime: 0
  Total peers: 4        Established: 4
  192.163.6.4+179
  192.168.40.4+53990
  192.168.0.1+179
  192.168.5.5+57458
  inet.0: 0/26/16/0

Groups: 1  Peers: 4    External: 0    Internal: 4    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                26          0          0          0          0          0
```

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

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Action From operational mode, enter the **show bgp summary** command.

```
user@A> show bgp summary
```

```
Groups: 1 Peers: 4 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                26          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
192.163.6.4              17       2981       2965       0       0    22:19:15 0/6/1/0              0/0/0/0
192.168.0.1              17         36        575       0       0       13:43 0/6/1/0              0/0/0/0
192.168.5.5              17       2988       2964       0       0    22:19:10 0/7/7/0              0/0/0/0
192.168.40.4             17       2980       2964       0       0    22:19:14 0/7/7/0              0/0/0/0
```

Verifying Routing Table Information

Purpose Verify that the routing table contains the IBGP routes.

Action From operational mode, enter the **show route** command.

```
user@A> show route
```

```
inet.0: 12 destinations, 38 routes (12 active, 0 holddown, 10 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.10.0/30      *[Direct/0] 22:22:03
                    > via fe-0/0/0.1
                    [BGP/170] 22:20:55, MED 2, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 3, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
10.10.10.1/32      *[Local/0] 22:22:03
                      Local via fe-0/0/0.1
10.10.10.4/30      *[OSPF/10] 22:21:13, metric 2
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 4, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
10.10.10.8/30      *[Direct/0] 22:22:03
                    > via fe-0/0/1.3
                    [BGP/170] 22:20:51, MED 2, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 3, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
10.10.10.9/32      *[Local/0] 22:22:03
                      Local via fe-0/0/1.3
10.10.10.12/30     *[OSPF/10] 22:21:08, metric 2
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 4, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.163.6.4/32     *[OSPF/10] 22:21:13, metric 1
```

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```
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:55, MED 1, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 3, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
192.168.0.1/32     *[OSPF/10] 22:21:08, metric 1
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:51, MED 1, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 3, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.168.5.5/32     *[OSPF/10] 22:21:08, metric 2
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 00:15:24, MED 1, localpref 100, from 192.168.0.1
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 4, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.168.6.5/32     *[Direct/0] 22:22:04
                    > via lo0.1
                    [BGP/170] 22:20:51, MED 2, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
                    [BGP/170] 22:20:55, MED 2, localpref 100, from 192.168.40.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
192.168.40.4/32    *[OSPF/10] 22:21:13, metric 2
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:55, MED 1, localpref 100, from 192.163.6.4
                      AS path: I
                    > to 10.10.10.2 via fe-0/0/0.1
                    [BGP/170] 22:20:51, MED 4, localpref 100, from 192.168.5.5
                      AS path: I
                    > to 10.10.10.10 via fe-0/0/1.3
224.0.0.5/32       *[OSPF/10] 22:22:07, metric 1
                      MultiRecv
```

Related Documentation

- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- Example: Configuring Internal BGP Peer Sessions on page 51
- Example: Configuring External BGP Point-to-Point Peer Sessions on page 24
- Understanding BGP Route Reflectors on page 729
- BGP Configuration Overview on page 13

Understanding a Route Reflector That Belongs to Two Different Clusters

The purpose of route reflection is loop prevention when the internal BGP (IBGP) routing devices are not fully meshed. To accomplish this, RRs break one of the rules of normal

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BGP operation: They readvertise routes learned from an internal BGP peer to other internal BGP peers.

Normally, a single RR is a member of only one cluster. Consider, for example, that in a hierarchical RR design, a tier-two RR can be the client of a tier-1 RR, but they can not be clients of each other.

However, when two RRs are clients of each other and the routes are being reflected from one cluster to another, only one of the cluster IDs is included in the cluster list. This is because having one cluster ID in the cluster list is adequate for loop prevention in this case.

Table 10 on page 749 summarizes the rules that route reflectors use when filling in a reflected route's cluster list with cluster IDs.

Table 10: Rules for Route Reflectors

Route Reflection Scenario	Configuration
When reflecting a route from one of the clients to a non-client router client -> RR -> non-client	The RR fills the cluster ID associated with that client in the cluster list of the reflected route.
When reflecting a route from a non-client router to a client router non-client -> RR -> client	The RR fills the cluster ID associated with that client in the cluster list of the reflected route.
When reflecting a route from a client router to another client router that is in a different cluster client1 -> RR -> client2 (different cluster)	The RR fills the cluster ID associated with client1 in the cluster list before reflecting the cluster ID to client2. The cluster ID associated with client 2 is not added.
When reflecting a route from a client router to a non-client router that is in a different autonomous system. For example, when you have configured a tier 2 RR and 2 BGP groups one for the RR clients and the other for tier 1 RR and you are reflecting a route from one autonomous system to another autonomous system. client -> RR -> non-client (different AS)	The RR does not fill the cluster list with the cluster-ID before reflecting the route to the non-client device because the cluster-ID is specific to one autonomous system.

Related Documentation

- Example: Configuring a Route Reflector That Belongs to Two Different Clusters on page 750

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Example: Configuring a Route Reflector That Belongs to Two Different Clusters

This example shows how to configure a route reflector (RRs) that belongs to two different clusters. This is not a common scenario, but it might be useful in some situations.

- Requirements on page 750
- Overview on page 750
- Configuration on page 750
- Verification on page 753

Requirements

Configure the device interfaces and an internal gateway protocol (IGP). For an example of an RR setup that includes the interface and IGP configuration, see "Example: Configuring a Route Reflector" on page 732.

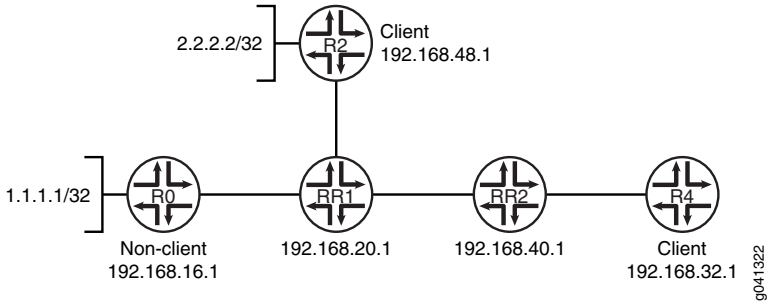
Overview

In this example, Device RR1 is a route reflector for both Device R2 and Device RR2.

Device RR2 is a route reflector for Device R4.

Consider figure Figure 68 on page 750.

Figure 68: Route Reflector in Two Different Clusters



This example shows the BGP configuration on Device RR1 and Device RR2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device RR1

```
set protocols bgp group RR1_client type internal
set protocols bgp group RR1_client local-address 192.168.20.1
set protocols bgp group RR1_client cluster 5.5.5.5
set protocols bgp group RR1_client neighbor 192.168.48.1
set protocols bgp group Non_client type internal
```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```
set protocols bgp group Non_client local-address 192.168.20.1
set protocols bgp group Non_client neighbor 192.168.16.1
set protocols bgp group RR1_to_RR2 type internal
set protocols bgp group RR1_to_RR2 local-address 192.168.20.1
set protocols bgp group RR1_to_RR2 cluster 6.6.6.6
set protocols bgp group RR1_to_RR2 neighbor 192.168.40.1
```

Device RR2

```
set protocols bgp group RR2_client type internal
set protocols bgp group RR2_client local-address 192.168.40.1
set protocols bgp group RR2_client cluster 7.7.7.7
set protocols bgp group RR2_client neighbor 192.168.32.1
set protocols bgp group RR2_to_RR1 type internal
set protocols bgp group RR2_to_RR1 local-address 192.168.40.1
set protocols bgp group RR2_to_RR1 neighbor 192.168.20.1
```

Configuring Device RR1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device RR1:

1. Configure the peering relationship with Device R2.

```
[edit protocols bgp group RR1_client]
user@RR1# set type internal
user@RR1# set local-address 192.168.20.1
user@RR1# set cluster 5.5.5.5
user@RR1# set neighbor 192.168.48.1
```

2. Configure the peering relationship with Device R0.

```
[edit protocols bgp group Non_client]
user@RR1# set type internal
user@RR1# set local-address 192.168.20.1
user@RR1# set neighbor 192.168.16.1
```

3. Configure the peering relationship with Device RR2.

```
[edit protocols bgp group RR1_to_RR2]
user@RR1# set type internal
user@RR1# set local-address 192.168.20.1
user@RR1# set cluster 6.6.6.6
user@RR1# set neighbor 192.168.40.1
```

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Results From configuration mode, confirm your configuration by entering the **show protocols** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@RR1# show protocols
bgp {
   group RR1_client {
      type internal;
      local-address 192.168.20.1;
      cluster 5.5.5.5;
      neighbor 192.168.48.1;
   }
   group Non_client {
      type internal;
      local-address 192.168.20.1;
      neighbor 192.168.16.1;
   }
   group RR1_to_RR2 {
      type internal;
      local-address 192.168.20.1;
      cluster 6.6.6.6;
      neighbor 192.168.40.1;
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device RR2

Step-by-Step Procedure The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device RR2:

1. Configure the peering relationship with Device R4.

```
[edit protocols bgp group RR2_client]
user@RR2# set type internal
user@RR2# set local-address 192.168.40.1
user@RR2# set cluster 7.7.7.7
user@RR2# set neighbor 192.168.32.1
```

2. Configure the peering relationship with Device RR1.

```
[edit protocols bgp group RR2_to_RR1]
user@RR2# set type internal
user@RR2# set local-address 192.168.40.1
user@RR2# set neighbor 192.168.20.1
```


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Results From configuration mode, confirm your configuration by entering the **show protocols** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@RR2# show protocols
bgp {
   group RR2_client {
      type internal;
      local-address 192.168.40.1;
      cluster 7.7.7.7;
      neighbor 192.168.32.1;
   }
   group RR2_to_RR1 {
      type internal;
      local-address 192.168.40.1;
      neighbor 192.168.20.1;
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the Cluster ID Advertised for Route 2.2.2.2 on page 753
- Checking the Cluster ID Advertised for Route 1.1.1.1 on page 754

Checking the Cluster ID Advertised for Route 2.2.2.2

Purpose Verify that BGP is running on configured interfaces and that the BGP session is established for each neighbor address.

Action From operational mode, enter the **show bgp neighbor** command.

```
user@RR1> show route advertising-protocol bgp 192.168.40.1 active-path 2.2.2.2 extensive

inet.0: 61 destinations, 61 routes (60 active, 0 holddown, 1 hidden)
* 2.2.2.2/32 (1 entry, 1 announced)
 BGP group RR1_to_RR2 type Internal
     Nexthop: 192.168.48.1
     Localpref: 100
     AS path: [100] I
     Cluster ID: 5.5.5.5
     Originator ID: 192.168.48.1
```

Meaning The 2.2.2.2/32 route originates from the Device RR1's client peer, Device R2. When this route is sent to RR1's client, Device RR2, the route has the 5.5.5.5 cluster ID attached, which is the cluster ID for RR1-R2.

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Checking the Cluster ID Advertised for Route 1.1.1.1

Purpose Check the route advertisement from Device RR1 to Device RR2.

Action From operational mode, enter the **show bgp group** command.

```
user@RR1> show route advertising-protocol bgp 192.168.40.1 active-path 1.1.1.1/32 extensive

inet.0: 61 destinations, 61 routes (60 active, 0 holddown, 1 hidden)
* 1.1.1.1/32 (1 entry, 1 announced)
 BGP group RR1_to_RR2 type Internal
     Nexthop: 192.168.16.1
     Localpref: 100
     AS path: [100] I
     Cluster ID: 6.6.6.6
     Originator ID: 192.168.16.1
```

Meaning The 1.1.1.1/32 route originates from the Device RR1's non-client peer, Device R0. When this route is sent to RR1's client, Device RR2, the route has the 6.6.6.6 cluster ID attached, which is the cluster ID for RR1-RR2.

Device RR1 preserves the inbound cluster ID from Device R2 when advertising to another client in a different cluster (Device R4).

Related Documentation

- Understanding a Route Reflector That Belongs to Two Different Clusters on page 748

Understanding BGP Confederations

BGP confederations are another way to solve the scaling problems created by the BGP full mesh requirement. BGP confederations effectively break up a large autonomous system (AS) into subautonomous systems (sub-ASs). Each sub-AS must be uniquely identified within the confederation AS by a sub-AS number. Typically, sub-AS numbers are taken from the private AS numbers between 64,512 and 65,535.

Within a sub-AS, the same internal BGP (IBGP) full mesh requirement exists. Connections to other confederations are made with standard external BGP (EBGP), and peers outside the sub-AS are treated as external. To avoid routing loops, a sub-AS uses a confederation sequence, which operates like an AS path but uses only the privately assigned sub-AS numbers.

The confederation AS appears whole to other confederation ASs. The AS path received by other ASs shows only the globally assigned AS number. It does not include the confederation sequence or the privately assigned sub-AS numbers. The sub-AS numbers are removed when the route is advertised out of the confederation AS.
Figure 69 on page 755 shows an AS divided into four confederations.

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Figure 69: BGP Confederations

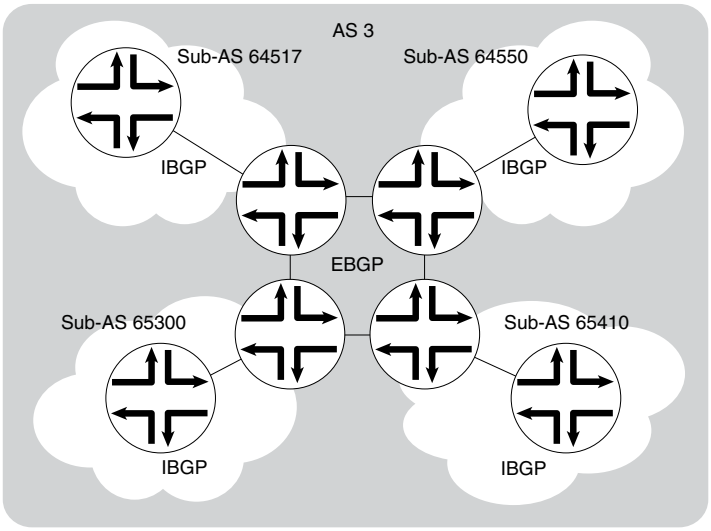

Figure 69 on page 755 shows AS 3 divided into four sub-ASs, 64517, 64550, 65300, and 65410, which are linked through EBGP sessions. Because the confederations are connected by EBGP, they do not need to be fully meshed. EBGP routes are readvertised to other sub-ASs.

Related Documentation

- Understanding BGP on page 4
- Example: Configuring BGP Confederations on page 755

Example: Configuring BGP Confederations

This example shows how to configure BGP confederations.

- Requirements on page 755
- Overview on page 756
- Configuration on page 756
- Verification on page 758

Requirements

- Configure network interfaces.
- Configure external peer sessions. See "Example: Configuring External BGP Point-to-Point Peer Sessions" on page 24.
- Configure interior gateway protocol (IGP) sessions between peers.
- Configure a routing policy to advertise the BGP routes.

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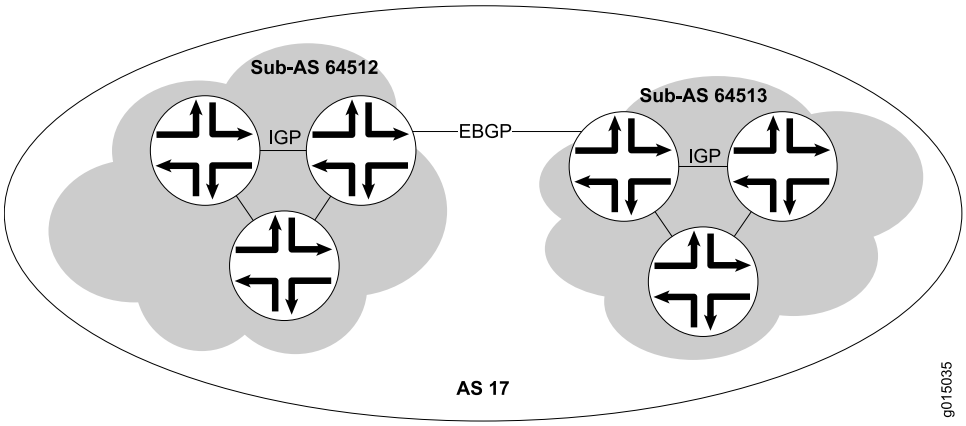
Overview

Within a BGP confederation, the links between the confederation member autonomous systems (ASs) must be external BGP (EBGP) links, not internal BGP (IBGP) links.

Similar to route reflectors, BGP confederations reduce the number of peer sessions and TCP sessions to maintain connections between IBGP routing devices. BGP confederation is one method used to solve the scaling problems created by the IBGP full mesh requirement. BGP confederations effectively break up a large AS into subautonomous systems. Each sub-AS must be uniquely identified within the confederation AS by a sub-AS number. Typically, sub-AS numbers are taken from the private AS numbers between 64512 and 65535. Within a sub-AS, the same IBGP full mesh requirement exists. Connections to other confederations are made with standard EBGP, and peers outside the sub-AS are treated as external. To avoid routing loops, a sub-AS uses a confederation sequence, which operates like an AS path but uses only the privately assigned sub-AS numbers.

Figure 70 on page 756 shows a sample network in which AS 17 has two separate confederations: sub-AS 64512 and sub-AS 64513, each of which has multiple routers. Within a sub-AS, an IGP is used to establish network connectivity with internal peers. Between sub-ASs, an EBGP peer session is established.

Figure 70: Typical Network Using BGP Confederations



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

All Devices in Sub-AS 64512

```
set routing-options autonomous-system 64512
set routing-options confederation 17 members 64512
set routing-options confederation 17 members 64513
set protocols bgp group sub-AS-64512 type internal
set protocols bgp group sub-AS-64512 local-address 192.168.5.1
set protocols bgp group sub-AS-64512 neighbor 192.168.8.1
```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```
set protocols bgp group sub-AS-64512 neighbor 192.168.15.1
```

Border Device in Sub-AS 64512

```
set protocols bgp group to-sub-AS-64513 type external
set protocols bgp group to-sub-AS-64513 peer-as 64513
set protocols bgp group to-sub-AS-64513 neighbor 192.168.5.2
```

All Devices in Sub-AS 64513

```
set routing-options autonomous-system 64513
set routing-options confederation 17 members 64512
set routing-options confederation 17 members 64513
set protocols bgp group sub-AS-64513 type internal
set protocols bgp group sub-AS-64513 local-address 192.168.5.2
set protocols bgp group sub-AS-64513 neighbor 192.168.9.1
set protocols bgp group sub-AS-64513 neighbor 192.168.16.1
```

Border Device in Sub-AS 64513

```
set protocols bgp group to-sub-AS-64512 type external
set protocols bgp group to-sub-AS-64512 peer-as 64512
set protocols bgp group to-sub-AS-64512 neighbor 192.168.5.1
```

Step-by-Step Procedure

This procedure shows the steps for the devices that are in sub-AS 64512.

The **autonomous-system** statement sets the sub-AS number of the device.

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BGP confederations:

1. Set the sub-AS number for the device.

   ```
   [edit routing-options]
   user@host# set autonomous-system 64512
   ```

2. In the confederation, include all sub-ASs in the main AS.

   The number 17 represents the main AS. The **members** statement lists all the sub-ASs in the main AS.

   ```
   [edit routing-options confederation]
   user@host# set 17 members 64512
   user@host# set 17 members 64513
   ```

3. On the border device in sub-AS 64512, configure an EBGP connection to the border device in AS 64513.

   ```
   [edit protocols bgp group to-sub-AS-64513]
   user@host# set type external
   ```

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```
user@host# set neighbor 192.168.5.2
user@host# set peer-as 64513
```

4. Configure an IBGP group for peering with the devices within sub-AS 64512.

```
[edit protocols bgp group sub-AS-64512]
user@host# set type internal
user@host# set local-address 192.168.5.1
user@host# neighbor 192.168.8.1
user@host# neighbor 192.168.15.1
```

Results From configuration mode, confirm your configuration by entering the **show routing-options** and **show protocols** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-options
autonomous-system 64512;
confederation 17 members [ 64512 64513 ];
```

```
user@host# show protocols
bgp {
   group to-sub-AS-64513 { # On the border devices only
      type external;
      peer-as 64513;
      neighbor 192.168.5.2;
   }
   group sub-AS-64512 {
      type internal;
      local-address 192.168.5.1;
      neighbor 192.168.8.1;
      neighbor 192.168.15.1;
   }
}
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat these steps for sSub-AS 64513.

Verification

Confirm that the configuration is working properly.

- Verifying BGP Neighbors on page 758
- Verifying BGP Groups on page 760
- Verifying BGP Summary Information on page 760

Verifying BGP Neighbors

Purpose Verify that BGP is running on configured interfaces and that the BGP session is active for each neighbor address.

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Action From the CLI, enter the **show bgp neighbor** command.

Sample Output

```
user@host> show bgp neighbor
Peer: 10.255.245.12+179 AS 35  Local: 10.255.245.13+2884 AS 35
  Type: Internal    State: Established  (route reflector client)Flags: Sync
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: Preference LocalAddress HoldTime Cluster AddressFamily Rib-group Refresh

  Address families configured: inet-vpn-unicast inet-labeled-unicast
  Local Address: 10.255.245.13 Holdtime: 90 Preference: 170
  Flags for NLRI inet-vpn-unicast: AggregateLabel
  Flags for NLRI inet-labeled-unicast: AggregateLabel
  Number of flaps: 0
  Peer ID: 10.255.245.12    Local ID: 10.255.245.13    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI advertised by peer: inet-vpn-unicast inet-labeled-unicast
  NLRI for this session: inet-vpn-unicast inet-labeled-unicast
  Peer supports Refresh capability (2)
Restart time configured on the peer: 300
  Stale routes from peer are kept for: 60
  Restart time requested by this peer: 300
  NLRI that peer supports restart for: inet-unicast inet6-unicast
  NLRI that restart is negotiated for: inet-unicast inet6-unicast
  NLRI of received end-of-rib markers: inet-unicast inet6-unicast
  NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
  Table inet.0 Bit: 10000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 4
    Received prefixes: 6
    Suppressed due to damping: 0
  Table inet6.0 Bit: 20000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 0
    Received prefixes: 2
    Suppressed due to damping: 0
  Last traffic (seconds): Received 3    Sent 3    Checked 3
  Input messages:  Total 9      Updates 6       Refreshes 0     Octets 403
  Output messages: Total 7      Updates 3       Refreshes 0     Octets 365
  Output Queue[0]: 0
  Output Queue[1]: 0
  Trace options: detail packets
  Trace file: /var/log/bgpgr size 131072 files 10
```

Meaning The output shows a list of the BGP neighbors with detailed session information. Verify the following information:

- Each configured peering neighbor is listed.
- For **State**, each BGP session is **Established**.
- For **Type**, each peer is configured as the correct type (either internal or external).
- For **AS**, the AS number of the BGP neighbor is correct.

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Verifying BGP Groups

Purpose Verify that the BGP groups are configured correctly.

Action From the CLI, enter the **show bgp group** command.

Sample Output

```
user@host> show bgp group
```

```
Group Type: Internal    AS: 10045       Local AS: 10045
  Name: pe-to-asbr2                                  Flags: Export Eval
  Export: [ match-all ]
  Total peers: 1        Established: 1
  10.0.0.4+179
  bgp.l3vpn.0: 1/1/0
  vpn-green.inet.0: 1/1/0

Groups: 1   Peers: 1    External: 0    Internal: 1    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0            1          1          0          0          0          0
```

Meaning The output shows a list of the BGP groups with detailed group information. Verify the following information:

- Each configured group is listed.
- For **AS**, each group's remote AS is configured correctly.
- For **Local AS**, each group's local AS is configured correctly.
- For **Group Type**, each group has the correct type (either internal or external).
- For **Total peers**, the expected number of peers within the group is shown.
- For **Established**, the expected number of peers within the group have BGP sessions in the **Established** state.
- The IP addresses of all the peers within the group are present.

Verifying BGP Summary Information

Purpose Verify that the BGP configuration is correct.

Action From the CLI, enter the **show bgp summary** command.

Sample Output

```
user@host> show bgp summary
```

```
Groups: 1 Peers: 3 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 6          4          0          0          0          0
```


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```
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65002      88675      88652       0       2       42:38 2/4/0
            0/0/0
10.0.0.3        65002      54528      54532       0       1     2w4d22h 0/0/0
            0/0/0
10.0.0.4        65002      51597      51584       0       0     2w3d22h 2/2/0
            0/0/0
```

Meaning The output shows a summary of BGP session information. Verify the following information:

- For **Groups**, the total number of configured groups is shown.
- For **Peers**, the total number of BGP peers is shown.
- For **Down Peers**, the total number of unestablished peers is 0. If this value is not zero, one or more peering sessions are not yet established.
- Under **Peer**, the IP address for each configured peer is shown.
- Under **AS**, the peer AS for each configured peer is correct.
- Under **Up/Dwn State**, the BGP state reflects the number of paths received from the neighbor, the number of these paths that have been accepted, and the number of routes being damped (such as 0/0/0). If the field is **Active**, it indicates a problem in the establishment of the BGP session.

Related Documentation

- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- Understanding BGP Confederations on page 754
- BGP Configuration Overview on page 13

Understanding BGP Optimal Route Reflection

You can configure BGP Optimal Route Reflection (BGP-ORR) with IS-IS and OSPF as the interior gateway protocol (IGP) on a route reflector to advertise the best path to the BGP-ORR client groups. This is done by using the shortest IGP metric from a client's perspective, instead of the route reflector's view.

Client groups sharing the same or similar IGP topology can be grouped as one BGP peer group. You can configure **optimal-route-reflection** to enable BGP-ORR in that BGP peer group. You can also configure one of the client nodes as the primary node (**igp-primary**) in a BGP peer group so that the IGP metric from that primary node is used to select the best path and advertise it to the clients in the same BGP peer group. Optionally, you can also select another client node as the backup node (**igp-backup**), which is used when the primary node (**igp-primary**) goes down or is unreachable.

To enable BGP-ORR, include the **optimal-route-reflection** statement at the [**edit protocols bgp group *group-name***] hierarchy level.

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NOTE: BGP-ORR only works when IGP is used for BGP route resolution. BGP-ORR does not work when MPLSLDP/RSVP is used for route resolution.

Use the following CLI hierarchy to configure BGP-ORR:

```
[edit protocols bgp]
group group-name{
   optimal-route-reflection {
      igp-primary ipv4-address;
      igp-backup ipv4-address;
   }
}
```

Related Documentation

- Understanding BGP on page 4
- Configuring BGP Optimal Route Reflection on a Route Reflector to Advertise the Best Path on page 762

Configuring BGP Optimal Route Reflection on a Route Reflector to Advertise the Best Path

You can configure BGP Optimal Route Reflection (BGP-ORR) with IS-IS and OSPF as the interior gateway protocol (IGP) on a route reflector to advertise the best path to the BGP-ORR client groups. This is done by using the shortest IGP metric from a client's perspective, instead of the route reflector's view.

To enable BGP-ORR, include the **optimal-route-reflection** statement at the [**edit protocols bgp group *group-name***] hierarchy level.

Client groups sharing the same or similar IGP topology can be grouped as one BGP peer group. You can configure **optimal-route-reflection** to enable BGP-ORR in that BGP peer group.

To configure BGP-ORR:

1. Configure optimal route reflection.

   ```
   [edit protocols bgp group group-name]
   user@host# set optimal-route-reflection
   ```

2. Configure one of the client nodes as the primary node (**igp-primary**) in a BGP peer group so that the IGP metric from that primary node is used to select the best path and advertise it to the clients in the same BGP peer group.

   ```
   [edit protocols bgp group group-name optimal-route-reflection]
   user@host# igp-primary ipv4-address;
   ```


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3. (Optional) Configure another client node as the backup node (**igp-backup**), which is used when the primary node (**igp-primary**) goes down or is unreachable.

```
[edit protocols bgp group group-name optimal-route-reflection]
user@host# igp-backup ipv4-address;
```

Use the following CLI commands to monitor and troubleshoot the configuration for BGP-ORR:

- **show bgp group**—View the primary and backup configurations of BGP-ORR.
- **show isis bgp-orr**—View the IS-IS BGP-ORR metric (RIB).
- **show ospf bgp-orr**—View the OSPF BGP-ORR metric (RIB).
- **show ospf route**—View the entries in the OSPF routing table
- **show route**—View the active entries in the routing tables.
- **show route advertising protocol bgp *peer***—Verify whether the routes are being advertised according to the BGP-ORR rules.

Related Documentation

- Understanding BGP on page 4
- Understanding BGP Optimal Route Reflection on page 761

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CHAPTER 18

Configuring BGP Route Server

- BGP Route Server Overview on page 765

BGP Route Server Overview

A BGP route server is the external BGP (EBGP) equivalent of an internal IBGP (IBGP) route reflector that simplifies the number of direct point-to-point EBGP sessions required in a network. EBGP route servers are transparent in terms of BGP attribute propagation so that a route received from a route server carries the set of BGP attributes (NEXT_HOP, AS_PATH, MULTI_EXIT_DISC, AIGP, and Communities) if the route is from a directly connected EBGP peer.

As with an IBGP route reflector, an EBGP route server is attached to a network outside of the direct forwarding path between the EBGP peers using the route server functionality. This connectivity can be through a direct physical link, or through Layer 2 networks such as VPLS LAN or EVPN, or through an IP fabric of point-to-point EBGP links providing reachability of loopback addresses of peers (typical in data center networks).

The BGP protocol is enhanced to provide route-server capability with the following functionalities described in RFC 7947:

- Attribute transparency for NEXT_HOP, AS_PATH, MULTI_EXIT_DISC, AIGP, and Communities.
- Per-client policy control and multiple route-server RIBs for mitigation of path-hiding.

BGP programmability leverages the route-server functionality. The BGP JET **bgp_route_service.proto** API has been enhanced to support route server functionality as follows:

- Program the EBGP route server.
- Inject routes to the specific route server RIB for selectively advertising it to the client groups in client-specific RIBs.

The BGP JET **bgp_route_service.proto** API includes a peer-type object that identifies individual routes as either EBGP or IBGP (default).

Route server functionality is generally address-family independent, although certain specific BGP attribute support may be address-family-specific (for example, AIGP is only

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supported for labeled-unicast address-families). Route server functionality is supported for all EBGP address families.

- BGP Attribute Transparency on page 766
- Next-Hop on page 767
- AS-Path on page 767
- Other Attributes on page 767
- BGP Route Server Client RIB on page 768
- Policy Requirements and Considerations on page 768

BGP Attribute Transparency

EBGP attribute transparency [RFC7947] for the route server is supported by modifying the normal BGP route propagation such that neither transitive nor non-transitive attributes are stripped or modified while propagating routes.

Changes to normal EBGP behavior are controlled by the **route-server-client** CLI configuration. The **route-server-client** CLI configuration at the [**edit protocols bgp group *group-name***] hierarchy level implements route server BGP attribute transparency behavior.

- The route server provides attribute transparency for both single-hop EBGP and multi-hop configurations. Therefore, the **route-server-client** configuration implicitly includes the functionality of **multihop no-nexthop-change** for single-hop and multi-hop sessions.
- The **route-server-client** can be configured at the protocol, group, or neighbor levels of the [**edit protocol bgp**] hierarchy.
- The **route-server-client** configuration is applicable only when the group type is *external*. When the **route-server-client** is configured for *internal* groups, a configuration error is issued when attempting to commit.
- The **route-server-client** configuration has no parameters.
- Normal BGP privilege applies to the **route-server-client** configuration.

NOTE: Attributes are handled independently with respect to attribute transparency. Even if next-hops cannot be sent unmodified by the route-server, other attributes are sent transparently as applicable for those attributes.

The following is a sample **route-server-client** configuration:

```
[edit]
protocols {
   bgp {
      group R0 {
         type external;
            route-server-client;
```


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```
            family inet {
            unicast;
            }
            peer-as 100;
          neighbor 10.0.0.1;
      }
    }
}
```

Next-Hop

The next-hop attribute must not be modified by imposing next-hop self or otherwise modifying the next-hop, unless explicitly configured through a policy. The route server must propagate BGP next-hops according to the third-party next-hop rules of RFC 4271.

Next-hop behavior is specified for the following route-server scenarios:

- In the case of LAN and WAN interconnect, when the route server is connected to client peers through a shared LAN and WAN subnet, the received third-party next-hops are advertised by the route server without modification as defined in RFC 4271.
- In the case of data center multihop interconnect, when the route server is connected to client peers through a multihop interconnect, EBGP multihop must be configured and the behavior of the **no-nexthop-change** CLI configuration is implicitly imposed by the **route-server-client** configuration. The received third-party next-hops are advertised by the route server without modification, as per the optional third-party behavior defined in RFC 4271.
- In other cases, such as point-to-point single-hop connections between the route server and client peers, normal next-hop advertisement procedures are used to prevent advertising next-hops that could be rejected by BGP peers (for example, most BGP implementations, by default, rejects next-hops addresses that are not covered by the subnet address on non-multipoint sessions.

AS-Path

AS-Path must not be modified by prepending the route server's local AS number. Configuring **route-server-client** CLI for a peer suppresses the prepending of the local AS number in the advertisements. In addition, the **show route advertising-protocol bgp** ***peer*** CLI command is changed for peers that are route server clients such that the local AS is not shown in the advertised metrics.

Other Attributes

- MULTI_EXIT_DISC attribute (optional, non-transitive) must be propagated as received.
- All community attributes, including no-advertise, no-export, and non-transitive extended communities, must be propagated as received.
- Accumulated IGP (AIGP) attribute (optional, non-transitive) must be propagated as received.

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NOTE: Junos OS supports AIGP only for BGP-LU address families (IPv4 and IPv6).

BGP Route Server Client RIB

A route server client-specific RIB is a distinct view of a BGP Loc-RIB which can contain different routes for the same destination than other views. Route server clients, through their peer groups, may associate with one individual client-specific view or a shared common RIB.

In order to provide the ability to advertise different routes to different clients for the same destination, it is conceptually necessary to allow for multiple instances of the BGP path selection to occur for the same destination but in different client/group contexts.

To implement the high-level requirement of flexible policy control with per-client/group path selection, BGP route server takes the approach of using non-forwarding routing instances (NFIs) to multi-instance the BGP pipeline, including BGP path selection, Loc-RIB, and policy. The route server is configured to group route server clients within BGP groups configured within separate non-forwarding routing instances. This approach leverages the fact that BGP running within a routing instance does path selection and has a RIB that is separate from BGP running in other routing instances.

Policy Requirements and Considerations

To propagate routes between route server clients, routes are leaked between the RIBs of the routing instances based on configured policies.

Configuration of the route server for policy control includes the following considerations:

- Route server clients should be configured within the same master instance or routing-instance to receive the same Loc-RIB view.
- Route server clients should be configured within their own routing-instance to receive totally unique Loc-RIB views.
- Route server clients should be configured in different BGP peer groups in the same routing-instance to have different export policy on the same Loc-RIB view.
- For the route server client-specific RIB views to receive all routes from other tables by default, a full-mesh of **instance-import** policies is configured with **instance-any**. When configuring **instance-import** with policy containing **instance-any**:
  - **instance-any** can be used in:
    - **policy-statement … term … from**
    - **policy-statement … from**
    - **policy-statement … term … to**
    - **policy-statement … to**
  - **instance-any** has no parameters.

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  - Using **instance-any** in policies other than **instance-import** does not have any effect.

- Configuring many distinct routing-instances and peer-groups impacts scale and performance.
- The BGP **forwarding-context** CLI configuration at the [**edit protocols bgp group neighbor**] hierarchy level splits the routing instance for a BGP neighbor into a configuration instance and a forwarding instance. The BGP **forwarding-context** CLI configuration also supports non-forwarding instance with BGP peers configured as **route-server-client** where the specified instance is any instance capable of forwarding a master or a routing-instance that is not of type no-forwarding.

Related Documentation

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PART 12

Configuring BGP Security

- Enabling Route Authentication on page 773
- Using IP Security to Protect IP Traffic on page 781
- Restricting TCP Access to a Port on page 787
- Validating the Origin of Route Advertisements on page 803

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CHAPTER 19

Enabling Route Authentication

- Understanding Router Authentication for BGP on page 773
- Example: Configuring Router Authentication for BGP on page 774

Understanding Router Authentication for BGP

The use of router and route authentication and route integrity greatly mitigates the risk of being attacked by a machine or router that has been configured to share incorrect routing information with another router. In this kind of attack, the attacked router can be tricked into creating a routing loop, or the attacked router's routing table can be greatly increased thus impacting performance, or routing information can be redirected to a place in the network for the attacker to analyze it. Bogus route advertisements can be sent out on a segment. These updates can be accepted into the routing tables of neighbor routers unless an authentication mechanism is in place to verify the source of the routes.

Router and route authentication enables routers to share information only if they can verify that they are talking to a trusted source, based on a password (key). In this method, a hashed key is sent along with the route being sent to another router. The receiving router compares the sent key to its own configured key. If they are the same, it accepts the route. By using a hashing algorithm, the key is not sent over the wire in plain text. Instead, a hash is calculated using the configured key. The routing update is used as the input text, along with the key, into the hashing function. This hash is sent along with the route update to the receiving router. The receiving router compares the received hash with a hash it generates on the route update using the preshared key configured on it. If the two hashes are the same, the route is assumed to be from a trusted source. The key is known only to the sending and receiving routers.

To further strengthen security, you can configure a series of authentication keys (a *keychain*). Each key has a unique start time within the keychain. Keychain authentication allows you to change the password information periodically without bringing down peering sessions. This keychain authentication method is referred to as *hitless* because the keys roll over from one to the next without resetting any peering sessions or interrupting the routing protocol.

The sending peer uses the following rules to identify the active authentication key:

- The start time is less than or equal to the current time (in other words, not in the future).

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- The start time is greater than that of all other keys in the chain whose start time is less than the current time (in other words, closest to the current time).

The receiving peer determines the key with which it authenticates based on the incoming key identifier.

The sending peer identifies the current authentication key based on a configured start time and then generates a hash value using the current key. The sending peer then inserts a TCP-enhanced authentication option object into the BGP update message. The object contains an object ID (assigned by IANA), the object length, the current key, and a hash value.

The receiving peer examines the incoming TCP-enhanced authentication option, looks up the received authentication key, and determines whether the key is acceptable based on the start time, the system time, and the tolerance parameter. If the key is accepted, the receiving peer calculates a hash and authenticates the update message.

Initial application of a keychain to a TCP session causes the session to reset. However, once the keychain is applied, the addition or removal of a password from the keychain does not cause the TCP session to reset. Also, the TCP session does not reset when the keychain changes from one authentication algorithm to another.

NOTE: In Release 19.1R1, Junos OS extends support for TCP authentication to BGP peers that are discovered through allowed prefix subnets configured in a BGP group. In releases before Junos OS Release 19.1, BGP supports TCP authentication at the **[edit protocols bgp group *group-name* neighbor *address*]** and **[edit protocols bgp group *group-name*]** hierarchy levels. Starting in Junos OS Release 19.1, you can configure TCP authentication under allow statements at the **[edit protocols bgp group *group-name* dynamic-neighbor *dyn-name*]** hierarchy level.

Related Documentation

- *Example: Configuring Hitless Authentication Key Rollover for IS-IS*
- Example: Configuring Router Authentication for BGP on page 774
- *Example: Configuring MD5 Authentication for OSPFv2 Exchanges*

Example: Configuring Router Authentication for BGP

All BGP protocol exchanges can be authenticated to guarantee that only trusted routing devices participate in autonomous system (AS) routing updates. By default, authentication is disabled.

- Requirements on page 775
- Overview on page 775
- Configuration on page 776
- Verification on page 778

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Requirements

Before you begin:

- Configure the router interfaces.
- Configure an interior gateway protocol (IGP).

Overview

When you configure authentication, the algorithm creates an encoded checksum that is included in the transmitted packet. The receiving routing device uses an authentication key (password) to verify the packet's checksum.

This example includes the following statements for configuring and applying the keychain:

- **key**—A keychain can have multiple keys. Each key within a keychain must be identified by a unique integer value. The range of valid identifier values is from 0 through 63.

  The key can be up to 126 characters long. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (" ").

- **tolerance**—(Optional) For each keychain, you can configure a clock-skew tolerance value in seconds. The clock-skew tolerance is applicable to the receiver accepting keys for BGP updates. The configurable range is 0 through 999,999,999 seconds. During the tolerance period, either the current or previous password is acceptable.

- **key-chain**—For each keychain, you must specify a name. This example defines one keychain: **bgp-auth**. You can have multiple keychains on a routing device. For example, you can have a keychain for BGP, a keychain for OSPF, and a keychain for LDP.

- **secret**—For each key in the keychain, you must set a secret password. This password can be entered in either encrypted or plain text format in the **secret** statement. It is always displayed in encrypted format.

- **start-time**—Each key must specify a start time in UTC format. Control gets passed from one key to the next. When a configured start time arrives (based on the routing device's clock), the key with that start time becomes active. Start times are specified in the local time zone for a routing device and must be unique within the keychain.

- **authentication-key-chain**—Enables you to apply a keychain at the global BGP level for all peers, for a group, or for a neighbor. This example applies the keychain to the peers defined in the external BGP (EBGP) group called **ext**.

- **authentication-algorithm**—For each keychain, you can specify a hashing algorithm. The algorithm can be AES-128, MD5, or SHA-1.

  You associate a keychain and an authentication algorithm with a BGP neighboring session.

This example configures a keychain named **bgp-auth**. Key 0 will be sent and accepted starting at 2011-6-23.20:19:33 -0700, and will stop being sent and accepted when the next key in the keychain (key 1) becomes active. Key 1 becomes active one year later at 2012-6-23.20:19:33 -0700, and will not stop being sent and accepted unless another key

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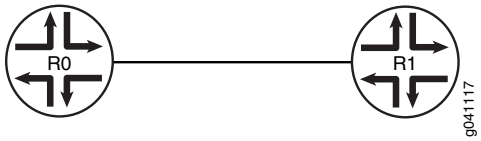
is configured with a start time that is later than the start time of key 1. A clock-skew tolerance of 30 seconds applies to the receiver accepting the keys. During the tolerance period, either the current or previous key is acceptable. The keys are shared-secret passwords. This means that the neighbors receiving the authenticated routing updates must have the same authentication keychain configuration, including the same keys (passwords). So Router R0 and Router R1 must have the same authentication-key-chain configuration if they are configured as peers. This example shows the configuration on only one of the routing devices.

Topology Diagram

Figure 71 on page 776 shows the topology used in this example.

Figure 71: Authentication for BGP



Configuration

- [xref target has no title]

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp group ext type external
set protocols bgp group ext peer-as 65530
set protocols bgp group ext neighbor 172.16.2.1
set routing-options autonomous-system 65533
set protocols bgp group ext authentication-key-chain bgp-auth
set protocols bgp group ext authentication-algorithm md5
set security authentication-key-chains key-chain bgp-auth tolerance 30
set security authentication-key-chains key-chain bgp-auth key 0 secret
  this-is-the-secret-password
set security authentication-key-chains key-chain bgp-auth key 0 start-time
  2011-6-23.20:19:33-0700
set security authentication-key-chains key-chain bgp-auth key 1 secret
  this-is-another-secret-password
set security authentication-key-chains key-chain bgp-auth key 1 start-time
  2012-6-23.20:19:33-0700
```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Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1 to accept route filters from Device CE1 and perform outbound route filtering using the received filters:

1. Configure the local autonomous system.

```
[edit routing-options]
user@R1# set autonomous-system 65533
```

2. Configure one or more BGP groups.

```
[edit protocols bgp group ext]
user@R1# set type external
user@R1# set peer-as 65530
user@R1# set neighbor 172.16.2.1
```

3. Configure authentication with multiple keys.

```
[edit security authentication-key-chains key-chain bgp-auth]
user@R1# set key 0 secret this-is-the-secret-password
user@R1# set key 0 start-time 2011-6-23.20:19:33-0700
user@R1# set key 1 secret this-is-another-secret-password
user@R1# set key 1 start-time 2012-6-23.20:19:33-0700
```

The start time of each key must be unique within the keychain.

4. Apply the authentication keychain to BGP, and set the hashing algorithm.

```
[edit protocols bgp group ext]
user@R1# set authentication-key-chain bgp-auth
user@R1# set authentication-algorithm md5
```

5. (Optional) Apply a clock-skew tolerance value in seconds.

```
[edit security authentication-key-chains key-chain bgp-auth]
user@R1# set tolerance 30
```

Results

From configuration mode, confirm your configuration by entering the **show protocols**, **show routing-options**, and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show protocols
bgp {
  group ext {
    type external;
```

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```
    peer-as 65530;
    neighbor 172.16.2.1;
    authentication-key-chain bgp-auth;
    authentication-algorithm md5;
  }
}
```

```
user@R1# show routing-options
autonomous-system 65533;
```

```
user@R1# show security
authentication-key-chains {
  key-chain bgp-auth {
    tolerance 30;
      key 0 {
      secret $ABC123$ABC123
      start-time “2011-6-23.20:19:33 -0700”;
    }
    key 1 {
      secret $ABC123$ABC123
      start-time “2012-6-23.20:19:33 -0700”;
    }
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Repeat the procedure for every BGP-enabled device in the network, using the appropriate interface names and addresses for each BGP-enabled device.

Verification

Confirm that the configuration is working properly.

- Verifying Authentication for the Neighbor on page 778
- Verifying That Authorization Messages Are Sent on page 779
- Checking Authentication Errors on page 780
- Verifying the Operation of the Keychain on page 780

Verifying Authentication for the Neighbor

Purpose Make sure that the **AutheKeyChain** option appears in the output of the **show bgp neighbor** command.

Action From operational mode, enter the show bgp neighbor command.

```
user@R1> show bgp neighbor
```

```
Peer: 172.16.2.1+179 AS 65530  Local: 172.16.2.2+1222 AS 65533
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
```


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```
Last Error: None
Export: [ direct-lo0 ]
Options: <Preference PeerAS Refresh>
Options: <AutheKeyChain>
Authentication key is configured
Authentication key chain: jni
Holdtime: 90 Preference: 170
Number of flaps: 0
Peer ID: 172.16.2.1       Local ID: 10.255.124.35    Active Holdtime: 90
Keepalive Interval: 30         Peer index: 0
Local Interface: fe-0/0/1.0
NLRI advertised by peer: inet-unicast
NLRI for this session: inet-unicast
Peer supports Refresh capability (2)
Table inet.0 Bit: 10000
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              2
  Received prefixes:            2
  Suppressed due to damping:    0
  Advertised prefixes:          1
Last traffic (seconds): Received 2    Sent 2    Checked 2
Input messages:  Total 21     Updates 2       Refreshes 0     Octets 477
Output messages: Total 22     Updates 1       Refreshes 0     Octets 471
Output Queue[0]: 0
```

Verifying That Authorization Messages Are Sent

Purpose Confirm that BGP has the enhanced authorization option.

Action From operational mode, enter the monitor traffic **interface fe-0/0/1** command.

```
user@R1> monitor traffic interface fe-0/0/1
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Listening on fe-0/0/1, capture size 96 bytes

13:08:00.618402  In arp who-has 172.16.2.66 tell 172.16.2.69
13:08:02.408249 Out IP 172.16.2.2.1122 > 172.16.2.1.646: P
1889289217:1889289235(18) ack 2215740969 win 58486 <nop,nop,timestamp 167557
1465469,nop,Enhanced Auth keyid 0 diglen 12 digest: fe3366001f45767165f17037>:
13:08:02.418396  In IP 172.16.2.1.646 > 172.16.2.2.1122: P 1:19(18) ack 18 win
57100 <nop,nop,timestamp 1466460 167557,nop,Enhanced Auth keyid 0 diglen 12
digest: a18c31eda1b14b2900921675>:
13:08:02.518146 Out IP 172.16.2.2.1122 > 172.16.2.1.646: . ack 19 win 58468
<nop,nop,timestamp 167568 1466460,nop,Enhanced Auth keyid 0 diglen 12 digest:
c3b6422eb6bd3fd9cf79742b>
13:08:28.199557 Out IP 172.16.2.2.nerv > 172.16.2.1.bgp: P
286842489:286842508(19) ack 931203976 win 57200 <nop,Enhanced Auth keyid 0
diglen 12 digest: fc0e42900a73736bcc07c1a4>: BGP, length: 19
13:08:28.209661  In IP 172.16.2.1.bgp > 172.16.2.2.nerv: P 1:20(19) ack 19 win
56835 <nop,Enhanced Auth keyid 0 diglen 12 digest: 0fc8578c489fabce63aeb2c3>:
BGP, length: 19
13:08:28.309525 Out IP 172.16.2.2.nerv > 172.16.2.1.bgp: . ack 20 win 57181
<nop,Enhanced Auth keyid 0 diglen 12 digest: ef03f282fb2ece0039491df8>
13:08:32.439708 Out IP 172.16.2.2.1122 > 172.16.2.1.646: P 54:72(18) ack 55 win
58432 <nop,nop,timestamp 170560 1468472,nop,Enhanced Auth keyid 0 diglen 12
```

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```
digest: 76e0cf926f348b726c631944>:
13:08:32.449795  In IP 172.16.2.1.646 > 172.16.2.2.1122: P 55:73(18) ack 72 win
57046 <nop,nop,timestamp 1469463 170560,nop,Enhanced Auth keyid 0 diglen 12
digest: dae3eec390d18a114431f4d8>:
13:08:32.549726 Out IP 172.16.2.2.1122 > 172.16.2.1.646: . ack 73 win 58414
<nop,nop,timestamp 170571 1469463,nop,Enhanced Auth keyid 0 diglen 12 digest:
851df771aee2ea7a43a0c46c>
13:08:33.719880  In arp who-has 172.16.2.66 tell 172.16.2.69
^C
35 packets received by filter
0 packets dropped by kernel
```

Checking Authentication Errors

Purpose Check the number of packets dropped by TCP because of authentication errors.

Action From operational mode, enter the **show system statistics tcp | match auth** command.

```
user@R1> show system statistics tcp | match auth
        0 send packets dropped by TCP due to auth errors
        58 rcv packets dropped by TCP due to auth errors
```

Verifying the Operation of the Keychain

Purpose Check the number of packets dropped by TCP because of authentication errors.

Action From operational mode, enter the show security keychain **detail** command.

```
user@R1> show security keychain detail
keychain                 Active-ID       Next-ID       Transition  Tolerance
                       Send  Receive   Send  Receive
 bgp-auth                3     3        1     1        1d 23:58    30
  Id 3, Algorithm hmac-md5, State send-receive, Option basic
  Start-time Wed Aug 11 16:28:00 2010, Mode send-receive
  Id 1, Algorithm hmac-md5, State inactive, Option basic
  Start-time Fri Aug 20 11:30:57 2010, Mode send-receive
```

Related Documentation

- Understanding External BGP Peering Sessions on page 23
- BGP Configuration Overview on page 13

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CHAPTER 20

Using IP Security to Protect IP Traffic

- Understanding IPsec for BGP on page 781
- Example: Using IPsec to Protect BGP Traffic on page 781

Understanding IPsec for BGP

You can apply the IP security (IPsec) to BGP traffic. IPsec is a protocol suite used for protecting IP traffic at the packet level. IPsec is based on security associations (SAs). An SA is a simplex connection that provides security services to the packets carried by the SA. After configuring the SA, you can apply it to BGP peers.

The Junos OS implementation of IPsec supports two types of security: host to host and gateway to gateway. Host-to-host security protects BGP sessions with other routers. An SA to be used with BGP must be configured manually and use transport mode. Static values must be configured on both ends of the security association. To apply host protection, you configure manual SAs in transport mode and then reference the SA by name in the BGP configuration to protect a session with a given peer.

Manual SAs require no negotiation between the peers. All values, including the keys, are static and specified in the configuration. Manual SAs statically define the security parameter index values, algorithms, and keys to be used and require matching configurations on both end points of the tunnel (on both peers). As a result, each peer must have the same configured options for communication to take place.

In transport mode, IPsec headers are inserted after the original IP header and before the transport header.

The security parameter index is an arbitrary value used in combination with a destination address and a security protocol to uniquely identify the SA.

Related Documentation

- Example: Using IPsec to Protect BGP Traffic on page 781

Example: Using IPsec to Protect BGP Traffic

IPsec is a suite of protocols used to provide secure network connections at the IP layer. It is used to provide data source authentication, data integrity, confidentiality and packet replay protection. This example shows how to configure IPsec functionality to protect

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Routing Engine-to-Routing Engine BGP sessions. Junos OS supports IPsec Authentication Header (AH) and Encapsulating Security Payload (ESP) in transport and tunnel mode, as well as a utility for creating policies and manually configuring keys.

- Requirements on page 782
- Overview on page 782
- Configuration on page 782
- Verification on page 784

Requirements

Before you begin:

- Configure the router interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.

No specific PIC hardware is required to configure this feature.

Overview

The SA is configured at the **[edit security ipsec security-association name]** hierarchy level with the **mode** statement set to transport. In transport mode, Junos OS does not support authentication header (AH) or encapsulating security payload (ESP) header bundles. Junos OS supports only the BGP protocol in transport mode.

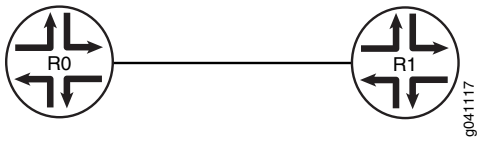
This example specifies bidirectional IPsec to decrypt and authenticate the incoming and outgoing traffic using the same algorithm, keys, and SPI in both directions, unlike inbound and outbound SAs that use different attributes in both directions.

A more specific SA overrides a more general SA. For example, if a specific SA is applied to a specific peer, that SA overrides the SA applied to the whole peer group.

Topology Diagram

Figure 72 on page 782 shows the topology used in this example.

Figure 72: IPsec for BGP



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

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```
[edit]
set security ipsec security-association test-sa mode transport
set security ipsec security-association test-sa manual direction bidirectional protocol
    esp
set security ipsec security-association test-sa manual direction bidirectional spi 1000
set security ipsec security-association test-sa manual direction bidirectional encryption
    algorithm 3des-cbc
set security ipsec security-association test-sa manual direction bidirectional encryption
    key ascii-text
    "$9$kPT3AtO1hr6/u1IhvM8X7Vb2JGimfz.PtuB1hcs2goGDkqf5Qndb.5QzCA0BlRrvx7VsgJ"
set protocols bgp group 1 neighbor 1.1.1.1 ipsec-sa test-sa
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R1:

1. Configure the SA mode.

   ```
   [edit security ipsec security-association test-sa]
   user@R1# set mode transport
   ```

2. Configure the IPsec protocol to be used.

   ```
   [edit security ipsec security-association test-sa]
   user@R1# set manual direction bidirectional protocol esp
   ```

3. Configure to security parameter index to uniquely identify the SA.

   ```
   [edit security ipsec security-association test-sa]
   user@R1# set manual direction bidirectional spi 1000
   ```

4. Configure the encryption algorithm.

   ```
   [edit security ipsec security-association test-sa]
   user@R1# set manual direction bidirectional encryption algorithm 3des-cbc
   ```

5. Configure the encryption key.

   ```
   [edit security ipsec security-association test-sa]
   user@R1# set manual direction bidirectional encryption key ascii-text
     "$9$kPT3AtO1hr6/u1IhvM8X7Vb2JGimfz.PtuB1hcs2goGDkqf5Qndb.5QzCA0BlRrvx7VsgJ"
   ```

   When you use an ASCII text key, the key must contain exactly 24 characters.

6. Apply the SA to the BGP peer.

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```
[edit protocols bgp group 1 neighbor 1.1.1.1]
user@R1# set ipsec-sa test-sa
```

Results From configuration mode, confirm your configuration by entering the **show protocols** and **show security** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show protocols
bgp {
  group 1 {
    neighbor 1.1.1.1 {
      ipsec-sa test-sa;
    }
  }
}
```

```
user@R1# show security
ipsec {
  security-association test-sa {
    mode transport;
    manual {
      direction bidirectional {
        protocol esp;
        spi 1000;
        encryption {
          algorithm 3des-cbc;
          key ascii-text
            "$9$kPT3AtO1hr6/u1lhvM8X7Vb2JGimfz.PtuB1hcs2goGDkqf5Qndb.5QzCA0BlRrvx7VsgJ";
            ## SECRET-DATA
        }
      }
    }
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode. Repeat the configuration on Router R0, changing only the neighbor address.

Verification

Confirm that the configuration is working properly.

- Verifying the Security Associaton on page 784

Verifying the Security Associaton

Purpose Make sure that the correct settings appear in the output of the **show ipsec security-associations** command.

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Action From operational mode, enter the **show ipsec security-associations** command.

```
user@R1> show ipsec security-associations
```

```
Security association: test-sa
    Direction SPI         AUX-SPI     Mode       Type     Protocol
    inbound   1000        0           transport  manual   ESP
    outbound  1000        0           transport  manual   ESP
```

Meaning The output is straighforward for most fields except the AUX-SPI field. The AUX-SPI is the value of the auxiliary security parameter index. When the value is AH or ESP, AUX-SPI is always 0. When the value is AH+ESP, AUX-SPI is always a positive integer.

Related Documentation

- Understanding IPsec for BGP on page 781

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CHAPTER 21

Restricting TCP Access to a Port

- Understanding Security Options for BGP with TCP on page 787
- Example: Configuring a Filter to Block TCP Access to a Port Except from Specified BGP Peers on page 788
- Example: Configuring a Filter to Limit TCP Access to a Port Based On a Prefix List on page 794
- Example: Limiting TCP Segment Size for BGP on page 797

Understanding Security Options for BGP with TCP

Among routing protocols, BGP is unique in using TCP as its transport protocol. BGP peers are established by manual configuration between routing devices to create a TCP session on port 179. A BGP-enabled device periodically sends keepalive messages to maintain the connection.

Over time, BGP has become the dominant interdomain routing protocol on the Internet. However, it has limited guarantees of stability and security. Configuring security options for BGP must balance suitable security measures with acceptable costs. No one method has emerged as superior to other methods. Each network administrator must configure security measures that meet the needs of the network being used.

For detailed information about the security issues associated with BGP's use of TCP as a transport protocol, see RFC 4272, *BGP Security Vulnerabilities Analysis*.

Related Documentation

- Example: Configuring a Filter to Block TCP Access to a Port Except from Specified BGP Peers on page 788
- Example: Configuring a Filter to Limit TCP Access to a Port Based On a Prefix List on page 794
- Example: Limiting TCP Segment Size for BGP on page 797

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Example: Configuring a Filter to Block TCP Access to a Port Except from Specified BGP Peers

This example shows how to configure a standard stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except from specified BGP peers.

- Requirements on page 788
- Overview on page 788
- Configuration on page 788
- Verification on page 792

Requirements

No special configuration beyond device initialization is required before you configure this example.

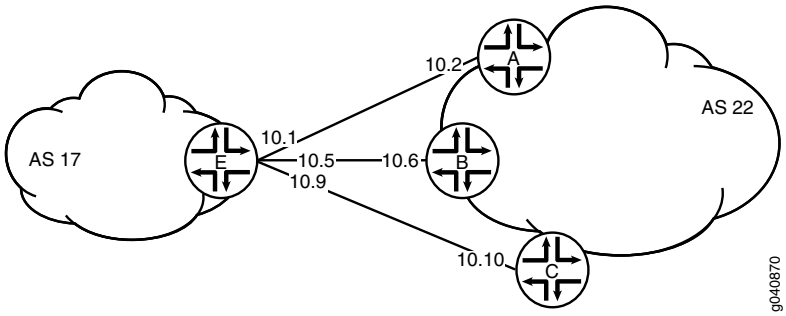
Overview

In this example, you create a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except the specified BGP peers.

The stateless firewall filter **filter_bgp179** matches all packets from the directly connected interfaces on Device A and Device B to the destination port number 179.

Figure 73 on page 788 shows the topology used in this example. Device C attempts to make a TCP connection to Device E. Device E blocks the connection attempt. This example shows the configuration on Device E.

Figure 73: Typical Network with BGP Peer Sessions



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device C

```
set interfaces ge-1/2/0 unit 10 description to-E
```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```
set interfaces ge-1/2/0 unit 10 family inet address 10.10.10.10/30
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 17
set protocols bgp group external-peers neighbor 10.10.10.9
set routing-options autonomous-system 22
```

Device E

```
set interfaces ge-1/2/0 unit 0 description to-A
set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30
set interfaces ge-1/2/1 unit 5 description to-B
set interfaces ge-1/2/1 unit 5 family inet address 10.10.10.5/30
set interfaces ge-1/0/0 unit 9 description to-C
set interfaces ge-1/0/0 unit 9 family inet address 10.10.10.9/30
set interfaces lo0 unit 2 family inet filter input filter_bgp179
set interfaces lo0 unit 2 family inet address 192.168.0.1/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers peer-as 22
set protocols bgp group external-peers neighbor 10.10.10.2
set protocols bgp group external-peers neighbor 10.10.10.6
set protocols bgp group external-peers neighbor 10.10.10.10
set routing-options autonomous-system 17
set firewall family inet filter filter_bgp179 term 1 from source-address 10.10.10.2/32
set firewall family inet filter filter_bgp179 term 1 from source-address 10.10.10.6/32
set firewall family inet filter filter_bgp179 term 1 from destination-port bgp
set firewall family inet filter filter_bgp179 term 1 then accept
set firewall family inet filter filter_bgp179 term 2 then reject
```

Configuring Device E

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device E with a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requestors except specified BGP peers:

1. Configure the interfaces.

```
user@E# set interfaces ge-1/2/0 unit 0 description to-A
user@E# set interfaces ge-1/2/0 unit 0 family inet address 10.10.10.1/30
user@E# set interfaces ge-1/2/1 unit 5 description to-B
user@E# set interfaces ge-1/2/1 unit 5 family inet address 10.10.10.5/30
user@E# set interfaces ge-1/0/0 unit 9 description to-C
user@E# set interfaces ge-1/0/0 unit 9 family inet address 10.10.10.9/30
```

2. Configure BGP.

```
[edit protocols bgp group external-peers]
user@E# set type external
user@E# set peer-as 22
user@E# set neighbor 10.10.10.2
user@E# set neighbor 10.10.10.6
```

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```
user@E# set neighbor 10.10.10.10
```

3. Configure the autonomous system number.

```
[edit routing-options]
user@E# set autonomous-system 17
```

4. Define the filter term that accepts TCP connection attempts to port 179 from the specified BGP peers.

```
[edit firewall family inet filter filter_bgp179]
user@E# set term 1 from source-address 10.10.10.2/32
user@E# set term 1 from source-address 10.10.10.6/32
user@E# set term 1 from destination-port bgp
user@E# set term 1 then accept
```

5. Define the other filter term to reject packets from other sources.

```
[edit firewall family inet filter filter_bgp179]
user@E# set term 2 then reject
```

6. Apply the firewall filter to the loopback interface.

```
[edit interfaces lo0 unit 2 family inet]
user@E# set filter input filter_bgp179
user@E# set address 192.168.0.1/32
```

Results From configuration mode, confirm your configuration by entering the **show firewall**, **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@E# show firewall
family inet {
   filter filter_bgp179 {
      term 1 {
         from {
            source-address {
               10.10.10.2/32;
               10.10.10.6/32;
            }
            destination-port bgp;
         }
         then accept;
      }
      term 2 {
         then {
```


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```
            reject;
        }
    }
  }
}
```

```
user@E# show interfaces
lo0 {
  unit 2 {
    family inet {
      filter {
        input filter_bgp179;
      }
      address 192.168.0.1/32;
    }
  }
}
ge-1/2/0 {
  unit 0 {
    description to-A;
    family inet {
      address 10.10.10.1/30;
    }
  }
}
ge-1/2/1 {
  unit 5 {
    description to-B;
    family inet {
      address 10.10.10.5/30;
    }
  }
}
ge-1/0/0 {
  unit 9 {
    description to-C;
    family inet {
      address 10.10.10.9/30;
    }
  }
}
```

```
user@E# show protocols
bgp {
  group external-peers {
    type external;
    peer-as 22;
    neighbor 10.10.10.2;
    neighbor 10.10.10.6;
    neighbor 10.10.10.10;
  }
}
```

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```
user@E# show routing-options
autonomous-system 17;
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Verifying That the Filter Is Configured on page 792
- Verifying the TCP Connections on page 792
- Monitoring Traffic on the Interfaces on page 793

Verifying That the Filter Is Configured

Purpose Make sure that the filter is listed in output of the **show firewall filter** command.

Action

```
user@E> show firewall filter filter_bgp179
Filter: filter_bgp179
```

Verifying the TCP Connections

Purpose Verify the TCP connections.

Action From operational mode, run the **show system connections extensive** command on Device C and Device E.

The output on Device C shows the attempt to establish a TCP connection. The output on Device E shows that connections are established with Device A and Device B only.

```
user@C> show system connections extensive | match 10.10.10

tcp4       0      0  10.10.10.9.51872     10.10.10.10.179        SYN_SENT
```

```
user@E> show system connections extensive | match 10.10.10

tcp4       0      0  10.10.10.5.179         10.10.10.6.62096     ESTABLISHED
tcp4       0      0  10.10.10.6.62096       10.10.10.5.179       ESTABLISHED
tcp4       0      0  10.10.10.1.179         10.10.10.2.61506     ESTABLISHED
tcp4       0      0  10.10.10.2.61506       10.10.10.1.179       ESTABLISHED
```


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Monitoring Traffic on the Interfaces

Purpose Use the **monitor traffic** command to compare the traffic on an interface that establishes a TCP connection with the traffic on an interface that does not establish a TCP connection.

Action From operational mode, run the **monitor traffic** command on the Device E interface to Device B and on the Device E interface to Device C. The following sample output verifies that in the first example, acknowledgment (**ack**) messages are received. In the second example, **ack** messages are not received.

```
user@E> monitor traffic size 1500 interface ge-1/2/1.5
19:02:49.700912 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: P
3330573561:3330573580(19) ack 915601686 win 16384 <nop,nop,timestamp 1869518816
1869504850>: BGP, length: 19
19:02:49.801244  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: . ack 19 win 16384
<nop,nop,timestamp 1869518916 1869518816>
19:03:03.323018  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: P 1:20(19) ack 19 win
16384 <nop,nop,timestamp 1869532439 1869518816>: BGP, length: 19
19:03:03.422418 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: . ack 20 win 16384
<nop,nop,timestamp 1869532539 1869532439>
19:03:17.220162 Out IP 10.10.10.5.bgp > 10.10.10.6.62096: P 19:38(19) ack 20 win
 16384 <nop,nop,timestamp 1869546338 1869532439>: BGP, length: 19
19:03:17.320501  In IP 10.10.10.6.62096 > 10.10.10.5.bgp: . ack 38 win 16384
<nop,nop,timestamp 1869546438 1869546338>
```

```
user@E> monitor traffic size 1500 interface ge-1/0/0.9

18:54:20.175471 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869009240 0,sackOK,eol>
18:54:23.174422 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869012240 0,sackOK,eol>
18:54:26.374118 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,nop,wscale 0,nop,nop,timestamp 1869015440 0,sackOK,eol>
18:54:29.573799 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
18:54:32.773493 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
18:54:35.973185 Out IP 10.10.10.9.61335 > 10.10.10.10.bgp: S 573929123:573929123(0)
 win 16384 <mss 1460,sackOK,eol>
```

Related Documentation

- *Understanding How to Use Standard Firewall Filters*
- *Example: Configuring a Stateless Firewall Filter to Protect Against TCP and ICMP Floods*
- *Example: Configuring a Filter to Accept Packets Based on IPv6 TCP Flags*

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Example: Configuring a Filter to Limit TCP Access to a Port Based On a Prefix List

This example shows how to configure a standard stateless firewall filter that limits certain TCP and Internet Control Message Protocol (ICMP) traffic destined for the Routing Engine by specifying a list of prefix sources that contain allowed BGP peers.

- Requirements on page 794
- Overview on page 794
- Configuration on page 794
- Verification on page 796

Requirements

No special configuration beyond device initialization is required before configuring this example.

Overview

In this example, you create a stateless firewall filter that blocks all TCP connection attempts to port 179 from all requesters except BGP peers that have a specified prefix.

A source prefix list, **plist_bgp179**, is created that specifies the list of source prefixes that contain allowed BGP peers.

The stateless firewall filter **filter_bgp179** matches all packets from the source prefix list **plist_bgp179** to the destination port number 179.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options prefix-list plist_bgp179 apply-path "protocols bgp group <*> neighbor
   <*>"
set firewall family inet filter filter_bgp179 term 1 from source-address 0.0.0.0/0
set firewall family inet filter filter_bgp179 term 1 from source-prefix-list plist_bgp179 except
set firewall family inet filter filter_bgp179 term 1 from destination-port bgp
set firewall family inet filter filter_bgp179 term 1 then reject
set firewall family inet filter filter_bgp179 term 2 then accept
set interfaces lo0 unit 0 family inet filter input filter_bgp179
set interfaces lo0 unit 0 family inet address 127.0.0.1/32
```


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Configure the Filter

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the filter:

1. Expand the prefix list **bgp179** to include all prefixes pointed to by the BGP peer group defined by **protocols bgp group <*> neighbor <*>**.

```
[edit policy-options prefix-list plist_bgp179]
user@host# set apply-path " protocolsbgp group <*> neighbor <*>"
```

2. Define the filter term that rejects TCP connection attempts to port 179 from all requesters except the specified BGP peers.

```
[edit firewall family inet filter filter_bgp179]
user@host# set term term1 from source-address 0.0.0.0/0
user@host# set term term1 from source-prefix-list bgp179 except
user@host# set term term1 from destination-port bgp
user@host# set term term1 then reject
```

3. Define the other filter term to accept all packets.

```
[edit firewall family inet filter filter_bgp179]
user@host# set term term2 then accept
```

4. Apply the firewall filter to the loopback interface.

```
[edit interfaces lo0 unit 0 family inet]
user@host# set filter input filter_bgp179
user@host# set address 127.0.0.1/32
```

Results

From configuration mode, confirm your configuration by entering the **show firewall**, **show interfaces**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show firewall
family inet {
   filter filter_bgp179 {
      term 1 {
         from {
            source-address {
               0.0.0.0/0;
```

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```
            }
            source-prefix-list {
              plist_bgp179 except;
            }
            destination-port bgp;
          }
          then {
            reject;
          }
        }
        term 2 {
          then {
            accept;
          }
        }
      }
    }
```

```
user@host# show interfaces
lo0 {
  unit 0 {
    family inet {
      filter {
        input filter_bgp179;
      }
      address 127.0.0.1/32;
    }
  }
}
```

```
user@host# show policy-options
prefix-list plist_bgp179 {
  apply-path "protocols bgp group <*> neighbor <*>";
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Displaying the Firewall Filter Applied to the Loopback Interface

Purpose Verify that the firewall filter **filter_bgp179** is applied to the IPv4 input traffic at logical interface **lo0.0**.

Action Use the **show interfaces statistics operational mode** command for logical interface **lo0.0**, and include the **detail** option. Under the **Protocol inet** section of the command output section, the **Input Filters** field displays the name of the stateless firewall filter applied to the logical interface in the input direction.

```
[edit]
```


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```
user@host> show interfaces statistics lo0.0 detail
  Logical interface lo0.0 (Index 321) (SNMP ifIndex 16) (Generation 130)
    Flags: SNMP-Traps Encapsulation: Unspecified
    Traffic statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Local statistics:
     Input  bytes  :                   0
     Output bytes  :                   0
     Input  packets:                   0
     Output packets:                   0
    Transit statistics:
     Input  bytes  :                   0                    0 bps
     Output bytes  :                   0                    0 bps
     Input  packets:                   0                    0 pps
     Output packets:                   0                    0 pps
    Protocol inet, MTU: Unlimited, Generation: 145, Route table: 0
      Flags: Sendbcast-pkt-to-re
      Input Filters: filter_bgp179
      Addresses, Flags: Primary
        Destination: Unspecified, Local: 127.0.0.1, Broadcast: Unspecified,
Generation: 138
```

Related Documentation

- *Understanding How to Use Standard Firewall Filters*
- *Firewall Filter Match Conditions Based on Address Fields*
- *Example: Configuring a Stateless Firewall Filter to Protect Against TCP and ICMP Floods*
- *Example: Configuring a Filter to Accept Packets Based on IPv6 TCP Flags*
- *prefix-list*

Example: Limiting TCP Segment Size for BGP

This example shows how to avoid Internet Control Message Protocol (ICMP) vulnerability issues by limiting TCP segment size when you are using maximum transmission unit (MTU) discovery. Using MTU discovery on TCP paths is one method of avoiding BGP packet fragmentation.

- Requirements on page 797
- Overview on page 798
- Configuration on page 798
- Verification on page 801
- Troubleshooting on page 801

Requirements

No special configuration beyond device initialization is required before you configure this example.

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Overview

TCP negotiates a maximum segment size (MSS) value during session connection establishment between two peers. The MSS value negotiated is primarily based on the maximum transmission unit (MTU) of the interfaces to which the communicating peers are directly connected. However, due to variations in link MTU on the path taken by the TCP packets, some packets in the network that are well within the MSS value might be fragmented when the packet size exceeds the link's MTU.

To configure the TCP MSS value, include the tcp-mss statement with a segment size from 1 through 4096.

If the router receives a TCP packet with the SYN bit and the MSS option set, and the MSS option specified in the packet is larger than the MSS value specified by the **tcp-mss** statement, the router replaces the MSS value in the packet with the lower value specified by the **tcp-mss** statement.

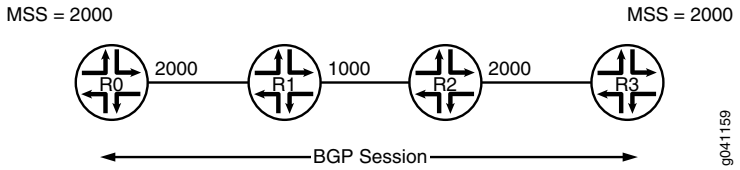
The configured MSS value is used as the maximum segment size for the sender. The assumption is that the TCP MSS value used by the sender to communicate with the BGP neighbor is the same as the TCP MSS value that the sender can accept from the BGP neighbor. If the MSS value from the BGP neighbor is less than the MSS value configured, the MSS value from the BGP neighbor is used as the maximum segment size for the sender.

This feature is supported with TCP over IPv4 and TCP over IPv6.

Topology Diagram

Figure 74 on page 798 shows the topology used in this example.

Figure 74: TCP Maximum Segment Size for BGP



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

R0

```
set interfaces fe-1/2/0 unit 1 family inet address 1.1.0.1/30
set interfaces lo0 unit 1 family inet address 10.255.14.179/32
set protocols bgp group-int tcp-mss 2020
set protocols bgp group int type internal
set protocols bgp group int local-address 10.255.14.179
set protocols bgp group int mtu-discovery
```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```
set protocols bgp group int neighbor 10.255.71.24 tcp-mss 2000
set protocols bgp group int neighbor 10.255.14.177
set protocols bgp group int neighbor 10.0.14.4 tcp-mss 4000
set protocols ospf area 0.0.0.0 interface fe-1/2/0.1
set protocols ospf area 0.0.0.0 interface 10.255.14.179
set routing-options autonomous-system 65000
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R0:

1. Configure the interfaces.

```
[edit interfaces]
user@R0# set fe-1/2/0 unit 1 family inet address 1.1.0.1/30
user@R0# set lo0 unit 1 family inet address 10.255.14.179/32
```

2. Configure an interior gateway protocol (IGP), OSPF in this example.

```
[edit protocols ospf area 0.0.0.0]
user@R0# set interface fe-1/2/0.1
user@R0# set interface 10.255.14.179
```

3. Configure one or more BGP groups.

```
[edit protocols bgp group int]
user@R0# set type internal
user@R0# set local-address 10.255.14.179
```

4. Configure MTU discovery to prevent packet fragmentation.

```
[edit protocols bgp group int]
user@R0# set mtu-discovery
```

5. Configure the BGP neighbors, with the TCP MSS set globally for the group or specifically for the various neighbors.

```
[edit protocols bgo group int]
user@R0# set tcp-mss 2020
user@R0# set neighbor 10.255.14.177
user@R0# set neighbor 10.255.71.24 tcp-mss 2000
user@R0# set neighbor 10.0.14.4 tcp-mss 4000
```

NOTE: The TCP MSS neighbor setting overrides the group setting.

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6. Configure the local autonomous system.

```
[edit routing-options]
user@R0# set autonomous-system 65000
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
fe-1/2/0 {
   unit 1 {
      family inet {
         address 1.1.0.1/30;
      }
   }
}
lo0 {
   unit 1 {
      family inet {
         address 10.255.14.179/32;
      }
   }
}
```

```
user@R0# show protocols
bgp {
   group int {
      type internal;
      local-address 10.255.14.179;
      mtu-discovery;
      tcp-mss 2020;
      neighbor 10.255.71.24 {
         tcp-mss 2000;
      }
      neighbor 10.255.14.177;
      neighbor 10.0.14.4 {
         tcp-mss 4000;
      }
   }
}
ospf {
   area 0.0.0.0 {
      interface fe-1/2/0.1;
      interface 10.255.14.179;
   }
}
```

```
user@R0# show routing-options
autonomous-system 65000;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

To confirm that the configuration is working properly, run the following commands:

- **show system connections extensive | find <neighbor-address>**, to check the negotiated TCP MSS value.
- monitor traffic **interface**, to monitor BGP traffic and to make sure that the configured TCP MSS value is used as the MSS option in the TCP SYN packet.

Troubleshooting

- MSS Calculation with MTU Discovery on page 801

MSS Calculation with MTU Discovery

Problem Consider an example in which two routing devices (R1 and R2) have an internal BGP (IBGP) connection. On both of the routers, the connected interfaces have 4034 as the IPv4 MTU.

```
user@R1# show protocols bgp | display set
[edit]
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 45.45.45.2
set protocols bgp group ibgp mtu-discovery
set protocols bgp group ibgp neighbor 45.45.45.1
```

```
user@R1# run show interfaces xe-0/0/3 extensive | match mtu

  Link-level type: Ethernet, MTU: 4048, LAN-PHY mode, Speed: 10Gbps,
    FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
    Protocol inet, MTU: 4034, Generation: 180, Route table: 0
    Protocol multiservice, MTU: Unlimited, Generation: 181, Route table: 0
```

In the following packet capture on Device R1, the negotiated MSS is 3994. In the **show system connections extensive** information for MSS, it is set to 2048.

```
05:50:01.575218 Out
        Juniper PCAP Flags [Ext], PCAP Extension(s) total length 16
          Device Media Type Extension TLV #3, length 1, value: Ethernet (1)
          Logical Interface Encapsulation Extension TLV #6, length 1, value:
Ethernet (14)
          Device Interface Index Extension TLV #1, length 2, value: 137
          Logical Interface Index Extension TLV #4, length 4, value: 69
        -----original packet-----
        00:21:59:e1:e8:03 > 00:19:e2:20:79:01, ethertype IPv4 (0x0800), length
78: (tos 0xc0, ttl 64, id 53193, offset 0, flags [DF], proto: TCP (6), length:
64) 45.45.45.2.62840 > 45.45.45.1.bgp: S 2939345813:2939345813(0) win 16384 **mss
 3994,nop,wscale 0,nop,nop,timestamp 70559970 0,sackOK,eol>
05:50:01.575875 In
        Juniper PCAP Flags [Ext, no-L2, In], PCAP Extension(s) total length 16
```

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```
         Device Media Type Extension TLV #3, length 1, value: Ethernet (1)
         Logical Interface Encapsulation Extension TLV #6, length 1, value:
Ethernet (14)
         Device Interface Index Extension TLV #1, length 2, value: 137
         Logical Interface Index Extension TLV #4, length 4, value: 69
       -----original packet-----
  PFE proto 2 (ipv4): (tos 0xc0, ttl 255, id 37709, offset 0, flags [DF], proto:
 TCP (6), length: 64) 45.45.45.1.bgp > 45.45.45.2.62840: S 2634967984:2634967984(0)
 ack 2939345814 win 16384 **mss 3994,nop,wscale 0,nop,nop,timestamp 174167273
70559970,sackOK,eol>
```

user@R1# run show system connections extensive | find 45.45

```
tcp4       0      0  45.45.45.2.62840                          45.45.45.1.179
                          ESTABLISHED
   sndsbcc:          0 sndsbmbcnt:          0  sndsbmbmax:     131072
sndsblowat:       2048 sndsbhiwat:      16384
   rcvsbcc:          0 rcvsbmbcnt:          0  rcvsbmbmax:     131072
rcvsblowat:          1 rcvsbhiwat:      16384
   proc id:      19725  proc name:        rpd
       iss: 2939345813      sndup: 2939345972
    snduna: 2939345991     sndnxt: 2939345991      sndwnd:      16384
    sndmax: 2939345991    sndcwnd:      10240 sndssthresh: 1073725440
       irs: 2634967984      rcvup: 2634968162
    rcvnxt: 2634968162     rcvadv: 2634984546      rcvwnd:      16384
       rtt:          0       srtt:       1538        rttv:       1040
    rxtcur:       1200   rxtshift:          0       rtseq: 2939345972
    rttmin:       1000  mss:        2048
```

Solution This is expected behavior with Junos OS. The MSS value is equal to the MTU value minus the IP or IPv6 and TCP headers. This means that the MSS value is generally 40 bytes less than the MTU (for IPv4) and 60 bytes less than the MTU (for IPv6). This value is negotiated between the peers. In this example, it is 4034 - 40 = 3994. Junos OS then rounds this value to a multiple of 2 KB. The value is 3994 / 2048 * 2048=2048. So it is not necessary to see same MSS value with in the **show system connections** output.

3994 / 2048 = 1.95

1.95 is rounded to 1.

1 * 2048 = 2048

Related Documentation

- BGP Configuration Overview on page 13
- Understanding External BGP Peering Sessions on page 23

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CHAPTER 22

Validating the Origin of Route Advertisements

- Configuring Origin Validation for BGP on page 803

Configuring Origin Validation for BGP

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

Use Case and Benefit of Origin Validation

If an administrator of an autonomous system (AS) begins advertising all or part of another company's assigned network, BGP has no built-in method to recognize the error and respond in a way that would avoid service interruptions.

Suppose, for example, that an administrator in a customer network mistakenly advertises a route (let's say 10.65.153.0/24) directing traffic to the customer's service provider AS 1. This /24 route is a more specific route than the one used by the actual content provider (10.65.152.0/22) which directs traffic to AS 2. Because of the way routers work, most routers select the more specific route and send traffic to AS 1 instead of AS 2.

The hijacked prefix is seen widely across the Internet as transit routers propagate the updated path information. The invalid routes can be distributed broadly across the Internet as the routers in the default free zone (DFZ) carry the hijacked route. Eventually the correct AS path is restored to BGP peers, but in the meantime service interruptions are to be expected.

Because BGP relies on a transitive trust model, validation between customer and provider is important. In the example above, the service provider AS 1 did not validate the faulty advertisement for 10.65.153.0/24. By accepting this advertisement and readvertising it to its peers and providers, AS 1 was propagating the wrong route. The routers that received this route from AS 1 selected it because it was a more specific route. The actual content provider was advertising 10.65.152.0/22 before the mistake occurred. The /24 was a smaller (and more specific) advertisement. According to the usual BGP route selection process, the /24 was then chosen, effectively completing the hijack.

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Even with fast detection and reaction of the content provider and cooperation with other providers, service for their prefix can be interrupted for many minutes up to several hours. The exact duration of the outage depends on your vantage point on the Internet. When these sorts of events occur, there is renewed interest in solutions to this vulnerability. BGP is fundamental to provider relationships and will not be going away anytime soon. This example demonstrates a solution that uses origin validation. This solution relies on cryptographic extensions to BGP and a distributed client-server model that avoids overtaxing router CPUs.

Origin validation helps to overcome the vulnerability of transitive trust by enabling a provider to limit the advertisements it accepts from a customer. The mechanics involve the communication of routing policies based on an extended BGP community attribute.

See Also

- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

Understanding Origin Validation for BGP

Origin validation helps to prevent the unintentional advertisement of routes. Sometimes network administrators mistakenly advertise routes to networks that they do not control. You can resolve this security issue by configuring origin validation (also known as secure interdomain routing). Origin validation is a mechanism by which route advertisements can be authenticated as originating from an expected autonomous system (AS). Origin validation uses one or more resource public key infrastructure (RPKI) cache servers to perform authentication for specified BGP prefixes. To authenticate a prefix, the router (BGP speaker) queries the database of validated prefix-to-AS mappings, which are downloaded from the cache server, and ensures that the prefix originated from an expected AS.

NOTE: **When you enable the RPKI authentication, Junos OS opens the TCP port 2222 automatically without any notice. You can apply a filter to block and secure this port.**

Junos OS supports origin validation for IPv4 and IPv6 prefixes.

Figure 75 on page 805 shows a sample topology.

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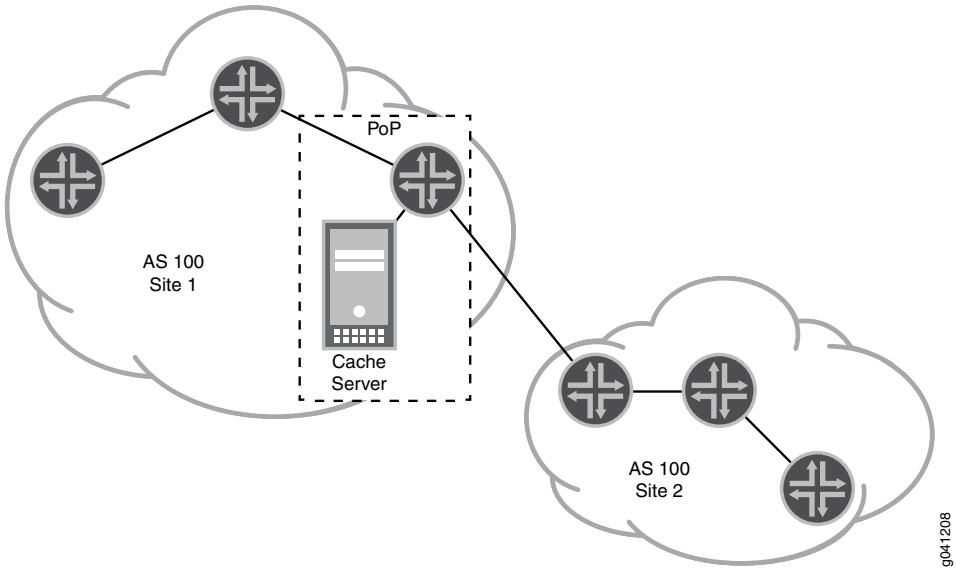
Figure 75: Sample Topology for Origin Validation



Supported Standards

The Junos OS implementation of origin validation supports the following RFCs and draft:

- RFC 6810, *The Resource Public Key Infrastructure (RPKI) to Router Protocol*
- RFC 6811, *BGP Prefix Origin Validation*
- Internet draft draft-ietf-sidr-origin-validation-signaling-00, *BGP Prefix Origin Validation State Extended Community* (partial support)

  The extended community (origin validation state) is supported in Junos OS routing policy. The specified change in the route selection procedure is not supported.

How Origin Validation Works

The RPKI and origin validation use X.509 certificates with extensions specified in RFC 3779, *X.509 Extensions for IP Addresses and AS Identifiers*.

The RPKI consists of a distributed collection of information. Each Certification Authority publishes its end-entity (EE) certificates, certificate revocation lists (CRLs), and signed objects at a particular location. All of these repositories form a complete set of information that is available to every RPKI cache server.

Each RPKI cache server maintains a local cache of the entire distributed repository collection by regularly synchronizing each element in the local cache against the original repository publication point.

On the router, the database entries are formatted as route validation (RV) records. An RV record is a (prefix, maximum length, origin AS) triple. It matches any route whose prefix matches the RV prefix, whose prefix length does not exceed the maximum length given in the RV record, and whose origin AS equals the origin AS given in the RV record.

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An RV record is a simplified version of a route origin authorization (ROA). An ROA is a digitally signed object that provides a means of verifying that an IP address block holder has authorized an AS to originate routes to one or more prefixes within the address block. ROAs are not directly used in route validation. The cache server exports a simplified version of the ROA to the router as an RV record.

The maximum length value must be greater than or equal to the length of the authorized prefix and less than or equal to the length (in bits) of an IP address in the address family (32 for IPv4 and 128 for IPv6). The maximum length defines the IP address prefix that the AS is authorized to advertise.

For example, if the IP address prefix is 200.4.66/24, and the maximum length is 26, the AS is authorized to advertise 200.4.66.0/24, 200.4.66.0/25, 200.4.66.128/25, 200.4.66.0/26, 200.4.66.64/26, 200.4.66.128/26, and 200.4.66.192/26. When the maximum length is not present, the AS is only authorized to advertise exactly the prefix specified in the RV.

As another example, an RV can contain the prefix 200.4.66/24 with a maximum length of 26, as well as the prefix 200.4.66.0/28 with a maximum length of 28. This RV would authorize the AS to advertise any prefix beginning with 200.4.66 with a length of at least 24 and no greater than 26, as well as the specific prefix 200.4.66.0/28.

The origin of a route is represented by the right-most AS number in the AS_PATH attribute. Origin validation operates by comparing the origin AS in a routing update with the authorized source AS published in RV records.

The security provided by origin validation alone is known to be weak against a determined attacker because there is no protection against such an attacker spoofing the source AS. That said, origin validation provides useful protection against accidental announcements.

Although origin validation could be implemented by having each router directly participate in the RPKI, this is seen as too resource intensive (because many public-key cryptography operations are required to validate the RPKI data) as well as operationally intensive to set up and maintain an RPKI configuration on each router. For this reason, a separate RPKI cache server performs public-key validations, and generates a validated database of prefix-to-AS mappings. The validated database is downloaded to a client router over a secure TCP connection. The router thus requires little information about the RPKI infrastructure and has no public-key cryptography requirements, other than the encrypted transport password. The router subsequently uses the downloaded data to validate received route updates.

When you configure server sessions, you can group the sessions together and configure session parameters for each session in the group. The router tries periodically to set up a configurable maximum number of connections to cache servers. If connection setup fails, a new connection attempt is made periodically.

In the meantime, after the validation import policy is applied to the BGP session, route-validation is performed irrespective of cache session state (up or down) and RV database (empty or not empty). If the RV database is empty or none of the cache server sessions are up, the validation state for each route is set to unknown, because no RV record exists to evaluate a received BGP prefix.

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The retry-attempt period is configurable. After successfully connecting to a cache server, the router queries for the latest database serial number and requests that the RPKI cache transmits all of the RV entries belonging to that version of the database.

Each inbound message resets a liveliness timer for the RPKI cache server. After all updates are learned, the router performs periodic liveliness checks based on a configurable interval. This is done by sending a serial query protocol data unit (PDU) with the same serial number that the cache server reported in its latest notification PDU. The cache server responds with zero or more updates and an end-of-data (EOD) PDU, which also refreshes the liveliness state of the cache server and resets a record-lifetime timer.

When a prefix is received from an external BGP (EBGP) peer, it is examined by an import policy and marked as Valid, Invalid, Unknown, or Unverified:

- Valid—Indicates that the prefix and AS pair are found in the database.
- Invalid—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database.
- Unknown—Indicates that the prefix is not among the prefixes or prefix ranges in the database.
- Unverified—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers.

If there are any potential matches for the route in the validation database, the route has to match one of them to be valid. Otherwise, it is invalid. Any match is adequate to make the route valid. It does not need to be a best match. Only if there are no potential matches is the route considered to be unknown. For more information about the prefix-to-AS mapping database logic, see Section 2 of Internet draft draft-ietf-sidr-pfx-validate-01, *BGP Prefix Origin Validation*.

BGP Interaction with the Route Validation Database

The route validation (RV) database contains a collection of RV records that the router downloads from the RPKI cache server. After the RV database is populated with RV records, the RV database scans the RIB-Local routing table to determine if there are any prefixes in RIB-Local that might be affected by the RV records in the database. (RIB-Local contains the IPv4 and IPv6 routes shown in the output of the **show route protocol bgp** command.)

This process triggers a BGP reevaluation of BGP import policies (not export policies).

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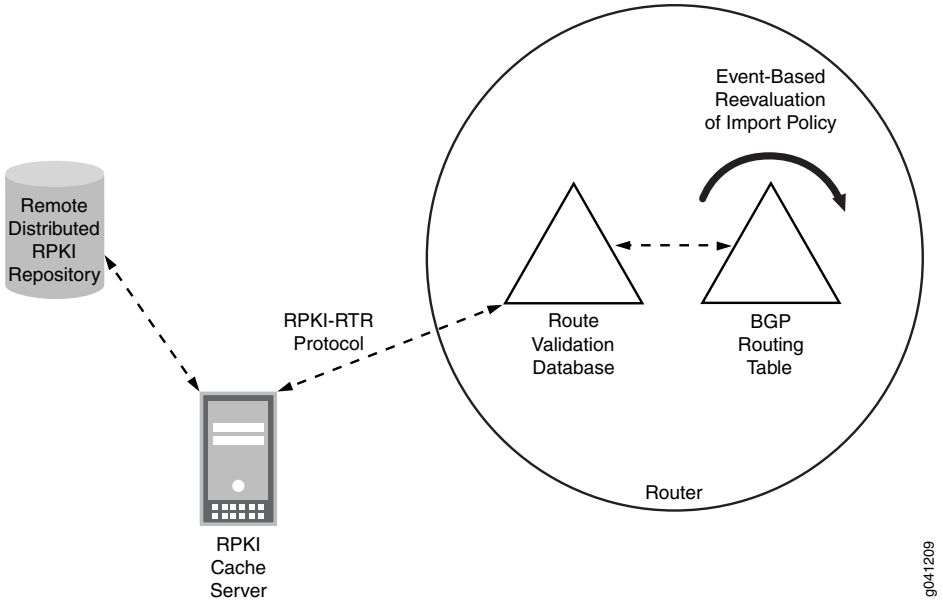
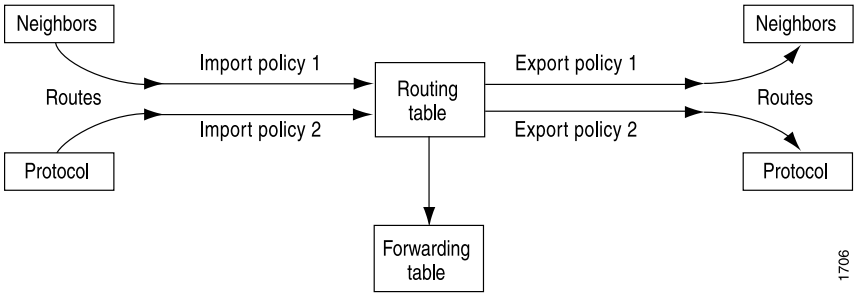
Figure 76 on page 808 shows the process.



Import policies are applied to RIB-In. Another way to understand this is that Import policies are applied to the routes that are shown in the output of the **show route receive-protocol bgp** command, while export policies are applied to routes that are shown by the **show route advertising-protocol bgp** command.

As shown in Figure 77 on page 808, you use import routing policies to control which routes BGP places in the routing table, and export routing policies to control which routes BGP advertises from the routing table to its neighbors.

Figure 77: Importing and Exporting Routing Policies



When you configure a route-validation import policy, the policy configuration uses a **validation-database** match condition. This match condition triggers a query in the RV database for the validation state of a prefix in a given routing instance. The default operation is to query the validation database matching the routing instance. If no route validation instance is found, the master instance is queried.

In the following BGP import policy, the **from validation-database** condition triggers a lookup in the router's RV database. An action is taken if the validation state is valid. The action is to accept the route and set the **validation-state** in the routing table to valid.

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```
[edit protocols bgp]
import validation;
```

```
[edit policy-options]
policy-statement validation-1 {
  term valid {
    from {
      protocol bgp;
      validation-database valid; # Triggers a lookup in the RV database
    }
    then {
      validation-state valid; # Sets the validation state in the routing table
      accept;
    }
  }
}
```

Community Attribute to Announce RPKI Validation State to IBGP Neighbors

Prefix validation is done only for external BGP (EBGP) updates. Within an AS, you likely do not want to have an RPKI session running on every internal BGP (IBGP) router. Instead, you need a way to carry the validation state across the IBGP mesh so that all IBGP speakers have consistent information. This is accomplished by carrying the validation state in a non-transitive extended community. The community attribute announces and receives the validation state of a prefix between IBGP neighbors.

Junos OS supports the following well-known extended communities for route validation:

- origin-validation-state-valid
- origin-validation-state-invalid
- origin-validation-state-unknown

The following sample BGP import policy is configured on the router that has a session with an RPKI server.

Router With RPKI Session

```
policy-statement validation-1 {
  term valid {
    from {
      protocol bgp;
      validation-database valid;
    }
    then {
      validation-state valid;
      community add origin-validation-state-valid;
      accept;
    }
  }
}
```

The following sample BGP import policy is configured on an IBGP peer router that does not have a session with an RPKI server.

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IBGP Peer Router Without RPKI Session

```
policy-statement validation-2 {
   term valid {
      from community origin-validation-state-valid;
      then validation-state valid;
   }
}
```

Nonstop Active Routing and Origin Validation

When you configure origin validation on a router that has dual Routing Engines and nonstop active routing is enabled, both the master and the standby Routing Engines have a copy of the RV database. These two RV databases remain synchronized with each other.

The router does not maintain two identical sessions with the RPKI server. The RPKI-RTR protocol runs on the master Routing Engine only. On the standby Routing Engine, the RPKI cache server session is always down.

The RV database is actively maintained by the master Routing Engine through its session with the RPKI server. This database is replicated on the standby Routing Engine. Though the session is down on the standby Routing Engine , the replicated RV database does contain RV records. When the standby Routing Engine switches over and becomes the master Routing Engine, it already has a fully populated RV database.

To view the contents of the two databases, use the show validation database and show validation replication database commands.

Marking a Prefix Range as Never Allowed

The route validation model has one major shortcoming: It only provides positive updates. It can declare which AS is the legitimate owner of a prefix. However, it cannot explicitly convey a negative update, as in: This prefix is never originated by a given AS. This functionality can be provided to some extent using an AS 0 workaround.

The Junos OS implementation does not attempt to restrict its inputs from the cache. For example, an RV record with origin AS 0 is installed and matched upon just like any other. This enables a workaround to mark a prefix range as never allowed to be announced because AS 0 is not a valid AS. The AS in the RV record never matches the AS received from the EBGP peer. Thus, any matching prefix is marked invalid.

See Also

- Example: Configuring Origin Validation for BGP on page 810

Example: Configuring Origin Validation for BGP

This example shows how to configure origin validation between BGP peers by ensuring that received route advertisements are sent (originated) from the expected autonomous

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system (AS). If the origin AS is validated, a policy can specify that the prefixes are, in turn, advertised.

- Requirements on page 811
- Overview on page 811
- Configuration on page 813
- Verification on page 823

Requirements

This example has the following hardware and software requirements:

- Resource public key infrastructure (RPKI) cache server, using third-party software to authenticate BGP prefixes.
- Junos OS Release 12.2 or later running on the routing device that communicates with the cache server over a TCP connection.

Overview

Sometimes routes are unintentionally advertised due to operator error. To prevent this security issue, you can configure BGP to validate the originating AS. This feature uses a cache server to authenticate prefixes or prefix ranges.

The following configuration statements enable origin AS validation:

```
[edit routing-options]
validation {
  group group-name {
    max-sessions number;
    session address {
      hold-time seconds;
      local-address local-ip-address;
      port port-number;
      preference number;
      record-lifetime seconds;
      refresh-time seconds;
    }
  }
  static {
    record destination {
      maximum-length prefix-length {
        origin-autonomous-system as-number {
          validation-state (invalid | valid);
        }
      }
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
  }
}
```

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This example uses default settings for the validation parameters.

Most of the available configuration statements are optional. The required settings are as follows:

```
validation {
  group group-name {
    session address {
    }
  }
}
```

The **[edit routing-options validation static]** hierarchy level enables you to configure static records on a routing device, thus overwriting records received from an RPKI cache server.

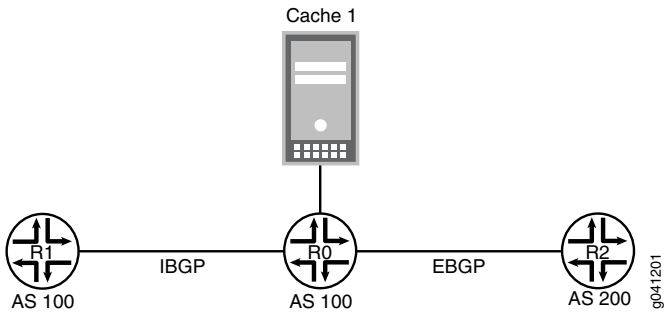
For example:

```
[edit routing-options validation]
user@R0# set static record 10.0.0.0/16 maximum-length 24 origin-autonomous-system
  200 validation-state valid
```

You can configure a routing policy that operates based on the validation state of a route prefix. You can use a community attribute to announce and receive the validation state of a prefix between external BGP (EBGP) and internal BGP (IBGP) peers. Using a routing policy might be more convenient on some routers than configuring a session with an RPKI server. This example demonstrates the use of the validation-state community attribute between IBGP peers.

Figure 78 on page 812 shows the sample topology.

Figure 78: Topology for Origin Validation



In this example, Device R0 has an IBGP connection to Device R1 and an EBGP connection to Device R2. Device R0 receives route validation (RV) records from the cache server using the protocol defined in Internet draft draft-ietf-sidr-rpki-rtr-19, *The RPKI/Router Protocol* to send the RV records. The RPKI-Router Protocol runs over TCP. The RV records are used by Device R0 to build a local RV database. On Device R1, the validation state is set based on the BGP community called validation-state, which is received with the route.

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Configuration

- Configuring Device R0 on page 814
- Configuring Device R1 on page 819
- Configuring Device R2 on page 821

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R0

```
set interfaces ge-1/2/0 unit 2 description to-R1
set interfaces ge-1/2/0 unit 2 family inet address 10.0.0.2/30
set interfaces ge-1/2/1 unit 5 description to-R2
set interfaces ge-1/2/1 unit 5 family inet address 10.0.0.5/30
set interfaces ge-1/2/2 unit 9 description to-cache
set interfaces ge-1/2/2 unit 9 family inet address 10.0.0.9/30
set interfaces lo0 unit 1 family inet address 1.0.1.1/32
set protocols bgp group int type internal
set protocols bgp group int local-address 1.0.1.1
set protocols bgp group int export send-direct
set protocols bgp group int neighbor 1.1.1.1
set protocols bgp group ext type external
set protocols bgp group ext import validation
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.6
set protocols ospf area 0.0.0.0 interface ge-1/2/0.2
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set policy-options policy-statement send-direct from protocol direct
set policy-options policy-statement send-direct then accept
set policy-options policy-statement validation term valid from protocol bgp
set policy-options policy-statement validation term valid from validation-database valid
set policy-options policy-statement validation term valid then local-preference 110
set policy-options policy-statement validation term valid then validation-state valid
set policy-options policy-statement validation term valid then community add
  origin-validation-state-valid
set policy-options policy-statement validation term valid then accept
set policy-options policy-statement validation term invalid from protocol bgp
set policy-options policy-statement validation term invalid from validation-database
  invalid
set policy-options policy-statement validation term invalid then local-preference 90
set policy-options policy-statement validation term invalid then validation-state invalid
set policy-options policy-statement validation term invalid then community add
  origin-validation-state-invalid
set policy-options policy-statement validation term invalid then accept
set policy-options policy-statement validation term unknown from protocol bgp
set policy-options policy-statement validation term unknown then validation-state
  unknown
set policy-options policy-statement validation term unknown then community add
  origin-validation-state-unknown
set policy-options policy-statement validation term unknown then accept
```

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```
set policy-options community origin-validation-state-invalid members 0x4300:0:2
set policy-options community origin-validation-state-unknown members 0x4300:0:1
set policy-options community origin-validation-state-valid members 0x4300:0:0
set routing-options autonomous-system 100
set routing-options validation group test session 10.0.0.10
```

Device R1

```
set interfaces ge-1/2/0 unit 1 family inet address 10.0.0.1/30
set interfaces lo0 unit 2 family inet address 1.1.1.1/32
set protocols bgp group int type internal
set protocols bgp group int local-address 1.1.1.1
set protocols bgp group int import validation-ibgp
set protocols bgp group int neighbor 1.0.1.1
set protocols ospf area 0.0.0.0 interface ge-1/2/0.1
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set policy-options policy-statement validation-ibgp term valid from community
  origin-validation-state-valid
set policy-options policy-statement validation-ibgp term valid then validation-state valid
set policy-options policy-statement validation-ibgp term invalid from community
  origin-validation-state-invalid
set policy-options policy-statement validation-ibgp term invalid then validation-state
  invalid
set policy-options policy-statement validation-ibgp term unknown from community
  origin-validation-state-unknown
set policy-options policy-statement validation-ibgp term unknown then validation-state
  unknown
set policy-options community origin-validation-state-invalid members 0x4300:0:2
set policy-options community origin-validation-state-unknown members 0x4300:0:1
set policy-options community origin-validation-state-valid members 0x4300:0:0
set routing-options autonomous-system 100
```

Device R2

```
set interfaces ge-1/2/0 unit 6 family inet address 10.0.0.6/30
set interfaces lo0 unit 5 family inet address 172.16.1.1/32
set interfaces lo0 unit 5 family inet address 192.168.2.3/32
set interfaces lo0 unit 5 family inet address 2.2.0.2/32
set protocols bgp group ext export send-direct
set protocols bgp group ext peer-as 100
set protocols bgp group ext neighbor 10.0.0.5
set policy-options policy-statement send-direct from protocol direct
set policy-options policy-statement send-direct from protocol local
set policy-options policy-statement send-direct then accept
set routing-options autonomous-system 200
```

Configuring Device R0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R0:

1. Configure the interfaces.

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```
[edit interfaces]
user@R0# set ge-1/2/0 unit 2 description to-R1
user@R0# set ge-1/2/0 unit 2 family inet address 10.0.0.2/30
user@R0# set ge-1/2/1 unit 5 description to-R2
user@R0# set ge-1/2/1 unit 5 family inet address 10.0.0.5/30
user@R0# set ge-1/2/2 unit 9 description to-cache
user@R0# set ge-1/2/2 unit 9 family inet address 10.0.0.9/30
user@R0# set lo0 unit 1 family inet address 1.0.1.1/32
```

2. Configure BGP.

   Apply the **send-direct** export policy so that direct routes are exported from the routing table into BGP.

   Apply the **validation** import policy to set the validation-state and BGP community attributes for all the routes imported (or received) from Device R0's EBGP peers.

   Configure an IBGP session with Device R1. Configure an EBGP session with Device R2.

   ```
   [edit protocols bgp]
   user@R0# set group int type internal
   user@R0# set group int local-address 1.0.1.1
   user@R0# set group int export send-direct
   user@R0# set group int neighbor 1.1.1.1
   user@R0# set group ext type external
   user@R0# set group ext import validation
   user@R0# set group ext export send-direct
   user@R0# set group ext peer-as 200
   user@R0# set group ext neighbor 10.0.0.6
   ```

3. Configure OSPF (or another interior gateway protocol [IGP]) on the interface that faces the IBGP peer and on the loopback interface.

   NOTE: If you use the loopback interface address in the IBGP **neighbor** statement, you must enable an IGP on the loopback interface. Otherwise, the IBGP session is not established.

   ```
   [edit protocols ospf area 0.0.0.0]
   user@R0# set interface ge-1/2/0.2
   user@R0# set interface lo0.1 passive
   ```

4. Configure the routing policy that exports direct routes from the routing table into BGP.

   ```
   [edit policy-options policy-statement send-direct]
   user@R0# set from protocol direct
   user@R0# set then accept
   ```

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5. Configure the routing policy that specifies attributes to be modified based on the validation state of each BGP route.

```
[edit policy-options policy-statement validation]
user@R0# set term valid from protocol bgp
user@R0# set term valid from validation-database valid
user@R0# set term valid then local-preference 110
user@R0# set term valid then validation-state valid
user@R0# set term valid then community add origin-validation-state-valid
user@R0# set term valid then accept
user@R0# set term invalid from protocol bgp
user@R0# set term invalid from validation-database invalid
user@R0# set term invalid then local-preference 90
user@R0# set term invalid then validation-state invalid
user@R0# set term invalid then community add origin-validation-state-invalid
user@R0# set term invalid then accept
user@R0# set term unknown from protocol bgp
user@R0# set term unknown then validation-state unknown
user@R0# set term unknown then community add origin-validation-state-unknown
user@R0# set term unknown then accept
[edit policy-options]
user@R0# set community origin-validation-state-invalid members 0x4300:0:2
user@R0# set community origin-validation-state-unknown members 0x4300:0:1
user@R0# set community origin-validation-state-valid members 0x4300:0:0
```

6. Configure the session with the RPKI cache server.

```
[edit routing-options validation]
user@R0# set group test session 10.0.0.10
```

7. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R0# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R0# show interfaces
ge-1/2/0 {
   unit 2 {
      description to-R1;
      family inet {
         address 10.0.0.2/30;
      }
   }
}
```


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```
ge-1/2/1 {
    unit 5 {
        description to-R2;
        family inet {
            address 10.0.0.5/30;
        }
    }
}
ge-1/2/2 {
    unit 9 {
        description to-cache;
        family inet {
            address 10.0.0.9/30;
        }
    }
}
lo0 {
    unit 1 {
        family inet {
            address 1.0.1.1/32;
        }
    }
}
```

```
user@R0# show protocols
bgp {
    group int {
        type internal;
        local-address 1.0.1.1;
        export send-direct;
        neighbor 1.1.1.1;
    }
    group ext {
        type external;
        import validation;
        export send-direct;
        peer-as 200;
        neighbor 10.0.0.6;
    }
}
ospf {
    area 0.0.0.0 {
        interface ge-1/2/0.2;
        interface lo0.1 {
            passive;
        }
    }
}
```

```
user@R0# show policy-options
policy-statement send-direct {
    from protocol direct;
    then accept;
}
```

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```
  policy-statement validation {
    term valid {
      from {
        protocol bgp;
        validation-database valid;
      }
      then {
        local-preference 110;
        validation-state valid;
        community add origin-validation-state-valid;
        accept;
      }
    }
    term invalid {
      from {
        protocol bgp;
        validation-database invalid;
      }
      then {
        local-preference 90;
        validation-state invalid;
        community add origin-validation-state-invalid;
        accept;
      }
    }
    term unknown {
      from protocol bgp;
      then {
        validation-state unknown;
        community add origin-validation-state-unknown;
        accept;
      }
    }
  }
community origin-validation-state-invalid members 0x4300:0:2;
community origin-validation-state-unknown members 0x4300:0:1;
community origin-validation-state-valid members 0x4300:0:0;
```

```
user@R0# show routing-options
autonomous-system 100;
validation {
  group test {
    session 10.0.0.10;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

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Configuring Device R1

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R1:

1. Configure the interfaces.

```
[edit interfaces]
user@R1# set ge-1/2/0 unit 1 family inet address 10.0.0.1/30
user@R1# set lo0 unit 2 family inet address 1.1.1.1/32
```

2. Configure BGP.

   Apply the **validation-ibgp** import policy to set the validation-state and BGP community attributes for all the routes received from Device R1's IBGP peers.

   Configure an IBGP session with Device R0.

```
[edit protocols bgp group int]
user@R1# set type internal
user@R1# set local-address 1.1.1.1
user@R1# set import validation-ibgp
user@R1# set neighbor 1.0.1.1
```

3. Configure OSPF.

```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface ge-1/2/0.1
user@R1# set interface lo0.2 passive
```

4. Configure the routing policy that specifies attributes to be modified based on the validation-state BGP community attribute of the BGP routes received from Device R0.

```
[edit policy-options policy-statement validation-ibgp]
user@R1# set term valid from community origin-validation-state-valid
user@R1# set term valid then validation-state valid
user@R1# set term invalid from community origin-validation-state-invalid
user@R1# set term invalid then validation-state invalid
user@R1# set term unknown from community origin-validation-state-unknown
user@R1# set term unknown then validation-state unknown
[edit policy-options]
user@R1# set community origin-validation-state-invalid members 0x4300:0:2
user@R1# set community origin-validation-state-unknown members 0x4300:0:1
user@R1# set community origin-validation-state-valid members 0x4300:0:0
```

5. Configure the autonomous system (AS) number.

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```
[edit routing-options]
user@R1# set autonomous-system 100
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
ge-1/2/0 {
   unit 1 {
      family inet {
         address 10.0.0.1/30;
      }
   }
}
lo0 {
   unit 2 {
      family inet {
         address 1.1.1.1/32;
      }
   }
}
```

```
user@R1# show protocols
bgp {
   group int {
      type internal;
      local-address 1.1.1.1;
      import validation-ibgp;
      neighbor 1.0.1.1;
   }
}
ospf {
   area 0.0.0.0 {
      interface ge-1/2/0.1;
      interface lo0.2 {
         passive;
      }
   }
}
```

```
user@R1# show policy-options
policy-statement validation-ibgp {
   term valid {
      from community origin-validation-state-valid;
      then validation-state valid;
   }
   term invalid {
      from community origin-validation-state-invalid;
      then validation-state invalid;
```


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```
    }
    term unknown {
      from community origin-validation-state-unknown;
      then validation-state unknown;
    }
}
community origin-validation-state-invalid members 0x4300:0:2;
community origin-validation-state-unknown members 0x4300:0:1;
community origin-validation-state-valid members 0x4300:0:0;
}
```

```
user@R1# show routing-options
autonomous-system 100;
```

If you are done configuring the device, enter **commit** from configuration mode.

Configuring Device R2

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R2:

1. Configure the interfaces.

   Several addresses are configured on the loopback interface to serve as routes for demonstration purposes.

   ```
   [edit interfaces]
   user@R2# set ge-1/2/0 unit 6 family inet address 10.0.0.6/30
   user@R2# set lo0 unit 5 family inet address 172.16.1.1/32
   user@R2# set lo0 unit 5 family inet address 192.168.2.3/32
   user@R2# set lo0 unit 5 family inet address 2.2.0.2/32
   ```

2. Configure BGP.

   ```
   [edit protocols bgp]
   user@R2# set group ext export send-direct
   user@R2# set group ext peer-as 100
   user@R2# set group ext neighbor 10.0.0.5
   ```

3. Configure the routing policy.

   ```
   [edit policy-options policy-statement send-direct]
   user@R2# set from protocol direct
   user@R2# set from protocol local
   user@R2# set then accept
   ```

4. Configure the autonomous system (AS) number.

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```
[edit routing-options]
user@R2# set autonomous-system 200
```

Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
ge-1/2/0 {
    unit 6 {
        family inet {
            address 10.0.0.6/30;
        }
    }
}
lo0 {
    unit 5 {
        family inet {
            address 172.16.1.1/32;
            address 192.168.2.3/32;
            address 2.2.0.2/32;
        }
    }
}
```

```
user@R2# show protocols
bgp {
    group ext {
        export send-direct;
        peer-as 100;
        neighbor 10.0.0.5;
    }
}
```

```
user@R2# show policy-options
policy-statement send-direct {
    from protocol [ direct local ];
    then accept;
}
```

```
user@R2# show routing-options
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Verifying That the Modified Attributes Are Displayed in the Routing Tables on page 823
- Using Trace Operations on page 824
- Displaying Validation Information on page 825

Verifying That the Modified Attributes Are Displayed in the Routing Tables

Purpose Verify that the BGP routes on Device R0 and Device R1 have the expected validation states and the expected local preferences.

Action From operational mode, enter the **show route** command.

```
user@R0> show route
inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.0.1.1/32         *[Direct/0] 04:53:39
                    >    via lo0.1
1.1.1.1/32         *[OSPF/10] 04:50:53, metric 1
                    > to 10.0.0.1 via lt-1/2/0.2
2.2.0.2/32         *[BGP/170] 01:30:37, localpref 110
                      AS path: 200 I, validation-state: valid
                    > to 10.0.0.6 via lt-1/2/0.5
10.0.0.0/30        *[Direct/0] 04:51:44
                    >    via lt-1/2/0.2
10.0.0.2/32        *[Local/0] 04:51:45
                          Local via lt-1/2/0.2
10.0.0.4/30        *[Direct/0] 04:51:44
                    >    via lt-1/2/0.5
                    [BGP/170] 02:24:57, localpref 110
                      AS path: 200 I, validation-state: valid
                    > to 10.0.0.6 via lt-1/2/0.5
10.0.0.5/32        *[Local/0] 04:51:45
                          Local via lt-1/2/0.5
10.0.0.8/30        *[Direct/0] 03:01:28
                    >    via lt-1/2/0.9
10.0.0.9/32        *[Local/0] 04:51:45
                          Local via lt-1/2/0.9
172.16.1.1/32      *[BGP/170] 02:24:57, localpref 90
                      AS path: 200 I, validation-state: invalid
                    > to 10.0.0.6 via lt-1/2/0.5
192.168.2.3/32     *[BGP/170] 02:24:57, localpref 100
                      AS path: 200 I, validation-state: validation-state: unknown
                    > to 10.0.0.6 via lt-1/2/0.5
224.0.0.5/32       *[OSPF/10] 04:53:46, metric 1
                          MultiRecv
```

```
user@R1> show route
inet.0: 10 destinations, 12 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```

```
2.2.0.2/32         *[BGP/170] 01:06:58, localpref 110, from 1.0.1.1
                      AS path: 200 I, validation-state: valid
                    > to 10.0.0.2 via lt-1/2/0.1
172.16.1.1/32      *[BGP/170] 00:40:52, localpref 90, from 1.0.1.1
                      AS path: 200 I, validation-state: invalid
                    > to 10.0.0.2 via lt-1/2/0.1
192.168.2.3/32     *[BGP/170] 01:06:58, localpref 100, from 1.0.1.1
                      AS path: 200 I, validation-state: unknown
                    > to 10.0.0.2 via lt-1/2/0.1
224.0.0.5/32       *[OSPF/10] 04:57:09, metric 1
                          MultiRecv
```

Meaning The routes have the expected validation states and local-preference values, based on information received from the RPKI cache server.

Using Trace Operations

Purpose Configure trace operations for origin validation, and monitor the results of a newly advertised route.

Action

- On Device R0, configure tracing.

```
[edit routing-options validation traceoptions]
user@R0# set file rv-tracing
user@R0# set flag all
user@R0# commit
```

- On Device R2, add a route by adding another address on the loopback interface.

```
[edit interfaces lo0 unit 5 family inet]
user@R2# set address 10.4.4.4/32
user@R2# commit
```

- On Device R0, check the trace file.

```
user@R0> file show /var/log/rv-tracing
Jan 27 11:27:43.804803 rv_get_policy_state: rt 10.4.4.4/32 origin-as 200,
validation result valid
Jan 27 11:27:43.944037 task_job_create_background: create prio 7 job
Route-validation GC for task Route Validation
Jan 27 11:27:43.986580 background dispatch running job Route-validation GC for
 task Route Validation
Jan 27 11:27:43.987374 task_job_delete: delete background job Route-validation
 GC for task Route Validation
Jan 27 11:27:43.987463 background dispatch completed job Route-validation GC
for task Route Validation
```

Meaning Route validation is operating as expected.

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Displaying Validation Information

Purpose Run the various validation commands.

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Action

```
user@R0> show validation statistics
Total RV records: 3
Total Replication RV records: 3
  Prefix entries: 3
  Origin-AS entries: 3
Memory utilization: 9789 bytes
Policy origin-validation requests: 114
  Valid: 32
  Invalid: 54
  Unknown: 28
BGP import policy reevaluation notifications: 156
  inet.0, 156
  inet6.0, 0
```

```
user@R0> show validation database
RV database for instance master

Prefix                Origin-AS Session                              State
 Mismatch
2.0.0.0/8-32                200 10.0.0.10                           valid
10.0.0.0/8-32               200 10.0.0.10                           valid
172.0.0.0/8-12              200 10.0.0.10                           invalid


  IPv4 records: 3
  IPv6 records: 0
```

```
user@R0> show validation replication database
RRV replication database for instance master

Prefix                Origin-AS Session                               State
2.0.0.0/8-32                200 10.0.0.10                           valid
10.0.0.0/8-32               200 10.0.0.10                           valid
172.0.0.0/8-12              200 10.0.0.10                           invalid


  IPv4 records: 3
  IPv6 records: 0
```

```
user@R0> show validation group
master
  Group: test, Maximum sessions: 2
    Session 10.0.0.10, State: Connect, Preference: 100
```

```
user@R0> show validation session
Session                                 State   Flaps     Uptime #IPv4/IPv6
records
10.0.0.10                               Up          0   00:02:28 1/0
```

```
user@R0> request validation policy
  Enqueued 3 IPv4 records
```


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```
Enqueued 0 IPv6 records
```

See Also

- Understanding Origin Validation for BGP on page 804

Related Documentation

- Understanding BGP Communities, Extended Communities, and Large Communities as Routing Policy Match Conditions on page 373
- *How BGP Communities and Extended Communities Are Evaluated in Routing Policy Match Conditions*
- *Example: Configuring Extended Communities in a Routing Policy*

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PART 13

Configuring BGP Route Flap Damping and Error Handling

- Preventing BGP Session Flaps on page 831
- Error Handling for BGP Update Messages on page 879
- Configuring BGP Egress Peer Traffic Engineering on page 893
- Configuring BGP-Based VPN on page 925

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CHAPTER 23

Preventing BGP Session Flaps

- Understanding BGP Session Resets on page 831
- Example: Preventing BGP Session Flaps When VPN Families Are Configured on page 832
- Understanding Damping Parameters on page 839
- Example: Configuring BGP Route Flap Damping Parameters on page 840
- Example: Configuring BGP Route Flap Damping Based on the MBGP MVPN Address Family on page 850
- Understanding BGP-Static Routes for Preventing Route Flaps on page 862
- Example: Configuring BGP-Static Routes to Prevent Route Flaps on page 863
- Configuring BGP-Static Routes for Preventing Route Flaps on page 877

Understanding BGP Session Resets

Certain configuration actions and events cause BGP sessions to be reset (dropped and then reestablished).

If you configure both route reflection and VPNs on the same routing device, the following modifications to the route reflection configuration cause current BGP sessions to be reset:

- Adding a cluster ID—If a BGP session shares the same autonomous system (AS) number with the group where you add the cluster ID, all BGP sessions are reset regardless of whether the BGP sessions are contained in the same group.
- Creating a new route reflector—If you have an internal BGP (IBGP) group with an AS number and create a new route reflector group with the same AS number, all BGP sessions in the IBGP group and the new route reflector group are reset.
- Changing configuration statements that affect BGP peers, such as renaming a BGP group, resets the BGP sessions.
- If you change the address family specified in the **[edit protocols bgp family]** hierarchy level, all current BGP sessions on the routing device are dropped and then reestablished.

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Example: Preventing BGP Session Flaps When VPN Families Are Configured

This example shows a workaround for a known issue in which BGP sessions sometimes go down and then come back up (in other words, flap) when virtual private network (VPN) families are configured. If any VPN family (for example, **inet-vpn**, **inet6-vpn**, **inet-mpvn**, **inet-mdt**, **inet6-mpvn**, **l2vpn**, **iso-vpn**, and so on) is configured on a BGP master instance, a flap of either a route reflector (RR) internal BGP (IBGP) session or an external BGP (EBGP) session causes flaps of other BGP sessions configured with the same VPN family.

- Requirements on page 832
- Overview on page 833
- Configuration on page 835
- Verification on page 838

Requirements

Before you begin:

- Configure router interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure VPNs.

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Overview

When a router or switch is configured as either a route reflector (RR) or an AS boundary router (an external BGP peer) and a VPN family (for example, the **family inet-vpn unicast** statement) is configured, a flap of either the RR IBGP session or the EBGP session causes flaps of all other BGP sessions that are configured with the **family inet-vpn unicast** statement. This example shows how to prevent these unnecessary session flaps.

The reason for the flapping behavior is related to BGP operation in Junos OS when originating VPN routes.

BGP has the following two modes of operation with respect to originating VPN routes:

- If BGP does not need to propagate VPN routes because the session has no EBGP peer and no RR clients, BGP exports VPN routes directly from the *instance*.inet.0 routing table to other PE routers. This behavior is efficient in that it avoids the creation of two copies of many routes (one in the *instance*.inet.0 table and one in the bgp.l3vpn.0 table).
- If BGP does need to propagate VPN routes because the session has an EBGP peer or RR clients, BGP first exports the VPN routes from the *instance*.inet.0 table to the bgp.l3vpn.0 table. Then BGP exports the routes to other PE routers. In this scenario, two copies of the route are needed to enable best-route selection. A PE router might receive the same VPN route from a CE device and also from an RR client or EBGP peer.

NOTE: The route export is not performed if the route in *instance*.inet.0 is a secondary route. In Junos OS, a route is only exported one time from one routing table as a primary route to another routing table as a secondary route. Because the route in *instance*.inet.0 is already a secondary route, it is not allowed to be moved again to the bgp.l3vpn.0 table, as needed to be advertised. The route does not reach the bgp.l3vpn.0 table and thus is not advertised. One workaround is to send the routes that should be advertised to inet.0 so that they are advertised.

When, because of a configuration change, BGP transitions from needing two copies of a route to not needing two copies of a route (or the reverse), all sessions over which VPN routes are exchanged go down and then come back up. Although this example focuses on the **family inet-vpn unicast** statement, the concept applies to all VPN network layer reachability information (NLRI) families. This issue impacts logical systems as well. All BGP sessions in the master instance related to the VPN NLRI family are brought down to implement the table advertisement change for the VPN NLRI family. Changing an RR to a non-RR or the reverse (by adding or removing the **cluster** statement) causes the table advertisement change. Also, configuring the first EBGP session or removing the EBGP session from the configuration in the master instance for a VPN NLRI family causes the table advertisement change.

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The way to prevent these unnecessary session flaps is to configure an extra RR client or EBGP session as a passive session with a neighbor address that does not exist. This example focuses on the EBGP case, but the same workaround works for the RR case.

When a session is passive, the routing device does not send Open requests to a peer. Once you configure the routing device to be passive, the routing device does not originate the TCP connection. However, when the routing device receives a connection from the peer and an Open message, it replies with another BGP Open message. Each routing device declares its own capabilities.

Figure 79 on page 834 shows the topology for the EBGP case. Router R1 has an IBGP session with Routers R2 and R3 and an EBGP session with Router R4. All sessions have the **family inet-vpn unicast** statement configured. If the R1-R4 EBGP session flaps, the R1-R2 and R1-R3 BGP sessions flap also.

Figure 79: Topology for the EBGP Case

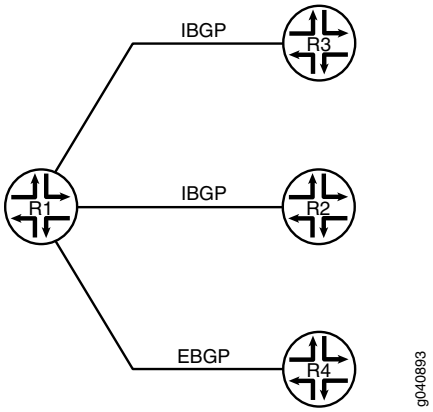
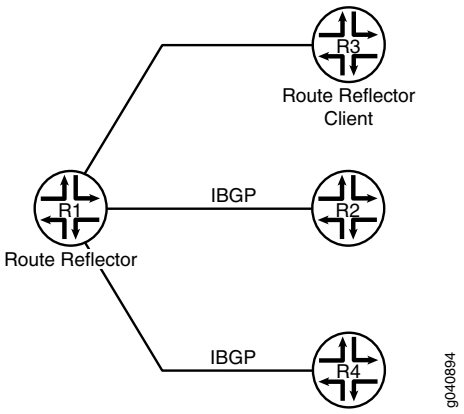


Figure 80 on page 834 shows the topology for the RR case. Router R1 is the RR, and Router R3 is the client. Router R1 has IBGP sessions with Routers R2 and R3. All sessions have the **family inet-vpn unicast** statement configured. If the R1-R3 session flaps, the R1-R2 and R1-R4 sessions flap also.

Figure 80: Topology for the RR Case



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Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set protocols bgp family inet-vpn unicast
set protocols bgp family l2vpn signaling
set protocols bgp group R1-R4 type external
set protocols bgp group R1-R4 local-address 4.4.4.2
set protocols bgp group R1-R4 neighbor 4.4.4.1 peer-as 200
set protocols bgp group R1-R2-R3 type internal
set protocols bgp group R1-R2-R3 log-updown
set protocols bgp group R1-R2-R3 local-address 15.15.15.15
set protocols bgp group R1-R2-R3 neighbor 12.12.12.12
set protocols bgp group R1-R2-R3 neighbor 13.13.13.13
set protocols bgp group Fake type external
set protocols bgp group Fake passive
set protocols bgp group Fake neighbor 100.100.100.100 peer-as 500
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the EBGP scenario:

1. Configure one or more VPN families.

```
[edit protocols bgp]
user@R1# set family inet-vpn unicast
user@R1# set family l2vpn signaling
```

2. Configure the EBGP session.

```
[edit protocols bgp]
user@R1# set group R1-R4 type external
user@R1# set group R1-R4 local-address 4.4.4.2
user@R1# set group R1-R4 neighbor 4.4.4.1 peer-as 200
```

3. Configure the IBGP sessions.

```
[edit protocols bgp]
user@R1# set group R1-R2-R3 type internal
user@R1# set group R1-R2-R3 local-address 15.15.15.15
user@R1# set group R1-R2-R3 neighbor 12.12.12.12
user@R1# set group R1-R2-R3 neighbor 13.13.13.13
```

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4. (Optional) Configure BGP so that it generates a **syslog** message whenever a BGP peer makes a state transition.

```
[edit protocols bgp]
user@R1# set group R1-R2-R3 log-updown
```

Enabling the **log-updown** statement causes BGP state transitions to be logged at **warning** level.

Step-by-Step Procedure

To verify that unnecessary session flaps are occurring:

1. Run the **show bgp summary** command to verify that the sessions have been established.

```
user@R1> show bgp summary
Groups: 2 Peers: 3 Down peers: 0
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
inet.0      0         0         0          0       0          0
Peer        AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1     200 6     5      0    0     1:08 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12 100 3     7      0    0     1:18 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
13.13.13.13 100 3     6      0    0     1:14 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
```

2. Deactivate the EBGP session.

```
user@R1# deactivate group R1-R4
user@R1# commit
```

```
Mar 10 18:27:40 R1: rpd[1464]: bgp_peer_delete:6589: NOTIFICATION sent to 4.4.4.1 (External AS 200): code
 6 (Cease) subcode 3 (Peer Unconfigured), Reason: Peer Deletion
Mar 10 18:27:40 R1: rpd[1464]: bgp_adv_main_update:7253: NOTIFICATION sent to 12.12.12.12 (Internal AS
100): code 6 (Cease) subcode 6 (Other Configuration Change), Reason: Configuration change - VPN table
advertise
Mar 10 18:27:40 R1: rpd[1464]: bgp_adv_main_update:7253: NOTIFICATION sent to 13.13.13.13 (Internal AS
100): code 6 (Cease) subcode 6 (Other Configuration Change), Reason: Configuration change - VPN table
advertise
```

3. Run the **show bgp summary** command to view the session flaps.

```
user@R1> show bgp summary
Groups: 1 Peers: 2 Down peers: 2
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
```


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```
bgp.l2vpn.0 0          0          0          0       0          0
inet.0      0          0          0          0       0          0
Peer        AS   InPkt  OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12 100  4      9      0    1     19   Active
13.13.13.13 100  4      8      0    1     19   Active
```

```
user@R1> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0          0          0          0       0          0
bgp.l2vpn.0 0          0          0          0       0          0
inet.0      0          0          0          0       0          0
Peer        AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12 100 2      3      0    1     0    Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
13.13.13.13 100 2      3      0    1     0    Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To prevent unnecessary BGP session flaps:

1. Add a passive EBGP session with a neighbor address that does not exist in the peer autonomous system (AS).

```
[edit protocols bgp]
user@R1# set group Fake type external
user@R1# set group Fake passive
user@R1# set neighbor 100.100.100.100 peer-as 500
```

2. Run the **show bgp summary** command to verify that the real sessions have been established and the passive session is idle.

```
user@R1> show bgp summary
Groups: 3 Peers: 4 Down peers: 1
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0          0          0          0       0          0
bgp.l2vpn.0 0          0          0          0       0          0
Peer            AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1         200 9500  9439   0    0     2d   23:14:23 Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12     100 10309 10239  0    0     3d    5:17:49 Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13     100 10306 10241  0    0     3d    5:18:25 Establ
```

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```
bgp.l3vpn.0: 0/0/0/0
100.100.100.100 500 0     0      0    0     2d   23:38:52 Idle
```

Verification

Confirm that the configuration is working properly.

- Bringing Down the EBGP Session on page 838
- Verifying That the IBGP Sessions Remain Up on page 838

Bringing Down the EBGP Session

Purpose Try to cause the flap issue after the workaround is configured.

Action

```
user@R1# deactivate group R1-R4
user@R1# commit
```

Verifying That the IBGP Sessions Remain Up

Purpose Make sure that the IBGP sessions do not flap after the EBGP session is deactivated.

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Action

```
user@R1> show bgp summary
Groups: 2 Peers: 3 Down peers: 1
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
Peer            AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
12.12.12.12     100 10312 10242  0    0     3d    5:19:01  Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13     100 10309 10244  0    0     3d    5:19:37  Establ
bgp.l3vpn.0: 0/0/0/0
100.100.100.100 500 0     0      0    0     2d   23:40:04  Idle
```

```
user@R1> show bgp summary
Groups: 3 Peers: 4 Down peers: 1
Table       Tot Paths Act Paths Suppressed History Damp State Pending
bgp.l3vpn.0 0         0         0          0       0          0
bgp.l2vpn.0 0         0         0          0       0          0
Peer            AS  InPkt OutPkt OutQ Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
4.4.4.1         200 5     4      0    0     28             Establ
bgp.l3vpn.0: 0/0/0/0
bgp.l2vpn.0: 0/0/0/0
12.12.12.12     100 10314 10244  0    0     3d    5:19:55  Establ
bgp.l3vpn.0: 0/0/0/0
13.13.13.13     100 10311 10246  0    0     3d    5:20:31  Establ
bgp.l3vpn.0: 0/0/0/0
100.100.100.100 500 0     0      0    0     2d   23:40:58  Idle
```

Related Documentation

- *Understanding Virtual Routing and Forwarding Tables*
- KB20870

Understanding Damping Parameters

BGP *route flapping* describes the situation in which BGP systems send an excessive number of update messages to advertise network reachability information. BGP *flap damping* is a method of reducing the number of update messages sent between BGP peers, thereby reducing the load on these peers, without adversely affecting the route convergence time for stable routes.

Flap damping reduces the number of update messages by marking routes as ineligible for selection as the active or preferable route. Marking routes in this way leads to some delay, or *suppression*, in the propagation of route information, but the result is increased network stability. You typically apply flap damping to external BGP (EBGP) routes (routes in different ASs). You can also apply flap damping within a confederation, between confederation member ASs. Because routing consistency within an AS is important, do not apply flap damping to internal BGP (IBGP) routes. (If you do, it is ignored.)

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There is an exception that rule. Starting in Junos OS Release 12.2, you can apply flap damping at the address family level. In a Junos OS Release 12.2 or later installation, when you apply flap damping at the address family level, it works for both IBGP and EBGP.

By default, route flap damping is not enabled. Damping is applied to external peers and to peers at confederation boundaries.

When you enable damping, default parameters are applied, as summarized in Table 11 on page 840.

Table 11: Damping Parameters

Damping Parameter	Description	Default Value	Possible Values
half-life ***minutes***	Decay half-life—Number of minutes after which an arbitrary value is halved if a route stays stable.	**15** (minutes)	**1** through **45**
max-suppress ***minutes***	Maximum hold-down time for a route, in minutes.	**60** (minutes)	**1** through **720**
reuse	Reuse threshold—Arbitrary value below which a suppressed route can be used again.	**750**	**1** through **20,000**
suppress	Cutoff (suppression) threshold—Arbitrary value above which a route can no longer be used or included in advertisements.	**3000**	**1** through **20,000**

To change the default BGP flap damping values, you define actions by creating a named set of damping parameters and including it in a routing policy with the damping action. For the damping routing policy to work, you also must enable BGP route flap damping.

Release History Table

Release	Description
12.2	Starting in Junos OS Release 12.2, you can apply flap damping at the address family level.

Related Documentation

- *Understanding Routing Policies*
- Example: Configuring BGP Route Flap Damping Parameters on page 840

Example: Configuring BGP Route Flap Damping Parameters

This example shows how to configure damping parameters.

- Requirements on page 841
- Overview on page 841
- Configuration on page 841
- Verification on page 846

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Requirements

Before you begin, configure router interfaces and configure routing protocols.

Overview

This example has three routing devices. Device R2 has external BGP (EBGP) connections with Device R1 and Device R3.

Device R1 and Device R3 have some static routes configured for testing purposes, and these static routes are advertised through BGP to Device R2.

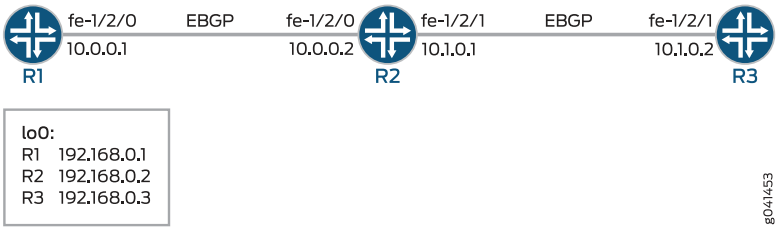
Device R2 damps routes received from Device R1 and Device R3 according to these criteria:

- Damp all prefixes with a mask length equal to or greater than 17 more aggressively than routes with a mask length between 9 and 16.
- Damp routes with a mask length between 0 and 8, inclusive, less than routes with a mask length greater than 8.
- Do not damp the 10.128.0.0/9 prefix at all.

The routing policy is evaluated when routes are being exported from the routing table into the forwarding table. Only the active routes are exported from the routing table.

Figure 81 on page 841 shows the sample network.

Figure 81: BGP Flap Damping Topology



"CLI Quick Configuration" on page 841 shows the configuration for all of the devices in Figure 81 on page 841.

The section "Step-by-Step Procedure" on page 843 describes the steps on Device R2.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct-and-static
```

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```
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.0.0.2
set policy-options policy-statement send-direct-and-static term 1 from protocol direct
set policy-options policy-statement send-direct-and-static term 1 from protocol static
set policy-options policy-statement send-direct-and-static term 1 then accept
set routing-options static route 172.16.0.0/16 reject
set routing-options static route 172.16.128.0/17 reject
set routing-options static route 172.16.192.0/20 reject
set routing-options static route 10.0.0.0/9 reject
set routing-options static route 172.16.233.0/7 reject
set routing-options static route 10.224.0.0/11 reject
set routing-options static route 0.0.0.0/0 reject
set routing-options autonomous-system 100
```

Device R2

```
set interfaces fe-1/2/0 unit 0 family inet address 10.0.0.2/30
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.1/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp damping
set protocols bgp group ext type external
set protocols bgp group ext import damp
set protocols bgp group ext export send-direct
set protocols bgp group ext neighbor 10.0.0.1 peer-as 100
set protocols bgp group ext neighbor 10.1.0.2 peer-as 300
set policy-options policy-statement damp term 1 from route-filter 10.128.0.0/9 exact
  damping dry
set policy-options policy-statement damp term 1 from route-filter 0.0.0.0/0
  prefix-length-range /0-/8 damping timid
set policy-options policy-statement damp term 1 from route-filter 0.0.0.0/0
  prefix-length-range /17-/32 damping aggressive
set policy-options policy-statement send-direct term 1 from protocol direct
set policy-options policy-statement send-direct term 1 then accept
set policy-options damping aggressive half-life 30
set policy-options damping aggressive suppress 2500
set policy-options damping timid half-life 5
set policy-options damping dry disable
set routing-options autonomous-system 200
```

Device R3

```
set interfaces fe-1/2/1 unit 0 family inet address 10.1.0.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group ext type external
set protocols bgp group ext export send-direct-and-static
set protocols bgp group ext peer-as 200
set protocols bgp group ext neighbor 10.1.0.1
set policy-options policy-statement send-direct-and-static term 1 from protocol direct
set policy-options policy-statement send-direct-and-static term 1 from protocol static
set policy-options policy-statement send-direct-and-static term 1 then accept
set routing-options static route 10.128.0.0/9 reject
set routing-options autonomous-system 300
```


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Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure damping parameters:

1. Configure the interfaces.

```
[edit interfaces]
user@R2# set fe-1/2/0 unit 0 family inet address 10.0.0.2/30
user@R2# set fe-1/2/1 unit 0 family inet address 10.1.0.1/30
user@R2# set lo0 unit 0 family inet address 192.168.0.2/32
```

2. Configure the BGP neighbors.

```
[edit protocols bgp group ext]
user@R2# set type external
user@R2# set neighbor 10.0.0.1 peer-as 100
user@R2# set neighbor 10.1.0.2 peer-as 300
```

3. Create and configure the damping parameter groups.

```
[edit policy-options]
user@R2# set damping aggressive half-life 30
user@R2# set damping aggressive suppress 2500
user@R2# set damping timid half-life 5
user@R2# set damping dry disable
```

4. Configure the damping policy.

```
[edit policy-options policy-statement damp term 1]
user@R2# set from route-filter 10.128.0.0/9 exact damping dry
user@R2# set from route-filter 0.0.0.0/0 prefix-length-range /0-/8 damping timid
user@R2# set from route-filter 0.0.0.0/0 prefix-length-range /17-/32 damping
  aggressive
```

5. Enable damping for BGP.

```
[edit protocols bgp]
user@R2# set damping
```

6. Apply the policy as an import policy for the BGP neighbor.

```
[edit protocols bgp group ext]
user@R2# set import damp
```

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NOTE: You can refer to the same routing policy one or more times in the same or different **import** statements.

7. Configure an export policy.

```
[edit policy-options policy-statement send-direct term 1]
user@R2# set from protocol direct
user@R2# set then accept
```

8. Apply the export policy.

```
[edit protocols bgp group ext]
user@R2# set export send-direct
```

9. Configure the autonomous system (AS) number.

```
[edit routing-options]
user@R2# set autonomous-system 200
```

Results From configuration mode, confirm your configuration by issuing the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R2# show interfaces
fe-1/2/0 {
   unit 0 {
      family inet {
         address 10.0.0.2/30;
      }
   }
}
fe-1/2/1 {
   unit 0 {
      family inet {
         address 10.1.0.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.2/32;
      }
   }
}
```


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```
user@R2# show protocols
bgp {
   damping;
   group ext {
      type external;
      import damp;
      export send-direct;
      neighbor 10.0.0.1 {
         peer-as 100;
      }
      neighbor 10.1.0.2 {
         peer-as 300;
      }
   }
}
```

```
user@R2# show policy-options
policy-statement damp {
   term 1 {
      from {
         route-filter 10.128.0.0/9 exact damping dry;
         route-filter 0.0.0.0/0 prefix-length-range /0-/8 damping timid;
         route-filter 0.0.0.0/0 prefix-length-range /17-/32 damping aggressive;
      }
   }
}
policy-statement send-direct {
   term 1 {
      from protocol direct;
      then accept;
   }
}
damping aggressive {
   half-life 30;
   suppress 2500;
}
damping timid {
   half-life 5;
}
damping dry {
   disable;
}
```

```
user@R2# show routing-options
autonomous-system 200;
```

If you are done configuring the device, enter **commit** from configuration mode.

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Verification

Confirm that the configuration is working properly.

- Causing Some Routes to Flap on page 846
- Checking the Route Flaps on page 846
- Verifying Route Flap Damping on page 847
- Displaying the Details of a Damped Route on page 848
- Verifying That Default Damping Parameters Are in Effect on page 849
- Filtering the Damping Information on page 850

Causing Some Routes to Flap

Purpose To verify your route flap damping policy, some routes must flap. Having a live Internet feed almost guarantees that a certain number of route flaps will be present. If you have control over a remote system that is advertising the routes, you can modify the advertising router's policy to effect the advertisement and withdrawal of all routes or of a given prefix. In a test environment, you can cause routes to flap by clearing the BGP neighbors or by restarting the routing process on the BGP neighbors, as shown here.

Action From operational mode on Device R1 and Device R3, enter the **restart routing** command.

CAUTION: Use this command cautiously in a production network.

```
user@R1> restart routing

R1 started, pid 10474
```

```
user@R3> restart routing

R3 started, pid 10478
```

Meaning On Device R2, all of the routes from the neighbors are withdrawn and re-advertised.

Checking the Route Flaps

Purpose View the number of neighbor flaps.

Action From operational mode, enter the **show bgp summary** command.

```
user@R2> show bgp summary
```


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```
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                      12          1         11          0          11          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.1                100         10         10       0       4        2:50
0/9/0/9              0/0/0/0
10.1.0.2                300         10         10       0       4        2:53
1/3/1/2              0/0/0/0
```

Meaning This output was captured after the routing process was restarted on Device R2's neighbors four times.

Verifying Route Flap Damping

Purpose Verify that routes are being hidden due to damping.

Action From operational mode, enter the **show route damping suppressed** command.

```
user@R2> show route damping suppressed
```

```
inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0           [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
10.0.0.0/9          [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
10.0.0.0/30         [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
10.1.0.0/30         [BGP ] 00:00:15, localpref 100
                      AS path: 300 I, validation-state: unverified
                    > to 10.1.0.2 via fe-1/2/1.0
10.224.0.0/11       [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
172.16.0.0/16       [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
172.16.128.0/17     [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
172.16.192.0/20     [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
192.168.0.1/32      [BGP ] 00:00:12, localpref 100
                      AS path: 100 I, validation-state: unverified
                    > to 10.0.0.1 via fe-1/2/0.0
192.168.0.3/32      [BGP ] 00:00:15, localpref 100
```

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```
                    AS path: 300 I, validation-state: unverified
                  > to 10.1.0.2 via fe-1/2/1.0
172.16.233.0/7      [BGP ] 00:00:12, localpref 100
                    AS path: 100 I, validation-state: unverified
                  > to 10.0.0.1 via fe-1/2/0.0
```

Meaning The output shows some routing instability. Eleven routes are hidden due to damping.

Displaying the Details of a Damped Route

Purpose Display the details of damped routes.

Action From operational mode, enter the **show route damping suppressed 172.16.192.0/20 detail** command.

```
user@R2> show route damping suppressed 172.16.192.0/20 detail

inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
172.16.192.0/20 (1 entry, 0 announced)
         BGP                 /-101
                Next hop type: Router, Next hop index: 758
                Address: 0x9414484
                Next-hop reference count: 9
                Source: 10.0.0.1
                Next hop: 10.0.0.1 via fe-1/2/0.0, selected
                Session Id: 0x100201
                State: <Hidden Ext>
                Local AS:   200 Peer AS:   100
                Age: 52
                Validation State: unverified
                Task: BGP_100.10.0.0.1+55922
                AS path: 100 I
                Localpref: 100
                Router ID: 192.168.0.1
                Merit (last update/now): 4278/4196
                damping-parameters: aggressive
                Last update:       00:00:52 First update:       01:01:55
                Flaps: 8
                Suppressed. Reusable in:       01:14:40
                Preference will be: 170
```

Meaning This output indicates that the displayed route has a mask length that is equal to or greater than /17, and confirms that it has been correctly mapped to the aggressive damping profile. You can also see the route's current (and last) figure of merit value, and when the route is expected to become active if it remains stable.

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Verifying That Default Damping Parameters Are in Effect

Purpose Locating a damped route with a /16 mask confirms that the default parameters are in effect.

Action From operational mode, enter the **show route damping suppressed detail | match 0/16** command.

```
user@R2> show route damping suppressed detail | match 0/16

172.16.0.0/16 (1 entry, 0 announced)
```

```
user@R2> show route damping suppressed 172.16.0.0/16 detail

inet.0: 15 destinations, 17 routes (6 active, 0 holddown, 11 hidden)
172.16.0.0/16 (1 entry, 0 announced)
         BGP                 /-101
                Next hop type: Router, Next hop index: 758
                Address: 0x9414484
                Next-hop reference count: 9
                Source: 10.0.0.1
                Next hop: 10.0.0.1 via fe-1/2/0.0, selected
                Session Id: 0x100201
                State: <Hidden Ext>
                Local AS:   200 Peer AS:   100
                Age: 1:58
                Validation State: unverified
                Task: BGP_100.10.0.0.1+55922
                AS path: 100 I
                Localpref: 100
                Router ID: 192.168.0.1
                Merit (last update/now): 3486/3202
                Default damping parameters used
                Last update:       00:01:58 First update:       01:03:01
                Flaps: 8
                Suppressed. Reusable in:       00:31:40
                Preference will be: 170
```

Meaning Routes with a /16 mask are not impacted by the custom damping rules. Therefore, the default damping rules are in effect.

To repeat, the custom rules are as follows:

- Damp all prefixes with a mask length equal to or greater than 17 more aggressively than routes with a mask length between 9 and 16.
- Damp routes with a mask length between 0 and 8, inclusive, less than routes with a mask length greater than 8.
- Do not damp the 10.128.0.0/9 prefix at all.

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Filtering the Damping Information

Purpose Use OR groupings or cascaded piping to simplify the determination of what damping profile is being used for routes with a given mask length.

Action From operational mode, enter the **show route damping suppressed** command.

```
user@R2> show route damping suppressed detail | match "0 announced | damp"

0.0.0.0/0 (1 entry, 0 announced)
                damping-parameters: timid
10.0.0.0/9 (1 entry, 0 announced)
                Default damping parameters used
                damping-parameters: aggressive
                damping-parameters: aggressive
10.224.0.0/11 (1 entry, 0 announced)
                Default damping parameters used
172.16.0.0/16 (1 entry, 0 announced)
                Default damping parameters used
172.16.128.0/17 (1 entry, 0 announced)
                damping-parameters: aggressive
172.16.192.0/20 (1 entry, 0 announced)
                damping-parameters: aggressive
192.168.0.1/32 (1 entry, 0 announced)
                damping-parameters: aggressive
192.168.0.3/32 (1 entry, 0 announced)
                damping-parameters: aggressive
172.16.233.0/7 (1 entry, 0 announced)
                damping-parameters: timid
```

Meaning When you are satisfied that your EBGP routes are correctly associated with a damping profile, you can issue the **clear bgp damping** operational mode command to restore an active status to your damped routes, which will return your connectivity to normal operation.

Related Documentation

- Understanding Damping Parameters on page 839
- *Using Routing Policies to Damp BGP Route Flapping*

Example: Configuring BGP Route Flap Damping Based on the MBGP MVPN Address Family

This example shows how to configure an multiprotocol BGP multicast VPN (also called Next-Generation MVPN) with BGP route flap damping.

- Requirements on page 851
- Overview on page 851

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- Configuration on page 851
- Verification on page 860

Requirements

This example uses Junos OS Release 12.2. BGP route flap damping support for MBGP MVPN, specifically, and on an address family basis, in general, is introduced in Junos OS Release 12.2.

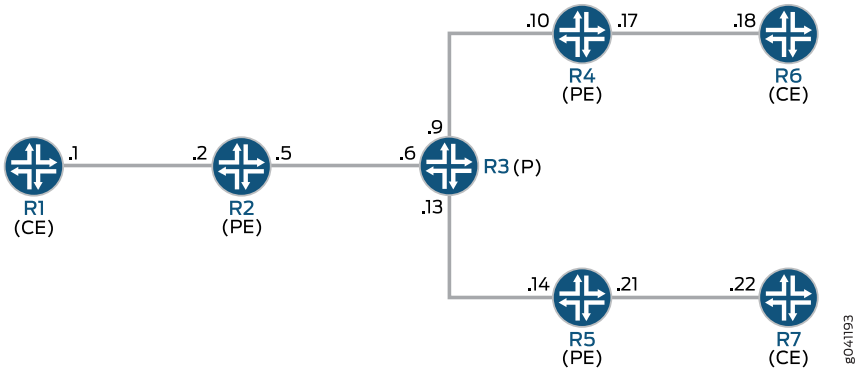
Overview

BGP route flap damping helps to diminish route instability caused by routes being repeatedly withdrawn and readvertised when a link is intermittently failing.

This example uses the default damping parameters and demonstrates an MBGP MVPN scenario with three provider edge (PE) routing devices, three customer edge (CE) routing devices, and one provider (P) routing device.

Figure 82 on page 851 shows the topology used in this example.

Figure 82: MBGP MVPN with BGP Route Flap Damping



On PE Device R4, BGP route flap damping is configured for address family **inet-mvpn**. A routing policy called **dampPolicy** uses the **nlri-route-type** match condition to damp only MVPN route types 3, 4, and 5. All other MVPN route types are not damped.

This example shows the full configuration on all devices in the "CLI Quick Configuration" on page 851 section. The "Configuring Device R4" on page 855 section shows the step-by-step configuration for PE Device R4.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R1

```
set interfaces ge-1/2/0 unit 1 family inet address 10.1.1.1/30
set interfaces ge-1/2/0 unit 1 family mpls
set interfaces lo0 unit 1 family inet address 172.16.1.1/32
```

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```
set protocols ospf area 0.0.0.0 interface lo0.1 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.1
set protocols pim rp static address 172.16.100.1
set protocols pim interface all
set routing-options router-id 172.16.1.1
```

Device R2

```
set interfaces ge-1/2/0 unit 2 family inet address 10.1.1.2/30
set interfaces ge-1/2/0 unit 2 family mpls
set interfaces ge-1/2/1 unit 5 family inet address 10.1.1.5/30
set interfaces ge-1/2/1 unit 5 family mpls
set interfaces vt-1/2/0 unit 2 family inet
set interfaces lo0 unit 2 family inet address 172.16.1.2/32
set interfaces lo0 unit 102 family inet address 172.16.100.1/32
set protocols mpls interface ge-1/2/1.5
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 172.16.1.2
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling
set protocols bgp group ibgp neighbor 172.16.1.4
set protocols bgp group ibgp neighbor 172.16.1.5
set protocols ospf area 0.0.0.0 interface lo0.2 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/1.5
set protocols ldp interface ge-1/2/1.5
set protocols ldp p2mp
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface ge-1/2/0.2
set routing-instances vpn-1 interface vt-1/2/0.2
set routing-instances vpn-1 interface lo0.102
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 provider-tunnel ldp-p2mp
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.102 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/0.2
set routing-instances vpn-1 protocols pim rp static address 172.16.1.2 with 172.16.4.1100.1
set routing-instances vpn-1 protocols pim interface ge-1/2/0.2 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 172.16.1.2
set routing-options autonomous-system 1001
```

Device R3

```
set interfaces ge-1/2/0 unit 6 family inet address 10.1.1.6/30
set interfaces ge-1/2/0 unit 6 family mpls
set interfaces ge-1/2/1 unit 9 family inet address 10.1.1.9/30
set interfaces ge-1/2/1 unit 9 family mpls
set interfaces ge-1/2/2 unit 13 family inet address 10.1.1.13/30
set interfaces ge-1/2/2 unit 13 family mpls
set interfaces lo0 unit 3 family inet address 172.16.1.3/32
set protocols mpls interface ge-1/2/0.6
set protocols mpls interface ge-1/2/1.9
set protocols mpls interface ge-1/2/2.13
```


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```
set protocols ospf area 0.0.0.0 interface lo0.3 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.6
set protocols ospf area 0.0.0.0 interface ge-1/2/1.9
set protocols ospf area 0.0.0.0 interface ge-1/2/2.13
set protocols ldp interface ge-1/2/0.6
set protocols ldp interface ge-1/2/1.9
set protocols ldp interface ge-1/2/2.13
set protocols ldp p2mp
set routing-options router-id 172.16.1.3
```

Device R4

```
set interfaces ge-1/2/0 unit 10 family inet address 10.1.1.10/30
set interfaces ge-1/2/0 unit 10 family mpls
set interfaces ge-1/2/1 unit 17 family inet address 10.1.1.17/30
set interfaces ge-1/2/1 unit 17 family mpls
set interfaces vt-1/2/0 unit 4 family inet
set interfaces lo0 unit 4 family inet address 172.16.1.4/32
set interfaces lo0 unit 104 family inet address 172.16.100.1/32
set protocols rsvp interface all aggregate
set protocols mpls interface all
set protocols mpls interface ge-1/2/0.10
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 172.16.1.4
set protocols bgp group ibgp family inet-vpn unicast
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling damping
set protocols bgp group ibgp neighbor 172.16.1.2 import dampPolicy
set protocols bgp group ibgp neighbor 172.16.1.5
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface lo0.4 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.10
set protocols ldp interface ge-1/2/0.10
set protocols ldp p2mp
set policy-options policy-statement dampPolicy term term1 from family inet-mvpn
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 3
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 4
set policy-options policy-statement dampPolicy term term1 from nlri-route-type 5
set policy-options policy-statement dampPolicy term term1 then accept
set policy-options policy-statement dampPolicy then damping no-damp
set policy-options policy-statement dampPolicy then accept
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set policy-options damping no-damp disable
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface vt-1/2/0.4
set routing-instances vpn-1 interface ge-1/2/1.17
set routing-instances vpn-1 interface lo0.104
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.104 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/1.17
set routing-instances vpn-1 protocols pim rp static address 172.16.100.1
```

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```
set routing-instances vpn-1 protocols pim interface ge-1/2/1.17 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 172.16.1.4
set routing-options autonomous-system 64501
```

Device R5

```
set interfaces ge-1/2/0 unit 14 family inet address 10.1.1.14/30
set interfaces ge-1/2/0 unit 14 family mpls
set interfaces ge-1/2/1 unit 21 family inet address 10.1.1.21/30
set interfaces ge-1/2/1 unit 21 family mpls
set interfaces vt-1/2/0 unit 5 family inet
set interfaces lo0 unit 5 family inet address 172.16.1.5/32
set interfaces lo0 unit 105 family inet address 172.16.100.5/32
set protocols mpls interface ge-1/2/0.14
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 172.16.1.5
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet-mvpn signaling
set protocols bgp group ibgp neighbor 172.16.1.2
set protocols bgp group ibgp neighbor 172.16.1.4
set protocols ospf area 0.0.0.0 interface lo0.5 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.14
set protocols ldp interface ge-1/2/0.14
set protocols ldp p2mp
set policy-options policy-statement parent_vpn_routes from protocol bgp
set policy-options policy-statement parent_vpn_routes then accept
set routing-instances vpn-1 instance-type vrf
set routing-instances vpn-1 interface vt-1/2/0.5
set routing-instances vpn-1 interface ge-1/2/1.21
set routing-instances vpn-1 interface lo0.105
set routing-instances vpn-1 route-distinguisher 100:100
set routing-instances vpn-1 vrf-target target:1:1
set routing-instances vpn-1 protocols ospf export parent_vpn_routes
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface lo0.105 passive
set routing-instances vpn-1 protocols ospf area 0.0.0.0 interface ge-1/2/1.21
set routing-instances vpn-1 protocols pim rp static address 172.16.100.2
set routing-instances vpn-1 protocols pim interface ge-1/2/1.21 mode sparse
set routing-instances vpn-1 protocols mvpn
set routing-options router-id 172.16.1.5
set routing-options autonomous-system 1001
```

Device R6

```
set interfaces ge-1/2/0 unit 18 family inet address 10.1.1.18/30
set interfaces ge-1/2/0 unit 18 family mpls
set interfaces lo0 unit 6 family inet address 172.16.1.6/32
set protocols sap listen 233.1.1.1
set protocols ospf area 0.0.0.0 interface lo0.6 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.18
set protocols pim rp static address 172.16.100.2
set protocols pim interface all
set routing-options router-id 172.16.1.6
```


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Device R7

```
set interfaces ge-1/2/0 unit 22 family inet address 10.1.1.22/30
set interfaces ge-1/2/0 unit 22 family mpls
set interfaces lo0 unit 7 family inet address 172.16.1.7/32
set protocols ospf area 0.0.0.0 interface lo0.7 passive
set protocols ospf area 0.0.0.0 interface ge-1/2/0.22
set protocols pim rp static address 172.16.100.2
set protocols pim interface all
set routing-options router-id 172.16.1.7
```

Configuring Device R4

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Device R4:

1. Configure the interfaces.

```
[edit interfaces]
user@R4# set ge-1/2/0 unit 10 family inet address 10.1.1.10/30
user@R4# set ge-1/2/0 unit 10 family mpls
user@R4# set ge-1/2/1 unit 17 family inet address 10.1.1.17/30
user@R4# set ge-1/2/1 unit 17 family mpls
user@R4# set vt-1/2/0 unit 4 family inet
user@R4# set lo0 unit 4 family inet address 172.16.1.4/32
user@R4# set lo0 unit 104 family inet address 172.16.100.4/32
```

2. Configure MPLS and the signaling protocols on the interfaces.

```
[edit protocols]
user@R4# set mpls interface all
user@R4# set mpls interface ge-1/2/0.10
user@R4# set rsvp interface all aggregate
user@R4# set ldp interface ge-1/2/0.10
user@R4# set ldp p2mp
```

3. Configure BGP.

   The BGP configuration enables BGP route flap damping for the **inet-mvpn** address family. The BGP configuration also imports into the routing table the routing policy called **dampPolicy**. This policy is applied to neighbor PE Device R2.

```
[edit protocols bgp group ibgp]
user@R4# set type internal
user@R4# set local-address 172.16.1.4
user@R4# set family inet-vpn unicast
user@R4# set family inet-vpn any
user@R4# set family inet-mvpn signaling damping
user@R4# set neighbor 172.16.1.2 import dampPolicy
user@R4# set neighbor 172.16.1.5
```

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4. Configure an interior gateway protocol.

```
[edit protocols ospf]
user@R4# set traffic-engineering
[edit protocols ospf area 0.0.0.0]
user@R4# set interface all
user@R4# set interface lo0.4 passive
user@R4# set interface ge-1/2/0.10
```

5. Configure a damping policy that uses the **nlri-route-type** match condition to damp only MVPN route types 3, 4, and 5.

```
[edit policy-options policy-statement dampPolicy term term1]
user@R4# set from family inet-mvpn
user@R4# set from nlri-route-type 3
user@R4# set from nlri-route-type 4
user@R4# set from nlri-route-type 5
user@R4# set then accept
```

6. Configure the **damping** policy to disable BGP route flap damping.

   The **no-damp** policy (**damping no-damp disable**) causes any damping state that is present in the routing table to be deleted. The **then damping no-damp** statement applies the **no-damp** policy as an action and has no **from** match conditions. Therefore, all routes that are not matched by **term1** are matched by this term, with the result that all other MVPN route types are not damped.

```
[edit policy-options policy-statement dampPolicy]
user@R4# set then damping no-damp
user@R4# set then accept
[edit policy-options]
user@R4# set damping no-damp disable
```

7. Configure the **parent_vpn_routes** to accept all other BGP routes that are not from the **inet-mvpn** address family.

   This policy is applied as an OSPF export policy in the routing instance.

```
[edit policy-options policy-statement parent_vpn_routes]
user@R4# set from protocol bgp
user@R4# set then accept
```

8. Configure the VPN routing and forwarding (VRF) instance.

```
[edit routing-instances vpn-1]
user@R4# set instance-type vrf
user@R4# set interface vt-1/2/0.4
user@R4# set interface ge-1/2/1.17
user@R4# set interface lo0.104
user@R4# set route-distinguisher 100:100
```


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```
user@R4# set vrf-target target:1:1
user@R4# set protocols ospf export parent_vpn_routes
user@R4# set protocols ospf area 0.0.0.0 interface lo0.104 passive
user@R4# set protocols ospf area 0.0.0.0 interface ge-1/2/1.17
user@R4# set protocols pim rp static address 172.16.100.2
user@R4# set protocols pim interface ge-1/2/1.17 mode sparse
user@R4# set protocols mvpn
```

9. Configure the router ID and the autonomous system (AS) number.

```
[edit routing-options]
user@R4# set router-id 172.16.1.4
user@R4# set autonomous-system 1001
```

10. If you are done configuring the device, commit the configuration.

```
user@R4# commit
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, **show routing-instances**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R4# show interfaces
ge-1/2/0 {
   unit 10 {
      family inet {
         address 10.1.1.10/30;
      }
      family mpls;
   }
}
ge-1/2/1 {
   unit 17 {
      family inet {
         address 10.1.1.17/30;
      }
      family mpls;
   }
}
vt-1/2/0 {
   unit 4 {
      family inet;
   }
}
lo0 {
   unit 4 {
```

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```
    family inet {
      address 172.16.1.4/32;
    }
  }
  unit 104 {
    family inet {
      address 172.16.100.4/32;
    }
  }
}
```

```
user@R4# show protocols
rsvp {
  interface all {
    aggregate;
  }
}
mpls {
  interface all;
  interface ge-1/2/0.10;
}
bgp {
  group ibgp {
    type internal;
    local-address 172.16.1.4;
    family inet-vpn {
      unicast;
      any;
    }
    family inet-mvpn {
      signaling {
        damping;
      }
    }
    neighbor 172.16.1.2 {
      import dampPolicy;
    }
    neighbor 172.16.1.5;
  }
}
ospf {
  traffic-engineering;
  area 0.0.0.0 {
    interface all;
    interface lo0.4 {
      passive;
    }
    interface ge-1/2/0.10;
  }
}
ldp {
  interface ge-1/2/0.10;
  p2mp;
}
```


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```
user@R4# show policy-options
policy-statement dampPolicy {
   term term1 {
      from {
         family inet-mvpn;
         nlri-route-type [ 3 4 5 ];
      }
      then accept;
   }
   then {
      damping no-damp;
      accept;
   }
}
policy-statement parent_vpn_routes {
   from protocol bgp;
   then accept;
}
damping no-damp {
   disable;
}
```

```
user@R4# show routing-instances
vpn-1 {
   instance-type vrf;
   interface vt-1/2/0.4;
   interface ge-1/2/1.17;
   interface lo0.104;
   route-distinguisher 100:100;
   vrf-target target:1:1;
   protocols {
      ospf {
         export parent_vpn_routes;
         area 0.0.0.0 {
            interface lo0.104 {
               passive;
            }
            interface ge-1/2/1.17;
         }
      }
      pim {
         rp {
            static {
               address 172.16.100.2;
            }
         }
         interface ge-1/2/1.17 {
            mode sparse;
         }
      }
      mvpn;
   }
}
```

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```
user@R4# show routing-optons
router-id 172.16.1.4;
autonomous-system 1001;
```

Verification

Confirm that the configuration is working properly.

- Verifying That Route Flap Damping Is Disabled on page 860
- Verifying Route Flap Damping on page 860

Verifying That Route Flap Damping Is Disabled

Purpose Verify the presence of the **no-damp** policy, which disables damping for MVPN route types other than 3, 4, and 5.

Action From operational mode, enter the **show policy damping** command.

```
user@R4> show policy damping
Default damping information:
  Halflife: 15 minutes
  Reuse merit: 750 Suppress/cutoff merit: 3000
  Maximum suppress time: 60 minutes
  Computed values:
    Merit ceiling: 12110
    Maximum decay: 6193
Damping information for "no-damp":
 Damping disabled
```

Meaning The output shows that the default damping parameters are in effect and that the **no-damp** policy is also in effect for the specified route types.

Verifying Route Flap Damping

Purpose Check whether BGP routes have been damped.

Action From operational mode, enter the **show bgp summary** command.

```
user@R4> show bgp summary
Groups: 1 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0
                       6          6          0          0          0          0
bgp.l3vpn.2
                       0          0          0          0          0          0
bgp.mvpn.0
                       2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
```


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```
172.16.1.2              1001       3159       3155       0       0     23:43:47
 Establ
  bgp.l3vpn.0: 3/3/3/0
  bgp.l3vpn.2: 0/0/0/0
  bgp.mvpn.0: 1/1/1/0
  vpn-1.inet.0: 3/3/3/0
  vpn-1.mvpn.0: 1/1/1/0
172.16.1.5              1001       3157       3154       0       0     23:43:40
 Establ
  bgp.l3vpn.0: 3/3/3/0
  bgp.l3vpn.2: 0/0/0/0
  bgp.mvpn.0: 1/1/1/0
  vpn-1.inet.0: 3/3/3/0
  vpn-1.mvpn.0: 1/1/1/0
```

Meaning The Damp State field shows that zero routes in the bgp.mvpn.0 routing table have been damped. Further down, the last number in the State field shows that zero routes have been damped for BGP peer 172.16.1.2.

Related Documentation

- Understanding Damping Parameters on page 839
- *Using Routing Policies to Damp BGP Route Flapping*
- Example: Configuring BGP Route Flap Damping Parameters on page 840

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Understanding BGP-Static Routes for Preventing Route Flaps

BGP-static routes can be configured to ensure that a prefix does not flap. BGP-static routes do not flap unless they are deleted manually. If the BGP-static routes are configured globally, then each neighbor, group, or all neighbors must be explicitly configured to receive them. Peer routers receive advertisements for these routes regardless of dynamic routing information learned by the advertising router for those prefixes. Despite being the active route, BGP-static routes are never advertised to a BGP neighbor for which they are not configured. You can specify any number of BGP-static routes in the configuration. You can also define a policy to specify which BGP-static routes need to be advertised and included in a BGP advertisement.

BGP-static routes are placed in the routing table. If the BGP-static routes are active routes (if there are no other routes for that prefix), they are placed in the forwarding table. These routes are advertised only to those BGP hosts that are configured to receive them. The configured BGP-static routes are not advertised by any other protocol besides BGP. Service providers who have one or more single-homed customers can configure BGP-static routes on a BGP network to advertise static paths for these customers.

NOTE: Configuring the advertisement of BGP-static routes at the neighbor level causes an internal group split. Configure the advertisement of BGP-static routes only at the global and group levels to keep the configuration simple. The configured BGP-static routes do not affect the VPN routes that are advertised.

If a BGP-static route is advertised to a neighbor, it is the only route advertised for the prefix. BGP-static routes are not considered as candidate routes for BGP multipath or protocol-independent multipath. They do not cause an aggregate or generated route to be added to the routing table.

CAUTION: Configuring BGP-static routes on networks that are accessible by multiple paths and are not the only point of access to all of the paths might cause traffic to be silently dropped or discarded. In a multihomed network, BGP-static routes can be configured on devices that are the only point of access to other paths. By default, all BGP-static routes that are advertised to the internal peers include a **local-pref** value of 0 to mitigate the risk of a black hole for multihomed networks. You can override this default value by setting an explicit **preference2** value on the BGP-static routes.

Related Documentation

- advertise-bgp-static on page 1084
- bgp-static on page 1123
- Example: Configuring BGP-Static Routes to Prevent Route Flaps on page 863
- Configuring BGP-Static Routes for Preventing Route Flaps on page 877

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Example: Configuring BGP-Static Routes to Prevent Route Flaps

This example shows how to configure BGP-static routes. BGP hosts advertise these BGP-static routes only to those neighbors who are configured to receive these routes. A BGP-static route is configured to ensure that a prefix does not flap. However, If the BGP-static routes are configured globally, then each neighbor, group, or all neighbors must be explicitly configured to receive them.

- Requirements on page 863
- Overview on page 863
- Configuration on page 864
- Verification on page 870

Requirements

This example uses the following hardware and software components:

- Seven MX Series routers with BGP enabled on the connected interfaces
- Junos OS Release 14.2 or later running on all devices

Overview

Beginning with Junos OS Release 14.2, you can configure and advertise BGP-static routes in a BGP network. You can advertise a BGP-static route in a BGP network even if it is not the active route for the prefix. BGP-static routes do not flap unless they are deleted manually. You can define a policy that determines which BGP-static routes need to be advertised and included in the advertisements. Peer routers receive advertisements for these BGP-static routes regardless of dynamic routing information learned by the advertising router.

In the sample BGP network, Devices CE1, CE2, and CE3 are directly connected to Routers PE1, PE2, and PE3. Both PE1 and PE2 are connected to Router P. Router P is directly connected to Router PE3. EBGP is configured on the provider edge and customer edge routers. IBGP is configured on directly connected provider edge routers. The IGP protocol IS-IS is configured on all provider routers. Configure a BGP-static route on Router PE1 to ensure that customer route 10.0.0.28 behind CE1 does not flap. Provider Router PE2 is configured to receive the BGP-static route. The objective is to advertise a BGP-static route only to CE2 and not to CE3, and to demonstrate that the configured BGP-static route does not flap.

Topology

Figure 83 on page 864 shows the sample topology.

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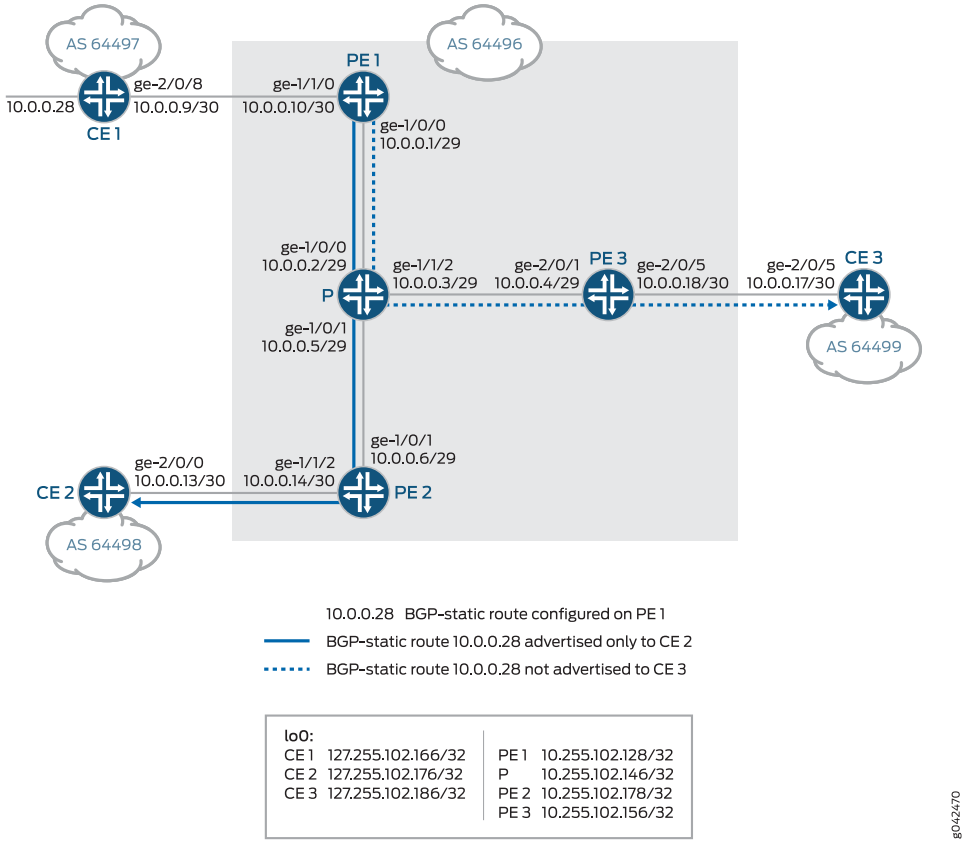
Figure 83: Configuring BGP-Static Route



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router P

```
set interfaces ge-1/0/0 unit 2 description P->PE1
set interfaces ge-1/0/0 unit 2 family inet address 10.0.0.2/29
set interfaces ge-1/0/0 unit 2 family iso
set interfaces ge-1/0/1 unit 5 description P->PE2
set interfaces ge-1/0/1 unit 5 family inet address 10.0.0.5/29
set interfaces ge-1/0/1 unit 5 family iso
set interfaces ge-1/1/2 unit 3 description P->PE3
set interfaces ge-1/1/2 unit 3 family inet address 10.0.0.3/29
set interfaces ge-1/1/2 unit 3 family iso
set interfaces lo0 unit 0 family inet address 10.255.102.146/32 primary
set interfaces lo0 unit 0 family iso address 49.0001.1720.1600.1050.00
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.102.146
set protocols bgp group ibgp neighbor 10.255.102.128 description PE1
```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```
set protocols bgp group ibgp neighbor 10.255.102.178 description PE2
set protocols bgp group ibgp neighbor 10.255.102.156 description PE3
set protocols isis interface ge-1/0/0.2
set protocols isis interface ge-1/0/1.5
set protocols isis interface ge-1/1/2.3
set protocols isis interface lo0.0 passive
set routing-options router-id 10.255.102.146
set routing-options autonomous-system 64496
```

Router PE1

```
set interfaces ge-1/0/0 unit 1 description PE1->P
set interfaces ge-1/0/0 unit 1 family inet address 10.0.0.1/29
set interfaces ge-1/0/0 unit 1 family iso
set interfaces ge-1/1/0 unit 10 description PE1->CE1
set interfaces ge-1/1/0 unit 10 family inet address 10.0.0.10/30
set interfaces lo0 unit 0 family inet address 10.255.102.128/32
set interfaces lo0 unit 0 family iso address 49.0001.1720.1600.1010.00
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64497
set protocols bgp group ebgp neighbor 10.0.0.9 description CE1
set protocols bgp group ebgp neighbor 10.0.0.9 local-address 10.0.0.10
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.102.128
set protocols bgp group ibgp export export-self
set protocols bgp group ibgp neighbor 10.255.102.146 description P
set protocols bgp group ibgp neighbor 10.255.102.178 description PE2
set protocols bgp group ibgp neighbor 10.255.102.178 advertise-bgp-static
set protocols bgp group ibgp neighbor 10.255.102.156 description PE3
set protocols isis interface ge-1/0/0.1
set protocols isis interface lo0.0 passive
set policy-options policy-statement export-self then next-hop self
set routing-options bgp-static route 10.0.0.28/32 preference2 4294967195
set routing-options bgp-static route 10.0.0.28/32 as-path path 64497
set routing-options router-id 10.255.102.128
set routing-options autonomous-system 64496
```

Router PE2

```
set interfaces ge-1/0/1 unit 6 description PE2->P
set interfaces ge-1/0/1 unit 6 family inet address 10.0.0.6/29
set interfaces ge-1/0/1 unit 6 family iso
set interfaces ge-1/1/2 unit 14 description PE2->CE2
set interfaces ge-1/1/2 unit 14 family inet address 10.0.0.14/30
set interfaces lo0 unit 0 family inet address 10.255.102.178/32
set interfaces lo0 unit 0 family iso address 49.0001.1720.1600.1030.00
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64498
set protocols bgp group ebgp neighbor 10.0.0.13 description CE2
set protocols bgp group ebgp neighbor 10.0.0.13 local-address 10.0.0.14
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.102.178
set protocols bgp group ibgp export export-self
set protocols bgp group ibgp neighbor 10.255.102.146 description P
set protocols bgp group ibgp neighbor 10.255.102.128 description PE1
set protocols bgp group ibgp neighbor 10.255.102.156 description PE3
```

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```
set protocols isis interface ge-1/0/1.6
set protocols isis interface lo0.0 passive
set policy-options policy-statement export-self then next-hop self
set routing-options router-id 10.255.102.178
set routing-options autonomous-system 64496
```

Router PE3

```
set interfaces ge-2/0/1 unit 4 description PE3->P
set interfaces ge-2/0/1 unit 4 family inet address 10.0.0.4/29
set interfaces ge-2/0/5 unit 18 description PE3->CE3
set interfaces ge-2/0/5 unit 18 family inet address 10.0.0.18/30
set interfaces lo0 unit 0 family inet address 10.255.102.156/32
set interfaces lo0 unit 0 family iso address 49.0001.1720.1600.1070.00
set protocols bgp group ebgp type external
set protocols bgp group ebgp peer-as 64499
set protocols bgp group ebgp neighbor 10.0.0.17 description CE3
set protocols bgp group ebgp neighbor 10.0.0.17 local-address 10.0.0.18
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.102.156
set protocols bgp group ibgp export export-self
set protocols bgp group ibgp neighbor 10.255.102.146 description P
set protocols bgp group ibgp neighbor 10.255.102.128 description PE1
set protocols bgp group ibgp neighbor 10.255.102.178 description PE2
set protocols isis interface ge-2/0/1.4
set protocols isis interface lo0.0 passive
set policy-options policy-statement export-self then next-hop self
set routing-options router-id 10.255.102.156
set routing-options autonomous-system 64496
```

Router CE1

```
set interfaces ge-2/0/8 unit 9 description CE1->PE1
set interfaces ge-2/0/8 unit 9 family inet address 10.0.0.9/30
set interfaces lo0 unit 0 family inet address 127.255.102.166/32
set interfaces lo0 unit 0 family inet address 10.0.0.28/32
set protocols bgp group ebgp type external
set protocols bgp group ebgp export export-direct
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp neighbor 10.0.0.10 description PE1
set protocols bgp group ebgp neighbor 10.0.0.10 local-address 10.0.0.9
set policy-options policy-statement export-direct from protocol direct route-filter
  10.0.0.0/29 or longer
set policy-options policy-statement export-direct then accept
set routing-options autonomous-system 64497
```

Router CE2

```
set interfaces ge-2/0/0 unit 13 description CE2->PE2
set interfaces ge-2/0/0 unit 13 family inet address 10.0.0.13/30
set interfaces lo0 unit 0 family inet address 127.255.102.176/32
set protocols bgp group ebgp type external
set protocols bgp export export-direct
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp neighbor 10.0.0.14 description PE2
set protocols bgp group ebgp neighbor 10.0.0.14 local-address 10.0.0.13
```


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```
set policy-options policy-statement export-direct from protocol direct route-filter
  10.0.0.0/29 or longer
set policy-options policy-statement export-direct then accept
set routing-options router-id 127.255.102.176
set routing-options autonomous-system 64498
```

Router CE3

```
set interfaces ge-2/0/5 unit 17 description CE3->PE3
set interfaces ge-2/0/5 unit 17 family inet address 10.0.0.17/30
set interfaces lo0 unit 0 family inet address 127.255.102.186/32
set protocols bgp group ebgp type external
set protocols bgp export export-direct
set protocols bgp group ebgp peer-as 64496
set protocols bgp group ebgp neighbor 10.0.0.18 description PE3
set protocols bgp group ebgp neighbor 10.0.0.18 local-address 10.0.0.17
set policy-options policy-statement export-direct from protocol direct route-filter
  10.0.0.0/29 or longer
set policy-options policy-statement export-direct then accept
set routing-options router-id 127.255.102.186
set routing-options autonomous-system 64499
```

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router PE1:

1. Configure the interfaces with IPv4 addresses.

```
[edit interfaces]
user@PE1# set ge-1/0/0 unit 1 description PE1->P
user@PE1# set ge-1/0/0 unit 1 family inet address 10.0.0.1/29

user@PE1# set ge-1/1/0 unit 10 description PE1->CE1
user@PE1# set ge-1/1/0 unit 10 family inet address 10.0.0.10/30
```

2. Enable the IS-IS protocol on interfaces connected to provider routers for learning and exchanging routes learned.

```
[edit interfaces]
user@PE1# set ge-1/0/0 unit 1 family iso
```

3. Configure loopback addresses for inet and IS-IS.

```
[edit interfaces lo0 unit 0]
user@PE1# set family inet address 10.255.102.128/32
user@PE1# set family iso address 49.0001.1720.1600.1010.00
```

4. Configure the IS-IS interfaces.

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```
[edit protocols isis]
user@PE1# set interface ge-1/0/0.1
user@PE1# set interface lo0.0 passive
```

5. Configure EBGP.

```
[edit protocols bgp group ebgp]
user@PE1# set type external
user@PE1# set peer-as 64497
user@PE1# set neighbor 10.0.0.9 description CE1
user@PE1# set neighbor 10.0.0.9 local-address 10.0.0.10
```

6. Configure an IBGP neighbor on internal routers connected to the provider network.

```
[edit protocols bgp group ibgp]
user@PE1# set type internal
user@PE1# set local-address 10.255.102.128
user@PE1# set export export-self
user@PE1# set neighbor 10.255.102.146 description P
user@PE1# set neighbor 10.255.102.178 description PE2
user@PE1# set neighbor 10.255.102.156 description PE3
```

7. Configure the BGP static route.

```
[edit routing-options]
user@PE1# set bgp-static route 10.0.0.28/32 preference2 4294967195
user@PE1# set bgp-static route 10.0.0.28/32 as-path path 64497
```

8. Configure the BGP neighbor PE2 to receive BGP-static advertisements.

```
[edit protocols bgp group ibgp neighbor 10.255.102.178]
user@PE1# set advertise-bgp-static
```

9. Define a policy to export routes to the BGP network.

```
[edit policy-options policy-statement export-self]
user@PE1# set then next-hop self
```

10. Apply the policy to the IBGP group.

```
[edit protocols bgp group ibgp]
user@PE1# set export export-self
```

11. Configure the router id and the autonomous system (AS) number.

```
[edit routing-options]
user@PE1# set router-id 10.255.102.128
```


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```
user@PE1# set autonomous-system 64496
```

Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show policy-options**, **show protocols**, and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@PE1> show interfaces
ge-1/0/0 {
   unit 1 {
      description PE1->P;
      family inet {
         address 10.0.0.1/29;
      }
      family iso;
   }
   ge-1/1/0 {
      unit 10 {
         description PE1->CE1;
         family inet {
            address 10.0.0.10/30;
         }
      }
   }
}
lo0 {
   unit 0{
      family inet {
         address 10.255.102.128/32;
      }
      family iso {
         address 49.0001.1720.1600.1010.00;
      }
   }
}
```

```
[edit]
user@PE1> show protocols
bgp {
   group ebgp {
      type external;
      peer-as 64497;
      neighbor 10.0.0.9 {
         description CE1;
         local-address 10.0.0.10;
      }
   }
   group ibgp {
      type internal;
```

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```
    local-address 10.255.102.128;
    export export-self;
    neighbor 10.255.102.146 {
      description P;
    }
    neighbor 10.255.102.178 {
      description PE2;
      advertise-bgp-static;
    }
    neighbor 10.255.102.156 {
      description PE3;
    }
  }
}
isis {
  interface ge-1/0/0.1;
  interface lo0.0 {
    passive;
  }
}
```

```
[edit]
user@PE1> show routing-options
bgp-static {
  route 10.0.0.28/32 {
    preference2 4294967195;
    as-path {
      path 64497;
    }
  }
}
router-id 10.255.102.128;
autonomous-system 64496;
```

```
[edit]
user@PE1> show policy-options
policy-statement export-self {
  then {
    next-hop self;
  }
}
```

If you are done configuring the device, enter **commit** from configuration mode.

```
[edit]
user@PE1# commit
```

Verification

Confirm that the configuration is working properly.

- Verifying the BGP Neighbors on page 871
- Verifying BGP Groups on page 873

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- Verifying the Routes on page 874
- Verifying That the Configured Hosts Receive the BGP-Static Routes on page 875
- Verifying That the Configured BGP-Static Route Does Not Flap on page 876

Verifying the BGP Neighbors

Purpose Verify that BGP is running on the configured interfaces and that the BGP session is active for each neighbor address.

Action From operational mode, run the **show bgp neighbor** command on Router PE1.

```
user@PE1> show bgp neighbor
Peer: 10.0.0.9+34260 AS 64497    Local: 10.0.0.10+45824 AS 64496
  Description: CE1
  Type: External    State: Established    Flags: <sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: Cease
  Options: <Preference LocalAddress PeerAS Refresh>
  LocalAddress: 10.0.0.10 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 127.255.102.166       Local ID: 10.255.102.128   Active Holdtime: 90

  Keepalive Interval: 30         Group index: 0           Peer index: 0
  BFD: disabled, down
  Local Interface: ge-1/1/0.0
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 64497)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            1
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 14   Sent 13   Checked 4
  Input messages:  Total 249     Updates 2       Refreshes 0     Octets 4764
  Output messages: Total 250     Updates 2       Refreshes 0     Octets 4883

Peer: 10.255.102.146+179 AS 64496  Local: 10.255.102.128+53460 AS 64496
  Description: P
  Type: Internal    State: Established    Flags: <Sync>
Last State: OpenConfirm   Last Event: RecvKeepAlive
Last Error: None
Export: [ export-self ]
Options: <Preference LocalAddress Refresh>
Local Address: 10.255.102.128  Holdtime: 90 Preference: 170
```

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```
Number of flaps: 0
Peer ID: 10.255.102.146      Local ID: 10.255.102.128     Active Holdtime: 90
Keepalive Interval: 30         Group index: 0         Peer index: 0
BFD: disabled, down
NLRI for restart configured on peer: inet-unicast
NLRI advertised by peer: inet-unicast
NLRI for this session: inet-unicast
Peer supports Refresh capability (2)
Stale routes from peer are kept for: 300
Peer does not support Restarter functionality
Restart flag received from the peer: Notification
NLRI that restart is negotiated for: inet-unicast
NLRI of received end-of-rib markers: inet-unicast
NLRI of all end-of-rib markers sent: inet-unicast
Peer does not support LLGR Restarter functionality
Peer supports 4 byte AS extension (peer-as 64496)
Peer does not support Addpath
Table inet.0 Bit: 10001
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              0
  Received prefixes:            0
  Accepted prefixes:            0
  Suppressed due to damping:    0
  Advertised prefixes:          1
Last traffic (seconds): Received 12   Sent 1    Checked 63
Input messages:  Total 246    Updates 1       Refreshes 0     Octets 4678
Output messages: Total 249    Updates 1       Refreshes 0     Octets 4834
Output Queue[0]: 0            (inet.0, inet-unicast)

Peer: 10.255.102.178+53463 AS 64496 Local: 10.255.102.128+179 AS 64496
Description: PE2   Type: Internal    State: Established    Flags: <Synch>
Last State: OpenConfirm   Last Event: RecvKeepAlive
Last Error: None
Export: [ export-self ]
Options:   <Preference LocalAddress Refresh>
Options:   <AdvertiseBGPStatic>
Local Address: 10.255.102.128 Holdtime: 90 Preference: 170
Number of flaps: 0
Peer ID: 10.255.102.178   Local ID: 10.255.102.128     Active Holdtime: 90
Keepalive Interval: 30         Group index: 1    Peer index: 0
BFD: disabled, down
NLRI for restart configured on peer: inet-unicast
NLRI advertised by peer: inet-unicast
NLRI for this session: inet-unicast
Peer supports Refresh capability (2)
Stale routes from peer are kept for: 300
Peer does not support Restarter functionality
Restart flag received from the peer: Notification
NLRI that restart is negotiated for: inet-unicast
NLRI of received end-of-rib markers: inet-unicast
NLRI of all end-of-rib markers sent: inet-unicast
Peer does not support LLGR Restarter functionality
Peer supports 4 byte AS extension (peer-as 64496)
Peer does not support Addpath
Table inet.0 Bit: 10002
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              1
  Received prefixes:            1
```


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```
  Accepted prefixes:           1
  Suppressed due to damping:   0
  Advertised prefixes:         1
Last traffic (seconds): Received 9    Sent 10   Checked 22
Input messages:  Total 247    Updates 2       Refreshes 0     Octets 4777
Output messages: Total 248    Updates 1       Refreshes 0     Octets 4815
Output Queue[0]: 0            (inet.0, inet-unicast)

Peer: 10.255.102.156+179 AS 64496 Local: 10.255.102.128+53462 AS 64496
Description: PE3
Type: Internal    State: Established    Flags:  <Synch>
Last State: OpenConfirm   Last Event: RecvKeepAlive
Last Error: None
Export: [ export-self ]
Options:  <Preference LocalAddress Refresh>
Local Address: 10.255.255.11 Holdtime: 90 Preference: 170
Number of flaps: 0
Peer ID: 10.255.102.156   Local ID: 10.255.102.128     Active Holdtime: 90
Keepalive Interval: 30         Group index: 0    Peer index: 1
BFD: disabled, down
NLRI for restart configured on peer: inet-unicast
NLRI advertised by peer: inet-unicast
NLRI for this session: inet-unicast
Peer supports Refresh capability (2)
Stale routes from peer are kept for: 300
Peer does not support Restarter functionality
Restart flag received from the peer: Notification
NLRI that restart is negotiated for: inet-unicast
NLRI of received end-of-rib markers: inet-unicast
NLRI of all end-of-rib markers sent: inet-unicast
Peer does not support LLGR Restarter functionality
Peer supports 4 byte AS extension (peer-as 64496)
Peer does not support Addpath
Table inet.0 Bit: 10001
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:             1
  Received prefixes:           1
  Accepted prefixes:           1
  Suppressed due to damping:   0
  Advertised prefixes:         1
Last traffic (seconds): Received 21   Sent 10   Checked 10
Input messages:  Total 245    Updates 2       Refreshes 0     Octets 4695
Output messages: Total 247    Updates 1       Refreshes 0     Octets 4796
Output Queue[0]: 0            (inet.0, inet-unicast)
```

Meaning The output displays the BGP neighbors of Router PE1 and the configured BGP options such as whether the neighbor is configured to receive BGP-static routes. Router PE2 is configured to receive BGP-static route advertisements.

Verifying BGP Groups

Purpose Verify that the intended BGP groups or neighbors are configured to receive the BGP-static routes.

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Action From operational mode, run the **show bgp group** command.

```
user@PE1> show bgp group

Group Type: External                              Local AS: 64496
Name: ebgp            Index: 3                  Flags: <Export Eval>
Holdtime: 0 Local AS: 64496 Local System AS: 64496
Total peers: 1        Established: 1
10.0.0.9+179
inet.0: 0/1/1/0

Group Type: Internal    AS: 64496                     Local AS: 64496
Name: ibgp            Index: 0                  Flags: <Export Eval>
Export: [ export-self ]
Options: <AdvertiseBGPStatic>
Holdtime: 0
Total peers: 1        Established: 1
10.255.102.178+179
inet.0: 0/0/0/0

Group Type: Internal    AS: 64496                     Local AS: 64496
Name: ibgp            Index: 0                  Flags: <Export Eval>
Export: [ export-self ]
Holdtime: 0
Total peers: 2        Established: 2
10.255.102.156+179
10.255.102.146+179
inet.0: 0/3/2/0


Groups: 3  Peers: 4    External: 1    Internal: 3    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending

inet.0     3          3          0          0          0          0
```

Meaning The output shows the BGP neighbor that is configured to receive BGP-static advertisements.

Verifying the Routes

Purpose Verify that the configured BGP-static route is saved in the routing table of the configured BGP neighbors.

Action From operational mode, run the **show route protocol bgp-static** command to display the routing table.

```
user@PE1> show route protocol bgp-static
inet.0: 13 destinations, 14 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.28/32       *[BGP-Static/4294967292/-101] 00:43:15
                      Discard
```


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```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
inet6.0: 15 destinations, 15 routes (15 active, 0 holddown, 0 hidden)
```

```
User@PE1> show route 10.0.0.28/32

inet.0: 13 destinations, 14 routes (13 active, 1 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.28/32       *[BGP/170] 00:00:15, localpref 100
                      AS path: 64497 I, validation-state: unverified
                    > to 10.0.0.9 via ge-2/1/8.0
                    [BGP-Static/4294967292/-101] 02:42:51
                      Discard
```

Meaning The output shows the BGP-static route configured on the device. The active path is learned from CE1, and the BGP-static route is inactive.

Verifying That the Configured Hosts Receive the BGP-Static Routes

Purpose Verify that the BGP-static route is being advertised to the host configured to receive it.

Action On Devices CE2 and CE3, from operational mode, run the **show route protocol bgp** command to display the learned routes in the routing table.

```
user@CE2> show route protocol bgp

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.28/32     *[BGP/170] 01:52:10, localpref 100
                    AS path: 64496 64497 I, validation-state: unverified
                  > to 10.0.0.14 via ge-2/0/0.13
1.0.0.29/32          *[BGP/170] 01:52:06, localpref 100
                      AS path: 64496 64499 I, validation-state: unverified
                    > to 10.0.0.14 via ge-2/0/0.13

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
```

```
user@CE3> show route protocol bgp

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.0.0.28/32        *[BGP/170] 01:52:19, localpref 100
                      AS path: 64496 64497 I, validation-state: unverified
                    > to 10.0.0.18 via ge-2/0/5.17
```

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```
1.0.0.29/32        *[BGP/170] 01:52:15, localpref 100
                      AS path: 64496 64498 I, validation-state: unverified
                    > to 10.0.0.18 via ge-2/0/5.17

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
```

Meaning Both Devices CE2 and CE3 have a route to 10.0.0.28/32. CE2 has received the BGP-static route and CE3 has received a dynamically-learned route, but you cannot tell the difference.

Verifying That the Configured BGP-Static Route Does Not Flap

Purpose Verify that the BGP-static route does not flap even when the BGP peering session between Router PE1 and Device CE1 goes down.

Action Deactivate the BGP peering session between Router PE1 and Device CE1. PE1 does not have a dynamically learned route to 10.0.0.28/32, but still has the configured BGP-static route.

```
[edit]
user@PE1# deactivate protocols bgp group ebgp
user@PE1# commit
```

```
user@PE1> show route 10.0.0.28/32

inet.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.28/32         *[BGP-Static/4294967292/-101] 02:46:21
                      Discard
```

```
user@CE2> show route protocol bgp

inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.28/32        *[BGP/170] 01:52:48, localpref 100
                      AS path: 64496 64497 I, validation-state: unverified
                    > to 10.0.0.18 via ge-2/0/5.17
1.0.0.29/32         *[BGP/170] 01:52:44, localpref 100
                      AS path: 64496 64499 I, validation-state: unverified
                    > to 10.0.0.18 via ge-2/0/5.17

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
```

```
user@CE3> show route protocol bgp

inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
10.0.0.29/32         *[BGP/170] 01:52:47, localpref 100
                      AS path: 64496 64498 I, validation-state: unverified
                    > to 10.0.0.18 via ge-2/0/5.17

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
```

Meaning Router PE1 and Device CE2 still have the configured BGP-static route. However, Device CE3 does not have the route to 10.0.0.28/32 because this prefix has flapped. BGP-static routes do not flap unless deleted manually.

Related Documentation

- advertise-bgp-static on page 1084
- bgp-static on page 1123
- Understanding BGP-Static Routes for Preventing Route Flaps on page 862
- Configuring BGP-Static Routes for Preventing Route Flaps on page 877

Configuring BGP-Static Routes for Preventing Route Flaps

BGP-static routes are configured to ensure that routes to a customer network do not flap. The configured BGP-static routes are not advertised by any other protocol besides BGP. BGP-static routes are configured globally, but each neighbor, group, or all neighbors must be explicitly configured to receive them. Peer routers will receive advertisements for these routes regardless of dynamic routing information learned by the advertising router for those prefixes. You can specify any number of BGP-static routes in the configuration. You can also define a policy to specify which BGP-static routes need to be advertised.

Before you configure BGP-static routes:

1. Ensure that the IGP and BGP protocols are configured and working.

2. Ensure that BGP-static route that you configure is behind a customer router.

   Do not use BGP-static routes for prefixes that BGP uses to reach BGP neighbors.

To configure BGP-static routes:

1. Configure a BGP-static route for a customer router on a BGP network to advertise static paths for these customers.

   You can also configure other configuration options such as as-path, color, community, tag, and preference as needed.

   ```
   [edit routing-options]
   user@host# set bgp-static route destination-prefix
   ```

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2. Configure the BGP groups or the BGP neighbors that are to receive the BGP-static route advertisements.

   You can also configure this statement at a global level if you want every host on the BGP network to receive the BGP-static advertisements.

   ```
   [edit protocols bgp]
   user@host# set advertise-bgp-static
   ```

3. (Optional) Specify an additional export policy to control whether or not a given BGP-static route needs to be advertised.

   The policy is applied to the BGP-static route and not the active route.

   ```
   [edit policy-options policy-statement policy name]
   user@host# set from prefix-list xyz
   user@host# set then accept
   ```

4. Apply the defined policy to a BGP group or neighbor.

   ```
   [edit protocols bgp group group-name]
   user@host# set advertise-bgp-static export policy name
   ```

Related Documentation

- advertise-bgp-static on page 1084
- bgp-static on page 1123
- Example: Configuring BGP-Static Routes to Prevent Route Flaps on page 863
- Understanding BGP-Static Routes for Preventing Route Flaps on page 862

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CHAPTER 24

Error Handling for BGP Update Messages

- Understanding Error Handling for BGP Update Messages on page 879
- Example: Configuring Error Handling for BGP Update Messages on page 881

Understanding Error Handling for BGP Update Messages

A BGP message is considered to be malformed when any one of the message attributes is malformed. When a router participating in a BGP session receives a malformed update message, the entire session is reset by default. This is undesirable because update messages with valid routes are also affected. To avoid this undesirable behavior, the error handling for BGP update messages needs to be modified.

To configure error handling for BGP update messages, configure the **bgp-error-tolerance** statement at the **[edit protocols bgp]**, **[edit protocols bgp group *group-name*]**, or **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.

```
bgp-error-tolerance {
  malformed-route-limit number;
  malformed-update-log-interval seconds;
  no-malformed-route-limit;
}
```

If an attribute contains attribute flags that conflict with the value of the Attribute Type field, the attribute flags are reset to the correct value and the update message is processed. The value of the Extended Length bit in the attribute flags is unchanged because this value defines whether the attribute length is one or two octets. Hence, the value of the attribute flag affects how the BGP update packet is parsed.

NOTE: There is no explicit specification for the attribute flag value for the path attributes.

Malformed update messages are treated on a case by case basis, depending on the values of the attributes contained in the messages. There are three ways of handling malformed BGP update messages, listed in the decreasing order of severity.

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1. **Notification message approach**—The malformed message error is logged locally, an error code update message is sent to the administration of the peer, and the entire BGP session is reset.

   This approach is chosen when:

   - The BGP update message contains the MP reach attribute or the MP unreach attribute.
   - The NLRI field or the BGP update message cannot be parsed correctly because of a mismatch between the attribute length and the value of the attribute length field.

2. **Treat-as-withdraw approach**—All routes within the malformed update message are treated as hidden routes, unless the **keep none** statement is configured, in which case the routes are discarded. In the absence of the **keep none** statement, the number of hidden malformed routes are configured with a limit, which when exceeded discards the routes and prevents any further malformed routes from being hidden. Junos OS removes the newly received malformed routes when the malformed route limit is reached.

3. **Attribute discard approach**—The malformed attributes in the update message are discarded; however, the message is processed. We do not recommend using this approach if the attributes to be discarded can affect route selection or installation.

NOTE: If an attribute appears more than once in an update message, all occurrences of the attribute, other than the first, will be discarded and the message will be processed.

The BGP update messages are scanned for the following attributes and are treated as malformed based on the values of these attributes:

- **The origin attribute**—Handled by the treat-as-withdraw approach.
- **The AS path attribute**—Handled by the treat-as-withdraw approach.
- **The AS 4 path attribute**—Handled by the attribute discard approach. If any attribute has attribute flags that conflict with the attribute type code, Junos OS resets the attribute flags to the correct value. The update message continues to be processed.

  Junos OS does not change the value of the extended length bit in the attribute flags. This bit defines whether the attribute length is one octet or two octets. The value of this flag affects how the BGP packet is parsed. There is no explicit specification of this value for the path attributes.
- **The aggregator attribute**—Handled by the attribute discard approach.
- **The aggregator 4 attribute**—Handled by the attribute discard approach.
- **The next-hop attribute**—Handled by the treat-as-withdraw approach.
- **The multiple exit discriminator attribute**—Handled by the treat-as-withdraw approach.
- **The local preference attribute**—Handled by the treat-as-withdraw approach.
- **The atomic aggregate attribute**—Handled by the attribute discard approach.

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- **The community attribute**—Handled by the treat-as-withdraw approach.
- **The extended community attribute**—Handled by the treat-as-withdraw approach.
- **The originator attribute**—Handled by the treat-as-withdraw approach.
- **The cluster attribute**—Handled by the treat-as-withdraw approach.
- **The PMSI attribute**—Handled by the treat-as-withdraw approach.
- **The MP reach attribute**—Handled by the notification message approach.
- **The MP unreach attribute**—Handled by the notification message approach.
- **The attribute set attribute**—Handled by the treat-as-withdraw approach.
- **The AIGP attribute**—Handled by the treat-as-withdraw approach.
- **Unknown attribute**—If the BGP flag does not indicate that this is an optional attribute, this malformed attribute is handled by the notification message approach.

NOTE: When a BGP update message contains multiple malformed attributes, the most severe approach triggered by one of the attributes is followed.

Related Documentation

- Example: Configuring Error Handling for BGP Update Messages on page 881

Example: Configuring Error Handling for BGP Update Messages

This example shows how to configure BGP error handling.

- Requirements on page 881
- Overview on page 881
- Configuration on page 883
- Verification on page 887

Requirements

Before you begin:

- Configure router interfaces.
- Configure an interior gateway protocol (IGP).
- Configure BGP.
- Configure routing policies.

Overview

When a routing device receives an update message with a malformed attribute, the router is required to reset the session. This is specified in RFC 4271, *A Border Gateway Protocol 4 (BGP-4)*. Session resets impact not only routes with the offending attribute, but also

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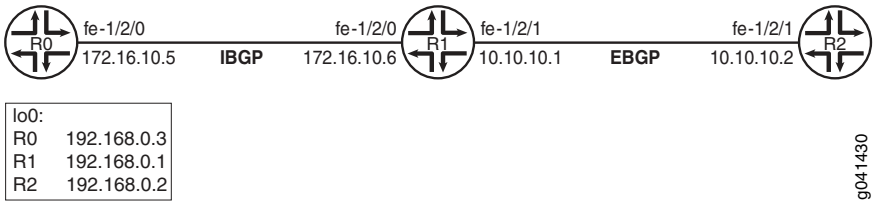
other valid routes exchanged over the session. Moreover, this behavior can present a potential security vulnerability in the case of optional transitive attributes. To minimize the impact on routing made by malformed update messages, the Internet draft draft-ietf-idr-error-handling-01.txt, *Revised Error Handling for BGP UPDATE Messages* specifies modifications for handling BGP update message with malformed attributes. The new error handling allows for maintaining the established session and keeping the valid routes exchanged, while removing the routes carried in the malformed UPDATE message.

In Figure 84 on page 882, Device R1 has an internal BGP peering session with Device R0, and an external BGP peering session with Device R2.

Figure 84: BGP Error Handling Example Topology



To protect against malformed update messages causing network instability, Device R1 has BGP error handling configured, as shown here:

```
bgp-error-tolerance {
   malformed-update-log-interval 10;
   malformed-route-limit 5;
}
```

By default, a BGP message is considered to be malformed when any one of the message attributes is malformed. When a router participating in a BGP session receives a malformed update message, the entire session is reset. The **bgp-error-tolerance** statement overrides this behavior so that the following BGP error handling is in effect:

- For fatal errors, Junos OS sends a notification message titled Error Code Update Message and resets the BGP session. An error in the MP_{UN}REACH attribute is considered to be fatal. The presence of multiple MP_{UN}REACH attributes in one BGP update is also considered to be a fatal error. Junos OS resets the BGP session if it cannot parse the NLRI field or the BGP update correctly. Failure to parse the BGP update packet can happen when the attribute length does not match the length of the attribute value.
- For some nonfatal errors, Junos OS treats all the routes contained in the malformed BGP update message as withdrawn routes and installs them as hidden, unless the **keep none** statement is included in the BGP is configuration. Junos OS uses this error handling approach for the cases that involve any of the following attributes: ORIGIN, AS_PATH, NEXT_HOP, MULTI_EXIT_DISC, LOCAL_PREF, ORIGINATOR, CLUSTER, ATTRSET, PMSI, Community, and Extended Community. In addition, if any of the mandatory well-known path attributes is missing, Junos OS treats the BGP update as malformed. To limit the memory usage of these malformed hidden routes, Junos OS stops installing new malformed hidden routes after the maximum number of such

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malformed hidden routes is reached. In this example, the maximum number is set to 5, using the **malformed-route-limit** statement. The default value is 1000. Optionally, you can allow an unlimited number of routes hidden due to malformed attributes. Do this by including the **no-malformed-route-limit** statement.

- For other nonfatal errors, Junos OS discards the malformed path attributes and continues to process the BGP update message. It is unsafe to use this approach on the path attributes that might affect route selection or installation. Junos OS uses this error handling approach for the cases that involve any of the following attributes: ATOMIC_AGGREGATE, AGGREGATOR, AGGREGATOR4, and AS4PATH.

To facilitate troubleshooting of malformed packets, Junos OS logs the error listing the malformed path attribute code, flag, length, information about the peer and family, and the first prefix from the malformed BGP update. Logging of the malformed packets might slow Junos OS performance if a significant number of malformed packets is received in a short time. To limit the performance impact, Junos OS implements an algorithm to log a malformed update, suppress logging for an interval, and log a summary. When the logging suppression timer expires, the software logs the total number of malformed attributes received during the interval. In this example, the timer is set to 10 seconds, using the **malformed-update-log-interval** statement. The default value is 300 seconds(5 minutes).

"CLI Quick Configuration" on page 883 shows the configuration for all of the devices in Figure 84 on page 882.

The section "Step-by-Step Procedure" on page 884 describes the steps on Device R1.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

Device R0

```
set interfaces fe-1/2/0 unit 0 description to-R1
set interfaces fe-1/2/0 unit 0 family inet address 172.16.10.5/30
set interfaces lo0 unit 0 family inet address 192.168.0.3/32
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.0.3
set protocols bgp group internal-peers export local-direct
set protocols bgp group internal-peers neighbor 192.168.0.1
set protocols ospf area 0.0.0.0 interface fe-1/2/0.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set policy-options policy-statement local-direct from protocol [local direct]
set policy-options policy-statement local-direct then accept
set routing-options autonomous-system 64510
set routing-options router-id 192.168.0.3
```

Device R1

```
set interfaces fe-1/2/1 unit 0 description to-R2
set interfaces fe-1/2/1 unit 0 family inet address 10.10.10.1/30
set interfaces fe-1/2/0 unit 0 description to-R0
```

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```
set interfaces fe-1/2/0 unit 0 family inet address 172.16.10.6/30
set interfaces lo0 unit 0 family inet address 192.168.0.1/32
set protocols bgp bgp-error-tolerance malformed-update-log-interval 10
set protocols bgp bgp-error-tolerance malformed-route-limit 5
set protocols bgp group internal-peers type internal
set protocols bgp group internal-peers local-address 192.168.0.1
set protocols bgp group internal-peers export local-direct
set protocols bgp group internal-peers neighbor 192.168.0.3
set protocols bgp group external-peers type external
set protocols bgp group external-peers export local-direct
set protocols bgp group external-peers peer-as 64511
set protocols bgp group external-peers neighbor 10.10.10.2
set protocols ospf area 0.0.0.0 interface fe-1/2/1.0
set protocols ospf area 0.0.0.0 interface fe-1/2/0.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set policy-options policy-statement local-direct from protocol [local direct]
set policy-options policy-statement local-direct then accept
set routing-options autonomous-system 64510
set routing-options router-id 192.168.0.1
```

Device R2

```
set interfaces fe-1/2/1 unit 0 description to-R1
set interfaces fe-1/2/1 unit 0 family inet address 10.10.10.2/30
set interfaces lo0 unit 0 family inet address 192.168.0.2/32
set protocols bgp group external-peers type external
set protocols bgp group external-peers export local-direct
set protocols bgp group external-peers peer-as 64510
set protocols bgp group external-peers neighbor 10.10.10.1
set protocols ospf area 0.0.0.0 interface fe-1/2/1.0
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set policy-options policy-statement local-direct from protocol [local direct]
set policy-options policy-statement local-direct then accept
set routing-options autonomous-system 64511
set routing-options router-id 192.168.10.2
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the BGP error handling:

1. Configure the router interfaces.

```
[edit interfaces]
user@R1# set fe-1/2/1 unit 0 description to-R2
user@R1# set fe-1/2/1 unit 0 family inet address 10.10.10.1/30
user@R1# set fe-1/2/0 unit 0 description to-R0
user@R1# set fe-1/2/0 unit 0 family inet address 172.16.10.6/30
user@R1# set lo0 unit 0 family inet address 192.168.0.1/32
```

2. Configure an interior gateway protocol (IGP), such as OSPF or IS-IS.

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```
[edit protocols ospf area 0.0.0.0]
user@R1# set interface fe-1/2/1.0
user@R1# set interface fe-1/2/0.0
user@R1# set interface lo0.0 passive
```

3. Configure the autonomous system (AS) number and router ID.

```
[edit routing-options]
user@R1# set autonomous-system 64510
user@R1# set router-id 192.168.0.1
```

4. Configure the routing policy.

```
[edit policy-options policy-statement local-direct]
user@R1# set from protocol [local direct]
user@R1# set then accept
```

5. Configure the EBGP session.

```
[edit protocols bgp group external-peers]
user@R1# set type external
user@R1# set export local-direct
user@R1# set peer-as 64511
user@R1# set neighbor 10.10.10.2
```

6. Configure the IBGP sessions.

```
[edit protocols bgp group internal-peers]
user@R1# set type internal
user@R1# set local-address 192.168.0.1
user@R1# set export local-direct
user@R1# set neighbor 192.168.0.3
```

7. Enable BGP error tolerance.

```
[edit protocols bgp]
user@R1# set bgp-error-tolerance
```

8. (Optional) Configure the log interval.

```
[edit protocols bgp bgp-error-tolerance]
user@R1# set malformed-update-log-interval 10
```

9. (Optional) Configure a limit for the number of hidden routes to store.

```
[edit protocols bgp bgp-error-tolerance]
user@R1# set malformed-route-limit 5
```

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Results From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show policy-options**, and **show routing-options**, commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@R1# show interfaces
fe-1/2/0 {
   unit 0 {
      description to-R0;
      family inet {
         address 172.16.10.6/30;
      }
   }
}
fe-1/2/1 {
   unit 0 {
      description to-R2;
      family inet {
         address 10.10.10.1/30;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 192.168.0.1/32;
      }
   }
}
```

```
user@R1# show protocols
bgp {
   bgp-error-tolerance {
      malformed-update-log-interval 10;
      malformed-route-limit 5;
   }
   group internal-peers {
      type internal;
      local-address 192.168.0.1;
      export local-direct;
      neighbor 192.168.0.3;
   }
   group external-peers {
      type external;
      export local-direct;
      peer-as 64511;
      neighbor 10.10.10.2;
   }
}
ospf {
   area 0.0.0.0 {
      interface fe-1/2/1.0;
      interface fe-1/2/0.0;
      interface lo0.0 {
```


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```
        passive;
      }
    }
}
```

```
user@R1# show policy-options
policy-statement local-direct {
   from protocol [local direct];
   then accept;
}
```

```
user@R1# show routing-options
router-id 192.168.0.1;
autonomous-system 64510;
```

If you are done configuring the devices, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

- Checking the BGP Neighbor Sessions on page 887
- Checking Hidden Routes on page 889
- Verifying the Source of the Hidden Routes on page 890

Checking the BGP Neighbor Sessions

Purpose Verify that BGP error tolerance is enabled, and display the counters related to malformed path attributes.

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Action

```
user@R1# show bgp neighbor
Peer: 10.10.10.2+50058 AS 64511 Local: 10.10.10.1+179 AS 64510
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ local-direct ]
  Options: <Preference PeerAS Refresh>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Malformed attributes    log interval: 10   route limit: 5
    Attribute:           ORIGIN(1) Last Received: 0 Total Received: 3
    Attribute:       LOCAL_PREF(5) Last Received: 0 Total Received: 2
  Peer ID: 192.168.10.2    Local ID: 192.168.10.1      Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  BFD: disabled, down
  Local Interface: fe-1/2/1.0
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 64511)
  Peer does not support Addpath
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              0
    Received prefixes:            3
    Accepted prefixes:            0
    Suppressed due to damping:    0
    Advertised prefixes:          2
  Last traffic (seconds): Received 25   Sent 17   Checked 73
  Input messages:  Total 2702   Updates 10      Refreshes 0     Octets 51652
  Output messages: Total 2701   Updates 6       Refreshes 0     Octets 51571
  Output Queue[0]: 0

Peer: 192.168.10.3+179 AS 64510 Local: 192.168.10.1+51127 AS 64510
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ local-direct ]
  Options: <Preference LocalAddress Refresh>
  Local Address: 192.168.10.1 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Malformed attributes    log interval: 10   route limit: 5
  Peer ID: 192.168.10.3    Local ID: 192.168.10.1      Active Holdtime: 90
  Keepalive Interval: 30         Group index: 1    Peer index: 0
  BFD: disabled, down
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
```


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```
NLRI of received end-of-rib markers: inet-unicast
NLRI of all end-of-rib markers sent: inet-unicast
Peer supports 4 byte AS extension (peer-as 64510)
Peer does not support Addpath
Table inet.0 Bit: 10001
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              0
  Received prefixes:            3
  Accepted prefixes:            0
  Suppressed due to damping:    0
  Advertised prefixes:          2
Last traffic (seconds): Received 5    Sent 24   Checked 51
Input messages:  Total 417    Updates 3       Refreshes 0     Octets 8006
Output messages: Total 421    Updates 2       Refreshes 0     Octets 8136
Output Queue[0]: 0
```

Meaning The Malformed attributes field shows that error tolerance is enabled. The log interval and route limit fields display the configured values.

The attribute counters show that on the EBGP connection, several malformed attributes were received from Device R2.

Checking Hidden Routes

Purpose View information about hidden routes and learn why they are hidden.

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Action `user@R1> show route hidden detail`

```
inet.0: 42 destinations, 45 routes (36 active, 0 holddown, 6 hidden)
10.0.0.0/32 (1 entry, 0 announced)
         BGP
                Next hop type: Router
                Address: 0x93d8b0c
                Next-hop reference count: 5
                Source: 10.10.10.2
                Next hop type: Router, Next hop index: 782
                Next hop: via fe-1/2/1.0, selected
                Session Id: 0x1
                State: <Hidden  Ext>
                Local AS:     1 Peer AS:     1
                Age: 5:32       Metric2: 1
                Validation State: unverified
                Task: BGP_1.10.10.5.62+56218
                AS path: I (MalformedAttr)
                Router ID: 192.168.0.2

10.0.0.1/32 (1 entry, 0 announced)
         BGP
                Next hop type: Router
                Address: 0x93d8b0c
                Next-hop reference count: 5
                Source: 10.10.10.2
                Next hop type: Router, Next hop index: 782
                Next hop: via fe-1/2/1.0, selected
                Session Id: 0x1
                Indirect next hop: 953c000 - INH Session ID: 0x3
                State: <Hidden Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 5:32       Metric2: 1
                Validation State: unverified
                Task: BGP_1.10.10.5.62+56218
                AS path: I (MalformedAttr)
                Router ID: 192.168.0.2
```

Meaning The malformed hidden routes are marked with MalformedAttr in the AS path field.

You can remove the hidden routes by running the clear bgp neighbor **10.10.10.2 malformed-route** command.

Verifying the Source of the Hidden Routes

Purpose View information about hidden routes and learn why they are hidden.

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Action

```
user@R1> show route receive-protocol bgp 10.10.10.2 detail hidden

inet.0: 42 destinations, 45 routes (36 active, 0 holddown, 6 hidden)
  10.0.0.0/32 (1 entry, 0 announced)
     Nexthop: 10.10.10.2
     Localpref: 100
     AS path: I (MalformedAttr)

  10.0.0.1/32 (1 entry, 0 announced)
     Nexthop: 10.10.10.2
     Localpref: 100
     AS path: I (MalformedAttr)
```

Meaning

Junos OS displays MalformedAttr in the AS path field in the output of the **show route receive-protocol bgp 10.10.10.2 detail hidden** command.

You can remove the hidden routes by running the **clear bgp neighbor 10.10.10.2 malformed-route** command.

Related Documentation

- *Example: Preventing BGP Session Resets*
- *Examples: Configuring BGP Flap Damping*

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CHAPTER 25

Configuring BGP Egress Peer Traffic Engineering

- Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute on page 893
- Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview on page 896
- Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast on page 897
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916
- Configuring Ingress Traffic Engineering with Segment Routing in a BGP Network on page 920
- Enabling Traffic Statistics Collection for BGP Labeled Unicast on page 923

Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute

Egress peer traffic engineering (TE) allows a central controller to instruct an ingress router in a domain to direct traffic towards a specific egress router and a specific external interface to reach a particular destination out of the network for optimum utilization of the advertised egress routes during load balancing.

BGP segregates the network into layers, such as transport and service layers. The BGP labeled unicasts form the transport layer, and the BGP unicast subsequent address family identifier (SAFI) add path routes form the service layer. The AS boundary router triggers the transport layer BGP labeled unicast label-switched paths (LSPs) that provide a route to the egress peers. The service layer add path routes use these egress peers as protocol next hop. The AS boundary routers optionally provide MPLS fast reroute (FRR) at the transport layer, which must be utilized because service layer peering issues are common. Therefore, you can specify one or more backup devices for the primary egress AS boundary router. Junos OS automatically installs the backup path in addition to the primary path into the MPLS forwarding table of the established egress BGP peer that has egress peer TE configured. The backup path provides FRR when the primary link fails.

1. To enable egress peer TE using BGP labeled unicast:

   Enable egress peer TE at the AS boundary router for the egress BGP peer.

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```
[edit protocols bgp group group-name neighbor address]
user@host# set egress-te
```

For example, enable egress peer TE on the egress BGP peer.

```
[edit protocols bgp group Peer1-lan-1 neighbor 200.200.201.1]
user@host# set egress-te
```

2. To enable FRR for the egress traffic on BGP labeled unicast LSP:

   a. Define a template with backup paths on the egress BGP peer to enable MPLS fast reroute.

      You can define more than one template and several BGP groups, or peers can use the same defined template. All addresses listed in one template must belong to the same IP address family as the egress BGP peer.

      ```
      [edit protocols bgp ]
      user@host# set egress-te-backup-paths template backup-path
      ```

      For example, define a backup path template to enable MPLS fast reroute.

      ```
      [edit protocols bgp ]
      user@host# set egress-te-backup-paths template Customer1
      ```

   b. Configure another directly connected external BGP peer as a backup path.

      ```
      [edit protocols bgp egress-te-backup-paths template backup-path]
      user@host# set peer peer-addr
      ```

      For example, configure the peer backup path for the defined template *customer1*.

      ```
      [edit protocols bgp egress-te-backup-paths template customer1]
      user@host# set peer 200.200.0.1
      ```

   c. Configure IP forwarding on the AS boundary router as the fast reroute backup path.

      Junos OS looks up the backup path in the **inet6.0** table.

      You can specify the routing instance for which you are configuring backup paths on the egress BGP peer. If you do not specify a routing instance, the device configures the backup path for the master instance. Optionally, you can configure a foo routing instance as the **ip-forward** backup option.

      You cannot use this option with the **remote-nexthop** option.

      ```
      [edit protocols bgp egress-te-backup-paths template backup-path]
      user@host# set ip-forward rti-name
      ```

      For example, configure ip forwarding instance foo for the defined template *customer1*.

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```
[edit protocols bgp egress-te-backup-paths template customer1]
user@host# set ip-forward foo
```

Junos OS looks up the backup path in the **foo.inet6.0** table.

d. Specify a remote next-hop address as the backup path for the egress BGP peer.

The egress peer TE AS boundary router tunnels the traffic to this remote next-hop address.

```
[edit protocols bgp egress-te-backup-paths template backup-path]
user@host# set remote-nexthop remote-nh-addr
```

For example, if you want to configure a remote next hop for the defined template *customer1*, enter:

```
[edit protocols bgp egress-te-backup-paths template customer1]
user@host# set remote-nexthop 100.100.0.1
```

e. Specify the defined template at a BGP group or neighbor level.

```
[edit protocols bgp group group-name neighbor address]
user@host# set egress-te
user@host# set backup-path backup-path
```

For example, specify the template *customer1* defined previously as the backup-path for BGP neighbor 200.200.201.1.

```
[edit protocols bgp group Peer1-lan-1 neighbor 200.200.201.1]
user@host# set egress-te
user@host# set backup-path customer1
```

Related Documentation

- Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview on page 896
- Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast on page 897
- egress-te on page 1150
- egress-te-backup-paths on page 1153

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Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview

In a data center environment, which mimics an ISP BGP-free core, the ingress nodes tunnel the service traffic to an egress router that is also the AS boundary router. Egress peer traffic engineering allows a central controller to instruct an ingress router in a domain to direct the traffic towards a specific egress router and a specific external interface to reach a particular destination out of the network. Egress peer traffic engineering allows for the selection of the best advertised egress route and mapping of the selected best route to a specific egress point. In case of load balancing at the ingress, this feature ensures optimum utilization of the advertised egress routes.

The ingress router controls the egress peer selection by pushing the corresponding MPLS label on an MPLS label stack for traffic engineering the links between ASs. AS boundary routers automatically install the IPv4 or IPv6 peer /32 or /128 route to an established external BGP peer that is configured with the egress traffic engineering feature into the **inet.3** forwarding table. These routes have a forwarding action of pop and forward, that is, remove the label, and forward the packet to the external BGP peer.

AS boundary routers advertise the IPv4 or IPv6 peer /32 or/128 route to the ingress BGP peers with self IPv4 next hop. Ingress BGP peers have a transport tunnel, such as MPLS LDP to reach the AS boundary router. Thus, all the network exit points are advertised to the MPLS network cloud as labeled BGP routes. The AS boundary routers advertise service routes with these exit points as protocol next hops. The AS boundary routers readvertise the service routes from the external BGP peers towards the core without altering the next-hop addresses. However, the ingress routers resolve the protocol next hop in the service routes to map to the correct transport tunnel to the egress peer interface. Thus, the ingress routers map traffic for a specific service prefix to a specific egress router or load-balance the traffic across available egress devices. This feature allows the ingress router to direct the service traffic towards a specific egress peer.

In addition to egress peer traffic engineering, this feature provides MPLS fast reroute (FRR) for each egress device it advertises to the MPLS IPv4 network cloud. You can configure one or more backup devices for the primary egress AS boundary router. Junos OS automatically installs the backup path in addition to the primary path into the MPLS forwarding table of the established egress BGP peer that has egress peer traffic engineering configured. The AS boundary router switches to the backup path when the primary link fails and provides MPLS FRR . The specified backup path is through another directly connected external BGP peer or a remote next hop. You can also configure a backup path using ip lookup in an **inet6.0** table. However, the **remote-nexthop** and **ip-forward** backup options are mutually exclusive.

Related Documentation

- Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute on page 893
- Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast on page 897
- egress-te on page 1150
- egress-te-backup-paths on page 1153

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Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast

This example shows how to configure egress peer traffic engineering using BGP labeled unicast. Egress peer traffic engineering allows a central controller to instruct an ingress router in a domain to direct traffic towards a specific egress router and a specific external interface to reach a particular destination out of the network. In case of load balancing at the ingress, this feature ensures optimum utilization of the advertised egress routes.

- Requirements on page 897
- Overview on page 897
- Configuration on page 898
- Verification on page 913

Requirements

This example uses the following hardware and software components:

- Nine MX Series routers
- Junos OS Release 14.2R4 or later

Overview

Beginning with Junos OS Release 14.2R4, you can enable traffic engineering (TE) of service traffic, such as MPLS LSP traffic between autonomous systems (ASs) using BGP labeled unicast for optimum utilization of the advertised egress routes during load balancing.

Configure egress peer TE to direct core service traffic such as MPLS RSVP to a specific egress BGP peer. The ingress BGP peer can traffic-engineer the core inet unicast and inet6 unicast service traffic using BGP labeled unicast towards a specific egress BGP peer.

NOTE: You cannot configure egress peer TE for external BGP multihop peers. The ARP routes in inet.3 are installed for peer /32 and /128 routes only.

Topology

Figure 85 on page 898 shows the sample topology. Router R3 and Router R4 are the AS boundary routers. Egress peer TE is enabled on R3. The ingress Router R0 directs traffic destined to a remote network to Router R3, which has egress peer TE enabled.

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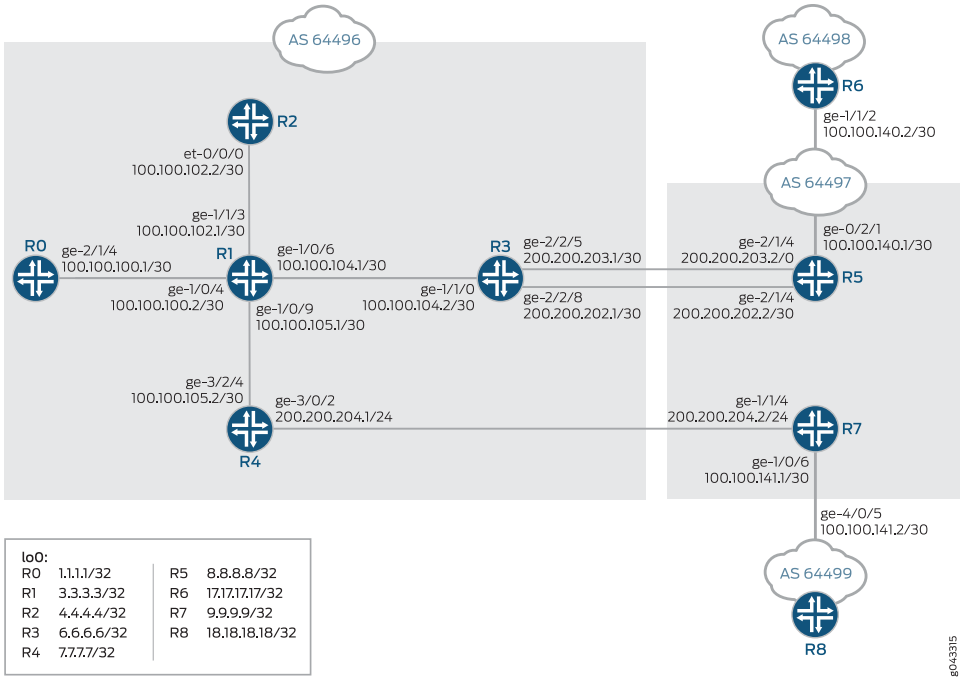
Figure 85: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast



Configuration

- Configuring Router R3 on page 906
- Results on page 909

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, copy and paste the commands into the CLI at the **[edit]** hierarchy level, and then enter **commit** from configuration mode.

Router R0

```
set interfaces ge-2/0/1 unit 0 family inet address 40.1.1.1/24
set interfaces ge-2/0/1 unit 0 family inet6 address 40::1/120
set interfaces ge-2/1/4 unit 0 family inet address 100.100.100.1/30
set interfaces ge-2/1/4 unit 0 family inet6 address ::100.100.100.1/126
set interfaces ge-2/1/4 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 1.1.1.1/32
set interfaces lo0 unit 0 family inet6 address ::1.1.1.1/128
set routing-options router-id 1.1.1.1
set routing-options autonomous-system 64496
set protocols rsvp interface all
set protocols rsvp interface fxp0.0 disable
set protocols mpls ipv6-tunneling
set protocols mpls no-cspf
set protocols mpls label-switched-path to_asbr1_r3 to 6.6.6.6
set protocols mpls label-switched-path to_asbr2_r4 to 7.7.7.7
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
```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```
set protocols bgp group RR-1-2 type internal
set protocols bgp group RR-1-2 local-address 1.1.1.1
set protocols bgp group RR-1-2 family inet unicast add-path receive
set protocols bgp group RR-1-2 family inet unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet labeled-unicast rib inet.3
set protocols bgp group RR-1-2 family inet6 unicast add-path receive
set protocols bgp group RR-1-2 family inet6 unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet6 labeled-unicast rib inet6.3
set protocols bgp group RR-1-2 export exp-svr-pre
set protocols bgp group RR-1-2 export nhs
set protocols bgp group RR-1-2 neighbor 4.4.4.4
set protocols bgp group R0RT0 type external
set protocols bgp group R0RT0 family inet unicast
set protocols bgp group R0RT0 peer-as 64496
set protocols bgp group R0RT0 neighbor 40.1.1.2
set protocols bgp group R0RT0-v6 type external
set protocols bgp group R0RT0-v6 family inet6 unicast
set protocols bgp group R0RT0-v6 peer-as 64496
set protocols bgp group R0RT0-v6 neighbor 40::2
set protocols ospf area 0.0.0.0 interface ge-2/1/4.0
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options prefix-list server_v4_prefix 1.1.1.1/32
set policy-options prefix-list server_v6_prefix ::1.1.1.1/128
set policy-options policy-statement exp-svr-pre term 1 from prefix-list server_v4_prefix
set policy-options policy-statement exp-svr-pre term 1 then accept
set policy-options policy-statement exp-svr-pre term 2 from prefix-list server_v6_prefix
set policy-options policy-statement exp-svr-pre term 2 then accept
set policy-options policy-statement nhs then next-hop self
```

Router R1

```
set interfaces ge-1/0/4 unit 0 family inet address 100.100.100.2/30
set interfaces ge-1/0/4 unit 0 family inet6 address ::100.100.100.2/126
set interfaces ge-1/0/4 unit 0 family mpls
set interfaces ge-1/0/6 unit 0 family inet address 100.100.104.1/30
set interfaces ge-1/0/6 unit 0 family inet6 address ::100.100.104.1/126
set interfaces ge-1/0/6 unit 0 family mpls
set interfaces ge-1/0/9 unit 0 family inet address 100.100.105.1/30
set interfaces ge-1/0/9 unit 0 family inet6 address ::100.100.105.1/126
set interfaces ge-1/0/9 unit 0 family mpls
set interfaces ge-1/1/3 unit 0 family inet address 100.100.102.1/30
set interfaces ge-1/1/3 unit 0 family inet6 address ::100.100.102.1/126
set interfaces ge-1/1/3 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 3.3.3.3/32
set interfaces lo0 unit 0 family inet6 address ::3.3.3.3/128
set routing-options router-id 3.3.3.3
set routing-options autonomous-system 64496
set protocols rsvp interface all
set protocols rsvp interface fxp0.0 disable
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
```

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```
set protocols ospf area 0.0.0.0 interface all
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
```

Router R2

```
set interfaces et-0/0/0 unit 0 family inet address 100.100.102.2/30
set interfaces et-0/0/0 unit 0 family inet6 address ::100.100.102.2/126
set interfaces et-0/0/0 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 4.4.4.4/32
set interfaces lo0 unit 0 family inet6 address ::4.4.4.4/128
set routing-options router-id 4.4.4.4
set routing-options autonomous-system 64496
set protocols rsvp interface all
set protocols rsvp interface fxp0.0 disable
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group Client type internal
set protocols bgp group Client local-address 4.4.4.4
set protocols bgp group Client advertise-inactive
set protocols bgp group Client family inet unicast add-path receive
set protocols bgp group Client family inet unicast add-path send path-count 6
set protocols bgp group Client family inet labeled-unicast rib inet.3
set protocols bgp group Client family inet6 unicast add-path receive
set protocols bgp group Client family inet6 unicast add-path send path-count 6
set protocols bgp group Client family inet6 labeled-unicast rib inet6.3
set protocols bgp group Client cluster 4.4.4.4
set protocols bgp group Client neighbor 1.1.1.1
set protocols bgp group Client neighbor 6.6.6.6
set protocols bgp group Client neighbor 7.7.7.7
set protocols ospf area 0.0.0.0 interface et-0/0/0.0
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
```

Router R3

```
set interfaces ge-1/1/0 unit 0 family inet address 100.100.104.2/30
set interfaces ge-1/1/0 unit 0 family inet6 address ::100.100.104.2/126
set interfaces ge-1/1/0 unit 0 family mpls
set interfaces ge-2/2/5 unit 0 family inet address 200.200.203.1/28
set interfaces ge-2/2/5 unit 0 family inet6 address ::200.200.203.1/124
set interfaces ge-2/2/8 unit 0 family inet address 200.200.202.1/30
set interfaces ge-2/2/8 unit 0 family inet6 address ::200.200.202.1/126
set interfaces lo0 unit 0 family inet address 6.6.6.6/32
set interfaces lo0 unit 0 family inet6 address ::6.6.6.6/128
set routing-options router-id 6.6.6.6
set routing-options autonomous-system 64496
set routing-options forwarding-table export pplb
set protocols rsvp interface all
set protocols rsvp interface fxp0.0 disable
set protocols mpls ipv6-tunneling
```


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```
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp log-updown
set protocols bgp group RR-1-2 type internal
set protocols bgp group RR-1-2 local-address 6.6.6.6
set protocols bgp group RR-1-2 family inet unicast add-path receive
set protocols bgp group RR-1-2 family inet unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet labeled-unicast rib inet.3
set protocols bgp group RR-1-2 family inet6 unicast add-path receive
set protocols bgp group RR-1-2 family inet6 unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet6 labeled-unicast rib inet6.3
set protocols bgp group RR-1-2 export exp-arp-to-rrs
set protocols bgp group RR-1-2 neighbor 4.4.4.4
set protocols bgp group Peer1-lan-1 type external
set protocols bgp group Peer1-lan-1 family inet unicast
set protocols bgp group Peer1-lan-1 export exp_server_v4_v6_peers
set protocols bgp group Peer1-lan-1 peer-as 64497
set protocols bgp group Peer1-lan-1 neighbor 200.200.202.2 egress-te
set protocols bgp group Peer1-lan-1 neighbor 200.200.203.2 egress-te
set protocols bgp group Peer1-lan-1-v6 family inet6 unicast
set protocols bgp group Peer1-lan-1-v6 export exp_server_v4_v6_peers
set protocols bgp group Peer1-lan-1-v6 peer-as 64497
set protocols bgp group Peer1-lan-1-v6 neighbor ::200.200.202.2 egress-te
set protocols bgp group Peer1-lan-1-v6 neighbor ::200.200.203.2 egress-te
set protocols ospf area 0.0.0.0 interface ge-1/1/0.0
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options prefix-list server_v4_pre 1.1.1.1/32
set policy-options prefix-list server_v6_pre ::1.1.1.1/128
set policy-options policy-statement exp-arp-to-rrs term 1 from protocol arp
set policy-options policy-statement exp-arp-to-rrs term 1 from rib inet.3
set policy-options policy-statement exp-arp-to-rrs term 1 then next-hop self
set policy-options policy-statement exp-arp-to-rrs term 1 then accept
set policy-options policy-statement exp-arp-to-rrs term 2 from protocol arp
set policy-options policy-statement exp-arp-to-rrs term 2 from rib inet6.3
set policy-options policy-statement exp-arp-to-rrs term 2 then next-hop self
set policy-options policy-statement exp-arp-to-rrs term 2 then accept
set policy-options policy-statement exp-arp-to-rrs term 3 from protocol bgp
set policy-options policy-statement exp-arp-to-rrs term 3 then accept
set policy-options policy-statement exp-arp-to-rrs term 4 then reject
set policy-options policy-statement exp_server_v4_v6_peers term 1 from prefix-list
  server_v4_pre
set policy-options policy-statement exp_server_v4_v6_peers term 1 then accept
set policy-options policy-statement exp_server_v4_v6_peers term 2 from prefix-list
  server_v6_pre
set policy-options policy-statement exp_server_v4_v6_peers term 2 then accept
set policy-options policy-statement pplb then load-balance per-packet
```

Router R4

```
set interfaces ge-3/0/2 vlan-tagging
set interfaces ge-3/0/2 unit 0 vlan-id 1
set interfaces ge-3/0/2 unit 0 family inet address 200.200.204.1/24
```

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```
set interfaces ge-3/0/2 unit 0 family inet6 address ::200.200.204.1/120
set interfaces ge-3/0/2 unit 0 family mpls
set interfaces ge-3/0/2 unit 1 vlan-id 2
set interfaces ge-3/2/4 unit 0 family inet address 100.100.105.2/30
set interfaces ge-3/2/4 unit 0 family inet6 address ::100.100.105.2/126
set interfaces ge-3/2/4 unit 0 family mpls
set interfaces lo0 unit 0 family inet address 7.7.7.7/32
set interfaces lo0 unit 0 family inet6 address ::7.7.7.7/128
set routing-options router-id 7.7.7.7
set routing-options autonomous-system 64496
set routing-options forwarding-table export pplb
set protocols rsvp interface all
set protocols rsvp interface fxp0.0 disable
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols mpls interface fxp0.0 disable
set protocols bgp group RR-1-2 type internal
set protocols bgp group RR-1-2 local-address 7.7.7.7
set protocols bgp group RR-1-2 family inet unicast add-path receive
set protocols bgp group RR-1-2 family inet unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet labeled-unicast rib inet.3
set protocols bgp group RR-1-2 family inet6 unicast add-path receive
set protocols bgp group RR-1-2 family inet6 unicast add-path send path-count 6
set protocols bgp group RR-1-2 family inet6 labeled-unicast rib inet6.3
set protocols bgp group RR-1-2 export exp-arp-to-rrs
set protocols bgp group RR-1-2 neighbor 4.4.4.4
set protocols bgp group Peer5-6-lan type external
set protocols bgp group Peer5-6-lan family inet unicast
set protocols bgp group Peer5-6-lan export exp_server_v4_v6_peers
set protocols bgp group Peer5-6-lan peer-as 64497
set protocols bgp group Peer5-6-lan-v6 type external
set protocols bgp group Peer5-6-lan-v6 family inet6 unicast
set protocols bgp group Peer5-6-lan-v6 export exp_server_v4_v6_peers
set protocols bgp group Peer5-6-lan-v6 peer-as 64497
set protocols ospf area 0.0.0.0 interface ge-3/2/4.0
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0 passive
set protocols ldp interface all
set protocols ldp interface fxp0.0 disable
set policy-options prefix-list server_v4_pre 1.1.1.1/32
set policy-options prefix-list server_v6_pre ::1.1.1.1/128
set policy-options policy-statement exp-arp-to-rrs term 1 from protocol arp
set policy-options policy-statement exp-arp-to-rrs term 1 from rib inet.3
set policy-options policy-statement exp-arp-to-rrs term 1 then next-hop self
set policy-options policy-statement exp-arp-to-rrs term 1 then accept
set policy-options policy-statement exp-arp-to-rrs term 2 from protocol arp
set policy-options policy-statement exp-arp-to-rrs term 2 from rib inet6.3
set policy-options policy-statement exp-arp-to-rrs term 2 then next-hop self
set policy-options policy-statement exp-arp-to-rrs term 2 then accept
set policy-options policy-statement exp-arp-to-rrs term 3 from protocol bgp
set policy-options policy-statement exp-arp-to-rrs term 3 then accept
set policy-options policy-statement exp-arp-to-rrs term 4 then reject
set policy-options policy-statement exp_server_v4_v6_peers term 1 from prefix-list
  server_v4_pre
set policy-options policy-statement exp_server_v4_v6_peers term 1 then accept
```


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```
set policy-options policy-statement exp_server_v4_v6_peers term 2 from prefix-list
  server_v6_pre
set policy-options policy-statement exp_server_v4_v6_peers term 2 then accept
set policy-options policy-statement pplb then load-balance per-packet
```

Router R5

```
set interfaces ge-0/2/1 unit 0 family inet address 100.100.140.1/30
set interfaces ge-0/2/1 unit 0 family inet6 address ::100.100.140.1/126
set interfaces ge-0/3/1 unit 0 family inet address 200.200.203.2/28
set interfaces ge-0/3/1 unit 0 family inet6 address ::200.200.203.2/124
set interfaces ge-0/3/4 unit 0 family inet address 200.200.202.2/30
set interfaces ge-0/3/4 unit 0 family inet6 address ::200.200.202.2/126
set interfaces lo0 unit 0 family inet address 8.8.8.8/32
set interfaces lo0 unit 0 family inet6 address ::8.8.8.8/128
set routing-options router-id 8.8.8.8
set routing-options autonomous-system 64497
set protocols bgp group Peer1-lan-1 type external
set protocols bgp group Peer1-lan-1 family inet unicast
set protocols bgp group Peer1-lan-1 export exp-lo0
set protocols bgp group Peer1-lan-1 peer-as 64497
set protocols bgp group Peer1-lan-1 neighbor 200.200.202.1
set protocols bgp group Peer1-lan-1 neighbor 200.200.203.1
set protocols bgp group Peer1-lan-1-v6 family inet6 unicast
set protocols bgp group Peer1-lan-1-v6 export exp-lo0
set protocols bgp group Peer1-lan-1-v6 peer-as 64497
set protocols bgp group Peer1-lan-1-v6 neighbor ::200.200.202.1
set protocols bgp group Peer1-lan-1-v6 neighbor ::200.200.203.1
set protocols bgp group Peer1-H1 type external
set protocols bgp group Peer1-H1 family inet unicast
set protocols bgp group Peer1-H1 neighbor 100.100.140.2 peer-as 64498
set protocols bgp group Peer1-H1-v6 type external
set protocols bgp group Peer1-H1-v6 family inet6 unicast
set protocols bgp group Peer1-H1-v6 neighbor ::100.100.140.2 peer-as 64498
set policy-options policy-statement exp-lo0 term 1 from interface lo0.0
set policy-options policy-statement exp-lo0 term 1 then accept
```

Router R6

```
set interfaces ge-1/1/2 unit 0 family inet address 100.100.140.2/30
set interfaces ge-1/1/2 unit 0 family inet6 address ::100.100.140.2/126
set interfaces ge-1/1/5 unit 0 family inet address 50.1.1.1/24
set interfaces ge-1/1/5 unit 0 family inet6 address 50::1/120
set interfaces lo0 unit 0 family inet address 17.17.17.1/32
set interfaces lo0 unit 0 family inet address 17.17.17.2/32
set interfaces lo0 unit 0 family inet address 17.17.17.3/32
set interfaces lo0 unit 0 family inet address 17.17.17.4/32
set interfaces lo0 unit 0 family inet address 17.17.17.5/32
set interfaces lo0 unit 0 family inet address 17.17.17.6/32
set interfaces lo0 unit 0 family inet address 17.17.17.7/32
set interfaces lo0 unit 0 family inet address 17.17.17.8/32
set interfaces lo0 unit 0 family inet address 17.17.17.9/32
set interfaces lo0 unit 0 family inet6 address ::17.17.17.1/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.2/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.3/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.4/128
```

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```
set interfaces lo0 unit 0 family inet6 address ::17.17.17.5/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.6/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.7/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.8/128
set interfaces lo0 unit 0 family inet6 address ::17.17.17.9/128
set routing-options router-id 17.17.17.1
set routing-options autonomous-system 64498
set protocols bgp group H1-Peer1 type external
set protocols bgp group H1-Peer1 family inet unicast
set protocols bgp group H1-Peer1 export exp-lo0
set protocols bgp group H1-Peer1 neighbor 100.100.140.1 peer-as 64497
set protocols bgp group H1-Peer1-v6 type external
set protocols bgp group H1-Peer1-v6 family inet6 unicast
set protocols bgp group H1-Peer1-v6 export exp-lo0
set protocols bgp group H1-Peer1-v6 neighbor ::100.100.140.1 peer-as 64497
set protocols bgp group R6RT0 type external
set protocols bgp group R6RT0 family inet unicast
set protocols bgp group R6RT0 peer-as 300
set protocols bgp group R6RT0 neighbor 50.1.1.2
set protocols bgp group R6RT0-v6 type external
set protocols bgp group R6RT0-v6 family inet6 unicast
set protocols bgp group R6RT0-v6 peer-as 300
set protocols bgp group R6RT0-v6 neighbor 50::2
set policy-options policy-statement exp-lo0 term 1 from interface lo0.0
set policy-options policy-statement exp-lo0 term 1 then accept
set policy-options policy-statement exp-lo0 term 2 from protocol direct
set policy-options policy-statement exp-lo0 term 2 from protocol local
set policy-options policy-statement exp-lo0 term 2 then accept
```

Router R7

```
set interfaces ge-1/0/6 unit 0 family inet address 100.100.141.1/30
set interfaces ge-1/0/6 unit 0 family inet6 address ::100.100.141.1/126
set interfaces ge-1/1/4 vlan-tagging
set interfaces ge-1/1/4 unit 0 vlan-id 1
set interfaces ge-1/1/4 unit 0 family inet address 200.200.204.2/24
set interfaces ge-1/1/4 unit 0 family inet6 address ::200.200.204.2/120
set interfaces ge-1/1/4 unit 1 vlan-id 2
set interfaces ge-1/1/4 unit 2 vlan-id 3
set interfaces lo0 unit 0 family inet address 9.9.9.9/32
set interfaces lo0 unit 0 family inet6 address ::9.9.9.9/128
set routing-options router-id 9.9.9.9
set routing-options autonomous-system 64497
set protocols bgp group Peer1-lan-1 type external
set protocols bgp group Peer1-lan-1 family inet unicast
set protocols bgp group Peer1-lan-1 export exp-lo0
set protocols bgp group Peer1-lan-1 peer-as 64497
set protocols bgp group Peer1-lan-1 neighbor 200.200.204.1
set protocols bgp group Peer1-lan-1-v6 family inet6 unicast
set protocols bgp group Peer1-lan-1-v6 export exp-lo0
set protocols bgp group Peer1-lan-1-v6 peer-as 64497
set protocols bgp group Peer1-lan-1-v6 neighbor ::200.200.204.1
set protocols bgp group Peer2-H2 type external
set protocols bgp group Peer2-H2 family inet unicast
set protocols bgp group Peer2-H2 neighbor 100.100.141.2 peer-as 64499
```


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```
set protocols bgp group Peer2-H2-v6 type external
set protocols bgp group Peer2-H2-v6 family inet6 unicast
set protocols bgp group Peer2-H2-v6 neighbor ::100.100.141.2 peer-as 64499
set policy-options policy-statement exp-lo0 term 1 from interface lo0.0
set policy-options policy-statement exp-lo0 term 1 then accept
```

Router R8

```
set interfaces ge-4/0/5 unit 0 family inet address 100.100.141.2/30
set interfaces ge-4/0/5 unit 0 family inet6 address ::100.100.141.2/126
set interfaces lo0 unit 0 family inet address 18.18.18.1/32
set interfaces lo0 unit 0 family inet address 18.18.18.2/32
set interfaces lo0 unit 0 family inet address 18.18.18.3/32
set interfaces lo0 unit 0 family inet address 18.18.18.4/32
set interfaces lo0 unit 0 family inet address 18.18.18.5/32
set interfaces lo0 unit 0 family inet address 18.18.18.6/32
set interfaces lo0 unit 0 family inet address 18.18.18.7/32
set interfaces lo0 unit 0 family inet address 18.18.18.8/32
set interfaces lo0 unit 0 family inet address 18.18.18.9/32
set interfaces lo0 unit 0 family inet6 address ::18.18.18.1/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.2/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.3/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.4/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.5/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.6/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.7/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.8/128
set interfaces lo0 unit 0 family inet6 address ::18.18.18.9/128
set routing-options router-id 18.18.18.1
set routing-options autonomous-system 64499
set protocols bgp group H2-Peer2 type external
set protocols bgp group H2-Peer2 family inet unicast
set protocols bgp group H2-Peer2 export exp-lo0
set protocols bgp group H2-Peer2 neighbor 100.100.141.1 peer-as 64497
set protocols bgp group H2-Peer2-v6 type external
set protocols bgp group H2-Peer2-v6 family inet6 unicast
set protocols bgp group H2-Peer2-v6 export exp-lo0
set protocols bgp group H2-Peer2-v6 neighbor ::100.100.141.1 peer-as 64497
set protocols bgp group R8RT0 type external
set protocols bgp group R8RT0 family inet unicast
set protocols bgp group R8RT0 peer-as 400
set protocols bgp group R8RT0 neighbor 60.1.1.2
set policy-options policy-statement exp-lo0 term 1 from interface lo0.0
set policy-options policy-statement exp-lo0 term 1 then accept
set policy-options policy-statement exp-lo0 term 2 then reject
```

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Configuring Router R3

Step-by-Step Procedure

The following example requires that you navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure Router R3:

NOTE: Repeat this procedure for other routers after modifying the appropriate interface names, addresses, and other parameters.

1. Configure the interfaces with IPv4 and IPv6 addresses.

```
[edit interfaces]
user@R3# set ge-1/1/0 unit 0 family inet address 100.100.104.2/30
user@R3# set ge-1/1/0 unit 0 family inet6 address ::100.100.104.2/126
user@R3# set ge-1/1/0 unit 0 family mpls

user@R3# set ge-2/2/5 unit 0 family inet address 200.200.203.1/28
user@R3# set ge-2/2/5 unit 0 family inet6 address ::200.200.203.1/124

user@R3# set ge-2/2/8 unit 0 family inet address 200.200.202.1/30
user@R3# set ge-2/2/8 unit 0 family inet6 address ::200.200.202.1/126
```

2. Configure the loopback addresses.

```
[edit interfaces]
user@R3# set lo0 unit 0 family inet address 6.6.6.6/32
user@R3# set lo0 unit 0 family inet6 address ::6.6.6.6/128
```

3. Configure the router ID and autonomous system (AS) number.

```
[edit routing-options]
user@R3# set router-id 6.6.6.6
user@R3# set autonomous-system 64496
```

4. Configure the RSVP protocol for all interfaces except the management interface.

```
[edit protocols]
user@R3# set rsvp interface all
user@R3# set rsvp interface fxp0.0 disable
```

5. Configure the MPLS protocol for all interfaces except the management interface.

```
[edit protocols]
```


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```
user@R3# set mpls ipv6-tunneling
user@R3# set mpls interface all
user@R3# set mpls interface fxp0.0 disable
```

6. Configure IBGP peering sessions on the core-facing interface.

```
[edit protocols]
user@R3# set bgp log-updown
user@R3# set bgp group RR-1-2 type internal
user@R3# set bgp group RR-1-2 local-address 6.6.6.6
user@R3# set bgp group RR-1-2 family inet unicast add-path receive
user@R3# set bgp group RR-1-2 family inet unicast add-path send path-count 6
user@R3# set bgp group RR-1-2 family inet labeled-unicast rib inet.3
user@R3# set bgp group RR-1-2 family inet6 unicast add-path receive
user@R3# set bgp group RR-1-2 family inet6 unicast add-path send path-count 6
user@R3# set bgp group RR-1-2 family inet6 labeled-unicast rib inet6.3
user@R3# set bgp group RR-1-2 neighbor 4.4.4.4
```

7. Configure EBGP peering sessions on interfaces facing external edge routers.

```
[edit protocols]
user@R3# set bgp group Peer1-lan-1 type external
user@R3# set bgp group Peer1-lan-1 family inet unicast
user@R3# set bgp group Peer1-lan-1 peer-as 64497
user@R3# set bgp group Peer1-lan-1-v6 family inet6 unicast
user@R3# set bgp group Peer1-lan-1-v6 peer-as 64497
```

8. Enable egress peer traffic engineering for external BGP group Peer1-lan-1 and for the IPv6 group Peer1-lan-1-v6.

```
[edit protocols]
user@R3# set bgp group Peer1-lan-1 neighbor 200.200.202.2 egress-te
user@R3# set bgp group Peer1-lan-1 neighbor 200.200.203.2 egress-te
user@R3# set bgp group Peer1-lan-1-v6 neighbor ::200.200.202.2 egress-te
user@R3# set bgp group Peer1-lan-1-v6 neighbor ::200.200.203.2 egress-te
```

9. Configure the OSPF protocol as the IGP.

```
[edit protocols]
user@R3# set ospf area 0.0.0.0 interface ge-1/1/0.0
user@R3# set ospf area 0.0.0.0 interface fxp0.0 disable
user@R3# set ospf area 0.0.0.0 interface lo0.0 passive
user@R3# set ldp interface all
user@R3# set ldp interface fxp0.0 disable
```

10. Define a policy for exporting ARP routes to route reflectors.

```
[edit policy-options]
user@R3# set policy-statement exp-arp-to-rrs term 1 from protocol arp
```

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```
user@R3# set policy-statement exp-arp-to-rrs term 1 from rib inet.3
user@R3# set policy-statement exp-arp-to-rrs term 1 then next-hop self
user@R3# set policy-statement exp-arp-to-rrs term 1 then accept
user@R3# set policy-statement exp-arp-to-rrs term 2 from protocol arp
user@R3# set policy-statement exp-arp-to-rrs term 2 from rib inet6.3
user@R3# set policy-statement exp-arp-to-rrs term 2 then next-hop self
user@R3# set policy-statement exp-arp-to-rrs term 2 then accept
user@R3# set policy-statement exp-arp-to-rrs term 3 from protocol bgp
user@R3# set policy-statement exp-arp-to-rrs term 3 then accept
user@R3# set policy-statement exp-arp-to-rrs term 4 then reject
```

11. Apply the policy exp-arp-to-rrs for exporting ARP routes to route reflectors to the external BGP group, ebgp-v6.

```
[edit protocols]
user@R3# set bgp group RR-1-2 export exp-arp-to-rrs
```

12. Define prefix lists with IPv4 and IPv6 routes.

```
[edit policy-options]
user@R3# set prefix-list server_v4_pre 1.1.1.1/32
user@R3# set prefix-list server_v6_pre ::1.1.1.1/128
```

13. Define a policy to export IPv4 and IPv6 routes to the server.

```
[edit policy-options]
user@R3# set policy-statement exp_server_v4_v6_peers term 1 from prefix-list
   server_v4_pre
user@R3# set policy-statement exp_server_v4_v6_peers term 1 then accept
user@R3# set policy-statement exp_server_v4_v6_peers term 2 from prefix-list
   server_v6_pre
user@R3# set policy-statement exp_server_v4_v6_peers term 2 then accept
```

14. Apply the policy to export IPv4 and IPv6 peer routes.

```
[edit protocols]
user@R3# set bgp group Peer1-lan-1 export exp_server_v4_v6_peers
user@R3# set bgp group Peer1-lan-1-v6 export exp_server_v4_v6_peers
```

15. Define a per-packet load-balancing policy.

```
[edit policy-options]
user@R3# set policy-statement pplb then load-balance per-packet
```

16. Apply the per-packet load-balancing policy.

```
[edit routing-options]
user@R3# set forwarding-table export pplb
```


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Results

From configuration mode, confirm your configuration by entering the **show interfaces**, **show protocols**, **show routing-options**, and **show policy-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
[edit]
user@R3# show interfaces
ge-1/1/0 {
   unit 0 {
      family inet {
         address 100.100.104.2/30;
      }
      family inet6 {
         address ::100.100.104.2/126;
      }
      family mpls;
   }
}
ge-2/2/5 {
   unit 0 {
      family inet {
         address 200.200.203.1/28;
      }
      family inet6 {
         address ::200.200.203.1/124;
      }
   }
}
ge-2/2/8 {
   unit 0 {
      family inet {
         address 200.200.202.1/30;
      }
      family inet6 {
         address ::200.200.202.1/126;
      }
   }
}
lo0 {
   unit 0 {
      family inet {
         address 6.6.6.6/32;
      }
      family inet6 {
         address ::6.6.6.6/128;
      }
   }
}
```

```
[edit]
user@R3# show protocols
```

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```
rsvp {
    interface all;
    interface fxp0.0 {
        disable;
    }
}
mpls {
    ipv6-tunneling;
    interface all;
    interface fxp0.0 {
        disable;
    }
}
bgp {
    log-updown;
    group RR-1-2 {
        type internal;
        local-address 6.6.6.6;
        family inet {
            unicast {
                add-path {
                    receive;
                    send {
                        path-count 6;
                    }
                }
            }
            labeled-unicast {
                rib {
                    inet.3;
                }
            }
        }
        family inet6 {
            unicast {
                add-path {
                    receive;
                    send {
                        path-count 6;
                    }
                }
            }
            labeled-unicast {
                rib {
                    inet6.3;
                }
            }
        }
        export exp-arp-to-rrs;
        neighbor 4.4.4.4;
    }
    group Peer1-lan-1 {
        type external;
        family inet {
            unicast;
```


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```
    }
    export exp_server_v4_v6_peers;
    peer-as 64497;
    neighbor 200.200.202.2 {
      egress-te;
    }
    neighbor 200.200.203.2 {
      egress-te;
    }
  }
  group Peer1-lan-1-v6 {
    family inet6 {
      unicast;
    }
    export exp_server_v4_v6_peers;
    peer-as 64497;
    neighbor ::200.200.202.2 {
      egress-te;
    }
    neighbor ::200.200.203.2 {
      egress-te;
    }
  }
}
ospf {
  area 0.0.0.0 {
    interface ge-1/1/0.0;
    interface fxp0.0 {
      disable;
    }
    interface lo0.0 {
      passive;
    }
  }
}
ldp {
  interface all;
  interface fxp0.0 {
    disable;
  }
}
```

```
[edit]
user@R3# show routing-options
router-id 6.6.6.6;
autonomous-system 64496;
  forwarding-table {
    export pplb;
  }
```

```
[edit]
user@R3# show policy-options
  prefix-list server_v4_pre {
    1.1.1.1/32;
```

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```
    }
    prefix-list server_v6_pre {
      ::1.1.1.1/128;
    }
    policy-statement exp-arp-to-rrs {
      term 1 {
        from {
          protocol arp;
          rib inet.3;
        }
        then {
          next-hop self;
          accept;
        }
      }
      term 2 {
        from {
          protocol arp;
          rib inet6.3;
        }
        then {
          next-hop self;
          accept;
        }
      }
      term 3 {
        from protocol bgp;
        then accept;
      }
      term 4 {
        then reject;
      }
    }
    policy-statement exp_server_v4_v6_peers {
      term 1 {
        from {
          prefix-list server_v4_pre;
        }
        then accept;
      }
      term 2 {
        from {
          prefix-list server_v6_pre;
        }
        then accept;
      }
    }
    policy-statement pplb {
      then {
        load-balance per-packet;
      }
    }
}
```


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Verification

Confirm that the configuration is working properly.

- Identifying the Label and the Protocol Next Hop on page 913
- Verifying the Path of Packet with Label 299888 on page 915
- Verifying That Egress Peer Traffic Engineering Is Enabled on Router R3 on page 915

Identifying the Label and the Protocol Next Hop

Purpose Get the label number of the packet transported from R0 to R6 and the next hop from the routing table for route 17.17.17.2.

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Action From operational mode, run the **show route 17.17.17.2 extensive active-path** command on Router R0.

```
user@R0> show route 17.17.17.2 extensive active-path

inet.0: 262 destinations, 516 routes (261 active, 0 holddown, 1 hidden)
17.17.17.1/32 (3 entries, 1 announced)
TSI:
KRT in-kernel 17.17.17.1/32 -> {indirect(1048576)}
Page 0 idx 0, (group R0RT0 type External) Type 1 val 0x9a87fe0 (adv_entry)
   Advertised metrics:
     Nexthop: Self
     AS path: [100] 1 10 I
     Communities:
Path 17.17.17.1 from 4.4.4.4 Vector len 4.  Val: 0
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Address: 0x97724a0
                Next-hop reference count: 339
                Source: 4.4.4.4
                Next hop type: Router, Next hop index: 624
                Next hop: 100.100.100.2 via ge-2/1/4.0, selected
                Label-switched-path to_asbr1_r3
                Label operation: Push 299888, Push 300128(top)
                Label TTL action: prop-ttl, prop-ttl(top)
                Load balance label: Label 299888: None; Label 300128: None;
                Session Id: 0x145
                Protocol next hop: 200.200.201.2
                Indirect next hop: 0x9a4c550 1048576 INH Session ID: 0x148
                State: <Active Int Ext>
                Local AS:   100 Peer AS:   100
         Age: 1:33       Metric2: 2
                Validation State: unverified
                Task: BGP_100.4.4.4.4+179
                Announcement bits (3): 0-KRT 5-BGP_RT_Background 6-Resolve tree
2
                AS path: 1 10 I (Originator)
                Cluster list:  4.4.4.4
                Originator ID: 6.6.6.6
                Accepted
                Localpref: 100
                Router ID: 4.4.4.4
                Addpath Path ID: 1
                Indirect next hops: 1
                          Protocol next hop: 200.200.202.2 Metric: 2
                          Indirect next hop: 0x9a4c550 1048576 INH Session ID:
0x148
                          Indirect path forwarding next hops: 1
                                  Next hop type: Router
                                  Next hop: 100.100.100.2 via ge-2/1/4.0
                                  Session Id: 0x145
                          200.200.201.2/32 Originating RIB: inet.3
                            Metric: 2                       Node path count: 1
                            Indirect nexthops: 1
                                  Protocol Nexthop: 6.6.6.6 Metric: 2 Push 299888

                                  Indirect nexthop: 0x9a4c220 - INH Session ID:
0x0                                Indirect path forwarding nexthops: 1
                                                  Nexthop: 100.100.100.2
 via ge-2/1/4.0
```


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Meaning Both the packet label 299888 and the next hop 200.200.202.2 are displayed in the output.

Verifying the Path of Packet with Label 299888

Purpose Trace the path of the label 299888 and verify that the VPN entry is present in the mpls.0 routing table.

Action

```
user@R3> show route table mpls.0 protocol vpn active-path label 299888 detail

mpls.0: 17 destinations, 17 routes (17 active, 0 holddown, 0 hidden)
523440 (1 entry, 1 announced)
        *VPN    Preference: 170
                Next hop type: Router, Next hop index: 640
                Address: 0xecfa130
                Next-hop reference count: 2
                Next hop: 200.200.202.2 via ge-2/2/8.0, selected
                Label operation: Pop
                Load balance label: None;
                Session Id: 0x16f
                State: <Active Int Ext>
         Local AS:   64496
         Age: 3:49:16
        Validation State: unverified
        Task: BGP_RT_Background
                 Announcement bits (1): 1-KRT
        AS path: I
          Ref Cnt: 1
```

Meaning The label 299888 with VPN entry and next hop 200.200.202.2 is present in the mpls.0 routing table.

Verifying That Egress Peer Traffic Engineering Is Enabled on Router R3

Purpose Verify that the egress peer traffic engineering is configured on Router R3.

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Action

```
user@R3> show route protocol arp detail match-prefix 200.200.202.2

inet.0: 263 destinations, 514 routes (262 active, 0 holddown, 1 hidden)

inet.3: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
200.200.201.2/32 (1 entry, 1 announced)
        *ARP    Preference: 170
                Next hop type: Router
                Address: 0xecf91e0
                Next-hop reference count: 5
                Next hop: 200.200.202.2 via ge-2/2/8.0, selected
                Label operation: Pop
                Load balance label: None;
                Session Id: 0x0
                State: <Active Int Ext>
         Local AS:   64496
        Age: 3:52:52
        Validation State: unverified
        Task: BgpEgressPeeringTE
        Announcement bits (3): 2-Resolve tree 1 3-BGP_RT_Background 4-Resolve
tree 2
```

Meaning The output indicates that BGP egress peer traffic engineering is enabled on Router R3.

Related Documentation

- egress-te on page 1150
- egress-te-backup-paths on page 1153
- Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute on page 893
- Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview on page 896

Segment Routing Traffic Engineering at BGP Ingress Peer Overview

This feature enables BGP to support a segment routing policy for traffic engineering at ingress routers. The controller can specify a segment routing policy consisting of multiple paths to steer labeled or IP traffic. The segment routing policy adds an ordered list of segments to the header of a packet for traffic steering. BGP installs the candidate routes of the segment routing policy into routing tables bgp.inetcolor.0 or bgp.inet6color.0. BGP selects one route from the candidate routes for a particular segment routing traffic engineering policy, and installs it in the new routing tables inetcolor.0 or inet6color.0. This feature supports both statically configured as well as BGP-installed segment routing traffic engineering policies in the forwarding table at ingress routers.

- Understanding Segment Routing Policies on page 917
- BGP's Role in Route Selection from a Segment Routing Policy on page 917
- Statically Configured Segment Routing Policies on page 917
- Supported and Unsupported Features on page 918

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Understanding Segment Routing Policies

In segment routing the controller allows the ingress nodes in a core network to steer traffic through explicit paths while eliminating the state for the explicit paths in intermediate nodes. An ordered list of segments associated with the segment routing policy is added to the header of a data packet. These segment lists or lists of segment identifiers (SIDs) represent paths in the network, which are the best candidate paths selected from multiple candidate paths learned from various sources. An ordered list of segments is encoded as a stack of labels. This feature enables steering a packet toward a specific path depending on the network or customer requirements. The traffic can be labeled or IP traffic and is steered with a label swap or a destination-based lookup toward these segment routing traffic engineering paths. You can configure static policies at ingress routers to steer traffic even when the link to the controller fails. Static segment routing policies are useful to ensure traffic steering when the controller is down or unreachable.

BGP's Role in Route Selection from a Segment Routing Policy

When BGP receives an update for segment routing traffic engineering subsequent address family identifier (SAFI) from the controller, BGP performs some basic checks and validation on these updates. Segments that are not MPLS labels are considered invalid. If the updates are valid then BGP installs the segment routing traffic engineering policy in the routing tables bgp.inetcolor.0 and bgp.inet6color.0 and these are subsequently installed in the routing tables inetcolor.0 or inet6color.0. These routing tables use attributes such as *distinguisher*, *endpoint address*, and *color* as the key.

The policy action **color:** ***color-mode*:*color-value*** is configured at the **[edit policy-options community *name* members]** hierarchy level to attach color communities when exporting prefixes from inet-unicast and inet6-unicast address families.

To enable BGP IPv4 segment routing traffic engineering capability for an address family, include the **segment-routing-te** statement at the **[edit protocols bgp family inet]** hierarchy level.

To enable BGP IPv6 segment routing traffic engineering capability for an address family include the **segment-routing-te** statement at the **[edit protocols bgp family inet6]** hierarchy level.

NOTE: Starting in Release 18.3R1, Junos OS supports collection of traffic statistics for both ingress IP and transit MPLS traffic in a network configured with segment routing traffic engineering policy. To enable collection of traffic statistics include the telemetry statement at the **[edit protocols source-packet-routing]** hierarchy level.

Statically Configured Segment Routing Policies

Static policies can be configured at ingress routers to allow routing of traffic even when the link to the controller fails. Configure **sr-preference** at the **[edit protocols source-packet-routing]** hierarchy level to choose a statically configured segment routing

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traffic engineering policy forwarding entry over a BGP-signaled segment routing traffic engineering forwarding entry. The top label of the segment identifier label stack is swapped with the interior gateway protocol (IGP) top label for resolution.

A static segment routing traffic engineering policy can contain multiple paths with or without weighted ECMP. If IGP configuration has weighted ECMP configured, then the forwarding path provides hierarchical weighted equal-cost multipath (ECMP). However, if weighted ECMP is not configured, equal balance is applied to all the segment routing traffic engineering paths.

Supported and Unsupported Features

Junos OS supports the following features with BGP segment routing traffic engineering:

- For PTX Series, this feature is supported for FPC-PTX-P1-A with enhanced chassis mode.
- Weighted ECMP and hierarchical weighted ECMP.
- MPLS fast reroute (FRR) is supported for the paths in segment routing traffic engineering policies. IGP backup paths corresponding to the top label are installed to the routing table when available for segment routing traffic engineering policy paths.

The following limitations apply to BGP segment routing traffic engineering::

- BGP and static segment routing traffic engineering policies are only supported for the master instance.
- The static segment routing traffic engineering paths that are explicitly configured or learned through BGP are limited to lists of segment identifiers that represent absolute MPLS labels only.
- A maximum of eight segment lists are supported for both BGP and static segment routing traffic engineering policies.
- The BGP segment routing traffic engineering SAFI is not supported for peers in routing instances.
- The BGP segment routing traffic engineering network layer reachability information (NLRI) cannot be imported to other routing tables using routing information base (RIB) groups (RIBs are also known as routing tables).
- Traffic statistics are not supported for traffic traversing the segment routing policy.
- The processing of time-to-live (TTL) MPLS label segment identifiers is not supported.
- Nonstop active routing is not supported.
- Class-of-service (CoS) policies work on the top label.
- Only non-VPN CoS rewrite CLI commands are supported; for example, EXP rewrite for the top label is supported.
- For an ingress packet, a maximum of eight labels can be parsed, and Layer 2 or Layer 3 MPLS payload fields are used in the load-balancing hash calculation. If label depth in the ingress packet is more than eight labels, then MPLS payload is not parsed and

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Layer 2 and Layer 3 MPLS payload fields are not used in the load-balancing hash calculation.

- The maximum label stack depth support is five. You must configure **maximum-segment-list-depth** to limit the label depth of segment routing traffic engineering policies. If **maximum-segment-list-depth** is not configured, meaningful defaults apply that restrict the maximum label depth to five.
- The color attribute must be specified in segment routing traffic engineering LSP configuration. Hence the ingress routes are downloaded to inetcolor{6}.0 tables.
- When there are multiple static segment routing traffic engineering policies with the same **Endpoint, color** preference but different binding segment identifiers are present, the route corresponding to the lesser binding segment identifier is installed in the **mpls.0** table.
- Mixed segment identifiers are not supported: the segment identifiers in the segment routing traffic engineering segment list must be exclusively IPv4 or IPv6.
- You must explicitly configure MPLS maximum transmission unit (MTU) on an interface to accommodate more than five labels; otherwise more than five labels might result in packet drops.
- The limits of the supported parameters are listed below in Table 12 on page 919:

Table 12: Supported Parameters for Segment Routing Traffic Engineering

Parameter	Limit
Maximum number of labels supported	5
Maximum number of paths in segment routing traffic engineering policy	8
Number of BGP segment routing traffic engineering policies	32,000
Number of static segment routing traffic engineering policies	32,000

Release History Table

Release	Description
18.3R1	Starting in Release 18.3R1, Junos OS supports collection of traffic statistics for both ingress IP and transit MPLS traffic in a network configured with segment routing traffic engineering policy. To enable collection of traffic statistics include the telemetry statement at the **[edit protocols source-packet-routing]** hierarchy level.

Related Documentation

- *extended-nexthop-color*
- segment-list on page 1340
- source-routing-path on page 1351
- source-packet-routing on page 1348

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- *sr-preference-override*
- Configuring Ingress Traffic Engineering with Segment Routing in a BGP Network on page 920

Configuring Ingress Traffic Engineering with Segment Routing in a BGP Network

Starting in Junos OS Release 17.4R1, a BGP speaker supports traffic steering based on a segment routing policy. The controller can specify a segment routing policy consisting of multiple paths to steer labeled or IP traffic. This feature enables BGP to support a segment routing policy for traffic engineering at ingress routers. The segment routing policy adds an ordered list of segments to the header of a packet for traffic steering. Static policies can be configured at ingress routers to allow routing of traffic even when the link to the controller fails.

NOTE: **This feature is supported on PTX Series with FPC-PTX-P1-A. For devices that have multiple FPCs, you must configure enhanced mode on the chassis.**

Before you begin configuring BGP to distribute IPv4 routes with IPv6 next-hop addresses, do the following tasks:

1. Configure the device interfaces.
2. Configure OSPF or any other IGP protocol.
3. Configure MPLS and LDP.
4. Configure BGP.
5. Configure segment routing on the controller and all other routers.

To configure traffic engineering for BGP segment routing:

1. Enable BGP IPv4 segment routing traffic engineering capability for an address family. This feature is available only for inet, inet unicast, inet6, and inet6 unicast network layer reachability information (NLRI) families.

   ```
   [edit protocols bgp family name]
   user@host# set segment-routing-te
   ```

   For example, enable segment routing for a particular BGP group as follows:

   ```
   [edit protocols bgp group srte]
   user@host# set family inet
   user@host# set family inet unicast
   ```


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```
user@host# set family inet segment-routing-te
user@host# set family inet6 unicast
user@host# set family inet6 segment-routing-te
user@host# set neighbor 27.2.1.2
user@host# set neighbor 27.2.1.2 peer-as-600
```

2. Configure segment routing global block (SRGB). Junos OS uses this label block for steering the packets to a remote destination. Configure the start label and SRGB index range.

```
[edit protocols isis source-packet-routing]
user@host# set srgb start-label start-label-value
user@host# set srgb index-rangeindex-range-value
```

For example, configure the start label and the SRGB index range with the following values:

```
[edit protocols isis source-packet-routing]
user@host# set srgb start-label 800000
user@host# set protocols isis source-packet-routing srgb index-range 80000
```

3. Configure the policy action to attach color communities when exporting prefixes from inet-unicast and inet6-unicast address families.

```
[edit policy-options community name ]
user@host# set members color: color-mode: color-value
```

For example, configure the following color attributes for a BGP community:

```
[edit policy-options community srte_community ]
user@host# set members color: 2: 1200
```

4. Configure the source routing LSP for steering traffic at the ingress router. Specify the attributes such as the tunnel endpoint, color, binding segment identifier, and preference for traffic engineering. Configuring binding segment identifier installs the route in the MPLS tables.

```
[edit protocols source-packet-routing]
user@host# set source-routing-path name to to
user@host# set source-routing-path name color color
user@host# set source-routing-path name binding-sid binding-sid
user@host# set source-routing-path name preference preference
```

For example, you can configure the attributes as follows:

```
[edit protocols source-packet-routing]
user@host# set source-routing-path srtelsp1 to 7.7.7.7
user@host# set source-routing-path srtelsp1 color 1200
user@host# set source-routing-path srtelsp1 binding-sid 1200
user@host# set source-routing-path srtelsp1 preference 70
```

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5. Configure weighted ECMP for the primary segment list of a segment routing path. If the forwarding interface is also configured with weighted ECMP then Junos OS applies hierarchical weighted ECMP. If you do not configure the weight percentage, then only IGP weights are applied on the forwarding interfaces.

```
[edit protocols source-packet-routing]
user@host# set source-routing-path name primary name weight weight
user@host# set source-routing-path name primary name weight weight
```

For example, you can configure the routing paths and weights as follows:

```
[edit protocols source-packet-routing]
user@host# set source-routing-path srtelsp1 primary sr1 weight 1
user@host# set source-routing-path srtelsp1 primary sr4 weight 2
```

6. Configure the segment routing preference for routes received for this tunnel. This segment routing preference value overrides the global segment routing preference value and is used to select between candidate segment routing policies installed by different protocols such as static and BGP.

```
[edit protocols source-packet-routing]
user@host# set sr-preference-override sr-preference-override
user@host# set sr-preference sr-preference
```

For example, you can configure the sr preference as follows:

```
[edit protocols source-packet-routing]
user@host# set sr-preference-override 300
user@host# set sr-preference 200
```

7. Configure static policies at ingress routers to allow routing of traffic even when the link to the controller fails. Specify one or more nexthop labels. The successfully resolved LSPs are used to resolve BGP payload prefixes that have the same color and endpoint.

```
[edit protocols source-packet-routing]
user@host# set segment-list segment-list-name hop-namelabel label
```

For example, configure two segment lists *sr1*, *sr4* and specify labels for steering segment routing traffic at an ingress router as follows:

```
[edit protocols source-packet-routing]
user@host# set segment-list sr1 hop1 label 801001
user@host# set segment-list sr1 hop2 label 801002
user@host# set segment-list sr1 hop3 label 801003
user@host# set segment-list sr1 hop4 label 801007
user@host# set segment-list sr4 hop1 label 801004
user@host# set segment-list sr4 hop2 label 801005
```


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NOTE: If BGP and static segment routing are configured together for traffic engineering, then by default Junos OS chooses statically configured segment routing policies.

8. Configure segment routing preference overide to replace the received segment routing traffic engineering preference value with the configured override value. Segment routing policy preference can change based on certain tie-breaking rules involving sr-preference-override, sr-preference, and admin-preference.

```
[edit protocols bgp]
user@host# set sr-preference-override sr-preference-override
```

For example, configure the following value for BGP segment routing preference override:

```
[edit protocols bgp]
user@host# set sr-preference-override 400
```

Related Documentation

- *extended-nexthop-color*
- segment-list on page 1340
- source-packet-routing on page 1348
- source-routing-path on page 1351
- *sr-preference-override*
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916

Enabling Traffic Statistics Collection for BGP Labeled Unicast

Starting in Junos OS Release 18.1R1, you can enable traffic statistics collection for BGP labeled unicast traffic at the ingress router in a network configured with segment routing. Traffic statistics are collected based on the label stack. For example, if there are two routes with the same label stack but different next-hops then traffic statistics are aggregated for these routes because the label stack is the same. Traffic statistics can be periodically collected and saved to a specified file based on the label stack received in the BGP route update. By default, traffic statistics collection is disabled. Enabling traffic statistics collection triggers a BGP import policy. Traffic statistics collection is supported only for IPv4 and IPv6 address families.

Before you begin configuring BGP to collect traffic statistics, do the following tasks:

1. Configure the device interfaces.

2. Configure OSPF or any other IGP protocol.

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3. Configure MPLS and LDP.

4. Configure BGP.

5. Configure segment routing on the controller and all other routers.

In a network configured with segment routing, each node and link is assigned a segment identifier (SID), which is advertised through IGP or BGP. In an MPLS network, each segment is assigned a unique segment label that serves as the SID for that segment. Each forwarding path is represented as a segment routing label-switched path (LSP). The segment routing LSP is represented with a stack of SID labels at ingress. The ingress router can impose these labels to route the traffic. With BGP labeled unicast a controller can program the ingress router to steer traffic and advertise a prefix with a label stack.

To enable traffic statistics collection for BGP labeled unicast at ingress:

1. Enable collection of traffic statistics of labeled unicast IPv4 and IPv6 families for specific BGP groups or BGP neighbors.

```
[edit protocols bgp group name family inet labeled-unicast traffic statistics]
user@host# set labeled-path
```

2. Configure periodic traffic statistics collection for BGP label-switched paths in a segmented routing network and save the statistics to a file.

```
[edit protocols bgp]
user@host# set traffic-statistics-labeled-path
```

   a. Specify the filename to save the collected traffic statistics collected at a specified time interval.

```
[edit protocols bgp traffic-statistics-labeled-path]
user@host# set file filename
```

   b. Specify the time interval in seconds for collecting traffic statistics. You can specify a number from 60 to 65535 seconds.

```
[edit protocols bgp traffic-statistics-labeled-path]
user@host# set interval interval
```

Related Documentation

- traffic-statistics-labeled-path on page 1380
- show bgp group traffic-statistics on page 1460

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CHAPTER 26

Configuring BGP-Based VPN

- Understanding Carrier-of-Carriers VPNs on page 926
- Understanding Interprovider and Carrier-of-Carriers VPNs on page 928
- Configuring Carrier-of-Carriers VPNs for Customers That Provide VPN Service on page 928

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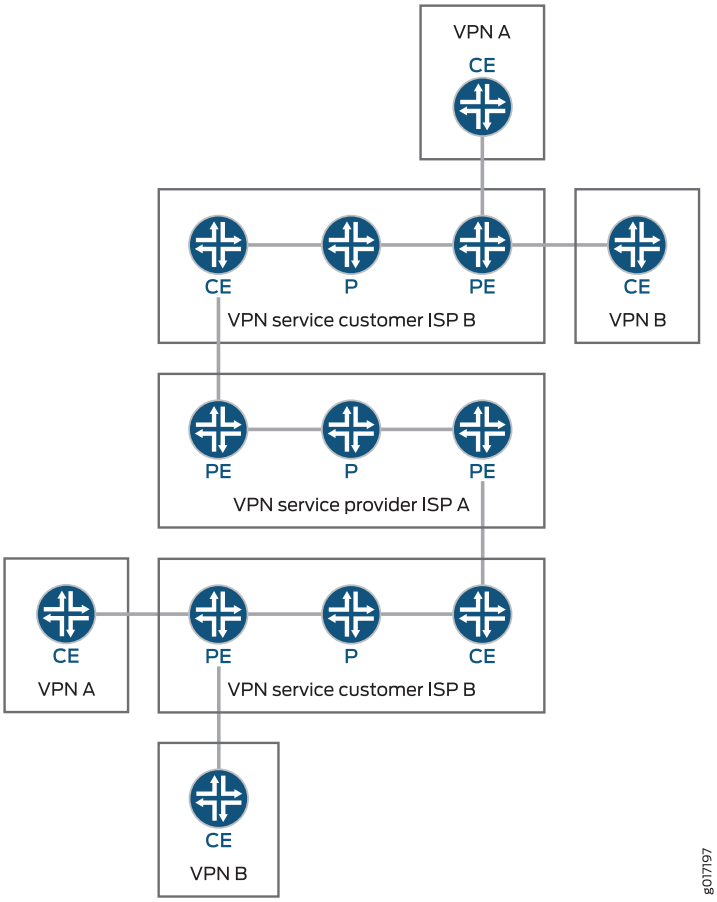
Understanding Carrier-of-Carriers VPNs

The customer of a VPN service provider might be a service provider for the end customer. The following are the two main types of carrier-of-carriers VPNs (as described in RFC 4364:

- "Internet Service Provider as the Customer" on page 927—The VPN customer is an ISP that uses the VPN service provider's network to connect its geographically disparate regional networks. The customer does not have to configure MPLS within its regional networks.
- "VPN Service Provider as the Customer" on page 927—The VPN customer is itself a VPN service provider offering VPN service to its customers. The carrier-of-carriers VPN service customer relies on the backbone VPN service provider for inter-site connectivity. The customer VPN service provider is required to run MPLS within its regional networks.

Figure 86 on page 926 illustrates the network architecture used for a carrier-of-carriers VPN service.

Figure 86: Carrier-of-Carriers VPN Architecture



This topic covers the following:

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- Internet Service Provider as the Customer on page 927
- VPN Service Provider as the Customer on page 927

Internet Service Provider as the Customer

In this type of carrier-of-carriers VPN configuration, ISP A configures its network to provide Internet service to ISP B. ISP B provides the connection to the customer wanting Internet service, but the actual Internet service is provided by ISP A.

This type of carrier-of-carriers VPN configuration has the following characteristics:

- The carrier-of-carriers VPN service customer (ISP B) does not need to configure MPLS on its network.
- The carrier-of-carriers VPN service provider (ISP A) must configure MPLS on its network.
- MPLS must also be configured on the CE routers and PE routers connected together in the carrier-of-carriers VPN service customer's and carrier-of-carriers VPN service provider's networks.

VPN Service Provider as the Customer

A VPN service provider can have customers that are themselves VPN service providers. In this type of configuration, also called a hierarchical or recursive VPN, the customer VPN service provider's VPN-IPv4 routes are considered external routes, and the backbone VPN service provider does not import them into its VRF table. The backbone VPN service provider imports only the customer VPN service provider's internal routes into its VRF table.

The similarities and differences between interprovider and carrier-of-carriers VPNs are shown in Table 13 on page 927.

Table 13: Comparison of Interprovider and Carrier-of-Carriers VPNs

Feature	ISP Customer	VPN Service Provider Customer
Customer edge device	AS border router	PE router
IBGP sessions	Carry IPv4 routes	Carry external VPN-IPv4 routes with associated labels
Forwarding within the customer network	MPLS is optional	MPLS is required

Support for VPN service as the customer is supported on QFX10000 switches starting with Junos OS Release 17.1R1.

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Release History Table

Release	Description
17.1R1	Support for VPN service as the customer is supported on QFX10000 switches starting with Junos OS Release 17.1R1.

Related Documentation

- *MPLS Feature Support on QFX Series and EX4600 Switches*
- Understanding Interprovider and Carrier-of-Carriers VPNs on page 928
- *Interprovider VPNs*

Understanding Interprovider and Carrier-of-Carriers VPNs

All interprovider and carrier-of-carriers VPNs share the following characteristics:

- Each interprovider or carrier-of-carriers VPN customer must distinguish between internal and external customer routes.
- Internal customer routes must be maintained by the VPN service provider in its PE routers.
- External customer routes are carried only by the customer's routing platforms, not by the VPN service provider's routing platforms.

The key difference between interprovider and carrier-of-carriers VPNs is whether the customer sites belong to the same AS or to separate ASs:

- *Interprovider VPNs*—The customer sites belong to different ASs. You need to configure EBGP to exchange the customer's external routes.
- "Understanding Carrier-of-Carriers VPNs" on page 926—The customer sites belong to the same AS. You need to configure IBGP to exchange the customer's external routes.

In general, each service provider in a VPN hierarchy is required to maintain its own internal routes in its P routers, and the internal routes of its customers in its PE routers. By recursively applying this rule, it is possible to create a hierarchy of VPNs.

The following are definitions of the types of PE routers specific to interprovider and carrier-of-carriers VPNs:

- The AS border router is located at the AS border and handles traffic leaving and entering the AS.
- The end PE router is the PE router in the customer VPN; it is connected to the CE router at the end customer's site.

Configuring Carrier-of-Carriers VPNs for Customers That Provide VPN Service

You can configure a carrier-of-carriers VPN service for customers who want VPN service.

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To configure the routers (or switches) in the customer's and provider's networks to enable carrier-of-carriers VPN service, perform the steps in the following sections:

- Configuring the Carrier-of-Carriers Customer's PE Router on page 929
- Configuring the Carrier-of-Carriers Customer's CE Router (or switch) on page 932
- Configuring the Provider's PE Router or Switch on page 934

Configuring the Carrier-of-Carriers Customer's PE Router

The carrier-of-carriers customer's PE router (or switch) is connected to the end customer's CE router (or switch).

The following sections describe how to configure the carrier-of-carriers customer's PE router (or switch):

- Configuring MPLS on page 929
- Configuring BGP on page 929
- Configuring OSPF on page 930
- Configuring LDP on page 930
- Configuring VPN Service in the Routing Instance on page 931
- Configuring Policy Options on page 931

Configuring MPLS

To configure MPLS on the carrier-of-carriers customer's PE router (or switch), include the **mpls** statement:

```
mpls {
   interface interface-name;
   interface interface-name;
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

Configuring BGP

Include the **labeled-unicast** statement in the configuration for the IBGP session to the carrier-of-carriers customer's CE router (or switch)), and include the **family-inet-vpn** statement in the configuration for the IBGP session to the carrier-of-carriers PE router (or switch) on the other side of the network:

```
bgp {
   group group-name {
      type internal;
      local-address address;
      neighbor address {
         family inet {
```

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```
            labeled-unicast;
            resolve-vpn;
        }
    }
  }
  neighbor address {
    family inet-vpn {
      any;
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

Configuring OSPF

To configure OSPF on the carrier-of-carriers customer's PE router (or switch), include the **ospf** statement:

```
ospf {
  area area-id {
    interface interface-name {
      passive;
    }
    interface interface-name;
  }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

Configuring LDP

To configure LDP on the carrier-of-carriers customer's PE router (or switch), include the **ldp** statement:

```
ldp {
  interface interface-name;
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

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Configuring VPN Service in the Routing Instance

To configure VPN service for the end customer's CE router (or switch) on the carrier-of-carriers customer's PE router (or switch), include the following statements:

```
instance-type vrf;
interface interface-name;
route-distinguisher address;
vrf-import policy-name;
vrf-export policy-name;
protocols {
  bgp {
    group group-name {
      peer-as as-number;
      neighbor address;
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- **[edit routing-instances *routing-instance-name*]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]**

Configuring Policy Options

To configure policy options to import and export routes to and from the end customer's CE router (or switch), include the **policy-statement** and **community** statements:

```
policy-statement policy-name {
  term term-name {
    from {
      protocol bgp;
      community community-name;
    }
    then accept;
  }
  term term-name {
    then reject;
  }
}
policy-statement policy-name {
  term term-name {
    from protocol bgp;
    then {
      community add community-name;
      accept;
    }
  }
  term term-name {
    then reject;
  }
}
```

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```
community community-name members value;
```

You can include these statements at the following hierarchy levels:

- **[edit policy-options]**
- **[edit logical-systems *logical-system-name* policy-options]**

Configuring the Carrier-of-Carriers Customer's CE Router (or switch)

The carrier-of-carriers customer's CE router (or switch) connects to the provider's PE router (or switch). Complete the instructions in the following sections to configure the carrier-of-carriers customers' CE router (or switch):

- Configuring MPLS on page 932
- Configuring BGP on page 932
- Configuring OSPF and LDP on page 933
- Configuring Policy Options on page 934

Configuring MPLS

In the MPLS configuration for the carrier-of-carriers customer's CE router (or switch), include the interfaces to the provider's PE router (or switch) and to a P router (or switch) in the customer's network:

```
mpls {
   traffic-engineering bgp-igp;
   interface interface-name;
   interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

Configuring BGP

In the BGP configuration for the carrier-of-carriers customer's CE router (or switch), configure a group that includes the **labeled-unicast** statement to extend VPN service to the PE router (or switch)connected to the end customer's CE router (or switch):

```
bgp {
   group group-name {
      type internal;
      local-address address;
      neighbor address {
         family inet {
            labeled-unicast;
         }
      }
```


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```
    }
}
```

You can include the **bgp** statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

To configure a group to send labeled internal routes to the provider's PE router (or switch), include the **bgp** statement:

```
bgp {
    group group-name {
        export internal;
        peer-as as-number;
        neighbor address {
            family inet {
                labeled-unicast;
            }
        }
    }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

Configuring OSPF and LDP

To configure OSPF and LDP on the carrier-of-carriers customer's CE router (or switch), include the **ospf** and **ldp** statements:

```
ospf {
    area area-id {
        interface interface-name {
            passive;
        }
        interface interface-name;
    }
}
ldp {
    interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems *logical-system-name* protocols]**

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Configuring Policy Options

To configure the policy options on the carrier-of-carriers customer's CE router (or switch), include the **policy-statement** statement:

```
policy-statement policy-statement-name {
   term term-name {
      from protocol [ ospf direct ldp ];
      then accept;
   }
   term term-name {
      then reject;
   }
}
```

You can include this statement at the following hierarchy levels:

- **[edit policy-options]**
- **[edit logical-systems *logical-system-name* policy-options]**

Configuring the Provider's PE Router or Switch

The carrier-of-carriers provider's PE routers (or switches) connect to the carrier customer's CE routers (or switches) . Complete the instructions in the following sections to configure the provider's PE router (or switch):

- Configuring MPLS on page 934
- Configuring a PE-to-PE BGP Session on page 934
- Configuring IS-IS and LDP on page 935
- Configuring Policy Options on page 935
- Configuring a Routing Instance to Send Routes to the CE Router on page 936

Configuring MPLS

In the MPLS configuration, specify at least two interfaces—one to the customer's CE router (or switch)and one to connect to the provider's PE router (or switch)on the other side of the provider's network:

```
interface interface-name;
interface interface-name;
```

You can include these statements at the following hierarchy levels:

- **[edit protocols mpls]**
- **[edit logical-systems *logical-system-name* protocols mpls]**

Configuring a PE-to-PE BGP Session

To configure a PE-to-PE BGP session on the provider's PE routers (or switches) to allow VPN-IPv4 routes to pass between the PE routers (or switches, include the **bgp** statement:

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```
bgp {
   group group-name {
      type internal;
      local-address address;
      family inet-vpn {
         any;
      }
      neighbor address;
   }
}
```

You can include this statement at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems** *logical-system-name* **protocols]**

Configuring IS-IS and LDP

To configure IS-IS and LDP on the provider's PE routers (or switches), include the **isis** and **ldp** statements:

```
isis {
   interface interface-name;
   interface interface-name {
      passive;
   }
}
ldp {
   interface interface-name;
}
```

You can include these statements at the following hierarchy levels:

- **[edit protocols]**
- **[edit logical-systems** *logical-system-name* **protocols]**

Configuring Policy Options

To configure policy statements on the provider's PE router (or switch) to export routes to and import routes from the carrier customer's network, include the **policy-statement** and **community** statements:

```
policy-statement statement-name {
   term term-name {
      from {
         protocol bgp;
         community community-name;
      }
      then accept;
   }
   term term-name {
      then reject;
```

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```
    }
}
policy-statement statement-name {
    term term-name {
        from protocol bgp;
        then {
            community add community-name;
            accept;
        }
    }
    term term-name {
        then reject;
    }
}
community community-name members value;
```

You can include these statements at the following hierarchy levels:

- **[edit policy-options]**
- **[edit logical-systems *logical-system-name* policy-options]**

Configuring a Routing Instance to Send Routes to the CE Router

To configure the routing instance on the provider's PE router (or switch) to send labeled routes to the carrier customer's CE router (or switch), include the following statements:

```
instance-type vrf;
interface interface-name;
route-distinguisher value;
vrf-import policy-name;
vrf-export policy-name;
protocols {
    bgp {
        group group-name {
            peer-as as-number;
            neighbor address {
                family inet {
                    labeled-unicast;
                }
            }
        }
    }
}
```

You can include these statements at the following hierarchy levels:

- **[edit routing-instances *routing-instance-name*]**
- **[edit logical-systems *logical-system-name* routing-instances *routing-instance-name*]**

Related Documentation

- *MPLS Feature Support on QFX Series and EX4600 Switches*
- Understanding Interprovider and Carrier-of-Carriers VPNs on page 928

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PART 14

Monitoring and Troubleshooting

- Monitoring a BGP Session on page 939
- Troubleshooting Network Issues on page 963
- Troubleshooting BGP Sessions on page 971

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CHAPTER 27

Monitoring a BGP Session

- Monitoring BGP Routing Information on page 939
- Understanding the BGP Monitoring Protocol on page 939
- Configuring BGP Monitoring Protocol to Run Over a Different Routing Instance on page 940
- Example: Configuring the BGP Monitoring Protocol on page 943
- Configuring BGP Monitoring Protocol Version 3 on page 946
- Understanding Trace Operations for BGP Protocol Traffic on page 946
- Example: Viewing BGP Trace Files on Logical Systems on page 948
- Tracing BMP Operations on page 954
- Checklist for Verifying the BGP Protocol and Peers on page 955
- Checklist for Checking the BGP Layer on page 956
- Example: Tracing Global Routing Protocol Operations on page 957

Monitoring BGP Routing Information

Purpose Use the monitoring functionality to monitor BGP routing information on the routing device.

Action To view BGP routing information in the CLI, enter the following commands:

- **show bgp summary**
- **show bgp neighbor**

Related Documentation

- show bgp neighbor on page 1463
- show bgp summary on page 1490

Understanding the BGP Monitoring Protocol

The BGP Monitoring Protocol (BMP) is a protocol to allow a monitoring station to receive routes from a BGP-enabled device. The monitoring station receives all routes, not just the active routes. BMP uses route monitoring messages (which are essentially

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encapsulated BGP update messages) and a few other message types for statistics and state changes. All messages flow from the router to the monitoring station.

NOTE: When an interface is disabled, the BMP that monitors the TCP session, is shut down for 240 seconds (4 minutes). This is an expected behavior.

The data is collected from the **Adjacency-RIB-In** routing tables. The **Adjacency-RIB-In** tables are the pre-policy tables, meaning that the routes in these tables have not been filtered or modified by routing policies.

NOTE: The **Local-RIB** tables are the post-policy tables.

Related Documentation

- Example: Configuring the BGP Monitoring Protocol on page 943
- Configuring BGP Monitoring Protocol Version 3 on page 946

Configuring BGP Monitoring Protocol to Run Over a Different Routing Instance

Starting in Junos OS Release 18.3R1, you can specify which routing instance you want the BGP Monitoring Protocol (BMP) to use. Prior to Junos OS Release 18.3R1, you had to use the default routing instance. By default, in Junos OS, the management Ethernet interface (usually named fxp0 or em0) provides the out-of-band management network for the device. There is no clear separation between either out-of-band management traffic and in-band protocol control traffic, or user traffic at the routing-instance or routing-table level. Instead, all traffic is handled through the default routing instance, giving rise to concerns over security, performance, and how to troubleshoot.

Starting with Junos OS Release 17.3R1, you can configure the management interface in a non-default virtual routing and forwarding (VRF) instance, the mgmt_junos routing instance. Once you configure this management routing instance as described in *Configuring the mgmt_junos Routing Instance*, management traffic no longer has to share a routing table (that is, the default.inet.0 table) with other control or protocol traffic in the system. But it is only as of Junos OS Release 18.3R1 that you can use this non-default management instance for BMP. You can also use any configured routing instance for BMP. It no longer has to be the default routing instance.

- Configuring a Non-default Routing Instance for BMP on page 941
- Configuring mgmt_junos for BMP on page 942

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Configuring a Non-default Routing Instance for BMP

To modify the routing instance that BMP uses, you must configure the BMP station and the connection mode, which is either passive or active. In active mode, the router attempts to start the TCP connection with the BMP station. In passive mode the routerl waits for the BMP station to initiate the TCP session. You also must configure a port and the station address.

NOTE: To use a non-default routing instance, you must configure it under the **[edit routing-instances]** hierarchy level.

To configure a non-default routing instance for BMP:

1. Configure the routing instance under the **edit routing-instances** hierarchy level.

   ```
   user@host# set routing-instances routing-instance-name description description
   ```

2. Configure the routing instance for the BMP routing instance.

   ```
   user@host# set routing-options bmp station station-name routing-instance
     routing-instance-name
   ```

3. Configure the connection mode.

   ```
   user@host# set routing-options bmp station station-name connection-mode (active
     | passive)
   ```

   - If you configure passive mode, configure the following additional statements:

     ```
     set routing-options bmp station station-name local-address ip-address
     set routing-options bmp station station-name local-port port-number
     set routing-options bmp station station-name station-address ip-address
     ```

   - If you configure active mode, configure at least the following additional statements:

     ```
     set routing-options bmp station station-name station-address ip-address
     set routing-options bmp station station-name station-port port-number
     ```

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Configuring mgmt_junos for BMP

To modify the routing instance that BMP uses, you must configure the BMP station and the connection mode, which is either passive or active. In active mode, the router attempts to start the TCP connection with the BMP station. In passive mode the router waits for the BMP station to initiate the TCP session. You also must configure a port and the station address.

NOTE: To use the management routing instance, you must configure it under the **[edit routing-instances]** hierarchy level, and you must enable it using the **management-instance** configuration statement.

To configure mgmt_junos as the routing-instance for BMP:

1. Configure the non-default management routing instance.

   ```
   user@host# set system management-instance
   ```

2. Configure the routing instance under the **edit routing-instances** hierarchy level.

   ```
   user@host# set routing-instances mgmt_junos description description
   ```

3. Configure the routing instance for the BMP routing instance.

   ```
   user@host# set routing-options bmp station station-name routing-instance
     mgmt_junos
   ```

4. Configure the connection mode.

   - If you configure passive mode, configure the following additional statements:

     ```
     set routing-options bmp station station-name connection-mode passive
     set routing-options bmp station station-name local-address ip-address
     set routing-options bmp station station-name local-port port-number
     set routing-options bmp station station-name station-address ip-address
     ```

   - If you configure active mode, configure the following additional statements:

     ```
     set routing-options bmp station station-name connection-mode active
     set routing-options bmp station station-name station-address ip-address
     set routing-options bmp station station-name station-port port-number
     ```


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Release History Table

Release	Description
18.3R1	Starting in Junos OS Release 18.3R1, you can specify which routing instance you want the BGP Monitoring Protocol (BMP) to use.

Related Documentation

- *management-instance*
- *Management Interface in a Nondefault Instance*
- routing-instance (BMP) on page 1337

Example: Configuring the BGP Monitoring Protocol

This example shows how to enable the BGP Monitoring Protocol (BMP). The Junos OS implementation of BMP is based on Internet draft draft-scudder-bmp-01.txt, *BGP Monitoring Protocol*.

- Requirements on page 943
- Overview on page 943
- Configuration on page 944
- Verification on page 945

Requirements

- Configure the router interfaces.

NOTE: When an interface is disabled, the BMP that monitors the TCP session, is shut down for 240 seconds (4 minutes). This is an expected behaviour.

- Configure an interior gateway protocol (IGP).
- Configure BGP and routing policies.
- Configure a monitoring station to listen on a particular TCP port.

Overview

To configure the monitoring station to which BMP data is sent, you must configure both the **station-address** and **station-port** statements. For the station address, you can specify either the IP address or the name of the monitoring station. For ***name***, specify a valid URL. For the station port, specify a TCP port. BMP operates over TCP. The monitoring station is configured to listen on a particular TCP port, and the router is configured to establish an active connection to that port and to send messages on that TCP connection. You configure BMP in the default routing instance only. However, BMP applies to routes in the default routing instance and to routes in other routing instances.

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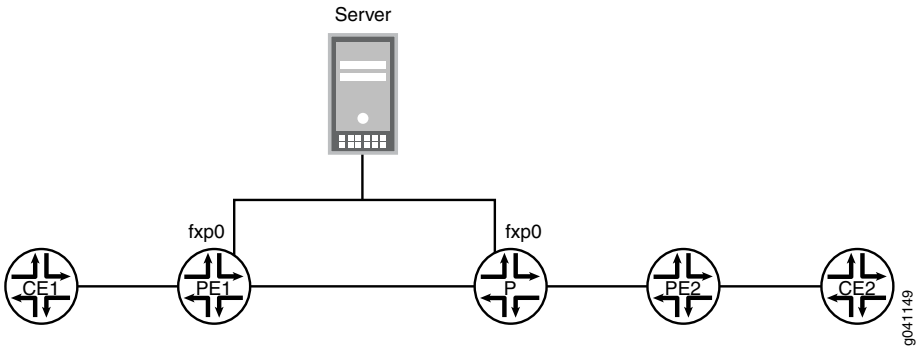
You can optionally specify how often to send data to the monitoring station. The default is 1 hour. To modify this interval, include the **statistics-timeout *seconds*** statement. For ***seconds***, you can specify a value from 15 through 65,535.

Figure 87 on page 944 shows a sample topology. In this example, BMP is configured on Router PE1. The server address is 192.168.64.180. The listening TCP port on the server is port 11019.

Figure 87: BMP Topology



Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set routing-options bmp station-address 192.168.64.180
set routing-options bmp station-port 11019
```

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure BMP:

1. Configure the receiving station address.

```
[edit routing-options]
user@PE1# set bmp station-address 192.168.64.180
```

2. Configure the receiving station port.

```
[edit routing-options]
user@PE1# set bmp station-port 11019
```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Results

From configuration mode, confirm your configuration by entering the **show routing-options** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@PE1# show routing-options
bmp {
   station-address 192.168.64.180;
   station-port 11019;
}
```

Verification

Verifying That BMP is Operating

Purpose Run the show bgp bmp command to display a set of statistics and the current BMP session state on the router.

Action

```
user@PE1> show bgp bmp
BMP station address/port: 192.168.64.180+11019
BMP session state: DOWN
 Statistics timeout: 15
```

Related Documentation

- Example: Viewing BGP Trace Files on Logical Systems on page 948

Configuring BGP Monitoring Protocol Version 3

BGP Monitoring Protocol (BMP) allows the Junos OS to send the BGP route information from the router to a monitoring application on a separate device. The monitoring application is called the BMP monitoring station or BMP station. To deploy BMP in your network, you need to configure BMP on each router and you also need to configure at least one BMP station. This procedure describes how to configure BMP on a router.

You can specify these settings for all BMP stations by configuring the statements described here at the **[edit routing-options** bmp**]** hierarchy level. You can also configure settings for specific BMP stations by configuring these statements at the **[edit routing-options bmp station *station-name*]** hierarchy level.

The following procedure describes how to configure BMP version 3 on the router:

1. Specify the memory limit for the BMP monitoring station by configuring the **memory limit** statement. The value must be in bytes.

   ```
   memory limit bytes;
   ```

2. Specify the name or address for the BMP monitoring station by configuring the **station-address** statement. You can specify one or the other but not both. The address must be a valid IPv4 or IPv6 address.

   ```
   station-address (ip-address | station-name);
   ```

3. Specify the port number for the BMP monitoring station by configuring the **station-port** statement. See also connection-mode.

   ```
   station-port port-number;
   ```

4. Configure how often statistics messages are sent to the BMP monitoring station by specifying the number of seconds between message transmissions using **statistics-timeout** statement. If you configure a value of 0, no statistics messages are sent.

   ```
   statistics-timeout seconds;
   ```

Related Documentation

- Example: Configuring Router Authentication for BGP on page 774

Understanding Trace Operations for BGP Protocol Traffic

You can trace various BGP protocol traffic to help you debug BGP protocol issues. To trace BGP protocol traffic, include the **traceoptions** statement at the **[edit protocols bgp]** hierarchy level. For routing instances, include the **traceoptions** statement at the **[edit routing-instances *routing-instance-name* protocols bgp]** hierarchy level.

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```
traceoptions {
   file filename <files number> <size size> <world-readable | no-world-readable>;
   flag flag <flag-modifier> <disable>;
}
```

You can specify the following BGP protocol-specific trace options using the **flag** statement:

- **4byte-as**—4-byte AS events.
- **bfd**—BFD protocol events.
- **damping**—Damping operations.
- **graceful-restart**—Graceful restart events.
- **keepalive**—BGP keepalive messages.
- **nsr-synchronization**—Nonstop active routing synchronization events.
- **open**—BGP open packets. These packets are sent between peers when they are establishing a connection.
- **packets**—All BGP protocol packets.
- **refresh**—BGP refresh packets.
- **update**—BGP update packets. These packets provide routing updates to BGP systems.

Global tracing options are inherited from the configuration set by the **traceoptions** statement at the **[edit routing-options]** hierarchy level. You can override the following global trace options for the BGP protocol using the **traceoptions flag** statement included at the **[edit protocols bgp]** hierarchy level:

- **all**—All tracing operations
- **general**—All normal operations and routing table changes (a combination of the normal and route trace operations)
- **normal**—Normal events
- **policy**—Policy processing
- **route**—Routing information
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

You can optionally specify one or more of the following flag modifiers:

- **detail**—Detailed trace information.
- **filter**—Filter trace information. Applies only to **route** and **damping** tracing flags.
- **receive**—Packets being received.
- **send**—Packets being transmitted.

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NOTE: Use the **all** trace flag and the **detail** flag modifier with caution because these might cause the CPU to become very busy.

NOTE: If you only enable the **update** flag, received keepalive messages do not generate a trace message.

You can filter trace statements and display only the statement information that passes through the filter by specifying the **filter** flag modifier. The **filter** modifier is only supported for the **route** and **damping** tracing flags.

The **match-on** statement specifies filter matches based on prefixes. It is used to match on route filters.

NOTE: Per-neighbor trace filtering is not supported on a BGP per-neighbor level for **route** and **damping** flags. Trace option filtering support is on a peer group level.

Related Documentation

- **traceoptions** on page 1374 statement
- *Junos OS Administration Library*

Example: Viewing BGP Trace Files on Logical Systems

This example shows how to list and view files that are stored on a logical system.

- Requirements on page 948
- Overview on page 949
- Configuration on page 949
- Verification on page 953

Requirements

- You must have the **view** privilege for the logical system.
- Configure a network, such as the BGP network shown in "Example: Configuring Internal BGP Peering Sessions on Logical Systems" on page 63.

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Overview

Logical systems have their individual directory structure created in the **/var/logical-systems/*logical-system-name*** directory. It contains the following subdirectories:

- **/config**—Contains the active configuration specific to the logical system.
- **/log**—Contains system log and tracing files specific to the logical system.

  To maintain backward compatibility for the log files with previous versions of Junos OS, a symbolic link (symlink) from the **/var/logs/*logical-system-name*** directory to the **/var/logical-systems/*logical-system-name*** directory is created when a logical system is configured.
- **/tmp**—Contains temporary files specific to the logical system.

The file system for each logical system enables logical system users to view trace logs and modify logical system files. Logical system administrators have full access to view and modify all files specific to the logical system.

Logical system users and administrators can save and load configuration files at the logical-system level using the **save** and **load** configuration mode commands. In addition, they can also issue the **show log**, **monitor**, and **file** operational mode commands at the logical-system level.

This example shows how to configure and view a BGP trace file on a logical system. The steps can be adapted to apply to trace operations for any Junos OS hierarchy level that supports trace operations.

TIP: To view a list of hierarchy levels that support tracing operations, enter the help apropos traceoptions command in configuration mode.

Configuration

- Configuring Trace Operations on page 950
- Viewing the Trace File on page 950
- Deactivating and Reactivating Trace Logging on page 952
- Results on page 953

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set logical-systems A protocols bgp group internal-peers traceoptions file bgp-log
set logical-systems A protocols bgp group internal-peers traceoptions file size 10k
set logical-systems A protocols bgp group internal-peers traceoptions file files 2
set logical-systems A protocols bgp group internal-peers traceoptions flag update detail
```

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Configuring Trace Operations

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the trace operations:

1. Configure trace operations on the logical system.

```
[edit logical-systems A protocols bgp group internal-peers]
user@host# set traceoptions file bgp-log
user@host# set traceoptions file size 10k
user@host# set traceoptions file files 2
user@host# set traceoptions flag update detail
```

2. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Viewing the Trace File

Step-by-Step Procedure

To view the trace file:

1. In operational mode on the main router, list the directories on the logical system.

```
user@host> file list /var/logical-systems/A
/var/logical-systems/A:
config/
log/
tmp/
```

2. In operational mode on the main router, list the log files on the logical system.

```
user@host> file list /var/logical-systems/A/log/
/var/logical-systems/A/log:
bgp-log
```

3. View the contents of the **bgp-log** file.

```
user@host> file show /var/logical-systems/A/log/bgp-log
Aug 10 17:12:01 trace_on: Tracing to "/var/log/A/bgp-log" started
Aug 10 17:14:22.826182 bgp_peer_mgmt_clear:5829: NOTIFICATION sent to
192.163.6.4 (Internal AS 17): code 6 (Cease) subcode 4 (Administratively
Reset), Reason: Management session cleared BGP neighbor
Aug 10 17:14:22.826445 bgp_send: sending 21 bytes to 192.163.6.4 (Internal
AS 17)
Aug 10 17:14:22.826499
```


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```
Aug 10 17:14:22.826499 BGP SEND 192.168.6.5+64965 -> 192.163.6.4+179
Aug 10 17:14:22.826559 BGP SEND message type 3 (Notification) length 21
Aug 10 17:14:22.826598 BGP SEND Notification code 6 (Cease) subcode 4
(Administratively Reset)
Aug 10 17:14:22.831756 bgp_peer_mgmt_clear:5829: NOTIFICATION sent to
192.168.40.4 (Internal AS 17): code 6 (Cease) subcode 4 (Administratively
Reset), Reason: Management session cleared BGP neighbor
Aug 10 17:14:22.831851 bgp_send: sending 21 bytes to 192.168.40.4 (Internal
 AS 17)
Aug 10 17:14:22.831901
Aug 10 17:14:22.831901 BGP SEND 192.168.6.5+53889 -> 192.168.40.4+179
Aug 10 17:14:22.831959 BGP SEND message type 3 (Notification) length 21
Aug 10 17:14:22.831999 BGP SEND Notification code 6 (Cease) subcode 4
(Administratively Reset)
...
```

4. Filter the output of the log file.

```
user@host> file show /var/logical-systems/A/log/bgp-log | match "flags 0x40"
Aug 10 17:14:54.867460 BGP SEND flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.867595 BGP SEND flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.867650 BGP SEND flags 0x40 code NextHop(3): 192.168.6.5
Aug 10 17:14:54.867692 BGP SEND flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.884529 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.884581 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.884628 BGP RECV flags 0x40 code NextHop(3): 192.163.6.4
Aug 10 17:14:54.884667 BGP RECV flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.911377 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.911422 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.911466 BGP RECV flags 0x40 code NextHop(3): 192.168.40.4
Aug 10 17:14:54.911507 BGP RECV flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.916008 BGP SEND flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.916054 BGP SEND flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.916100 BGP SEND flags 0x40 code NextHop(3): 192.168.6.5
Aug 10 17:14:54.916143 BGP SEND flags 0x40 code LocalPref(5): 100
Aug 10 17:14:54.920304 BGP RECV flags 0x40 code Origin(1): IGP
Aug 10 17:14:54.920348 BGP RECV flags 0x40 code ASPath(2) length 0: <null>
Aug 10 17:14:54.920393 BGP RECV flags 0x40 code NextHop(3): 10.0.0.10
Aug 10 17:14:54.920434 BGP RECV flags 0x40 code LocalPref(5): 100
```

5. View the tracing operations in real time.

```
user@host> clear bgp neighbor logical-system A
Cleared 2 connections
```

CAUTION: Clearing the BGP neighbor table is disruptive in a production environment.

6. Run the **monitor start** command with an optional **match** condition.

```
user@host> monitor start A/bgp-log | match 0.0.0.0/0
```

```
Aug 10 19:21:40.773467 BGP RECV         0.0.0.0/0
Aug 10 19:21:40.773685 bgp_rcv_nlri: 0.0.0.0/0
Aug 10 19:21:40.773778 bgp_rcv_nlri: 0.0.0.0/0 belongs to meshgroup
Aug 10 19:21:40.773832 bgp_rcv_nlri: 0.0.0.0/0 qualified bnp->ribact 0x0
l2afcb 0x0
```

7. Pause the **monitor** command by pressing Esc-Q.
   To unpause the output, press Esc-Q again.

8. Halt the **monitor** command by pressing Enter and typing **monitor stop**.

```
[Enter]
user@host> monitor stop
```

9. When you are finished troubleshooting, consider deactivating trace logging to avoid any unnecessary impact to system resources.

```
[edit protocols bgp group internal-peers]
user@host:A# deactivate traceoptions
user@host:A# commit
```

   When configuration is deactivated, it appears in the configuration with the **inactive** tag.To reactivate trace operations, use the **activate** configuration-mode statement.

```
[edit protocols bgp group internal-peers]
user@host:A# show
```

```
type internal;
inactive: traceoptions {
    file bgp-log size 10k files 2;
    flag update detail;
    flag all;
}
local-address 192.168.6.5;
export send-direct;
neighbor 192.163.6.4;
neighbor 192.168.40.4;
```

10. To reactivate trace operations, use the **activate** configuration-mode statement.

```
[edit protocols bgp group internal-peers]
user@host:A# activate traceoptions
user@host:A# commit
```

Deactivating and Reactivating Trace Logging

Step-by-Step Procedure

To deactivate and reactivate the trace file:

1. When you are finished troubleshooting, consider deactivating trace logging to avoid an unnecessary impact to system resources.

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```
[edit protocols bgp group internal-peers]
user@host:A# deactivate traceoptions
user@host:A# commit
```

When configuration is deactivated, the statement appears in the configuration with the **inactive** tag.

```
[edit protocols bgp group internal-peers]
user@host:A# show

type internal;
inactive: traceoptions {
    file bgp-log size 10k files 2;
    flag update detail;
    flag all;
}
local-address 192.168.6.5;
export send-direct;
neighbor 192.163.6.4;
neighbor 192.168.40.4;
```

2. To reactivate logging, use the **activate** configuration-mode statement.

```
[edit protocols bgp group internal-peers]
user@host:A# activate traceoptions
user@host:A# commit
```

Results

From configuration mode, confirm your configuration by entering the **show logical-systems A protocols bgp group internal-peers** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show logical-systems A protocols bgp group internal-peers
traceoptions {
   file bgp-log size 10k files 2;
   flag update detail;
}
```

Verification

Confirm that the configuration is working properly.

Verifying That the Trace Log File Is Operating

Purpose Make sure that events are being written to the log file.

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Action `user@host:A>` **show log bgp-log**

```
Aug 12 11:20:57 trace_on: Tracing to "/var/log/A/bgp-log" started
```

Tracing BMP Operations

You can trace BMP operations for all BMP stations by configuring the **traceoptions** statement at the **[edit routing-options** bmp**]** hierarchy level or for specific BMP stations at the **[edit routing-options bmp** station ***station-name*****]** hierarchy level.

To trace BMP operations, complete the following steps:

1. Configure the **traceoptions** statement:

```
traceoptions {
   file filename <files number> <size size> <world-readable | no-world-readable>;
   flag flag <flag-modifier> <disable>;
}
```

2. Specify the name of the file to receive the output of the tracing operation using the **file** option. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BMP tracing output in the file **bmp-log**.

3. (Optional) Specify the maximum number of trace files using the **files** option. When a trace file named ***trace-file*.0** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

4. (Optional) Specify the maximum size of each trace file using the **size** option in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

5. (Optional) You can specify that the log files are either **world-readalbe** (accessible to all users on the device) or **no-world-readable** (not accessible to all users on the device).

6. You can specify the following BMP-specific trace options using the **flag** statement:

   - **all**—Trace all BMP monitoring operations.
   - **down**—Down messages.
   - **error**—Error conditions.

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- **event**—Major events, station establishment, errors, and events.
- **general**—General events.
- **normal**—Normal events.
- **packets**—All messages.
- **policy**—Policy processing.
- **route**—Routing information.
- **route-monitoring**—Route monitoring messages.
- **state**—State transitions.
- **statistics**—Statistics messages.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.
- **up**—Up messages.
- **write**—Writing of messages.

You can optionally specify one or more of the following flag modifiers:

- **detail**—Provide detailed trace information.
- **disable**—Disable the tracing flag.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

NOTE: **Use the all trace flag and the detail flag modifier with caution due to the increased computer processing power required.**

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

Checklist for Verifying the BGP Protocol and Peers

Purpose Table 14 on page 956 provides links and commands for verifying whether the Border Gateway Protocol (BGP) is configured correctly on a Juniper Networks router in your network, the internal Border Gateway Protocol (IBGP) and exterior Border Gateway Protocol (EBGP) sessions are properly established, the external routes are advertised and received correctly, and the BGP path selection process is working properly.

Action

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Table 14: Checklist for Verifying the BGP Protocol and Peers

Tasks	Command or Action
"Verify the BGP Protocol" on page 998	
1. Verify BGP on an Internal Router on page 990	**show configuration**
2. Verify BGP on a Border Router on page 992	**show configuration**
"Verify BGP Peers" on page 988	
1. Check BGP Sessions on page 976	**show bgp summary**
2. Verify Advertised BGP Routes on page 996	**show route advertising-protocol bgp *neighbor-address***
3. Verify That a Particular BGP Route Is Received on Your Router on page 996	**show route receive-protocol bgp *neighbor-address***
"Examine BGP Routes and Route Selection" on page 1013	
1. Examine the Local Preference Selection on page 1015	**show route *destination-prefix* < detail >**
2. Examine the Multiple Exit Discriminator Route Selection on page 1016	**show route *destination-prefix* < detail >**
3. Examine the EBGP over IBGP Selection on page 997	**show route *destination-prefix* < detail >**
4. Examine the IGP Cost Selection on page 1019	**show route *destination-prefix* < detail >**
"Examine Routes in the Forwarding Table" on page 1020	**show route forwarding-table**

Checklist for Checking the BGP Layer

Problem **Description:** This checklist provides the steps and commands for checking the BGP configuration of the Multiprotocol Label Switching (MPLS) network. The checklist provides links to an overview of the BGP configuration and more detailed information about the commands used to configure BGP. (See Table 15 on page 956.)

Table 15: Checklist for Checking the BGP Layer

Solution

Tasks	Command or Action
"Checking the BGP Layer" on page 973	
1. Check That BGP Traffic Is Using the LSP on page 975	**traceroute *hostname***
2. Check BGP Sessions on page 976	**show bgp summary**
3. Verify the BGP Configuration on page 977	**show configuration**
4. Examine BGP Routes on page 983	**show route *destination-prefix* detail**

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Table 15: Checklist for Checking the BGP Layer (continued)

Tasks	Command or Action
5. Verify Received BGP Routes on page 984	**show route receive protocol bgp** *neighbor-address*
6. Taking Appropriate Action for Resolving the Network Problem on page 967	The following sequence of commands addresses the specific problem described in this topic: **[edit]** **edit protocols bgp** **[edit protocols bgp]** **show** **set local-address 10.0.0.1** **delete group internal neighbor 10.1.36.2** **show** **commit**
7. Check That BGP Traffic Is Using the LSP Again on page 986	**traceroute** *hostname*

Example: Tracing Global Routing Protocol Operations

This example shows how to list and view files that are created when you enable global routing trace operations.

- Requirements on page 957
- Overview on page 957
- Configuration on page 958
- Verification on page 961

Requirements

You must have the **view** privilege.

Overview

To configure global routing protocol tracing, include the **traceoptions** statement at the **[edit routing-options]** hierarchy level:

```
traceoptions {
   file filename <files number> <size size> <world-readable | no-world-readable>;
   flag flag <disable>;
}
```

The flags in a **traceoptions flag** statement are identifiers. When you use the **set** command to configure a flag, any flags that might already be set are not modified. In the following example, setting the **timer** tracing flag has no effect on the already configured **task** flag. Use the **delete** command to delete a particular flag.

```
[edit routing-options traceoptions]
```

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```
user@host# show
flag task;
user@host# set traceoptions flag timer
user@host# show
flag task;
flag timer;
user@host# delete traceoptions flag task
user@host# show
flag timer;
```

This example shows how to configure and view a trace file that tracks changes in the routing table. The steps can be adapted to apply to trace operations for any Junos OS hierarchy level that supports trace operations.

TIP: To view a list of hierarchy levels that support tracing operations, enter the **help apropos traceoptions** command in configuration mode.

Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set routing-options traceoptions file routing-table-changes
set routing-options traceoptions file size 10m
set routing-options traceoptions file files 10
set routing-options traceoptions flag route
set routing-options static route 1.1.1.2/32 next-hop 10.0.45.6
```

Configuring Trace Operations

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To configure the trace operations:

1. Configure trace operations.

```
[edit routing-options traceoptions]
user@host# set file routing-table-changes
user@host# set file size 10m
user@host# set file files 10
user@host# set flag route
```


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2. Configure a static route to cause a change in the routing table.

```
[edit routing-options static]
user@host# set route 1.1.1.2/32 next-hop 10.0.45.6
```

3. If you are done configuring the device, commit the configuration.

```
[edit]
user@host# commit
```

Viewing the Trace File

Step-by-Step Procedure

To view the trace file:

1. In operational mode, list the log files on the system.

```
user@host> file list /var/log
/var/log:
...
routing-table-changes
...
```

2. View the contents of the **routing-table-changes** file.

```
user@host> file show /var/log/routing-table-changes
Dec 15 11:09:29 trace_on: Tracing to "/var/log/routing-table-changes" started
Dec 15 11:09:29.496507
Dec 15 11:09:29.496507 Tracing flags enabled: route
Dec 15 11:09:29.496507
Dec 15 11:09:29.533203 inet_routerid_notify: Router ID: 192.168.4.1
Dec 15 11:09:29.533334 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.533381 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.533420 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.534915 inet_routerid_notify: Router ID: 192.168.4.1
Dec 15 11:09:29.542934 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.549253 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.556878 inet_routerid_notify: No Router ID assigned
Dec 15 11:09:29.582990 rt_static_reinit: examined 3 static nexthops, 0
unreferenced
Dec 15 11:09:29.589920
Dec 15 11:09:29.589920 task_reconfigure reinitializing done
...
```

3. Filter the output of the log file.

```
user@host> file show /var/log/routing-table-changes | match 1.1.1.2
Dec 15 11:15:30.780314 ADD      1.1.1.2/32          nhid 0 gw 10.0.45.6
   Static   pref 5/0 metric  at-0/2/0.0 <ctive Int Ext>
Dec 15 11:15:30.782276 KRT Request: send len 216 v104 seq 0 ADD route/user
af 2 table 0 infot 0 addr 1.1.1.2 nhop-type unicast nhindex 663
```

4. View the tracing operations in real time by running the **monitor start** command with an optional **match** condition.

```
user@host> monitor start routing-table-changes | match 1.1.1.2
Aug 10 19:21:40.773467 BGP RECV         0.0.0.0/0
Aug 10 19:21:40.773685 bgp_rcv_nlri: 0.0.0.0/0
Aug 10 19:21:40.773778 bgp_rcv_nlri: 0.0.0.0/0 belongs to meshgroup
Aug 10 19:21:40.773832 bgp_rcv_nlri: 0.0.0.0/0 qualified bnp->ribact 0x0
l2afcb 0x0
```

5. Deactivate the static route.

```
user@host# deactivate routing-options static route 1.1.1.2/32
user@host# commit
```

```
*** routing-table-changes ***
Dec 15 11:42:59.355557 CHANGE   1.1.1.2/32          nhid 663 gw 10.0.45.6
     Static   pref 5/0 metric  at-0/2/0.0 <Delete Int Ext>
Dec 15 11:42:59.426887 KRT Request: send len 216 v104 seq 0 DELETE route/user
 af 2 table 0 infot 0 addr 1.1.1.2 nhop-type discard filtidx 0
Dec 15 11:42:59.427366 RELEASE  1.1.1.2/32          nhid 663 gw 10.0.45.6
     Static   pref 5/0 metric  at-0/2/0.0 <Release Delete Int Ext>
```

6. Halt the **monitor** command by pressing Enter and typing **monitor stop**.

```
[Enter]
user@host> monitor stop
```

7. When you are finished troubleshooting, consider deactivating trace logging to avoid any unnecessary impact to system resources.

   When configuration is deactivated, it appears in the configuration with the **inactive** tag.

```
[edit routing-options]
user@host# deactivate traceoptions
user@host# commit
```

```
[edit routing-options]
user@host# show

inactive: traceoptions {
    file routing-table-changes size 10m files 10;
    flag route;
}
static {
    inactive: route 1.1.1.2/32 next-hop 10.0.45.6;
}
```

8. To reactivate trace operations, use the **activate** configuration-mode statement.

```
[edit routing-options]
user@host# activate traceoptions
```


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```
user@host# commit
```

Results

From configuration mode, confirm your configuration by entering the **show routing-options** command. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show routing-options
traceoptions {
   file routing-table-changes size 10m files 10;
   flag route;
}
static {
   route 1.1.1.2/32 next-hop 10.0.45.6;
}
```

Verification

Confirm that the configuration is working properly.

Verifying That the Trace Log File Is Operating

Purpose Make sure that events are being written to the log file.

Action

```
user@host> show log routing-table-changes
Dec 15 11:09:29 trace_on: Tracing to "/var/log/routing-table-changes" started
```

Related Documentation

- *Understanding Global Routing Protocol Tracing Operations*
- CLI Explorer

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CHAPTER 28

Troubleshooting Network Issues

- Working with Problems on Your Network on page 963
- Isolating a Broken Network Connection on page 964
- Identifying the Symptoms of a Broken Network Connection on page 965
- Isolating the Causes of a Network Problem on page 966
- Taking Appropriate Action for Resolving the Network Problem on page 967
- Evaluating the Solution to Check Whether the Network Problem Is Resolved on page 968

Working with Problems on Your Network

Problem **Description:** This checklist provides links to troubleshooting basics, an example network, and includes a summary of the commands you might use to diagnose problems with the router and network.

Table 16: Checklist for Working with Problems on Your Network

Tasks	Command or Action
Solution	
"Isolating a Broken Network Connection" on page 964	
1. Identifying the Symptoms of a Broken Network Connection on page 965	ping (*ip-address* | *hostname*) show route (*ip-address* | *hostname*) traceroute (*ip-address* | *hostname*)
2. Isolating the Causes of a Network Problem on page 966	show < configuration | interfaces | protocols | route >
3. Taking Appropriate Action for Resolving the Network Problem on page 967	[edit] delete routing options static route *destination-prefix* commit and-quit show route *destination-prefix*
4. Evaluating the Solution to Check Whether the Network Problem Is Resolved on page 968	show route (*ip-address* | *hostname*) ping (*ip-address* | *hostname*) count 3 traceroute (*ip-address* | *hostname*)

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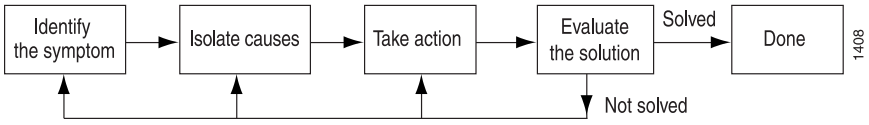
Isolating a Broken Network Connection

By applying the standard four-step process illustrated in Figure 88 on page 964, you can isolate a failed node in the network. Note that the functionality described in this section is not supported in versions 15.1X49, 15.1X49-D30, or 15.1X49-D40.

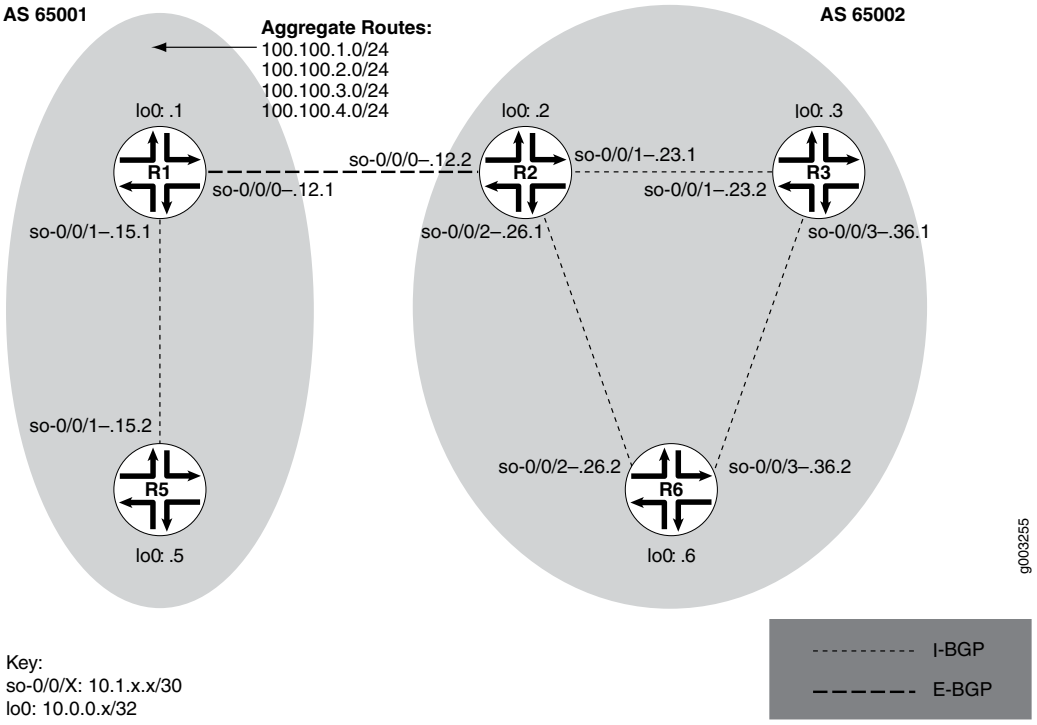
Figure 88: Process for Diagnosing Problems in Your Network



Before you embark on the four-step process, however, it is important that you are prepared for the inevitable problems that occur on all networks. While you might find a solution to a problem by simply trying a variety of actions, you can reach an appropriate solution more quickly if you are systematic in your approach to the maintenance and monitoring of your network. To prepare for problems on your network, understand how the network functions under normal conditions, have records of baseline network activity, and carefully observe the behavior of your network during a problem situation.

Figure 89 on page 964 shows the network topology used in this topic to illustrate the process of diagnosing problems in a network.

Figure 89: Network with a Problem



Key:
so-0/0/X: 10.1.x.x/30
lo0: 10.0.0.x/32

The network in Figure 89 on page 964 consists of two autonomous systems (ASs). AS 65001 includes two routers, and AS 65002 includes three routers. The border router (**R1**) in AS 65001 announces aggregated prefixes **100.100/24** to the AS 65002 network. The

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problem in this network is that **R6** does not have access to **R5** because of a loop between **R2** and **R6**.

To isolate a failed connection in your network, follow the steps in these topics:

- Identifying the Symptoms of a Broken Network Connection on page 965
- Isolating the Causes of a Network Problem on page 966
- Taking Appropriate Action for Resolving the Network Problem on page 967
- Taking Appropriate Action for Resolving the Network Problem on page 967
- Evaluating the Solution to Check Whether the Network Problem Is Resolved on page 968

Identifying the Symptoms of a Broken Network Connection

Problem **Description:** The symptoms of a problem in your network are usually quite obvious, such as the failure to reach a remote host.

Solution To identify the symptoms of a problem on your network, start at one end of your network and follow the routes to the other end, entering all or one of the following Junos OS command-line interfaces (CLI) operational mode commands:

```
user@host> ping (ip-address | host-name)
user@host> show route (ip-address | host-name)
user@host> traceroute (ip-address | host-name)
```

Sample Output

```
user@R6> ping 10.0.0.5
PING 10.0.0.5 (10.0.0.5): 56 data bytes
36 bytes from 10.1.26.1: Time to live exceeded
Vr HL TOS  Len   ID Flg  off TTL Pro  cks      Src      Dst
 4  5  00 0054 e2db   0 0000  01  01 a8c6 10.1.26.2  10.0.0.5

36 bytes from 10.1.26.1: Time to live exceeded
Vr HL TOS  Len   ID Flg  off TTL Pro  cks      Src      Dst
 4  5  00 0054 e2de   0 0000  01  01 a8c3 10.1.26.2  10.0.0.5

36 bytes from 10.1.26.1: Time to live exceeded
Vr HL TOS  Len   ID Flg  off TTL Pro  cks      Src      Dst
 4  5  00 0054 e2e2   0 0000  01  01 a8bf 10.1.26.2  10.0.0.5

^C
--- 10.0.0.5 ping statistics ---
3 packets transmitted, 0 packets received, 100% packet loss

user@R6> show route 10.0.0.5

inet.0: 20 destinations, 20 routes (20 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.5/32        *[IS-IS/165] 00:02:39, metric 10
                     > to 10.1.26.1  via so-0/0/2.0
```

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```
user@R6> traceroute 10.0.0.5
traceroute to 10.0.0.5 (10.0.0.5), 30 hops max, 40 byte packets
 1  10.1.26.1 (10.1.26.1)  0.649 ms  0.521 ms  0.490 ms
 2  10.1.26.2 (10.1.26.2)  0.521 ms  0.537 ms  0.507 ms
 3  10.1.26.1 (10.1.26.1)  0.523 ms  0.536 ms  0.514 ms
 4  10.1.26.2 (10.1.26.2)  0.528 ms  0.551 ms  0.523 ms
 5  10.1.26.1 (10.1.26.1)  0.531 ms  0.550 ms  0.524 ms
```

Meaning

The sample output shows an unsuccessful **ping** command in which the packets are being rejected because the time to live is exceeded. The output for the **show route** command shows the interface (**10.1.26.1**) that you can examine further for possible problems. The **traceroute** command shows the loop between **10.1.26.1** (**R2**) and **10.1.26.2** (**R6**), as indicated by the continuous repetition of the two interface addresses.

Isolating the Causes of a Network Problem

Problem **Description:** A particular symptom can be the result of one or more causes. Narrow down the focus of your search to find each individual cause of the unwanted behavior.

Solution To isolate the cause of a particular problem, enter one or all of the following Junos OS CLI operational mode command:

```
user@host> show < configuration | bgp | interfaces | isis | ospf | route >
```

Your particular problem may require the use of more than just the commands listed above. See the appropriate command reference for a more exhaustive list of commonly used operational mode commands.

Sample Output

```
user@R6> show interfaces terse
Interface               Admin Link Proto Local                 Remote
so-0/0/0                up    up
so-0/0/0.0              up    up   inet  10.1.56.2/30
                                   iso
so-0/0/2                up    up
so-0/0/2.0              up    up   inet  10.1.26.2/30
                                   iso
so-0/0/3                up    up
so-0/0/3.0              up    up   inet  10.1.36.2/30
                                   iso
[...Output truncated...]
```

The following sample output is from **R2**:

```
user@R2> show route 10.0.0.5

inet.0: 22 destinations, 25 routes (22 active, 0 holddown, 0 hidden)
```


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```
+ = Active Route, - = Last Active, * = Both

10.0.0.5/32         *[Static/5] 00:16:21
                    > to 10.1.26.2 via so-0/0/2.0
                    [BGP/170] 3d 20:23:35, MED 5, localpref 100
                      AS path: 65001 I
                    > to 10.1.12.1 via so-0/0/0.0
```

Meaning

The sample output shows that all interfaces on **R6** are up. The output from **R2** shows that a static route [**Static/5**] configured on **R2** points to **R6** (**10.1.26.2**) and is the preferred route to **R5** because of its low preference value. However, the route is looping from **R2** to **R6**, as indicated by the missing reference to **R5** (**10.1.15.2**).

Taking Appropriate Action for Resolving the Network Problem

Problem **Description:** The appropriate action depends on the type of problem you have isolated. In this example, a static route configured on **R2** is deleted from the [**routing-options**] hierarchy level. Other appropriate actions might include the following:

Solution

- Check the local router's configuration and edit it if appropriate.
- Troubleshoot the intermediate router.
- Check the remote host configuration and edit it if appropriate.
- Troubleshoot routing protocols.
- Identify additional possible causes.

To resolve the problem in this example, enter the following Junos OS CLI commands:

```
[edit]
user@R2# delete routing-options static route destination-prefix
user@R2# commit and-quit
user@R2# show route destination-prefix
```

Sample Output

```
[edit]
user@R2# delete routing-options static route 10.0.0.5/32

[edit]
user@R2# commit and-quit
commit complete
Exiting configuration mode

user@R2> show route 10.0.0.5

inet.0: 22 destinations, 24 routes (22 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```

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```
10.0.0.5/32        *[BGP/170] 3d 20:26:17, MED 5, localpref 100
                      AS path: 65001 I
                    > to 10.1.12.1 via so-0/0/0.0
```

Meaning

The sample output shows the static route deleted from the [**routing-options**] hierarchy and the new configuration committed. The output for the **show route** command now shows the BGP route as the preferred route, as indicated by the asterisk (*).

Evaluating the Solution to Check Whether the Network Problem Is Resolved

Problem **Description:** If the problem is solved, you are finished. If the problem remains or a new problem is identified, start the process over again.

You can address possible causes in any order. In relation to the network in "Isolating a Broken Network Connection" on page 964, we chose to work from the local router toward the remote router, but you might start at a different point, particularly if you have reason to believe that the problem is related to a known issue, such as a recent change in configuration.

Solution To evaluate the solution, enter the following Junos OS CLI commands:

```
user@host> show route (ip-address |host-name)
user@host> ping (ip-address | host-name)
user@host> traceroute (ip-address | host-name)
```

Sample Output

```
user@R6> show route 10.0.0.5

inet.0: 20 destinations, 20 routes (20 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.5/32         *[BGP/170]  00:01:35, MED 5, localpref 100, from 10.0.0.2
                      AS path: 65001 I
                    > to 10.1.26.1 via so-0/0/2.0

user@R6> ping 10.0.0.5
PING 10.0.0.5 (10.0.0.5): 56 data bytes
64 bytes from 10.0.0.5: icmp_seq=0 ttl=253 time=0.866 ms
64 bytes from 10.0.0.5: icmp_seq=1 ttl=253 time=0.837 ms
64 bytes from 10.0.0.5: icmp_seq=2 ttl=253 time=0.796 ms
^C
--- 10.0.0.5 ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.796/0.833/0.866/0.029 ms

user@R6> traceroute 10.0.0.5
traceroute to 10.0.0.5 (10.0.0.5), 30 hops max, 40 byte packets
 1  10.1.26.1 (10.1.26.1)  0.629 ms  0.538 ms  0.497 ms
```


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```
2  10.1.12.1 (10.1.12.1)  0.534 ms  0.538 ms  0.510 ms
3  10.0.0.5 (10.0.0.5)  0.776 ms  0.705 ms  0.672 ms
```

Meaning

The sample output shows that there is now a connection between **R6** and **R5.** The **show route** command shows that the BGP route to **R5** is preferred, as indicated by the asterisk (*****). The **ping** command is successful and the **traceroute** command shows that the path from **R6** to **R5** is through **R2** (**10.1.26.1**), and then through **R1** (**10.1.12.1**).

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CHAPTER 29

Troubleshooting BGP Sessions

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- Checking the BGP Layer on page 973
- Check BGP Sessions on page 987
- Verify BGP Peers on page 988
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- Examine the EBGP over IBGP Selection on page 1064
- Verify BGP on an Internal Router on page 1065
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Understanding Hidden Routes

Hidden routes are routes that the device cannot use for reasons such as an invalid next hop or a routing policy that rejects the routes.

NOTE: If a route is completely invalid, the route is not placed into the routing table as a candidate route and does not even appear as hidden.

Following are some useful commands for viewing and troubleshooting hidden routes:

- show route hidden **(terse | detail | extensive)**
- show route ***hidden-route*** **extensive**
- show route ***next-hop-of-hidden-route*** **extensive**
- **show route resolution unresolved detail**

Routes can be hidden for the following reasons:

- An import policy rejects the route.
- The next hop cannot be resolved using the current indirect next hop resolution rule. Because routing protocols such as internal BGP (IBGP) can send routing information about indirectly connected routes, Junos OS relies on routes from intra-AS routing protocols (OSPF, IS-IS, RIP, and static) to resolve the best directly connected next hop. The Routing Engine performs route resolution to determine the best directly connected next hop and installs the route to the Packet Forwarding Engine.
- A damping policy suppresses the route.
- The AS path contains illegal or invalid confederation attributes.
- The next hop address is the address of the local routing device.
- The AS path contains illegal or invalid transitive attributes.
- The AS path is empty. This only applies to EBGP. For IBGP, an empty AS path is normal.
- The AS path contains a zero.
- The next hop address is a multicast address.
- The next hop address is an IPv6 link-local address.

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- The route prefix or the route next hop is a martian address.
- The LDP (Label Distribution Protocol) session fails. The received routes are not installed in the routing table until the peer router reestablishes the LDP session.

Related Documentation

- *Example: Configuring a Basic Set of Static Routes for Connecting to Stub Networks*
- *Example: Configuring IPv6 Static Routes*
- *Example: Optimizing Route Reconvergence by Enabling Indirect Next Hops on the Packet Forwarding Engine*
- *Example: Configuring BGP Route Reflectors*
- Example: Configuring BGP Confederations on page 755
- *Examples: Configuring BGP Flap Damping*
- *Understanding Basic Static Routing*
- Understanding BGP Confederations on page 754
- *Understanding Indirect Next Hops*

Checking the BGP Layer

Purpose After you have configured the label-switched path (LSP) and determined that it is up, and configured BGP and determined that sessions are established, ensure that BGP is using the LSP to forward traffic.

Figure 90 on page 974 illustrates the BGP layer of the layered MPLS model.

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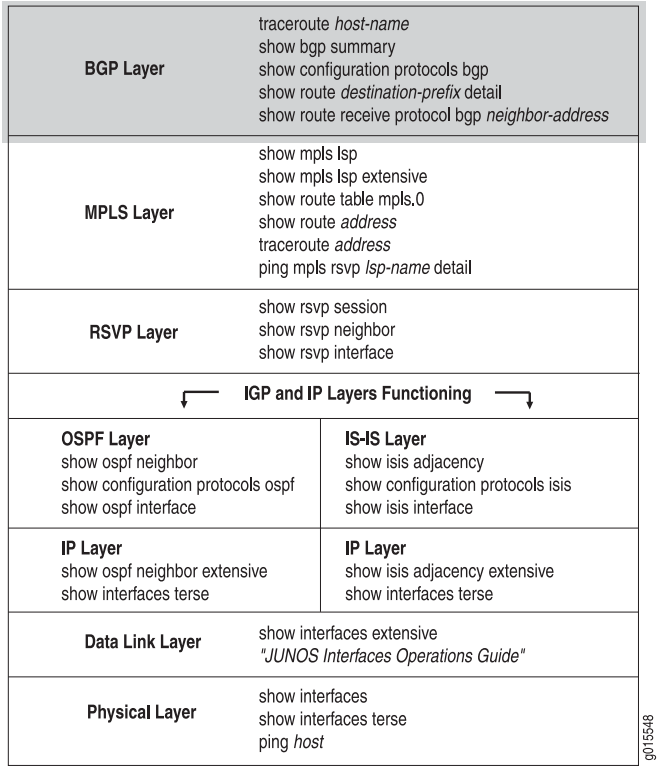
Figure 90: Checking the BGP Layer



When you check the BGP layer, you verify that the route is present and active, and more importantly, you ensure that the next hop is the LSP. There is no point in checking the BGP layer unless the LSP is established, because BGP uses the MPLS LSP to forward traffic. If the network is not functioning at the BGP layer, the LSP does not work as configured.

Figure 91 on page 975 illustrates the MPLS network used in this topic.

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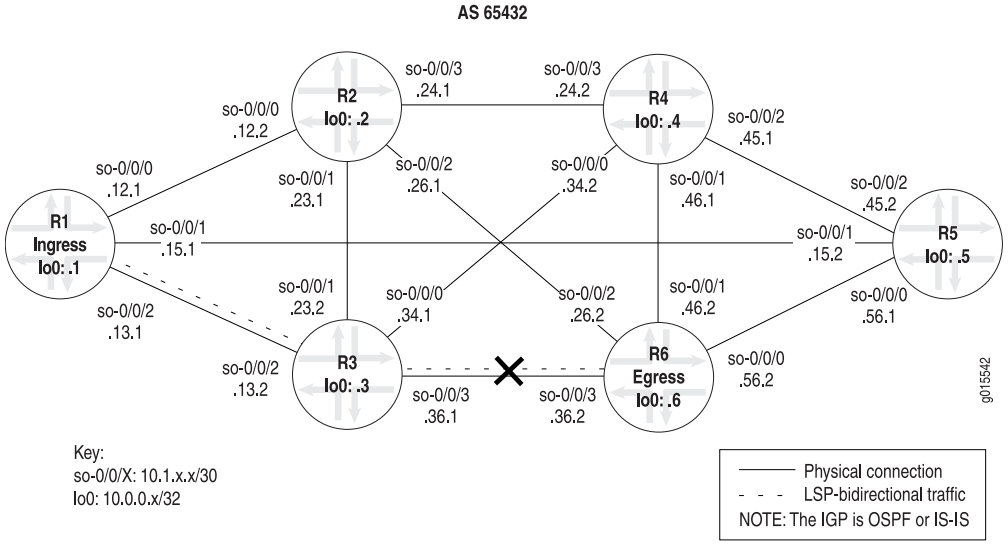
Figure 91: MPLS Network Broken at the BGP Layer



The network shown in Figure 91 on page 975 is a fully meshed configuration where every directly connected interface can receive and send packets to every other similar interface. The LSP in this network is configured to run from ingress router **R1**, through transit router **R3**, to egress router **R6**. In addition, a reverse LSP is configured to run from **R6** through **R3** to **R1**, creating bidirectional traffic.

The cross shown in Figure 91 on page 975 indicates where BGP is not being used to forward traffic through the LSP. Possible reasons for the LSP not working correctly are that the destination IP address of the LSP does not equal the BGP next hop or that BGP is not configured properly.

To check the BGP layer, follow these steps:

1. Check That BGP Traffic Is Using the LSP on page 975
2. Check BGP Sessions on page 976
3. Verify the BGP Configuration on page 977
4. Examine BGP Routes on page 983
5. Verify Received BGP Routes on page 984
6. Taking Appropriate Action for Resolving the Network Problem on page 985
7. Check That BGP Traffic Is Using the LSP Again on page 986

Check That BGP Traffic Is Using the LSP

Purpose At this level of the troubleshooting model, BGP and the LSP may be up, however BGP traffic might not be using the LSP to forward traffic.

Action To verify that BGP traffic is using the LSP, enter the following Junos OS command-line interface (CLI) operational mode command from the ingress router:

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```
user@host> traceroute hostname
```

Sample Output

```
user@R1> traceroute 100.100.6.1
traceroute to 100.100.6.1 (100.100.6.1), 30 hops max, 40 byte packets
 1  10.1.13.2 (10.1.13.2)  0.653 ms  0.590 ms  0.543 ms
 2  10.1.36.2 (10.1.36.2)  0.553 ms !N  0.552 ms !N  0.537 ms !N

user@R6> traceroute 100.100.1.1
traceroute to 100.100.1.1 (100.100.1.1), 30 hops max, 40 byte packets
 1  10.1.36.1 (10.1.36.1)  0.660 ms  0.551 ms  0.526 ms
 2  10.1.13.1 (10.1.13.1)  0.568 ms !N  0.553 ms !N  0.536 ms !N
```

Meaning The sample output shows that BGP traffic is not using the LSP, consequently MPLS labels do not appear in the output. Instead of using the LSP, BGP traffic is using the interior gateway protocol (IGP) to reach the BGP next-hop LSP egress address for **R6** and **R1**. The Junos OS default is to use LSPs for BGP traffic when the BGP next hop equals the LSP egress address.

Check BGP Sessions

Purpose Display summary information about BGP and its neighbors to determine if routes are received from peers in the autonomous system (AS). When a BGP session is established, the peers are exchanging update messages.

Action To check that BGP sessions are up, enter the following Junos OS CLI operational mode command from the ingress router:

```
user@host> show bgp summary
```

Sample Output 1

```
user@R1> show bgp summary
Groups: 1 Peers: 6   Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          1          0          0          0          0
Peer              AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65432      11257      11259       0       0 3d 21:49:57  0/0/0
               0/0/0
10.0.0.3        65432      11257      11259       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.4        65432      11257      11259       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.5        65432      11257      11260       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.6    65432    4    4572    0    1 3d 21:46:59 Active
10.1.36.2       65432      11252      11257       0       0 3d 21:46:49  1/1/0
               0/0/0
```


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Sample Output 2

```
user@R1> show bgp summary
Groups: 1 Peers: 5 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          1          0          0          0          0
Peer              AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65432         64         68       0       0       32:18 0/0/0
             0/0/0
10.0.0.3        65432         64         67       0       0       32:02 0/0/0
             0/0/0
10.0.0.4        65432         64         67       0       0       32:10 0/0/0
             0/0/0
10.0.0.5        65432         64         67       0       0       32:14 0/0/0
             0/0/0
10.0.0.6        65432         38         39       0       1       18:02 1/1/0
             0/0/0
```

Meaning Sample Output 1 shows that one peer (egress router **10.0.0.6**) is not established, as indicated by the **Down Peers: 1** field. The last column (**State|#Active/Received/Damped**) shows that peer **10.0.0.6** is active, indicating that is it not established. All other peers are established as indicated by the number of active, received, and damped routes. For example, **0/0/0** for peer **10.0.0.2** indicates that no BGP routes were active or received in the routing table, and no BGP routes were damped; **1/1/0** for peer **10.1.36.2** indicates that one BGP route was active and received in the routing table, and no BGP routes were damped.

If the output of the **show bgp summary** command of an ingress router shows that a neighbor is down, check the BGP configuration. For information on checking the BGP configuration, see "Verify the BGP Configuration" on page 977.

Sample Output 2 shows output from ingress router **R1** after the BGP configurations on **R1** and **R6** were corrected in "Taking Appropriate Action for Resolving the Network Problem" on page 967.. All BGP peers are established and one route is active and received. No BGP routes were damped.

If the output of the **show bgp summary** command shows that a neighbor is up but packets are not being forwarded, check for received routes from the egress router. For information on checking the egress router for received routes, see "Verify Received BGP Routes" on page 984.

Verify the BGP Configuration

Purpose For BGP to run on the router, you must define the local AS number, configure at least one group, and include information about at least one peer in the group (the peer's IP address and AS number). When BGP is part of an MPLS network, you must ensure that the LSP is configured with a destination IP address equal to the BGP next hop in order for BGP routes to be installed with the LSP as the next hop for those routes.

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Action To verify the BGP configuration, enter the following Junos OS CLI operational mode command:

```
user@host> show configuration
```

Sample Output 1

```
user@R1> show configuration
[...Output truncated...]
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.12.1/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.15.1/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.13.1/30;
            }
             family iso;
            family mpls;
        }
    }
    fxp0 {
        unit 0 {
            family inet {
                address 192.168.70.143/21;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.1/32;
            }
             family iso {
                address 49.0004.1000.0000.0001.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
         route 100.100.1.0/24 reject;
```


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```
    }
     router-id 10.0.0.1;
     autonomous-system 65432;
}
protocols {
    rsvp {
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface fxp0.0 {
            disable;
        }
    }
    mpls {
        label-switched-path R1-to-R6 {
            to  10.0.0.6; <<< destination address of the LSP
        }
        inactive: interface so-0/0/0.0;
        inactive: interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface fxp0.0 {
            disable;
        }
    }
    bgp {
        export send-statics; <<< missing local-address statement
         group internal {
            type internal;
            neighbor 10.0.0.2;
            neighbor 10.0.0.5;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
            neighbor 10.0.0.3;
            neighbor 10.1.36.2; <<< incorrect interface address
        }
    }
    isis {
        level 1 disable;
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface all {
            level 2 metric 10;
        }
        interface fxp0.0 {
            disable;
        }
        interface lo0.0 {
            passive;
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface so-0/0/1.0;
            interface so-0/0/2.0;
            interface lo0.0; {
                passive
            }
```

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```
        }
    }
}
policy-options {
    policy-statement send-statics {
        term statics {
            from {
                route-filter 100.100.1.0/24 exact;
            }
            then accept;
        }
    }
}
```

Sample Output 2

```
user@R6> show configuration
[...Output truncated...]
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.56.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.26.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.2/30;
            }
             family iso;
            family mpls;
        }
    }
    fxp0 {
        unit 0 {
            family inet {
```


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```
                address 192.168.70.148/21;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.6/32;
                address 127.0.0.1/32;
            }
            family iso {
                address 49.0004.1000.0000.0006.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
         route 100.100.6.0/24 reject;
    }
     router-id 10.0.0.6;
     autonomous-system 65432;
}
protocols {
    rsvp {
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface so-0/0/3.0;
        interface fxp0.0 {
            disable;
        }
    }
    mpls {
        label-switched-path R6-to-R1 {
            to 10.0.0.1; <<< destination address of the reverse LSP
        }
        inactive: interface so-0/0/0.0;
        inactive: interface so-0/0/1.0;
        inactive: interface so-0/0/2.0;
        interface so-0/0/3.0;
    }
    bgp {
        group internal {
            type internal;
            export send-statics; <<< missing local-address statement
             neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
            neighbor 10.0.0.5;
            neighbor 10.0.0.1;
            neighbor 10.1.13.1;          <<< incorrect interface address
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface fxp0.0 {
```

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```
            disable;
        }
        interface lo0.0 {
            passive;
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface so-0/0/1.0;
            interface so-0/0/2.0;
            interface so-0/0/3.0;
            interface lo0.0 {
                passive;
            }
        }
    }
}
policy-options {
    policy-statement send-statics {
        term statics {
            from {
                route-filter 100.100.6.0/24 exact;
            }
            then accept;
        }
    }
}
```

Meaning The sample output shows the BGP configurations on ingress router **R1** and egress router **R6**. Both configurations show the local AS (**65432**), one group (**internal**), and six peers configured. The underlying interior gateway protocol is IS-IS, and the relevant interfaces are configured to run IS-IS.

NOTE: In this configuration, the RID is manually configured to avoid any duplicate RID problems, and all interfaces configured with BGP include the **family inet** statement at the [**edit interfaces** *type-fpc/pic/port* **unit** *logical-unit-number*] hierarchy level.

Sample output for ingress router **R1** and egress router **R6** shows that the BGP protocol configuration is missing the **local-address** statement for the internal group. When the **local-address** statement is configured, BGP packets are forwarded from the local router loopback (**lo0**) interface address, which is the address to which BGP peers are peering. If the **local-address** statement is not configured, BGP packets are forwarded from the outgoing interface address, which does not match the address to which BGP peers are peering, and BGP does not come up.

On the ingress router, the IP address (**10.0.0.1**) in the **local-address** statement should be the same as the address configured for the LSP on the egress router (**R6**) in the **to** statement at the [**edit protocols mpls label-switched-path** *lsp-path-name*] hierarchy level.

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BGP uses this address, which is identical to the LSP address, to forward BGP traffic through the LSP.

In addition, the BGP configuration on **R1** includes two IP addresses for **R6**, an interface address (**10.1.36.2**) and a loopback (**lo0**) interface address (**10.0.0.6**), resulting in the LSP destination address (**10.0.0.6**) not matching the BGP next-hop address (**10.1.36.2**). The BGP configuration on **R6** also includes two IP addresses for **R1**, an interface address (**10.1.13.1**) and a loopback (**lo0**) interface address, resulting in the reverse LSP destination address (**10.0.0.1**) not matching the BGP next-hop address (**10.1.13.1**).

In this instance, because the **local-address** statement is missing in the BGP configurations of both routers and the LSP destination address does not match the BGP next-hop address, BGP is not using the LSP to forward traffic.

Examine BGP Routes

Purpose You can examine the BGP path selection process to determine the single, active path when BGP receives multiple routes to the same destination. In this step, we examine the reverse LSP **R6-to-R1**, making **R6** the ingress router for that LSP.

Action To examine BGP routes and route selection, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix detail
```

Sample Output 1

```
user@R6> show route 100.100.1.1 detail
inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
100.100.1.0/24 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.1.13.1
                Next hop: via so-0/0/3.0, selected
                 Protocol next hop: 10.1.13.1  Indirect next hop: 8671594 304
                State: <Active Int Ext>
                Local AS: 65432 Peer AS: 65432
                Age: 4d 5:15:39         Metric2: 2
                Task: BGP_65432.10.1.13.1+3048
                Announcement bits (2): 0-KRT 4-Resolve inet.0
                AS path: I
                Localpref: 100
                 Router ID: 10.0.0.1
```

Sample Output 2

```
user@R6> show route 100.100.1.1 detail
inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
100.100.1.0/24 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.0.0.1
                Next hop: via so-0/0/3.0 weight 1, selected
```

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```
  Label-switched-path R6-to-R1
Label operation: Push 100000
  Protocol next hop: 10.0.0.1  Indirect next hop: 8671330 301
State: <Active Int Ext>
Local AS: 65432 Peer AS: 65432
Age: 24:35      Metric2: 2
Task: BGP_65432.10.0.0.1+179
Announcement bits (2): 0-KRT 4-Resolve inet.0
AS path: I
Localpref: 100
  Router ID: 10.0.0.1
```

Meaning Sample Output 1 shows that the BGP next hop (**10.1.13.1**) does not equal the LSP destination address (**10.0.0.1**) in the **to** statement at the [**edit protocols mpls label-switched-path** *label-switched-path-name*] hierarchy level when the BGP configuration of **R6** and **R1** is incorrect.

Sample Output 2, taken after the configurations on R1 and R6 are corrected, shows that the BGP next hop (**10.0.0.1**) and the LSP destination address (**10.0.0.1**) are the same, indicating that BGP can use the LSP to forward BGP traffic.

Verify Received BGP Routes

Purpose Display the routing information received on router **R6**, the ingress router for the reverse LSP **R6-to-R1**.

Action To verify that a particular BGP route is received on the egress router, enter the following Junos OS CLI operational mode command:

```
user@host> show route receive protocol bgp neighbor-address
```

Sample Output 1

```
user@R6> show route receive-protocol bgp 10.0.0.1

inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
<<< missing route
inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

__juniper_private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0
hidden)
```

Sample Output 2

```
user@R6> show route receive-protocol bgp 10.0.0.1
```


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```
inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24    10.0.0.1        100    I

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

__juniper_private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0
hidden)
```

Meaning Sample Output 1 shows that ingress router **R6** (reverse LSP **R6-to-R1**) does not receive any BGP routes into the **inet.0** routing table when the BGP configurations of **R1** and **R6** are incorrect.

Sample Output 2 shows a BGP route installed in the **inet.0** routing table after the BGP configurations on **R1** and **R6** are corrected using "Taking Appropriate Action for Resolving the Network Problem" on page 967.

Taking Appropriate Action for Resolving the Network Problem

Problem **Description:** The appropriate action depends on the type of problem you have isolated. In this example, a static route configured on **R2** is deleted from the [**routing-options**] hierarchy level. Other appropriate actions might include the following:

Solution

- Check the local router's configuration and edit it if appropriate.
- Troubleshoot the intermediate router.
- Check the remote host configuration and edit it if appropriate.
- Troubleshoot routing protocols.
- Identify additional possible causes.

To resolve the problem in this example, enter the following Junos OS CLI commands:

```
[edit]
user@R2# delete routing-options static route destination-prefix
user@R2# commit and-quit
user@R2# show route destination-prefix
```

Sample Output

```
[edit]
user@R2#  delete routing-options static route 10.0.0.5/32

[edit]
user@R2#  commit and-quit
```

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```
commit complete
Exiting configuration mode

user@R2> show route 10.0.0.5

inet.0: 22 destinations, 24 routes (22 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.5/32         *[BGP/170] 3d 20:26:17, MED 5, localpref 100
                       AS path: 65001 I
                     > to 10.1.12.1 via so-0/0/0.0
```

Meaning

The sample output shows the static route deleted from the [**routing-options**] hierarchy and the new configuration committed. The output for the **show route** command now shows the BGP route as the preferred route, as indicated by the asterisk (*).

Check That BGP Traffic Is Using the LSP Again

Purpose After taking the appropriate action to correct the error, the LSP needs to be checked again to confirm that BGP traffic is using the LSP and that the problem in the BGP layer has been resolved.

Action To verify that BGP traffic is using the LSP, enter the following Junos OS CLI operational mode command from the ingress router:

```
user@host> traceroute hostname
```

Sample Output

```
user@R1> traceroute 100.100.6.1
traceroute to 100.100.6.1 (100.100.6.1), 30 hops max, 40 byte packets
 1  10.1.13.2 (10.1.13.2)  0.858 ms  0.740 ms  0.714 ms
      MPLS Label=100016 CoS=0 TTL=1 S=1
 2  10.1.36.2 (10.1.36.2)  0.592 ms !N  0.564 ms !N  0.548 ms !N

user@R6> traceroute 100.100.1.1
traceroute to 100.100.1.1 (100.100.1.1), 30 hops max, 40 byte packets
 1  10.1.36.1 (10.1.36.1)  0.817 ms  0.697 ms  0.771 ms
      MPLS Label=100000 CoS=0 TTL=1 S=1
 2  10.1.13.1 (10.1.13.1)  0.581 ms !N  0.567 ms !N  0.544 ms !N
```

Meaning The sample output shows that MPLS labels are used to forward packets through the LSP. Included in the output is a label value (**MPLS Label=100016**), the time-to-live value (**TTL=1**), and the stack bit value (**S=1**).

The **MPLS Label** field is used to identify the packet to a particular LSP. It is a 20-bit field, with a maximum value of (2^^20-1), approximately 1,000,000.

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The time-to-live (TTL) value contains a limit on the number of hops that this MPLS packet can travel through the network (1). It is decremented at each hop, and if the TTL value drops below one, the packet is discarded.

The bottom of the stack bit value (**S=1**) indicates that is the last label in the stack and that this MPLS packet has one label associated with it. The MPLS implementation in the Junos OS supports a stacking depth of 3 on the M-series routers and up to 5 on the T-series routing platforms. For more information on MPLS label stacking, see RFC 3032, *MPLS Label Stack Encoding*.

MPLS labels appear in the sample output because the **traceroute** command is issued to a BGP destination where the BGP next hop for that route is the LSP egress address. The Junos OS by default uses LSPs for BGP traffic when the BGP next hop equals the LSP egress address.

If the BGP next hop does not equal the LSP egress address, the BGP traffic does not use the LSP, and consequently MPLS labels do not appear in the output for the **traceroute** command, as indicated in the sample output in "Check BGP Sessions" on page 976.

Check BGP Sessions

Purpose Display summary information about BGP and its neighbors to determine if routes are received from peers in the autonomous system (AS). When a BGP session is established, the peers are exchanging update messages.

Action To check that BGP sessions are up, enter the following Junos OS CLI operational mode command from the ingress router:

```
user@host> show bgp summary
```

Sample Output 1

```
user@R1> show bgp summary
Groups: 1 Peers: 6   Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          1          0          0          0          0
Peer              AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65432      11257      11259       0       0 3d 21:49:57  0/0/0
               0/0/0
10.0.0.3        65432      11257      11259       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.4        65432      11257      11259       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.5        65432      11257      11260       0       0 3d 21:49:57 0/0/0
              0/0/0
10.0.0.6    65432    4   4572    0    1 3d 21:46:59 Active
10.1.36.2       65432      11252      11257       0       0 3d 21:46:49  1/1/0
               0/0/0
```

Sample Output 2

```
user@R1> show bgp summary
Groups: 1 Peers: 5 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 1          1          0          0          0          0
Peer              AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.2        65432         64         68       0       0       32:18 0/0/0
            0/0/0
10.0.0.3        65432         64         67       0       0       32:02 0/0/0
            0/0/0
10.0.0.4        65432         64         67       0       0       32:10 0/0/0
            0/0/0
10.0.0.5        65432         64         67       0       0       32:14 0/0/0
            0/0/0
10.0.0.6        65432         38         39       0       1       18:02 1/1/0
            0/0/0
```

Meaning Sample Output 1 shows that one peer (egress router **10.0.0.6**) is not established, as indicated by the **Down Peers: 1** field. The last column (**State|#Active/Received/Damped**) shows that peer **10.0.0.6** is active, indicating that is it not established. All other peers are established as indicated by the number of active, received, and damped routes. For example, **0/0/0** for peer **10.0.0.2** indicates that no BGP routes were active or received in the routing table, and no BGP routes were damped; **1/1/0** for peer **10.1.36.2** indicates that one BGP route was active and received in the routing table, and no BGP routes were damped.

If the output of the **show bgp summary** command of an ingress router shows that a neighbor is down, check the BGP configuration. For information on checking the BGP configuration, see "Verify the BGP Configuration" on page 977.

Sample Output 2 shows output from ingress router **R1** after the BGP configurations on **R1** and **R6** were corrected in "Taking Appropriate Action for Resolving the Network Problem" on page 967.. All BGP peers are established and one route is active and received. No BGP routes were damped.

If the output of the **show bgp summary** command shows that a neighbor is up but packets are not being forwarded, check for received routes from the egress router. For information on checking the egress router for received routes, see "Verify Received BGP Routes" on page 984.

Verify BGP Peers

Purpose

Assuming that all the routers are correctly configured for BGP, you can verify if IBGP and EBGP sessions are properly established, external routes are advertised and received correctly, and the BGP path selection process is working properly.

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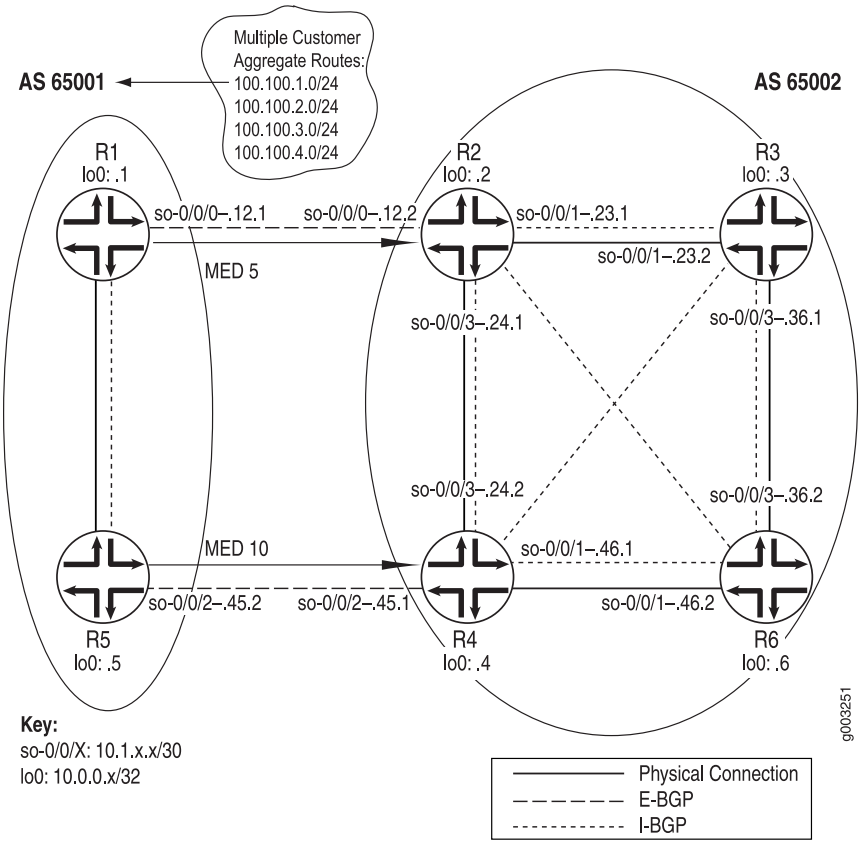
Figure 92 on page 989 illustrates an example BGP network topology used in this topic.

Figure 92: BGP Network Topology



The network consists of two directly connected ASs consisting of external and internal peers. The external peers are directly connected through a shared interface and are running EBGP. The internal peers are connected through their loopback (**lo0**) interfaces through IBGP. AS 65001 is running OSPF and AS 65002 is running IS-IS as its underlying IGP. IBGP routers do not have to be directly connected, the underlying IGP allows neighbors to reach one another.

The two routers in AS 65001 each contain one EBGP link to AS 65002 (**R2** and **R4**) over which they announce aggregated prefixes: **100.100.1.0**, **100.100.2.0**, **100.100.3.0**, and **100.100.4.0**. Also, **R1** and **R5** are injecting multiple exit discriminator (MED) values of 5 and 10, respectively, for some routes.

The internal routers in both ASs are using a full mesh IBGP topology. A full mesh is required because the networks are not using confederations or route reflectors, so any routes learned through IBGP are not distributed to other internal neighbors. For example, when **R3** learns a route from **R2**, **R3** does not distribute that route to **R6** because the route is learned through IBGP, so **R6** must have a direct BGP connection to **R2** to learn the route.

In a full mesh topology, only the border router receiving external BGP information distributes that information to other routers within its AS. The receiving router does not redistribute that information to other IBGP routers in its own AS.

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From the point of view of AS 65002, the following sessions should be up:

- The four routers in AS 65002 should have IBGP sessions established with each other.
- **R2** should have an EBGP session established with **R1**.
- **R4** should have an EBGP session established with **R5**.

To verify BGP peers, follow these steps:

1. Verify BGP on an Internal Router on page 990
2. Verify BGP on a Border Router on page 992
3. Verify Advertised BGP Routes on page 996
4. Verify That a Particular BGP Route Is Received on Your Router on page 996
5. Examine the EBGP over IBGP Selection on page 997

Verify BGP on an Internal Router

Purpose To verify the BGP configuration of an internal router.

Action To verify the BGP configuration of an internal router, enter the following Junos OS command-line interface (CLI) command:

```
user@host> show configuration
```

The following sample output is for a BGP configuration on R3, as shown in "Verify the BGP Protocol" on page 998:

Sample Output

```
user@R3> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
             family inet {
                 address 10.1.23.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.3/32;
```


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```
            }
            family iso {
                address 49.0002.1000.0000.0003.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
    router-id 10.0.0.3;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.3;
            neighbor 10.0.0.2;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}

user@R6> show configuration |
[Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.6/32;
            }
            family iso {
                address 49.0003.1000.0000.0006.00;
            }
        }
    }
```

```
}
routing-options {
    [Output truncated...]
    router-id 10.0.0.6;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.6;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
```

Meaning The sample output shows a basic BGP configuration on routers **R3** and **R6**. The local AS (65002) and one group (**internal**) are configured on both routers. **R3** has three internal peers—**10.0.0.2**, **10.0.0.4**, and **10.0.0.6**—included at the [**protocols bgp group *group***] hierarchy level. **R6** also has three internal peers: **10.0.0.2**, **10.0.0.3**, and **10.0.0.4**. The underlying IGP protocol is Intermediate System-to-Intermediate System (IS-IS), and relevant interfaces are configured to run IS-IS.

Note that in this configuration the router ID is manually configured to avoid any duplicate router ID problems.

Verify BGP on a Border Router

Purpose To verify the BGP configuration of a border router.

Action To verify the BGP configuration of a border router, enter the following Junos OS CLI operational mode command:

```
user@host> show configuration
```

Sample Output

The following sample output is for a BGP configuration on two border routers from AS 65002 (R2 and R4 as shown in "Verify the BGP Protocol" on page 998):

```
user@R2> show configuration
[...Output truncated...]
```

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```
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.12.2/30;
            }
            family iso;
        }
    }
    so-0/0/1 {
        unit 0 {
             family inet {
                address 10.1.23.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
             family inet {
                address 10.1.24.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
             family inet {
                address 10.0.0.2/32;
            }
            family iso {
                address 49.0002.1000.0000.0002.00;
            }
        }
    }
}
routing-options {
[...Output truncated...]
     router-id 10.0.0.2;
    autonomous-system 65002;
}
protocols {
     bgp {
        group internal {
            type internal;
            export next-hop-self;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
        group toR1 {
            type external;
            import import-toR1;
            peer-as 65001;
            neighbor 10.1.12.1;
        }
    }
    isis {
        level 1 disable;
        interface all {
```

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```
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.12.1;
            then {
                next-hop self;
            }
        }
    }
    policy-statement import-toR1 {
        term 1 {
            from {
                route-filter 100.100.1.0/24 exact;
            }
            then {
                local-preference 200;
            }
        }
    }

user@R4> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.1/30;
            }
            family iso;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.45.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.24.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.4/32;
            }
            family iso {
                address 49.0001.1000.0000.0004.00;
            }
```


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```
        }
    }
}
routing-options {
    [...Output truncated...]
    router-id 10.0.0.4;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.4;
            export next-hop-self;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.6;
        }
        group toR5 {
            type external;
            peer-as 65001;
            neighbor 10.1.45.2;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.45.2;
            then {
                next-hop self;
            }
        }
    }
```

Meaning The sample output shows a basic BGP configuration on border routers **R2** and **R4**. Both routers have the AS (65002) included at the [**routing-options**] hierarchy level. Each router has two groups included at the [**protocols bgp group** *group*] hierarchy level. External peers are included in the external group, either *toR1* or **toR5**, depending on the router. Internal peers are included in the **internal** group. The underlying IGP protocol is IS-IS on both routers, and relevant interfaces are configured to run IS-IS.

Note that in the configuration on both routers, the router ID is manually configured to avoid duplicate router ID problems, and the **next-hop-self** statement is included to avoid any BGP next-hop reachability problems.

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Verify Advertised BGP Routes

Purpose You can determine if a particular route that you have configured is being advertised to a neighbor.

Action To verify the routing information as it has been prepared for advertisement to the specified BGP neighbor, enter the following Junos OS CLI operational mode command:

```
user@host> show route advertising-protocol bgp neighbor-address
```

Sample Output

```
user@R2> show route advertising-protocol bgp 10.0.0.4\

inet.0: 20 destinations, 22 routes (20 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24          Self                 5       200        65001 I
* 100.100.2.0/24          Self                 5       100        65001 I
* 100.100.3.0/24          Self                         100        65001 I
* 100.100.4.0/24          Self                         100        65001 I
```

Meaning The sample output shows the BGP routes advertised from **R2** to its neighbor, **10.0.0.4** (**R4**). Out of 22 total routes in the **inet.0** routing table, 20 are active destinations . No routes are **hidden** or in the **hold-down** state. Routes reside in the **hold-down** state prior to being declared active, and routes rejected by a routing policy can be placed into the **hidden** state. The information displayed reflects the routes that the routing table exported to the BGP routing protocol.

Verify That a Particular BGP Route Is Received on Your Router

Purpose Display the routing information as it is received through a particular BGP neighbor and advertised by the local router to the neighbor.

Action To verify that a particular BGP route is received on your router, enter the following Junos OS CLI operational mode command:

```
user@host> show route receive-protocol bgp neighbor-address
```

Sample Output

```
user@R6> show route receive-protocol bgp 10.0.0.2

inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24          10.0.0.2             5       200        65001 I
* 100.100.2.0/24          10.0.0.2             5       100        65001 I
  100.100.3.0/24          10.0.0.2                     100        65001 I
  100.100.4.0/24          10.0.0.2                     100        65001 I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```


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```
user@R6> show route receive-protocol bgp 10.0.0.4
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.3.0/24          10.0.0.4                     100        65001 I
* 100.100.4.0/24          10.0.0.4                     100        65001 I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

Meaning The sample output shows four BGP routes from **R2** and two from **R4**. Of the four routes from **R2**, only two are active in the routing table, as indicated by the asterisk (*), while both routes received from **R4** are active in the routing table. All BGP routes came through AS 65001.

Examine the EBGP over IBGP Selection

Purpose To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path.

Action To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R4> show route 100.100.3.0 detail

inet.0: 20 destinations, 24 routes (20 active, 0 holddown, 0 hidden)
100.100.3.0/24 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.1.45.2
                Next hop: 10.1.45.2 via so-0/0/2.0, selected
                State: <Active Ext>
                Local AS: 65002 Peer AS: 65001
                Age: 5d 0:31:25
                Task: BGP_65001.10.1.45.2+179
                Announcement bits (3): 0-KRT 3-BGP.0.0.0.0+179 4-Resolve inet.0

                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.5
        BGP     Preference: 170/-101
                Source: 10.0.0.2
                Next hop: 10.1.24.1 via so-0/0/3.0, selected
                Protocol next hop: 10.0.0.2 Indirect next hop: 8644000 277
                State: <NotBest Int Ext>
                Inactive reason: Interior > Exterior > Exterior via Interior
                Local AS: 65002 Peer AS: 65002
                Age: 2:48:18    Metric2: 10
                Task: BGP_65002.10.0.0.2+179
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.2
```

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Meaning The sample output shows that **R4** received two instances of the **100.100.3.0** route: one from **10.1.45.2** (**R5**) and one from **10.0.0.2** (**R2**). **R4** selected the path from **R5** as its active path, as indicated by the asterisk (*). The selection is based on a preference for routes learned from an EBGP peer over routes learned from an IBGP. **R5** is an EBGP peer.

You can determine if a path is received from an EBGP or IBGP peer by examining the **Local As** and **Peer As** fields. For example, the route from **R5** shows the local AS is 65002 and the peer AS is 65001, indicating that the route is received from an EBGP peer. The route from **R2** shows that both the local and peer AS is 65002, indicating that it is received from an IBGP peer.

The reason that the inactive path is not selected is displayed in the **Inactive reason** field, in this case, **Interior > Exterior > Exterior via Interior**. The wording of this reason shows the order of preferences applied when the same route is received from two routers. The route received from a strictly internal source (IGP) is preferred first, the route received from an external source (EBGP) is preferred next, and any route which comes from an external source and is received internally (IBGP) is preferred last.

Verify the BGP Protocol

Purpose

For BGP to run on a router in your network, you must define the local autonomous system (AS) number, configure at least one group, and include information about at least one peer in the group. If the peer is an EBGP peer, include the peer's AS number. For all peers, include either the peer's interface IP address or loopback (**lo0**) IP address. When configuring BGP on an interface, you must also include the **family inet** statement at the [**edit interfaces** *interface-name* **unit** *logical-unit-number*] hierarchy level.

Figure 93 on page 999 illustrates the example configurations used in this topic.

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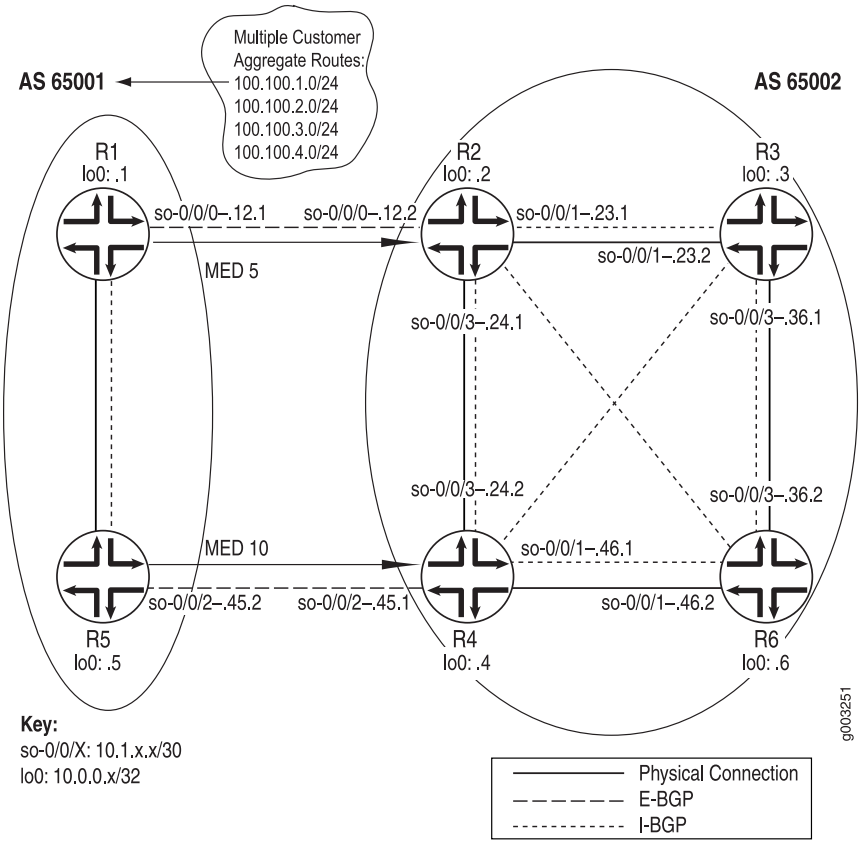
Figure 93: BGP Configuration Topology



The network in Figure 93 on page 999 consists of two directly connected ASs. IP addresses included in the network diagram are as follows:

- **10.1.12.1**—AS 650001external IP address on **R1**
- **10.1.45.2**—AS 650001 external IP address on **R5**
- **10.0.0.1**—Internal loopback (**lo0**) IP address for **R1**
- **10.0.0.5**—Internal loopback (**lo0**) IP address for **R5**
- **10.1.12.2**—AS 65002 external IP address on **R2**
- **10.1.45.1**—AS 65002 external IP address on **R5**
- **10.0.0.2**—Internal loopback (**lo0**) address for **R2**
- **10.0.0.3**—Internal loopback (**lo0**) address for **R3**
- **10.0.0.4**—Internal loopback (**lo0**) address for **R4**
- **10.0.0.6**—Internal loopback (**lo0**) address for **R6**

All routers within each AS maintain an IBGP session between each router in that AS. **R1** and **R5** have an IBGP session through their loopback (**lo0**) interfaces: **10.0.0.1** and **10.0.05**. **R2**, **R3**, **R4**, and **R6** maintain IBGP sessions between each other through their loopback (**lo0**) interfaces: **10.0.0.2**, **10.0.0.3**, **10.0.0.4**, and **10.0.0.6**.

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The two routers in AS 65001 each contain one EBGP link to AS 65002 (**R2** and **R4**) over which they announce aggregated prefixes: **100.100/16**. Routers at the edge of a network that communicate directly with routers in other networks are called border routers. Border routers use EBGP to exchange routing information between networks.

Adjacent BGP routers are referred to as neighbors or peers. Peers can be internal or external to the AS. Internal and external peers are configured slightly differently. In general, internal peers communicate using the loopback (**lo0**) interface, and external peers communicate through the shared interface. See Figure 93 on page 999 for the loopback (**lo0**) and interface information.

To verify the BGP configuration of a router in your network, follow these steps:

1. Verify BGP on an Internal Router on page 1000
2. Verify BGP on a Border Router on page 1002

Verify BGP on an Internal Router

Purpose To verify the BGP configuration of an internal router.

Action To verify the BGP configuration of an internal router, enter the following Junos OS command-line interface (CLI) command:

```
user@host> show configuration
```

The following sample output is for a BGP configuration on R3, as shown in "Verify the BGP Protocol" on page 998:

Sample Output

```
user@R3> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
             family inet {
                 address 10.1.23.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.3/32;
```


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```
            }
            family iso {
                address 49.0002.1000.0000.0003.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
    router-id 10.0.0.3;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.3;
            neighbor 10.0.0.2;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}

user@R6> show configuration |
[Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.6/32;
            }
            family iso {
                address 49.0003.1000.0000.0006.00;
            }
        }
    }
```

```
}
routing-options {
    [Output truncated...]
    router-id 10.0.0.6;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.6;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
```

Meaning The sample output shows a basic BGP configuration on routers **R3** and **R6**. The local AS (65002) and one group (**internal**) are configured on both routers. **R3** has three internal peers—**10.0.0.2**, **10.0.0.4**, and **10.0.0.6**—included at the [**protocols bgp group *group***] hierarchy level. **R6** also has three internal peers: **10.0.0.2**, **10.0.0.3**, and **10.0.0.4**. The underlying IGP protocol is Intermediate System-to-Intermediate System (IS-IS), and relevant interfaces are configured to run IS-IS.

Note that in this configuration the router ID is manually configured to avoid any duplicate router ID problems.

Verify BGP on a Border Router

Purpose To verify the BGP configuration of a border router.

Action To verify the BGP configuration of a border router, enter the following Junos OS CLI operational mode command:

```
user@host> show configuration
```

Sample Output

The following sample output is for a BGP configuration on two border routers from AS 65002 (R2 and R4 as shown in "Verify the BGP Protocol" on page 998):

```
user@R2> show configuration
[...Output truncated...]
```

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```
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.12.2/30;
            }
            family iso;
        }
    }
    so-0/0/1 {
        unit 0 {
             family inet {
                address 10.1.23.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
             family inet {
                address 10.1.24.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
             family inet {
                address 10.0.0.2/32;
            }
            family iso {
                address 49.0002.1000.0000.0002.00;
            }
        }
    }
}
routing-options {
[...Output truncated...]
     router-id 10.0.0.2;
    autonomous-system 65002;
}
protocols {
     bgp {
        group internal {
            type internal;
            export next-hop-self;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
        group toR1 {
            type external;
            import import-toR1;
            peer-as 65001;
            neighbor 10.1.12.1;
        }
    }
    isis {
        level 1 disable;
        interface all {
```

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```
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.12.1;
            then {
                next-hop self;
            }
        }
    }
    policy-statement import-toR1 {
        term 1 {
            from {
                route-filter 100.100.1.0/24 exact;
            }
            then {
                local-preference 200;
            }
        }
    }

user@R4> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.1/30;
            }
            family iso;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.45.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.24.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.4/32;
            }
            family iso {
                address 49.0001.1000.0000.0004.00;
            }
```


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```
        }
    }
}
routing-options {
    [...Output truncated...]
    router-id 10.0.0.4;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.4;
            export next-hop-self;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.6;
        }
        group toR5 {
            type external;
            peer-as 65001;
            neighbor 10.1.45.2;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.45.2;
            then {
                next-hop self;
            }
        }
    }
```

Meaning The sample output shows a basic BGP configuration on border routers **R2** and **R4**. Both routers have the AS (65002) included at the [**routing-options**] hierarchy level. Each router has two groups included at the [**protocols bgp group** *group*] hierarchy level. External peers are included in the external group, either *toR1* or **toR5**, depending on the router. Internal peers are included in the **internal** group. The underlying IGP protocol is IS-IS on both routers, and relevant interfaces are configured to run IS-IS.

Note that in the configuration on both routers, the router ID is manually configured to avoid duplicate router ID problems, and the **next-hop-self** statement is included to avoid any BGP next-hop reachability problems.

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Verify the BGP Configuration

Purpose For BGP to run on the router, you must define the local AS number, configure at least one group, and include information about at least one peer in the group (the peer's IP address and AS number). When BGP is part of an MPLS network, you must ensure that the LSP is configured with a destination IP address equal to the BGP next hop in order for BGP routes to be installed with the LSP as the next hop for those routes.

Action To verify the BGP configuration, enter the following Junos OS CLI operational mode command:

```
user@host> show configuration
```

Sample Output 1

```
user@R1> show configuration
[...Output truncated...]
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.12.1/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.15.1/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.13.1/30;
            }
             family iso;
            family mpls;
        }
    }
    fxp0 {
        unit 0 {
            family inet {
                address 192.168.70.143/21;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
```


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```
                address 10.0.0.1/32;
            }
             family iso {
                address 49.0004.1000.0000.0001.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
         route 100.100.1.0/24 reject;
    }
     router-id 10.0.0.1;
     autonomous-system 65432;
}
protocols {
    rsvp {
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface fxp0.0 {
            disable;
        }
    }
    mpls {
        label-switched-path R1-to-R6 {
            to  10.0.0.6; <<< destination address of the LSP
        }
        inactive: interface so-0/0/0.0;
        inactive: interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface fxp0.0 {
            disable;
        }
    }
    bgp {
        export send-statics; <<< missing local-address statement
         group internal {
            type internal;
            neighbor 10.0.0.2;
            neighbor 10.0.0.5;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
            neighbor 10.0.0.3;
            neighbor 10.1.36.2; <<< incorrect interface address
        }
    }
    isis {
        level 1 disable;
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface all {
            level 2 metric 10;
        }
        interface fxp0.0 {
            disable;
        }
        interface lo0.0 {
            passive;
```

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```
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface so-0/0/1.0;
            interface so-0/0/2.0;
            interface lo0.0; {
                passive
            }
        }
    }
}
policy-options {
    policy-statement send-statics {
        term statics {
            from {
                route-filter 100.100.1.0/24 exact;
            }
            then accept;
        }
    }
}
```

Sample Output 2

```
user@R6> show configuration
[...Output truncated...]
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
                address 10.1.56.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.26.2/30;
            }
            family iso;
            family mpls;
        }
    }
    so-0/0/3 {
```


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```
        unit 0 {
            family inet {
                address 10.1.36.2/30;
            }
             family iso;
            family mpls;
        }
    }
    fxp0 {
        unit 0 {
            family inet {
                address 192.168.70.148/21;
            }
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.6/32;
                address 127.0.0.1/32;
            }
            family iso {
                address 49.0004.1000.0000.0006.00;
            }
        }
    }
}
routing-options {
    [...Output truncated...]
         route 100.100.6.0/24 reject;
    }
     router-id 10.0.0.6;
     autonomous-system 65432;
}
protocols {
    rsvp {
        interface so-0/0/0.0;
        interface so-0/0/1.0;
        interface so-0/0/2.0;
        interface so-0/0/3.0;
        interface fxp0.0 {
            disable;
        }
    }
    mpls {
        label-switched-path R6-to-R1 {
            to 10.0.0.1; <<< destination address of the reverse LSP
        }
        inactive: interface so-0/0/0.0;
        inactive: interface so-0/0/1.0;
        inactive: interface so-0/0/2.0;
        interface so-0/0/3.0;
    }
    bgp {
        group internal {
            type internal;
            export send-statics; <<< missing local-address statement
             neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
```

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```
            neighbor 10.0.0.5;
            neighbor 10.0.0.1;
            neighbor 10.1.13.1;            <<< incorrect interface address
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface fxp0.0 {
            disable;
        }
        interface lo0.0 {
            passive;
        }
    }
    ospf {
        traffic-engineering;
        area 0.0.0.0 {
            interface so-0/0/0.0;
            interface so-0/0/1.0;
            interface so-0/0/2.0;
            interface so-0/0/3.0;
            interface lo0.0 {
                passive;
            }
        }
    }
}
policy-options {
    policy-statement send-statics {
        term statics {
            from {
                route-filter 100.100.6.0/24 exact;
            }
            then accept;
        }
    }
}
```

Meaning The sample output shows the BGP configurations on ingress router **R1** and egress router **R6**. Both configurations show the local AS (**65432**), one group (**internal**), and six peers configured. The underlying interior gateway protocol is IS-IS, and the relevant interfaces are configured to run IS-IS.

NOTE: In this configuration, the RID is manually configured to avoid any duplicate RID problems, and all interfaces configured with BGP include the **family inet** statement at the [**edit interfaces** *type-fpc/pic/port* **unit** *logical-unit-number*] hierarchy level.

Sample output for ingress router **R1** and egress router **R6** shows that the BGP protocol configuration is missing the **local-address** statement for the internal group. When the

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local-address statement is configured, BGP packets are forwarded from the local router loopback (**lo0**) interface address, which is the address to which BGP peers are peering. If the **local-address** statement is not configured, BGP packets are forwarded from the outgoing interface address, which does not match the address to which BGP peers are peering, and BGP does not come up.

On the ingress router, the IP address (**10.0.0.1**) in the **local-address** statement should be the same as the address configured for the LSP on the egress router (**R6**) in the **to** statement at the [**edit protocols mpls label-switched-path** *lsp-path-name*] hierarchy level. BGP uses this address, which is identical to the LSP address, to forward BGP traffic through the LSP.

In addition, the BGP configuration on **R1** includes two IP addresses for **R6**, an interface address (**10.1.36.2**) and a loopback (**lo0**) interface address (**10.0.0.6**), resulting in the LSP destination address (**10.0.0.6**) not matching the BGP next-hop address (**10.1.36.2**). The BGP configuration on **R6** also includes two IP addresses for **R1**, an interface address (**10.1.13.1**) and a loopback (**lo0**) interface address, resulting in the reverse LSP destination address (**10.0.0.1**) not matching the BGP next-hop address (**10.1.13.1**).

In this instance, because the **local-address** statement is missing in the BGP configurations of both routers and the LSP destination address does not match the BGP next-hop address, BGP is not using the LSP to forward traffic.

Display Sent or Received BGP Packets

Action To configure the tracing for sent or received BGP protocol packets, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocol bgp traceoptions
```

2. Configure the flag to display sent, received, or both sent and received packet information:

```
[edit protocols bgp traceoptions]
user@host#  set flag update send
```

or

```
[edit protocols bgp traceoptions]
user@host# set flag update receive
```

or

```
[edit protocols bgp traceoptions]
user@host# set flag update
```

3. Verify the configuration:

```
user@host# show
```

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For example:

```
[edit protocols bgp traceoptions]
user@host# show
file bgplog size 10k files 10;
flag update send;
```

or

```
[edit protocols bgp traceoptions]
user@host# show
file bgplog size 10k files 10;
flag update receive;
```

or

```
[edit protocols bgp traceoptions]
user@host# show
file bgplog size 10k files 10;
flag update send receive;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
[edit protocols bgp traceoptions]
user@host# run show log bgplog
Sep 13 12:58:23 trace_on: Tracing to "/var/log/bgplog" started
Sep 13 12:58:23 BGP RECV flags 0x40 code ASPath(2): <null>
Sep 13 12:58:23 BGP RECV flags 0x40 code LocalPref(5): 100
Sep 13 12:58:23 BGP RECV flags 0xc0 code Extended Communities(16): 2:10458:3
[...Output truncated...]
```

Diagnose BGP Session Establishment Problems

Purpose To trace BGP session establishment problems.

Action To trace BGP session establishment problems, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host#  edit protocol bgp
```

2. Configure BGP open messages:

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```
[edit protocols bgp]
user@host#  set traceoptions flag open detail
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols bgp]
user@host# show
traceoptions {
   file bgplog size 10k files 10;
   flag open detail;
}
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host#run show log  filename
```

For example:

```
[edit protocols bgp]
user@hotst# run show log bgplog
```

```
Sep 17 17:13:14 trace_on: Tracing to "/var/log/bgplog" started
Sep 17 17:13:14 bgp_read_v4_update: done with 201.0.0.2 (Internal AS 10458)
received 19 octets 0 updates 0 routes
Sep 17 17:13:15 bgp_read_v4_update: receiving packet(s) from 201.0.0.3 (Internal
AS 10458)
Sep 17 17:13:15 bgp_read_v4_update: done with 201.0.0.3 (Internal AS 10458)
received 19 octets 0 updates 0 routes
Sep 17 17:13:44 bgp_read_v4_update: receiving packet(s) from 201.0.0.2 (Internal
AS 10458)
[...Output truncated...]
```

Examine BGP Routes and Route Selection

Purpose

You can examine the BGP path selection process to determine the single, active path when BGP receives multiple routes to the same destination prefix.

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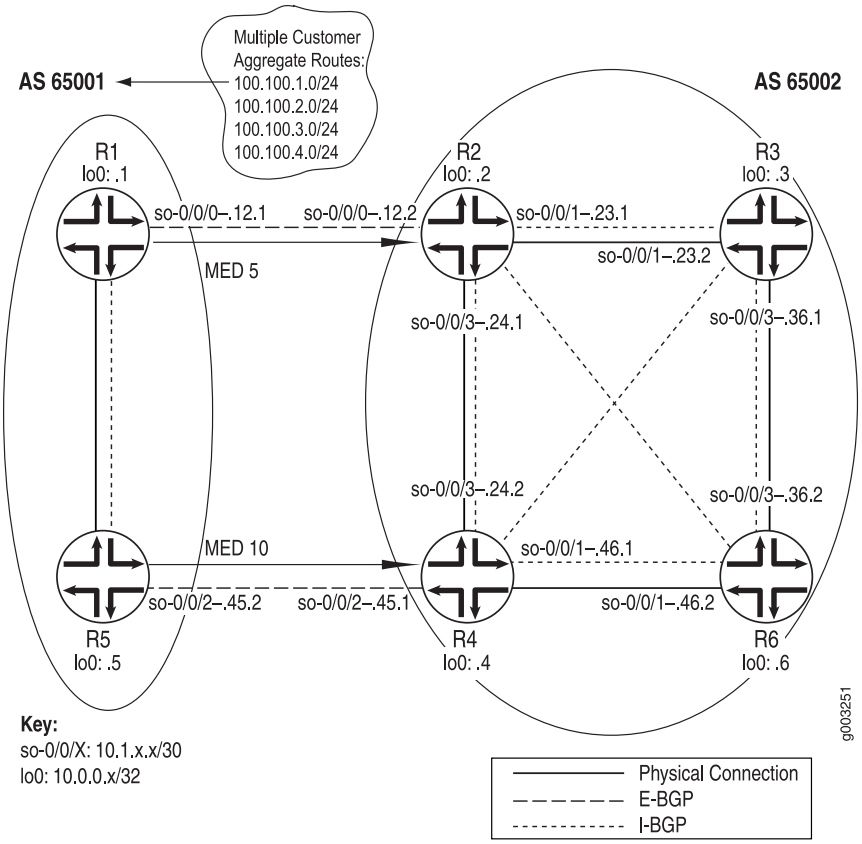
Figure 94: BGP Network Topology



The network in Figure 94 on page 1014 shows that **R1** and **R5** announce the same aggregate routes to **R2** and **R4,** which results in **R2** and **R4** receiving two routes to the same destination prefix. The route selection process on **R2** and **R4** determines which of the two BGP routes received is active and advertised to the other internal routers (**R3** and **R6**).

Before the router installs a BGP route, it must make sure that the BGP **next-hop** attribute is reachable. If the BGP next hop cannot be resolved, the route is not installed. When a BGP route is installed in the routing table, it must go through a path selection process if multiple routes exist to the same destination prefix. The BGP path selection process proceeds in the following order:

1. Route preference in the routing table is compared. For example, if an OSPF and a BGP route exist for a particular destination, the OSPF route is selected as the active route because the OSPF route has a default preference of 110, while the BGP route has a default preference of 170.
2. Routes are compared for local preference. The route with the highest local preference is preferred. For example, see "Examine the Local Preference Selection" on page 1015.
3. The AS path attribute is evaluated. The shorter AS path is preferred.
4. The origin code is evaluated. The lowest origin code is preferred (**I (IGP) < E (EGP) < ? (Incomplete)**).

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5. The MED value is evaluated. By default, if any of the routes are advertised from the same neighboring AS, the lowest MED value is preferred. The absence of a MED value is interpreted as a MED of 0. For an example, see "Examine the Multiple Exit Discriminator Route Selection" on page 1016.
6. The route is evaluated as to whether it is learned through EBGP or IBGP. EBGP learned routes are preferred to IBGP learned routes. For an example, see "Examine the EBGP over IBGP Selection" on page 997
7. If the route is learned from IBGP, the route with the lowest IGP cost is preferred. For an example, see "Examine the IGP Cost Selection" on page 1019. The physical next hop to the IBGP peer is installed according to the following three rules:
    a. After BGP examines the **inet.0** and **inet.3** routing tables, the physical next hop of the route with the lowest preference is used.
    b. If the preference values in the **inet.0** and the **inet.3** routing tables are a tie, the physical next hop of the route in the **inet.3** routing table is used.
    c. When a preference tie exists in the same routing table, the physical next hop of the route with more paths is installed.
8. The route reflection cluster list attribute is evaluated. The shortest length cluster list is preferred. Routes without a cluster list are considered to have a cluster list length of 0.
9. The router ID is evaluated. The route from the peer with the lowest router ID is preferred (usually the loopback address).
10. The peer address value is examined. The peer with the lowest peer IP address is preferred.

To determine the single, active path when BGP receives multiple routes to the same destination prefix, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

The following steps illustrate the inactive reason displayed when BGP receives multiple routes to the same destination prefix and one route is selected as the single, active path:

1. Examine the Local Preference Selection on page 1015
2. Examine the Multiple Exit Discriminator Route Selection on page 1016
3. Examine the EBGP over IBGP Selection on page 1017
4. Examine the IGP Cost Selection on page 1019

Examine the Local Preference Selection

Purpose To examine a route to determine if local preference is the selection criteria for the single, active path.

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Action To examine a route to determine if local preference is the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R4> show route 100.100.1.0 detail

inet.0: 20 destinations, 24 routes (20 active, 0 holddown, 0 hidden)
100.100.1.0/24 (2 entries, 1 announced)
        *BGP    Preference: 170/-201
                Source: 10.0.0.2
                Next hop: 10.1.24.1 via so-0/0/3.0, selected
                Protocol next hop: 10.0.0.2 Indirect next hop: 8644000 277
                State: <Active Int Ext>
                Local AS: 65002 Peer AS: 65002
                Age: 2:22:34    Metric: 5       Metric2: 10
                Task: BGP_65002.10.0.0.2+179
                Announcement bits (3): 0-KRT 3-BGP.0.0.0.0+179 4-Resolve inet.0

                AS path: 65001 I
                Localpref: 200
                Router ID: 10.0.0.2
        BGP     Preference: 170/-101
                Source: 10.1.45.2
                Next hop: 10.1.45.2 via so-0/0/2.0, selected
                State: <Ext>
                Inactive reason: Local Preference
                Local AS: 65002 Peer AS: 65001
                Age: 2w0d 1:28:31       Metric: 10
                Task: BGP_65001.10.1.45.2+179
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.5
```

Meaning The sample output shows that **R4** received two instances of the **100.100.1.0** route: one from **10.0.0.2** (**R2**) and one from **10.1.45.2** (**R5**). **R4** selected the path from **R2** as its active path, as indicated by the asterisk (*). The selection is based on the local preference value contained in the **Localpref** field. The path with the *highest* local preference is preferred. In the example, the path with the higher local preference value is the path from **R2**, 200.

The reason that the route from **R5** is not selected is in the **Inactive reason** field, in this case, **Local Preference**.

Note that the two paths are from the same neighboring network: AS 65001.

Examine the Multiple Exit Discriminator Route Selection

Purpose To examine a route to determine if the MED is the selection criteria for the single, active path.

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Action To examine a route to determine if the MED is the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R4> show route 100.100.2.0 detail

inet.0: 20 destinations, 24 routes (20 active, 0 holddown, 0 hidden)
100.100.2.0/24 (2 entries, 1 announced)
        *BGP     Preference: 170/-101
                 Source: 10.0.0.2
                Next hop: 10.1.24.1 via so-0/0/3.0, selected
                Protocol next hop: 10.0.0.2 Indirect next hop: 8644000 277
                State: <Active Int Ext>
                Local AS: 65002 Peer AS: 65002
                Age: 2:32:01     Metric: 5       Metric2: 10
                Task: BGP_65002.10.0.0.2+179
                Announcement bits (3): 0-KRT 3-BGP.0.0.0.0+179 4-Resolve inet.0

                 AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.2
        BGP     Preference: 170/-101
                 Source: 10.1.45.2
                Next hop: 10.1.45.2 via so-0/0/2.0, selected
                State: <NotBest Ext>
                 Inactive reason: Not Best in its group
                Local AS: 65002 Peer AS: 65001
                Age: 2w0d 1:37:58        Metric: 10
                Task: BGP_65001.10.1.45.2+179
                 AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.5
```

Meaning The sample output shows that **R4** received two instances of the **100.100.2.0** route: one from **10.0.0.2** (**R2**), and one from **10.1.45.2** (**R5**). **R4** selected the path from **R2** as its active route, as indicated by the asterisk (*). The selection is based on the MED value contained in the **Metric:** field. The path with the lowest MED value is preferred. In the example, the path with the lowest MED value (5) is the path from **R2**. Note that the two paths are from the same neighboring network: AS 65001.

The reason that the inactive path is not selected is displayed in the **Inactive reason:** field, in this case, **Not Best in its group**. The wording is used because the Junos OS uses the process of deterministic MED selection, by default.

Examine the EBGP over IBGP Selection

Purpose To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path.

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Action To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R4> show route 100.100.3.0 detail

inet.0: 20 destinations, 24 routes (20 active, 0 holddown, 0 hidden)
100.100.3.0/24 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.1.45.2
                Next hop: 10.1.45.2 via so-0/0/2.0, selected
                State: <Active Ext>
                Local AS: 65002 Peer AS: 65001
                Age: 5d 0:31:25
                Task: BGP_65001.10.1.45.2+179
                Announcement bits (3): 0-KRT 3-BGP.0.0.0.0+179 4-Resolve inet.0

                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.5
        BGP     Preference: 170/-101
                Source: 10.0.0.2
                Next hop: 10.1.24.1 via so-0/0/3.0, selected
                Protocol next hop: 10.0.0.2 Indirect next hop: 8644000 277
                State: <NotBest Int Ext>
                Inactive reason: Interior > Exterior > Exterior via Interior
                Local AS: 65002 Peer AS: 65002
                Age: 2:48:18    Metric2: 10
                Task: BGP_65002.10.0.0.2+179
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.2
```

Meaning The sample output shows that **R4** received two instances of the **100.100.3.0** route: one from **10.1.45.2** (**R5**) and one from **10.0.0.2** (**R2**). **R4** selected the path from **R5** as its active path, as indicated by the asterisk (*). The selection is based on a preference for routes learned from an EBGP peer over routes learned from an IBGP. **R5** is an EBGP peer.

You can determine if a path is received from an EBGP or IBGP peer by examining the **Local As** and **Peer As** fields. For example, the route from **R5** shows the local AS is 65002 and the peer AS is 65001, indicating that the route is received from an EBGP peer. The route from **R2** shows that both the local and peer AS is 65002, indicating that it is received from an IBGP peer.

The reason that the inactive path is not selected is displayed in the **Inactive reason** field, in this case, **Interior > Exterior > Exterior via Interior**. The wording of this reason shows the order of preferences applied when the same route is received from two routers. The route received from a strictly internal source (IGP) is preferred first, the route received from an external source (EBGP) is preferred next, and any route which comes from an external source and is received internally (IBGP) is preferred last.

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Examine the IGP Cost Selection

Purpose To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path.

Action To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R6> show route 100.100.4.0 detail

inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
100.100.4.0/24 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.0.0.4
                Next hop: 10.1.46.1 via so-0/0/1.0, selected
                Protocol next hop: 10.0.0.4 Indirect next hop: 864c000 276
                State: <Active Int Ext>
                Local AS: 65002 Peer AS: 65002
                Age: 2:16:11    Metric2: 10
                Task: BGP_65002.10.0.0.4+4120
                Announcement bits (2): 0-KRT 4-Resolve inet.0
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.4
         BGP    Preference: 170/-101
                Source: 10.0.0.2
                Next hop: 10.1.46.1 via so-0/0/1.0, selected
                Next hop: 10.1.36.1 via so-0/0/3.0
                Protocol next hop: 10.0.0.2 Indirect next hop: 864c0b0 278
                State: <NotBest Int Ext>
                Inactive reason: IGP metric
                Local AS: 65002 Peer AS: 65002
                Age: 2:16:03    Metric2: 20
                Task: BGP_65002.10.0.0.2+179
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.2
```

Meaning The sample output shows that **R6** received two instances of the **100.100.4.0** route: one from **10.0.0.4** (**R4**) and one from **10.0.0.2** (**R2**). **R6** selected the path from **R4** as its active route, as indicated by the asterisk (*). The selection is based on the IGP metric, displayed in the **Metric2** field. The route with the lowest IGP metric is preferred. In the example, the path with the lowest IGP metric value is the path from **R4**, with an IGP metric value of 10, while the path from **R2** has an IGP metric of 20. Note that the two paths are from the same neighboring network: AS 65001.

The reason that the inactive path was not selected is displayed in the **Inactive reason** field, in this case, **IGP metric**.

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Examine Routes in the Forwarding Table

Purpose When you run into problems, such as connectivity problems, you may need to examine routes in the forwarding table to verify that the routing protocol process has relayed the correct information into the forwarding table.

Action To display the set of routes installed in the forwarding table, enter the following Junos OS CLI operational mode command:

```
user@host> show route forwarding-table
```

Sample Output

```
user@R2> show route forwarding-table
Routing table: inet
Internet:
Destination        Type RtRef Next hop           Type  Index NhRef Netif
default            perm     0                    rjct    10     1
10.0.0.2/32        intf     0 10.0.0.2           locl   256     1
10.0.0.3/32        user     1 10.1.23.0          ucst   282     4 so-0/0/1.0
10.0.0.4/32        user     1 10.1.24.0          ucst   290     7 so-0/0/3.0
10.0.0.6/32        user     1 10.1.24.0          ucst   290     7 so-0/0/3.0
10.1.12.0/30       intf     1 ff.3.0.21          ucst   278     6 so-0/0/0.0
10.1.12.0/32       dest     0 10.1.12.0          recv   280     1 so-0/0/0.0
10.1.12.2/32       intf     0 10.1.12.2          locl   277     1
10.1.12.3/32       dest     0 10.1.12.3          bcst   279     1 so-0/0/0.0
10.1.23.0/30       intf     0 ff.3.0.21          ucst   282     4 so-0/0/1.0
10.1.23.0/32       dest     0 10.1.23.0          recv   284     1 so-0/0/1.0
10.1.23.1/32       intf     0 10.1.23.1          locl   281     1
10.1.23.3/32       dest     0 10.1.23.3          bcst   283     1 so-0/0/1.0
10.1.24.0/30       intf     0 ff.3.0.21          ucst   290     7 so-0/0/3.0
10.1.24.0/32       dest     0 10.1.24.0          recv   292     1 so-0/0/3.0
10.1.24.1/32       intf     0 10.1.24.1          locl   289     1
10.1.24.3/32       dest     0 10.1.24.3          bcst   291     1 so-0/0/3.0
10.1.36.0/30       user     0 10.1.23.0          ucst   282     4 so-0/0/1.0
10.1.46.0/30       user     0 10.1.24.0          ucst   290     7 so-0/0/3.0
100.100.1.0/24     user     0 10.1.12.0          ucst   278     6 so-0/0/0.0
100.100.2.0/24     user     0 10.1.12.0          ucst   278     6 so-0/0/0.0
100.100.3.0/24     user     0 10.1.12.0          ucst   278     6 so-0/0/0.0
100.100.4.0/24     user     0 10.1.12.0          ucst   278     6 so-0/0/0.0
[...Output truncated...]
```

Meaning The sample output shows the network-layer prefixes and their next hops installed in the forwarding table. The output includes the same next-hop information as in the **show route detail** command (the next-hop address and interface name). Additional information includes the destination type, the next-hop type, the number of references to this next hop, and an index into an internal next-hop database. (The internal database contains additional information used by the Packet Forwarding Engine to ensure proper encapsulation of packets sent out an interface. This database is not accessible to the user.

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For detailed information about the meanings of the various flags and types fields, see the *Routing Policies, Firewall Filters, and Traffic Policers.*

Example: Overriding the Default BGP Routing Policy on PTX Series Packet Transport Routers

This example shows how to override the default routing policy on packet transport routers, such as the PTX Series Packet Transport Routers.

- Requirements on page 1021
- Overview on page 1021
- Configuration on page 1022
- Verification on page 1023

Requirements

This example requires Junos OS Release 12.1 or later.

Overview

By default, the PTX Series routers do not install BGP routes in the forwarding table.

For PTX Series routers, the configuration of the **from protocols bgp** condition with the **then accept** action does not have the usual result that it has on other Junos OS routing devices. With the following routing policy on PTX Series routers, BGP routes do not get installed in the forwarding table.

```
user@host# show policy-options
policy-statement accept-no-install {
  term 1 {
    from protocol bgp;
    then accept;
  }
}
user@host# show routing-options
forwarding-table {
  export accept-no-install;
}
```

```
user@host> show route forwarding-table
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    36     2
```

No BGP routes are installed in the forwarding table. This is the expected behavior.

This example shows how to use the **then install-to-fib** action to effectively override the default BGP routing policy.

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Configuration

CLI Quick Configuration

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the **[edit]** hierarchy level.

```
set policy-options prefix-list install-bgp 66.0.0.1/32
set policy-options policy-statement override-ptx-series-default term 1 from prefix-list
    install-bgp
set policy-options policy-statement override-ptx-series-default term 1 then load-balance
    per-prefix
set policy-options policy-statement override-ptx-series-default term 1 then install-to-fib
set routing-options forwarding-table export override-ptx-series-default
```

Installing Selected BGP Routes in the Forwarding Table

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see *Using the CLI Editor in Configuration Mode* in the *CLI User Guide*.

To install selected BGP routes in the forwarding table:

1. Configure a list of prefixes to install in the forwarding table.

```
[edit policy-options prefix-list install-bgp]
user@host# set 66.0.0.1/32
```

2. Configure the routing policy, applying the prefix list as a condition.

```
[edit policy-options policy-statement override-ptx-series-default term 1]
user@host# set from prefix-list install-bgp
user@host# set then install-to-fib
user@host# set then load-balance per-prefix
```

3. Apply the routing policy to the forwarding table.

```
[edit routing-options forwarding-table]
user@host# set export override-ptx-series-default
```

Results

From configuration mode, confirm your configuration by entering the **show policy-options** and **show routing-options** commands. If the output does not display the intended configuration, repeat the instructions in this example to correct the configuration.

```
user@host# show policy-options
prefix-list install-bgp {
    66.0.0.1/32;
```


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```
}
policy-statement override-ptx-series-default {
  term 1 {
    from {
      prefix-list install-bgp;
    }
    then {
      load-balance per-prefix;
      install-to-fib;
    }
  }
}
```

```
user@host# show routing-options
forwarding-table {
  export override-ptx-series-default;
}
```

If you are done configuring the device, enter **commit** from configuration mode.

Verification

Confirm that the configuration is working properly.

Verifying That the Selected Route Is Installed in the Forwarding Table

Purpose Make sure that the configured policy overrides the default policy.

Action From operational mode, enter the show route forwarding-table command.

```
user@host> show route forwarding-table destination 66.0.0.1
```

```
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
66.0.0.1/32        user     0                    indr 2097159     3
                                                 ulst 2097156     2
                              5.1.0.2            ucst   574     1 et-6/0/0.1
                              5.2.0.2            ucst   575     1 et-6/0/0.2
```

Meaning This output shows that the route to 66.0.0.1/32 is installed in the forwarding table.

Related Documentation

- Understanding the Default BGP Routing Policy on Packet Transport Routers on page 346

Log BGP State Transition Events

Purpose Border Gateway Protocol (BGP) state transitions indicate a network problem and need to be logged and investigated.

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Action To log BGP state transition events to the system log, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocol bgp
```

2. Configure the system log:

```
user@host#  set log-updown
```

3. Verify the configuration:

```
user@host# show
```

4. Commit the configuration:

```
user@host# commit
```

Meaning Log messages from BGP state transition events are sufficient to diagnose most BGP session problems. Table 17 on page 1024 lists and describes the six states of a BGP session.

Table 17: Six States of a BGP Session

BGP State	Description
Idle	This is the first state of a connection. BGP waits for a start event initiated by an administrator. The start event might be the establishment of a BGP session through router configuration or the resetting of an existing session. After the start event, BGP initializes its resources, resets a connect-retry timer, initiates a TCP transport connection, and starts listening for connections initiated by remote peers. BGP then transitions to a **Connect** state. If there are errors, BGP falls back to the **Idle** state.
Connect	BGP waits for the transport protocol connection to complete. If the TCP transport connection is successful, the state transitions to **OpenSent**. If the transport connection is not successful, the state transitions to **Active**. If the connect-retry timer has expired, the state remains in the **Connect** state, the timer is reset, and a transport connection is initiated. With any other event, the state goes back to **Idle**.

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Table 17: Six States of a BGP Session (continued)

BGP State	Description
Active	BGP tries to acquire a peer by initiating a transport protocol connection. If it is successful, the state transitions to **OpenSent**. If the connect-retry timer expires, BGP restarts the connect timer and falls back to the **Connect** state. BGP continues to listen for a connection that may be initiated from another peer. The state may go back to **Idle** in case of other events, such as a stop event. In general, a neighbor state flip-flopping between **Connect** and **Active** is an indication that there is a problem with the TCP transport connection. Such a problem might be caused by many TCP retransmissions or the inability of a neighbor to reach the IP address of its peer.
OpenSent	BGP receives an open message from its peer. In the **OpenSent** state, BGP compares its autonomous system (AS) number with the AS number of its peer and recognizes whether the peer belongs to the same AS (internal BGP) or to a different AS (external BGP). The open message is checked for correctness. In case of errors, such as a bad version number of an unacceptable AS, BGP sends an error-notification message and goes back to **Idle**. For any other errors, such as expiration of the hold timer or a stop event, BGP sends a notification message with the corresponding error code and falls back to the **Idle** state. If there are no errors, BGP sends keepalive messages and resets the keepalive timer. In this state, the hold time is negotiated. If the hold time is 0, the hold and keepalive timers are not restarted. When a TCP transport disconnect is detected, the state falls back to **Active**.
OpenConfirm	BGP waits for a keepalive or notification message. If a keepalive is received, the state becomes **Established**, and the neighbor negotiation is complete. If the system receives an update or keepalive message, it restarts the hold timer (assuming that the negotiated hold time is not 0). If a notification message is received, the state falls back to **Idle**. The system sends periodic keepalive messages at the rate set by the keepalive timer. In case of a transport disconnect notification or in response to a stop event, the state falls back to **Idle**. In response to other events, the system sends a notification message with a finite state machine (FSM) error code and goes back to **Idle**.

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Table 17: Six States of a BGP Session (continued)

BGP State	Description
Established	This is the final state in the neighbor negotiation. In this state, BGP exchanges update ackets with its peers and the hold timer is restarted at the receipt of an update or keepalive message when it is not set to zero. If the system receives a notification message, the state falls back to **Idle**. Update messages are checked for errors, such as missing attributes, duplicate attributes, and so on. If errors are found, a notification is sent to the peer, and the state falls back to **Idle**. BGP goes back to **Idle** when the hold timer expires, a disconnect notification is received from the transport protocol, a stop event is received, or in response to any other event.

For more detailed BGP protocol packet information, configure BGP-specific tracing. See "Checklist for Tracking Error Conditions" on page 1026 for more information.

Checklist for Tracking Error Conditions

Problem **Description:** Table 18 on page 1026 provides links and commands for configuring routing protocol daemon tracing, Border Gateway Protocol (BGP), Intermediate System-to-Intermediate System (IS-IS) protocol, and Open Shortest Path First (OSPF) protocol tracing to diagnose error conditions.

Table 18: Checklist for Tracking Error Conditions

Solution

Tasks	Command or Action
Configure Routing Protocol Process Tracing	
1. Configure Routing Protocol Process Tracing on page 1028	**[edit]** **edit routing-options traceoptions** **set file *filename* size *size* files *number*** **show** **commit** **run show log *filename***
2. Configure Routing Protocol Tracing for a Specific Routing Protocol on page 1030	**[edit]** **edit protocol *protocol-name* traceoptions** **set file *filename* size *size* files *number*** **show** **commit** **run show log *filename***
3. Monitor Trace File Messages Written in Near-Real Time on page 1032	**monitor start *filename***
4. Stop Trace File Monitoring on page 1033	**monitor stop *filename***
"Configure BGP-Specific Options" on page 1033	

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Table 18: Checklist for Tracking Error Conditions (continued)

Tasks	Command or Action
1. Display Detailed BGP Protocol Information on page 1033	[edit] edit protocol bgp traceoptions set flag update detail show commit run show log *filename*
2. Display Sent or Received BGP Packets on page 1011	[edit] edit protocol bgp traceoptions set flag update (send | receive) show commit run show log *filename*
3. Diagnose BGP Session Establishment Problems on page 1012	[edit] edit protocol bgp set traceoptions flag open detail show commit run show log *filename*
"Configure IS-IS-Specific Options" on page 1038	
1. Displaying Detailed IS-IS Protocol Information on page 1038	[edit] edit protocol isis traceoptions set flag hello detail show commit run show log *filename*
2. Displaying Sent or Received IS-IS Protocol Packets on page 1041	[edit] edit protocols isis traceoptions set flag hello (send | receive) show commit run show log *filename*
3. Analyzing IS-IS Link-State PDUs in Detail on page 1042	[edit] edit protocols isis traceoptions set flag lsp detail show commit run show log *filename*
"Configure OSPF-Specific Options" on page 1050	
1. Diagnose OSPF Session Establishment Problems on page 1050	[edit] edit protocols ospf traceoptions set flag hello detail show commit run show log *filename*

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Table 18: Checklist for Tracking Error Conditions (continued)

Tasks	Command or Action
2. Analyze OSPF Link-State Advertisement Packets in Detail on page 1054	**[edit]** **edit protocols ospf traceoptions** **set flag lsa update detail** **show** **commit** **run show log *filename***

Configure Routing Protocol Process Tracing

Action To configure routing protocol process (rpd) tracing, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit routing-options traceoptions
```

2. Configure the file, file size, number, and flags:

```
[edit routing-options traceoptions]
user@host#  set file filename size size file number
[edit routing-options traceoptions]
user@host#  set flag flag
```

For example:

```
[edit routing-options traceoptions]
user@host# set file daemonlog size 10240 files 10
[edit routing-options traceoptions]
user@host# set flag general
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit routing-options traceoptions]
user@host# show
file daemonlog size 10k files 10;
flag general;
```

4. Commit the configuration:

```
user@host# commit
```


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NOTE: Some traceoptions flags generate an extensive amount of information. Tracing can also slow down the operation of routing protocols. Delete the traceoptions configuration if you no longer require it.

1. View the contents of the file containing the detailed messages:

   ```
   user@host# run show log filename
   ```

   For example:

   ```
   [edit routing-options traceoptions]
   user@pro4-a# run show log daemonlog
   Sep 17 14:17:31 trace_on: Tracing to "/var/log/daemonlog" started
   Sep 17 14:17:31 Tracing flags enabled: general
   Sep 17 14:17:31 inet_routerid_notify: Router ID: 10.255.245.44
   Sep 17 14:17:31 inet_routerid_notify: No Router ID assigned
   Sep 17 14:17:31 Initializing LSI globals
   Sep 17 14:17:31 LSI initialization complete
   Sep 17 14:17:31 Initializing OSPF instances
   Sep 17 14:17:31 Reinitializing OSPFv2 instance master
   Sep 17 14:17:31 OSPFv2 instance master running
   [...Output truncated...]
   ```

Meaning Table 19 on page 1029 lists tracing flags and example output for Junos-supported routing protocol daemon tracing.

Table 19: Routing Protocol Daemon Tracing Flags

Tracing Flag	Description	Example Output
all	All operations	Not available.
general	Normal operations and routing table change	Not available.
normal	Normal operations	Not available.
policy	Policy operations and actions	**Nov 29 22:19:58 export: Dest 10.0.0.0 proto Static** **Nov 29 22:19:58 policy_match_qual_or: Qualifier proto Sense: 0** **Nov 29 22:19:58 policy_match_qual_or: Qualifier proto Sense: 0** **Nov 29 22:19:58 export: Dest 10.10.10.0 proto IS-IS**

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Table 19: Routing Protocol Daemon Tracing Flags (continued)

Tracing Flag	Description	Example Output
route	Routing table changes	Nov 29 22:23:59 Nov 29 22:23:59 rtlist_walker_job: rt_list walk for RIB inet.0 started with 42 entries Nov 29 22:23:59 rt_flash_update_callback: flash KRT (inet.0) start Nov 29 22:23:59 rt_flash_update_callback: flash KRT (inet.0) done Nov 29 22:23:59 rtlist_walker_job: rt_list walk for inet.0 ended with 42 entries Nov 29 22:23:59 Nov 29 22:23:59 KRT Request: send len 68 v14 seq 0 CHANGE route/user af 2 addr 172.16.0.0 nhop-type unicast nhop 10.10.10.33 Nov 29 22:23:59 KRT Request: send len 68 v14 seq 0 ADD route/user af 2 addr 172.17.0.0 nhop-type unicast nhop 10.10.10.33 Nov 29 22:23:59 KRT Request: send len 68 v14 seq 0 ADD route/user af 2 addr 10.149.3.0 nhop-type unicast nhop 10.10.10.33 Nov 29 22:24:19 trace_on: Tracing to "/var/log/rpdlog" started Nov 29 22:24:19 KRT Request: send len 68 v14 seq 0 DELETE route/user af 2 addr 10.10.218.0 nhop-type unicast nhop 10.10.10.29 Nov 29 22:24:19 RELEASE 10.10.218.0 255.255.255.0 gw 10.10.10.29,10.10.10.33 BGP pref 170/-101 metric so-1/1/0.0,so-1/1/1.0 <Release Delete Int Ext> as 65401 Nov 29 22:24:19 KRT Request: send len 68 v14 seq 0 DELETE route/user af 2 addr 172.18.0.0 nhop-type unicast nhop 10.10.10.33
state	State transitions	Not available.
task	Interface transactions and processing	Nov 29 22:50:04 foreground dispatch running job task_collect for task Scheduler Nov 29 22:50:04 task_collect_job: freeing task MGMT_Listen (DELETED) Nov 29 22:50:04 foreground dispatch completed job task_collect for task Scheduler Nov 29 22:50:04 background dispatch running job rt_static_update for task RT Nov 29 22:50:04 task_job_delete: delete background job rt_static_update for task RT Nov 29 22:50:04 background dispatch completed job rt_static_update for task RT Nov 29 22:50:04 background dispatch running job Flash update for task RT Nov 29 22:50:04 background dispatch returned job Flash update for task RT Nov 29 22:50:04 background dispatch running job Flash update for task RT Nov 29 22:50:04 task_job_delete: delete background job Flash update for task RT Nov 29 22:50:04 background dispatch completed job Flash update for task RT Nov 29 22:50:04 background dispatch running job Flash update for task RT Nov 29 22:50:04 task_job_delete: delete background job Flash update for task RT
timer	Timer usage	Nov 29 22:52:07 task_timer_hiprio_dispatch: ran 1 timer Nov 29 22:52:07 main: running normal priority timer queue Nov 29 22:52:07 main: ran 1 timer Nov 29 22:52:07 task_timer_hiprio_dispatch: running high priority timer queue Nov 29 22:52:07 task_timer_hiprio_dispatch: ran 1 timer Nov 29 22:52:07 main: running normal priority timer queue Nov 29 22:52:07 main: ran 1 timer Nov 29 22:52:07 main: running normal priority timer queue Nov 29 22:52:07 main: ran 2 timers

Configure Routing Protocol Tracing for a Specific Routing Protocol

Action To configure routing protocol tracing for a specific routing protocol, follow these steps:

1. In configuration mode, go to the following hierarchy level:

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```
[edit]
user@host# edit protocol protocol-name traceoptions
```

2. Configure the file, file size, number, and flags:

```
[edit protocols protocol name traceoptions]
user@host# set file filename size size files number
[edit protocols protocol name traceoptions]
user@host# set flag flag
```

For example:

```
[edit protocols ospf traceoptions]
user@host# set file ospflog size 10240 files 10
[edit protocols ospf traceoptions]
user@host# set flag general
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols ospf traceoptions]
user@host# show
file ospflog size 10k files 10;
flag general;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
[edit protocols ospf traceoptions]
user@pro4-a# run show log ospflog
Sep 17 14:23:10 trace_on: Tracing to "/var/log/ospflog" started
Sep 17 14:23:10 rt_flash_update_callback: flash OSPF (inet.0) start
Sep 17 14:23:10 OSPF: multicast address 224.0.0.5/32, route ignored
Sep 17 14:23:10 rt_flash_update_callback: flash OSPF (inet.0) done
Sep 17 14:23:10 CHANGE 10.255.245.46/32 gw 10.10.208.67 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Delete Int>
Sep 17 14:23:10 CHANGE 10.255.245.46/32 gw 10.10.208.67 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Active Int>
Sep 17 14:23:10 ADD 10.255.245.46/32 gw 10.10.208.67 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Active Int>
Sep 17 14:23:10 CHANGE 10.255.245.48/32 gw 10.10.208.69 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Delete Int>
Sep 17 14:23:10 CHANGE 10.255.245.48/32 gw 10.10.208.69 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Active Int>
```

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```
Sep 17 14:23:10 ADD 10.255.245.48/32 gw 10.10.208.69 OSPF pref 10/0 metric 1/0
   fe-0/0/0.0 <Active Int>
Sep 17 14:23:10 rt_close: 4/4 routes proto OSPF
[...Output truncated...]
```

Meaning Table 20 on page 1032 lists standard tracing options that are available globally or that can be applied to specific protocols. You can also configure tracing for a specific BGP peer or peer group. For more information, see the *Junos System Basics Configuration Guide*.

Table 20: Standard Trace Options for Routing Protocols

Tracing Flag	Description
all	All operations
general	Normal operations and routing table changes
normal	Normal operations
policy	Policy operations and actions
route	Routing table changes
state	State transitions
task	Interface transactions and processing
timer	Timer usage

Monitor Trace File Messages Written in Near-Real Time

Purpose To monitor messages in near-real time as they are being written to a trace file.

Action To monitor messages in near-real time as they are being written to a trace file, use the following Junos OS command-line interface (CLI) operational mode command:

```
user@host> monitor start filename
```

Sample Output

```
user@host> monitor start isis
user@host>
*** isis ***
Sep 15 18:32:21 Updating LSP isis5.02-00 in database
Sep 15 18:32:21 Updating L2 LSP isis5.02-00 in TED
Sep 15 18:32:21 Adding a half link from isis5.02 to isis6.00
Sep 15 18:32:21 Adding a half link from isis5.02 to isis5.00
Sep 15 18:32:21 Adding a half link from isis5.02 to isis6.00
```


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```
Sep 15 18:32:21 Adding a half link from isis5.02 to isis5.00
Sep 15 18:32:21 Scheduling L2 LSP isis5.02-00 sequence 0xd87 on interface fxp2.3
Sep 15 18:32:21 Updating LSP isis5.00-00 in database
Sep 15 18:32:21 Updating L1 LSP isis5.00-00 in TED
Sep 15 18:32:21 Sending L2 LSP isis5.02-00 on interface fxp2.3
Sep 15 18:32:21     sequence 0xd87, checksum 0xc1c8, lifetime 1200
```

Stop Trace File Monitoring

Action To stop monitoring a trace file in near-real time, use the following Junos OS CLI operational mode command after you have started monitoring:

```
user@host  monitor stop filename
```

Sample Output `user@host>` **monitor start isis**

```
user@host>
*** isis ***
Sep 15 18:32:21 Updating LSP isis5.02-00 in database
Sep 15 18:32:21 Updating L2 LSP isis5.02-00 in TED
Sep 15 18:32:21 Adding a half link from isis5.02 to isis6.00
Sep 15 18:32:21 Adding a half link from isis5.02 to isis5.00
Sep 15 18:32:21 Adding a half link from isis5.02 to isis6.00
Sep 15 18:32:21 Adding a half link from isis5.02 to isis5.00
Sep 15 18:32:21 Scheduling L2 LSP isis5.02-00 sequence 0xd87 on interface fxp2.3
Sep 15 18:32:21 Updating LSP isis5.00-00 in database
Sep 15 18:32:21 Updating L1 LSP isis5.00-00 in TED
Sep 15 18:32:21 Sending L2 LSP isis5.02-00 on interface fxp2.3
Sep 15 18:32:21     sequence 0xd87, checksum 0xc1c8, lifetime 1200
monitor stop isis
user@host>
```

Configure BGP-Specific Options

Purpose When unexpected events or problems occur, or if you want to diagnose BGP establishment issues, you can view more detailed information by configuring options specific to BGP. You can also configure tracing for a specific BGP peer or peer group. For more information, see the *Junos System Basics Configuration Guide*.

1. Display Detailed BGP Protocol Information on page 1033
2. Diagnose BGP Session Establishment Problems on page 1035

Display Detailed BGP Protocol Information

Action To display BGP protocol information in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

   ```
   [edit]
   ```

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```
user@host#  edit protocol bgp traceoptions
```

2. Configure the flag to display detailed BGP protocol messages:

```
[edit protocols bgp traceoptions]
user@host#  set flag update detail
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols bgp traceoptions]
user@host# show
flag update detail;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
[edit protocols bgp traceoptions]
user@pro5-a# run show log bgp
Sep 17 14:47:16 trace_on: Tracing to "/var/log/bgp" started
Sep 17 14:47:17 bgp_read_v4_update: receiving packet(s) from 10.255.245.53 (Internal
  AS 10458)
Sep 17 14:47:17 BGP RECV 10.255.245.53+179 -> 10.255.245.50+1141
Sep 17 14:47:17 BGP RECV message type 2 (Update) length 128
Sep 17 14:47:17 BGP RECV flags 0x40 code Origin(1): IGP
Sep 17 14:47:17 BGP RECV flags 0x40 code ASPath(2): 2
Sep 17 14:47:17 BGP RECV flags 0x80 code MultiExitDisc(4): 0
Sep 17 14:47:17 BGP RECV flags 0x40 code LocalPref(5): 100
Sep 17 14:47:17 BGP RECV flags 0xc0 code Extended Communities(16): 2:10458:1
[...Output truncated...]
```

Meaning Table 21 on page 1034 lists tracing flags specific to BGP and presents example output for some of the flags. You can also configure tracing for a specific BGP peer or peer group. For more information, see the *Junos System Basics Configuration Guide*.

Table 21: BGP Protocol Tracing Flags

Tracing Flags	Description	Example Output
aspath	AS path regular expression operations	Not available.

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Table 21: BGP Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
damping	Damping operations	Nov 28 17:01:12 bgp_damp_change: Change event Nov 28 17:01:12 bgp_dampen: Damping 10.10.1.0 Nov 28 17:01:12 bgp_damp_change: Change event Nov 28 17:01:12 bgp_dampen: Damping 10.10.2.0 Nov 28 17:01:12 bgp_damp_change: Change event Nov 28 17:01:12 bgp_dampen: Damping 10.10.3.0
keepalive	BGP keepalive messages	Nov 28 17:09:27 bgp_send: sending 19 bytes to 10.217.5.101 (External AS 65471) Nov 28 17:09:27 Nov 28 17:09:27 BGP SEND 10.217.5.1+179 -> 10.217.5.101+52162 Nov 28 17:09:27 BGP SEND message type 4 (KeepAlive) length 19 Nov 28 17:09:28 Nov 28 17:09:28 BGP RECV 10.217.5.101+52162 -> 10.217.5.1+179 Nov 28 17:09:28 BGP RECV message type 4 (KeepAlive) length 19
open	BGP open packets	Nov 28 18:37:42 bgp_send: sending 37 bytes to 10.217.5.101 (External AS 65471) Nov 28 18:37:42 Nov 28 18:37:42 BGP SEND 10.217.5.1+179 -> 10.217.5.101+38135 Nov 28 18:37:42 BGP SEND message type 1 (Open) length 37
packets	All BGP protocol packets	Sep 27 17:45:31 BGP RECV 10.0.100.108+179 -> 10.0.100.105+1033 Sep 27 17:45:31 BGP RECV message type 4 (KeepAlive) length 19 Sep 27 17:45:31 bgp_send: sending 19 bytes to 10.0.100.108 (Internal AS 100) Sep 27 17:45:31 BGP SEND 10.0.100.105+1033 -> 10.0.100.108+179 Sep 27 17:45:31 BGP SEND message type 4 (KeepAlive) length 19 Sep 27 17:45:31 bgp_read_v4_update: receiving packet(s) from 10.0.100.108 (Internal AS 100)
update	Update packets	Nov 28 19:05:24 BGP SEND 10.217.5.1+179 -> 10.217.5.101+55813 Nov 28 19:05:24 BGP SEND message type 2 (Update) length 53 Nov 28 19:05:24 bgp_send: sending 65 bytes to 10.217.5.101 (External AS 65471) Nov 28 19:05:24 Nov 28 19:05:24 BGP SEND 10.217.5.1+179 -> 10.217.5.101+55813 Nov 28 19:05:24 BGP SEND message type 2 (Update) length 65 Nov 28 19:05:24 bgp_send: sending 55 bytes to 10.217.5.101 (External AS 65471)

Diagnose BGP Session Establishment Problems

Purpose To trace BGP session establishment problems.

Action To trace BGP session establishment problems, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocol bgp
```

2. Configure BGP open messages:

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```
[edit protocols bgp]
user@host#  set traceoptions flag open detail
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols bgp]
user@host# show
traceoptions {
   file bgplog size 10k files 10;
   flag open detail;
}
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host#run show log  filename
```

For example:

```
[edit protocols bgp]
user@hotst# run show log bgplog
```

```
Sep 17 17:13:14 trace_on: Tracing to "/var/log/bgplog" started
Sep 17 17:13:14 bgp_read_v4_update: done with 201.0.0.2 (Internal AS 10458)
received 19 octets 0 updates 0 routes
Sep 17 17:13:15 bgp_read_v4_update: receiving packet(s) from 201.0.0.3 (Internal
AS 10458)
Sep 17 17:13:15 bgp_read_v4_update: done with 201.0.0.3 (Internal AS 10458)
received 19 octets 0 updates 0 routes
Sep 17 17:13:44 bgp_read_v4_update: receiving packet(s) from 201.0.0.2 (Internal
AS 10458)
[...Output truncated...]
```

Display Detailed BGP Protocol Information

Action To display BGP protocol information in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host#  edit protocol bgp traceoptions
```

2. Configure the flag to display detailed BGP protocol messages:

```
[edit protocols bgp traceoptions]
user@host#  set flag update detail
```


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3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols bgp traceoptions]
user@host# show
flag update detail;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
[edit protocols bgp traceoptions]
user@pro5-a# run show log bgp
Sep 17 14:47:16 trace_on: Tracing to "/var/log/bgp" started
Sep 17 14:47:17 bgp_read_v4_update: receiving packet(s) from 10.255.245.53 (Internal
  AS 10458)
Sep 17 14:47:17 BGP RECV 10.255.245.53+179 -> 10.255.245.50+1141
Sep 17 14:47:17 BGP RECV message type 2 (Update) length 128
Sep 17 14:47:17 BGP RECV flags 0x40 code Origin(1): IGP
Sep 17 14:47:17 BGP RECV flags 0x40 code ASPath(2): 2
Sep 17 14:47:17 BGP RECV flags 0x80 code MultiExitDisc(4): 0
Sep 17 14:47:17 BGP RECV flags 0x40 code LocalPref(5): 100
Sep 17 14:47:17 BGP RECV flags 0xc0 code Extended Communities(16): 2:10458:1
[...Output truncated...]
```

Meaning Table 21 on page 1034 lists tracing flags specific to BGP and presents example output for some of the flags. You can also configure tracing for a specific BGP peer or peer group. For more information, see the *Junos System Basics Configuration Guide*.

Table 22: BGP Protocol Tracing Flags

Tracing Flags	Description	Example Output
aspath	AS path regular expression operations	Not available.
damping	Damping operations	**Nov 28 17:01:12 bgp_damp_change: Change event** **Nov 28 17:01:12 bgp_dampen: Damping 10.10.1.0** **Nov 28 17:01:12 bgp_damp_change: Change event** **Nov 28 17:01:12 bgp_dampen: Damping 10.10.2.0** **Nov 28 17:01:12 bgp_damp_change: Change event** **Nov 28 17:01:12 bgp_dampen: Damping 10.10.3.0**

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Table 22: BGP Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
keepalive	BGP keepalive messages	**Nov 28 17:09:27 bgp_send: sending 19 bytes to 10.217.5.101 (External AS 65471)** **Nov 28 17:09:27** **Nov 28 17:09:27 BGP SEND 10.217.5.1+179 -> 10.217.5.101+52162** **Nov 28 17:09:27 BGP SEND message type 4 (KeepAlive) length 19** **Nov 28 17:09:28** **Nov 28 17:09:28 BGP RECV 10.217.5.101+52162 -> 10.217.5.1+179** **Nov 28 17:09:28 BGP RECV message type 4 (KeepAlive) length 19**
open	BGP open packets	**Nov 28 18:37:42 bgp_send: sending 37 bytes to 10.217.5.101 (External AS 65471)** **Nov 28 18:37:42** **Nov 28 18:37:42 BGP SEND 10.217.5.1+179 -> 10.217.5.101+38135** **Nov 28 18:37:42 BGP SEND message type 1 (Open) length 37**
packets	All BGP protocol packets	**Sep 27 17:45:31 BGP RECV 10.0.100.108+179 -> 10.0.100.105+1033** **Sep 27 17:45:31 BGP RECV message type 4 (KeepAlive) length 19** **Sep 27 17:45:31 bgp_send: sending 19 bytes to 10.0.100.108 (Internal AS 100)** **Sep 27 17:45:31 BGP SEND 10.0.100.105+1033 -> 10.0.100.108+179** **Sep 27 17:45:31 BGP SEND message type 4 (KeepAlive) length 19** **Sep 27 17:45:31 bgp_read_v4_update: receiving packet(s) from 10.0.100.108 (Internal AS 100)**
update	Update packets	**Nov 28 19:05:24 BGP SEND 10.217.5.1+179 -> 10.217.5.101+55813** **Nov 28 19:05:24 BGP SEND message type 2 (Update) length 53** **Nov 28 19:05:24 bgp_send: sending 65 bytes to 10.217.5.101 (External AS 65471)** **Nov 28 19:05:24** **Nov 28 19:05:24 BGP SEND 10.217.5.1+179 -> 10.217.5.101+55813** **Nov 28 19:05:24 BGP SEND message type 2 (Update) length 65** **Nov 28 19:05:24 bgp_send: sending 55 bytes to 10.217.5.101 (External AS 65471)**

Configure IS-IS-Specific Options

Purpose When unexpected events or problems occur, or if you want to diagnose IS-IS adjacency establishment issues, you can view more detailed information by configuring options specific to IS-IS.

To configure IS-IS options, follow these steps:

1. Displaying Detailed IS-IS Protocol Information on page 1038
2. Displaying Sent or Received IS-IS Protocol Packets on page 1041
3. Analyzing IS-IS Link-State PDUs in Detail on page 1042

Displaying Detailed IS-IS Protocol Information

Action To trace IS-IS messages in detail, follow these steps:

1. Configure the flag to display detailed IS-IS protocol messages.

```
[edit protocols isis traceoptions]
user@host#  set flag hello detail
```


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2. Verify the configuration.

```
user@host# show
```

For example:

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello detail;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host# run show log isislog
```

```
Nov 29 23:17:50 trace_on: Tracing to "/var/log/isislog" started
Nov 29 23:17:50 Sending PTP IIH on so-1/1/1.0
Nov 29 23:17:53 Sending PTP IIH on so-1/1/0.0
Nov 29 23:17:54 Received PTP IIH, source id abc-core-01 on so-1/1/0.0
Nov 29 23:17:54     from interface index 11
Nov 29 23:17:54     max area 0, circuit type l2, packet length 4469
Nov 29 23:17:54     hold time 30, circuit id 6
Nov 29 23:17:54     neighbor state up
Nov 29 23:17:54     speaks IP
Nov 29 23:17:54     area address 99.0008 (1)
Nov 29 23:17:54     IP address 10.10.10.29
Nov 29 23:17:54     4396 bytes of total padding
Nov 29 23:17:54     updating neighbor abc-core-01
Nov 29 23:17:55 Received PTP IIH, source id abc-core-02 on so-1/1/1.0
Nov 29 23:17:55     from interface index 12
Nov 29 23:17:55     max area 0, circuit type l2, packet length 4469
Nov 29 23:17:55     hold time 30, circuit id 6
Nov 29 23:17:55     neighbor state up
Nov 29 23:17:55     speaks IP
Nov 29 23:17:55     area address 99.0000 (1)
Nov 29 23:17:55     IP address 10.10.10.33
Nov 29 23:17:55     4396 bytes of total padding
Nov 29 23:17:55     updating neighbor abc-core-02
```

Meaning Table 23 on page 1040 lists tracing flags that can be configured specific to IS-IS and presents example output for some of the flags.

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Table 23: IS-IS Protocol Tracing Flags

Tracing Flags	Description	Example Output
csn	Complete sequence number PDU (CSNP)	**Nov 28 20:02:48 Sending L2 CSN on interface so-1/1/0.0Nov 28 20:02:48 Sending L2 CSN on interface so-1/1/1.0** With the **detail** option. **Nov 28 20:06:08 Sending L2 CSN on interface so-1/1/1.0Nov 28 20:06:08 LSP abc-core-01.00-00 lifetime 1146Nov 28 20:06:08 sequence 0x1c4f8 checksum 0xa1e9Nov 28 20:06:08 LSP abc-core-02.00-00 lifetime 411Nov 28 20:06:08 sequence 0x7435 checksum 0x5424Nov 28 20:06:08 LSP abc-brdr-01.00-00 lifetime 465Nov 28 20:06:08 sequence 0xf73 checksum 0xab10Nov 28 20:06:08 LSP abc-edge-01.00-00 lifetime 1089Nov 28 20:06:08 sequence 0x1616 checksum 0xdb29Nov 28 20:06:08 LSP abc-edge-02.00-00 lifetime 1103Nov 28 20:06:08 sequence 0x45cc checksum 0x6883**
hello	Hello packet	**Nov 28 20:13:50 Sending PTP IIH on so-1/1/1.0Nov 28 20:13:50 Received PTP IIH, source id abc-core-01 on so-1/1/0.0Nov 28 20:13:53 Received PTP IIH, source id abc-core-02 on so-1/1/1.0Nov 28 20:13:57 Sending PTP IIH on so-1/1/0.0Nov 28 20:13:58 Received PTP IIH, source id abc-core-01 on so-1/1/0.0Nov 28 20:13:59 Sending PTP IIH on so-1/1/1.0**
lsp	Link-state PDUs (LSPs)	**Nov 28 20:15:46 Received L2 LSP abc-edge-01.00-00, interface so-1/1/0.0Nov 28 20:15:46 from abc-core-01Nov 28 20:15:46 sequence 0x1617, checksum 0xd92a, lifetime 1197Nov 28 20:15:46 Updating L2 LSP abc-edge-01.00-00 in TEDNov 28 20:15:47 Received L2 LSP abc-edge-01.00-00, interface so-1/1/1.0Nov 28 20:15:47 from abc-core-02Nov 28 20:15:47 sequence 0x1617, checksum 0xd92a, lifetime 1197**
lsp-generation	Link-state PDU generation packets	**Nov 28 20:21:24 Regenerating L1 LSP abc-edge-03.00-00, old sequence 0x682Nov 28 20:21:27 Rebuilding L1, fragment abc-edge-03.00-00Nov 28 20:21:27 Rebuilt L1 fragment abc-edge-03.00-00, size 59Nov 28 20:31:52 Regenerating L2 LSP abc-edge-03.00-00, old sequence 0x689Nov 28 20:31:54 Rebuilding L2, fragment abc-edge-03.00-00Nov 28 20:31:54 Rebuilt L2 fragment abc-edge-03.00-00, size 256Nov 28 20:34:05 Regenerating L1 LSP abc-edge-03.00-00, old sequence 0x683Nov 28 20:34:08 Rebuilding L1, fragment abc-edge-03.00-00Nov 28 20:34:08 Rebuilt L1 fragment abc-edge-03.00-00, size 59**
packets	All IS-IS protocol packets	Not available.
psn	Partial sequence number PDU (PSNP) packets	**Nov 28 20:40:39 Received L2 PSN, source abc-core-01, interface so-1/1/0.0Nov 28 20:40:39 Received L2 PSN, source abc-core-02, interface so-1/1/1.0Nov 28 20:41:36 Sending L2 PSN on interface so-1/1/1.0Nov 28 20:41:36 Sending L2 PSN on interface so-1/1/0.0Nov 28 20:42:35 Received L2 PSN, source abc-core-02, interface so-1/1/1.0Nov 28 20:42:35 LSP abc-edge-03.00-00 lifetime 1196Nov 28 20:42:35 sequence 0x68c checksum 0x746dNov 28 20:42:35 Received L2 PSN, source abc-core-01, interface so-1/1/0.0Nov 28 20:42:35 LSP abc-edge-03.00-00 lifetime 1196Nov 28 20:42:35 sequence 0x68c checksum 0x746dNov 28 20:42:49 Sending L2 PSN on interface so-1/1/1.0Nov 28 20:42:49 LSP abc-core-01.00-00 lifetime 1197Nov 28 20:42:49 sequence 0x1c4fb checksum 0x9becNov 28 20:42:49 Sending L2 PSN on interface so-1/1/0.0Nov 28 20:42:49 LSP abc-core-01.00-00 lifetime 1197Nov 28 20:42:49 sequence 0x1c4fb checksum 0x9bec**

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Table 23: IS-IS Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
spf	Shortest-path-first (SPF) calculations	**Nov 28 20:44:01 Scheduling SPF for L1: ReconfigNov 28 20:44:01 Scheduling multicast SPF for L1: ReconfigNov 28 20:44:01 Scheduling SPF for L2: ReconfigNov 28 20:44:01 Scheduling multicast SPF for L2: ReconfigNov 28 20:44:02 Running L1 SPFNov 28 20:44:02 L1 SPF initialization complete: 0.000099s cumulative timeNov 28 20:44:02 L1 SPF primary processing complete: 0.000303s cumulative timeNov 28 20:44:02 L1 SPF result postprocessing complete: 0.000497s cumulative timeNov 28 20:44:02 L1 SPF RIB postprocessing complete: 0.000626s cumulative timeNov 28 20:44:02 L1 SPF routing table postprocessing complete: 0.000736s cumulative time**

See Also

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Displaying Sent or Received IS-IS Protocol Packets

To configure the tracing for only sent or received IS-IS protocol packets, follow these steps:

1. Configure the flag to display sent, received, or both sent and received packets.

```
[edit protocols isis traceoptions]
user@host# set flag hello send
```

or

```
[edit protocols isis traceoptions]
user@host# set flag hello receive
```

or

```
[edit protocols isis traceoptions]
user@host# set flag hello
```

2. Verify the configuration.

```
user@host# show
```

For example:

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello send;
```

or

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```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello receive;
```

or

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello send receive;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host# run show log isislog
Sep 27 18:17:01 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:01 ISIS periodic xmit to 01:80:c2:00:00:14 (IFL 2)
Sep 27 18:17:03 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:04 ISIS periodic xmit to 01:80:c2:00:00:14 (IFL 2)
Sep 27 18:17:06 ISIS L2 hello from 0000.0000.0008 (IFL 2) absorbed
Sep 27 18:17:06 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:06 ISIS L1 hello from 0000.0000.0008 (IFL 2) absorbed
```

See Also

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Analyzing IS-IS Link-State PDUs in Detail

To analyze IS-IS link-state PDUs in detail, follow these steps:

1. Configure IS-IS open messages.

```
[edit protocols isis traceoptions]
user@host# set flag lsp detail
```

2. Verify the configuration.

```
user@host# show
```

For example:

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```
[edit protocols isis traceoptions]
user@host# show
file isislog size 5m world-readable;
flag error;
flag lsp detail;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host#  run show log isislog
Nov 28 20:17:24 Received L2 LSP abc-core-01.00-00, interface so-1/1/0.0
Nov 28 20:17:24     from abc-core-01
Nov 28 20:17:24     sequence 0x1c4f9, checksum 0x9fea, lifetime 1199
Nov 28 20:17:24     max area 0, length 426
Nov 28 20:17:24     no partition repair, no database overload
Nov 28 20:17:24     IS type 3, metric type 0
Nov 28 20:17:24     area address 99.0908 (1)
Nov 28 20:17:24     speaks CLNP
Nov 28 20:17:24     speaks IP
Nov 28 20:17:24     dyn hostname abc-core-01
Nov 28 20:17:24     IP address 10.10.134.11
Nov 28 20:17:24    IP prefix: 10.10.10.0/30 metric 1 up
Nov 28 20:17:24    IP prefix: 10.10.10.4/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.56/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.52/30 metric 1 up
Nov 28 20:17:24    IP prefix: 10.10.10.64/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.20/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.28/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.44/30 metric 5 up
Nov 28 20:17:24     IP prefix 10.10.10.0 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 1
Nov 28 20:17:24     IP prefix 10.10.10.4 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.56 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.52 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 1
Nov 28 20:17:24     IP prefix 10.10.10.64 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.20 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.28 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.44 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbors:
Nov 28 20:17:24     IS neighbor abc-core-02.00
Nov 28 20:17:24     internal, metrics: default 1
[...Output truncated...]
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbor abc-brdr-01.00
```

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```
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbor abc-core-02.00, metric: 1
Nov 28 20:17:24     IS neighbor abc-esr-02.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-03.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-01.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-02.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-brdr-01.00, metric: 5
Nov 28 20:17:24    IP prefix: 10.10.134.11/32 metric 0 up
Nov 28 20:17:24    IP prefix: 10.11.0.0/16 metric 5 up
Nov 28 20:17:24    IP prefix: 10.211.0.0/16 metric 0 up
Nov 28 20:17:24     IP prefix 10.10.134.11 255.255.255.255
Nov 28 20:17:24     internal, metrics: default 0
Nov 28 20:17:24     IP prefix 10.11.0.0 255.255.0.0
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.211.0.0 255.255.0.0
Nov 28 20:17:24     internal, metrics: default 0
Nov 28 20:17:24     Updating LSP
Nov 28 20:17:24 Updating L2 LSP abc-core-01.00-00 in TED
Nov 28 20:17:24 Analyzing subtlv's for abc-core-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-esr-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-03.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-01.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-brdr-01.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24     Scheduling L2 LSP abc-core-01.00-00 sequence 0x1c4f9 on
interface so-1/1/1.0
```

See Also

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Displaying Detailed IS-IS Protocol Information

Action To trace IS-IS messages in detail, follow these steps:

1. Configure the flag to display detailed IS-IS protocol messages.

```
[edit protocols isis traceoptions]
user@host#  set flag hello detail
```

2. Verify the configuration.

```
user@host# show
```

For example:

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
```


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```
flag hello detail;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host# run show log isislog
```

```
Nov 29 23:17:50 trace_on: Tracing to "/var/log/isislog" started
Nov 29 23:17:50 Sending PTP IIH on so-1/1/1.0
Nov 29 23:17:53 Sending PTP IIH on so-1/1/0.0
Nov 29 23:17:54 Received PTP IIH, source id abc-core-01 on so-1/1/0.0
Nov 29 23:17:54     from interface index 11
Nov 29 23:17:54     max area 0, circuit type l2, packet length 4469
Nov 29 23:17:54     hold time 30, circuit id 6
Nov 29 23:17:54     neighbor state up
Nov 29 23:17:54     speaks IP
Nov 29 23:17:54     area address 99.0008 (1)
Nov 29 23:17:54     IP address 10.10.10.29
Nov 29 23:17:54     4396 bytes of total padding
Nov 29 23:17:54     updating neighbor abc-core-01
Nov 29 23:17:55 Received PTP IIH, source id abc-core-02 on so-1/1/1.0
Nov 29 23:17:55     from interface index 12
Nov 29 23:17:55     max area 0, circuit type l2, packet length 4469
Nov 29 23:17:55     hold time 30, circuit id 6
Nov 29 23:17:55     neighbor state up
Nov 29 23:17:55     speaks IP
Nov 29 23:17:55     area address 99.0000 (1)
Nov 29 23:17:55     IP address 10.10.10.33
Nov 29 23:17:55     4396 bytes of total padding
Nov 29 23:17:55     updating neighbor abc-core-02
```

Meaning Table 23 on page 1040 lists tracing flags that can be configured specific to IS-IS and presents example output for some of the flags.

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Table 24: IS-IS Protocol Tracing Flags

Tracing Flags	Description	Example Output
csn	Complete sequence number PDU (CSNP)	**Nov 28 20:02:48 Sending L2 CSN on interface so-1/1/0.0Nov 28 20:02:48 Sending L2 CSN on interface so-1/1/1.0** With the **detail** option. **Nov 28 20:06:08 Sending L2 CSN on interface so-1/1/1.0Nov 28 20:06:08 LSP abc-core-01.00-00 lifetime 1146Nov 28 20:06:08 sequence 0x1c4f8 checksum 0xa1e9Nov 28 20:06:08 LSP abc-core-02.00-00 lifetime 411Nov 28 20:06:08 sequence 0x7435 checksum 0x5424Nov 28 20:06:08 LSP abc-brdr-01.00-00 lifetime 465Nov 28 20:06:08 sequence 0xf73 checksum 0xab10Nov 28 20:06:08 LSP abc-edge-01.00-00 lifetime 1089Nov 28 20:06:08 sequence 0x1616 checksum 0xdb29Nov 28 20:06:08 LSP abc-edge-02.00-00 lifetime 1103Nov 28 20:06:08 sequence 0x45cc checksum 0x6883**
hello	Hello packet	**Nov 28 20:13:50 Sending PTP IIH on so-1/1/1.0Nov 28 20:13:50 Received PTP IIH, source id abc-core-01 on so-1/1/0.0Nov 28 20:13:53 Received PTP IIH, source id abc-core-02 on so-1/1/1.0Nov 28 20:13:57 Sending PTP IIH on so-1/1/0.0Nov 28 20:13:58 Received PTP IIH, source id abc-core-01 on so-1/1/0.0Nov 28 20:13:59 Sending PTP IIH on so-1/1/1.0**
lsp	Link-state PDUs (LSPs)	**Nov 28 20:15:46 Received L2 LSP abc-edge-01.00-00, interface so-1/1/0.0Nov 28 20:15:46 from abc-core-01Nov 28 20:15:46 sequence 0x1617, checksum 0xd92a, lifetime 1197Nov 28 20:15:46 Updating L2 LSP abc-edge-01.00-00 in TEDNov 28 20:15:47 Received L2 LSP abc-edge-01.00-00, interface so-1/1/1.0Nov 28 20:15:47 from abc-core-02Nov 28 20:15:47 sequence 0x1617, checksum 0xd92a, lifetime 1197**
lsp-generation	Link-state PDU generation packets	**Nov 28 20:21:24 Regenerating L1 LSP abc-edge-03.00-00, old sequence 0x682Nov 28 20:21:27 Rebuilding L1, fragment abc-edge-03.00-00Nov 28 20:21:27 Rebuilt L1 fragment abc-edge-03.00-00, size 59Nov 28 20:31:52 Regenerating L2 LSP abc-edge-03.00-00, old sequence 0x689Nov 28 20:31:54 Rebuilding L2, fragment abc-edge-03.00-00Nov 28 20:31:54 Rebuilt L2 fragment abc-edge-03.00-00, size 256Nov 28 20:34:05 Regenerating L1 LSP abc-edge-03.00-00, old sequence 0x683Nov 28 20:34:08 Rebuilding L1, fragment abc-edge-03.00-00Nov 28 20:34:08 Rebuilt L1 fragment abc-edge-03.00-00, size 59**
packets	All IS-IS protocol packets	Not available.
psn	Partial sequence number PDU (PSNP) packets	**Nov 28 20:40:39 Received L2 PSN, source abc-core-01, interface so-1/1/0.0Nov 28 20:40:39 Received L2 PSN, source abc-core-02, interface so-1/1/1.0Nov 28 20:41:36 Sending L2 PSN on interface so-1/1/1.0Nov 28 20:41:36 Sending L2 PSN on interface so-1/1/0.0Nov 28 20:42:35 Received L2 PSN, source abc-core-02, interface so-1/1/1.0Nov 28 20:42:35 LSP abc-edge-03.00-00 lifetime 1196Nov 28 20:42:35 sequence 0x68c checksum 0x746dNov 28 20:42:35 Received L2 PSN, source abc-core-01, interface so-1/1/0.0Nov 28 20:42:35 LSP abc-edge-03.00-00 lifetime 1196Nov 28 20:42:35 sequence 0x68c checksum 0x746dNov 28 20:42:49 Sending L2 PSN on interface so-1/1/1.0Nov 28 20:42:49 LSP abc-core-01.00-00 lifetime 1197Nov 28 20:42:49 sequence 0x1c4fb checksum 0x9becNov 28 20:42:49 Sending L2 PSN on interface so-1/1/0.0Nov 28 20:42:49 LSP abc-core-01.00-00 lifetime 1197Nov 28 20:42:49 sequence 0x1c4fb checksum 0x9bec**

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Table 24: IS-IS Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
spf	Shortest-path-first (SPF) calculations	**Nov 28 20:44:01 Scheduling SPF for L1: ReconfigNov 28 20:44:01 Scheduling multicast SPF for L1: ReconfigNov 28 20:44:01 Scheduling SPF for L2: ReconfigNov 28 20:44:01 Scheduling multicast SPF for L2: ReconfigNov 28 20:44:02 Running L1 SPFNov 28 20:44:02 L1 SPF initialization complete: 0.000099s cumulative timeNov 28 20:44:02 L1 SPF primary processing complete: 0.000303s cumulative timeNov 28 20:44:02 L1 SPF result postprocessing complete: 0.000497s cumulative timeNov 28 20:44:02 L1 SPF RIB postprocessing complete: 0.000626s cumulative timeNov 28 20:44:02 L1 SPF routing table postprocessing complete: 0.000736s cumulative time**

Related Documentation

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Displaying Sent or Received IS-IS Protocol Packets

To configure the tracing for only sent or received IS-IS protocol packets, follow these steps:

1. Configure the flag to display sent, received, or both sent and received packets.

```
[edit protocols isis traceoptions]
user@host# set flag hello send
```

or

```
[edit protocols isis traceoptions]
user@host# set flag hello receive
```

or

```
[edit protocols isis traceoptions]
user@host# set flag hello
```

2. Verify the configuration.

```
user@host# show
```

For example:

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello send;
```

or

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```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello receive;
```

or

```
[edit protocols isis traceoptions]
user@host# show
file isislog size 10k files 10;
flag hello send receive;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host# run show log isislog
Sep 27 18:17:01 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:01 ISIS periodic xmit to 01:80:c2:00:00:14 (IFL 2)
Sep 27 18:17:03 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:04 ISIS periodic xmit to 01:80:c2:00:00:14 (IFL 2)
Sep 27 18:17:06 ISIS L2 hello from 0000.0000.0008 (IFL 2) absorbed
Sep 27 18:17:06 ISIS periodic xmit to 01:80:c2:00:00:15 (IFL 2)
Sep 27 18:17:06 ISIS L1 hello from 0000.0000.0008 (IFL 2) absorbed
```

Related Documentation

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Analyzing IS-IS Link-State PDUs in Detail

To analyze IS-IS link-state PDUs in detail, follow these steps:

1. Configure IS-IS open messages.

```
[edit protocols isis traceoptions]
user@host# set flag lsp detail
```

2. Verify the configuration.

```
user@host# show
```

For example:

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```
[edit protocols isis traceoptions]
user@host# show
file isislog size 5m world-readable;
flag error;
flag lsp detail;
```

3. Commit the configuration.

```
user@host# commit
```

4. View the contents of the file containing the detailed messages.

```
user@host# run show log filename
```

For example:

```
user@host#  run show log isislog
Nov 28 20:17:24 Received L2 LSP abc-core-01.00-00, interface so-1/1/0.0
Nov 28 20:17:24     from abc-core-01
Nov 28 20:17:24     sequence 0x1c4f9, checksum 0x9fea, lifetime 1199
Nov 28 20:17:24     max area 0, length 426
Nov 28 20:17:24     no partition repair, no database overload
Nov 28 20:17:24     IS type 3, metric type 0
Nov 28 20:17:24     area address 99.0908 (1)
Nov 28 20:17:24     speaks CLNP
Nov 28 20:17:24     speaks IP
Nov 28 20:17:24     dyn hostname abc-core-01
Nov 28 20:17:24     IP address 10.10.134.11
Nov 28 20:17:24    IP prefix: 10.10.10.0/30 metric 1 up
Nov 28 20:17:24    IP prefix: 10.10.10.4/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.56/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.52/30 metric 1 up
Nov 28 20:17:24    IP prefix: 10.10.10.64/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.20/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.28/30 metric 5 up
Nov 28 20:17:24    IP prefix: 10.10.10.44/30 metric 5 up
Nov 28 20:17:24     IP prefix 10.10.10.0 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 1
Nov 28 20:17:24     IP prefix 10.10.10.4 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.56 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.52 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 1
Nov 28 20:17:24     IP prefix 10.10.10.64 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.20 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.28 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.10.10.44 255.255.255.252
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbors:
Nov 28 20:17:24     IS neighbor abc-core-02.00
Nov 28 20:17:24     internal, metrics: default 1
[...Output truncated...]
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbor abc-brdr-01.00
```

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```
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IS neighbor abc-core-02.00, metric: 1
Nov 28 20:17:24     IS neighbor abc-esr-02.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-03.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-01.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-edge-02.00, metric: 5
Nov 28 20:17:24     IS neighbor abc-brdr-01.00, metric: 5
Nov 28 20:17:24    IP prefix: 10.10.134.11/32 metric 0 up
Nov 28 20:17:24    IP prefix: 10.11.0.0/16 metric 5 up
Nov 28 20:17:24    IP prefix: 10.211.0.0/16 metric 0 up
Nov 28 20:17:24     IP prefix 10.10.134.11 255.255.255.255
Nov 28 20:17:24     internal, metrics: default 0
Nov 28 20:17:24     IP prefix 10.11.0.0 255.255.0.0
Nov 28 20:17:24     internal, metrics: default 5
Nov 28 20:17:24     IP prefix 10.211.0.0 255.255.0.0
Nov 28 20:17:24     internal, metrics: default 0
Nov 28 20:17:24     Updating LSP
Nov 28 20:17:24 Updating L2 LSP abc-core-01.00-00 in TED
Nov 28 20:17:24 Analyzing subtlv's for abc-core-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-esr-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-03.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-01.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-edge-02.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24 Analyzing subtlv's for abc-brdr-01.00
Nov 28 20:17:24 Analysis complete
Nov 28 20:17:24     Scheduling L2 LSP abc-core-01.00-00 sequence 0x1c4f9 on
interface so-1/1/1.0
```

Related Documentation

- *Understanding IS-IS Areas to Divide an Autonomous System into Smaller Groups*
- *Example: Configuring a Multi-Level IS-IS Topology to Control Interarea Flooding*

Configure OSPF-Specific Options

Purpose When unexpected events or problems occur, or if you want to diagnose OSPF neighbor establishment issues, you can view more detailed information by configuring options specific to OSPF.

To configure OSPF options, follow these steps:

1. Diagnose OSPF Session Establishment Problems on page 1050
2. Analyze OSPF Link-State Advertisement Packets in Detail on page 1054

Diagnose OSPF Session Establishment Problems

Action To trace OSPF messages in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

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```
[edit]
user@host# edit protocols ospf traceoptions
```

2. Configure OSPF hello messages:

```
[edit protocols ospf traceoptions]
user@host# set flag hello detail
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols ospf traceoptions]
user@host# show
file ospf size 5m world-readable;
flag hello detail;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
user@host# run show log ospf
```

```
Dec 2 16:14:24 Version 2, length 44, ID 10.0.0.6, area 1.0.0.0
Dec 2 16:14:24 checksum 0xf01a, authtype 0
Dec 2 16:14:24 mask 0.0.0.0, hello_ivl 10, opts 0x2, prio 128
Dec 2 16:14:24 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:24 OSPF sent Hello (1) -> 224.0.0.5 (so-1/1/2.0)
Dec 2 16:14:24 Version 2, length 44, ID 10.0.0.6, area 1.0.0.0
Dec 2 16:14:24 checksum 0xf01a, authtype 0
Dec 2 16:14:24 mask 0.0.0.0, hello_ivl 10, opts 0x2, prio 128
Dec 2 16:14:24 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:26 OSPF rcvd Hello 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0)
Dec 2 16:14:26 Version 2, length 48, ID 10.10.134.12, area 0.0.0.0
Dec 2 16:14:26 checksum 0x99b8, authtype 0Dec 2 16:14:26 mask 255.255.255.252,
hello_ivl 10, opts 0x2, prio 1
ec 2 16:14:26 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:29 OSPF rcvd Hello 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0)
Dec 2 16:14:29 Version 2, length 48, ID 10.108.134.11, area 0.0.0.0
Dec 2 16:14:29 checksum 0x99b9, authtype 0Dec 2 16:14:29 mask 255.255.255.252,
hello_ivl 10, opts 0x2, prio 1
Dec 2 16:14:29 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
```

Meaning Table 25 on page 1052 lists OSPF tracing flags and presents example output for some of the flags.

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Table 25: OSPF Protocol Tracing Flags

Tracing Flags	Description	Example Output
database-descriptttion	All database description packets	Dec 2 15:44:51 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:44:51 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:44:55 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:44:55 OSPF sent DbD (2) -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:44:55 Version 2, length 32, ID 10.0.0.6, area 0.0.0.0 Dec 2 15:44:55 checksum 0xf76b, authtype 0 Dec 2 15:44:55 options 0x42, i 1, m 1, ms 1, seq 0xa009eee, mtu 4470 Dec 2 15:44:55 OSPF rcvd DbD 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:44:55 Version 2, length 32, ID 10.10.134.12, area 0.0.0.0 Dec 2 15:44:55 checksum 0x312c, authtype 0 Dec 2 15:44:55 options 0x42, i 1, m 1, ms 1, seq 0x2154, mtu 4470
error	OSPF errored packets	Dec 2 15:49:34 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:49:44 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:49:54 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:50:04 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:50:14 OSPF packet ignored: no matching interface from 172.16.120.29
event	OSPF state transitions	Dec 2 15:52:35 OSPF interface ge-2/2/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-3/1/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-3/2/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-4/2/0.0 state changed from DR to DR Dec 2 15:53:21 OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:53:21 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:53:21 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:53:21 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Down to Init Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:53:25 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from ExStart to Exchange Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Exchange to Full Dec 2 15:53:25 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Exchange to Full

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Table 25: OSPF Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
flooding	Link-state flooding packets	Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 flooding on so-1/1/0.0 Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 flooding on so-1/1/1.0 Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 on no so-1/1/2.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 on no so-1/1/3.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.245.0.1 10.0.0.6 on no so-1/1/2.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.245.0.1 10.0.0.6 on no so-1/1/3.0 rexmit lists, no flood
hello	Hello packets	Dec 2 15:57:25 OSPF sent Hello (1) -> 224.0.0.5 (ge-3/1/0.0) Dec 2 15:57:25 Version 2, length 44, ID 10.0.0.6, area 2.0.0.0 Dec 2 15:57:25 checksum 0xe43f, authtype 0 Dec 2 15:57:25 mask 255.255.0.0, hello_ivl 10, opts 0x2, prio 128 Dec 2 15:57:25 dead_ivl 40, DR 10.218.0.1, BDR 0.0.0.0 Dec 2 15:57:25 OSPF rcvd Hello 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:57:25 Version 2, length 48, ID 10.10.134.12, area 0.0.0.0 Dec 2 15:57:25 checksum 0x99b8, authtype 0 Dec 2 15:57:25 mask 255.255.255.252, hello_ivl 10, opts 0x2, prio 1 Dec 2 15:57:25 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0 Dec 2 15:57:27 OSPF sent Hello (1) -> 224.0.0.5 (ge-3/2/0.0) Dec 2 15:57:27 Version 2, length 44, ID 10.0.0.6, area 2.0.0.0 Dec 2 15:57:27 checksum 0xe4a5, authtype 0 Dec 2 15:57:27 mask 255.255.0.0, hello_ivl 10, opts 0x2, prio 128 Dec 2 15:57:27 dead_ivl 40, DR 10.116.0.1, BDR 0.0.0.0 Dec 2 15:57:28 OSPF rcvd Hello 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 15:57:28 Version 2, length 48, ID 10.10.134.11, area 0.0.0.0 Dec 2 15:57:28 checksum 0x99b9, authtype 0 Dec 2 15:57:28 mask 255.255.255.252, hello_ivl 10, opts 0x2, prio 1 Dec 2 15:57:28 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
lsa-ack	Link-state acknowledgment packets	Dec 2 16:00:11 OSPF rcvd LSAck 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 16:00:11 Version 2, length 44, ID 10.10.134.11, area 0.0.0.0 Dec 2 16:00:11 checksum 0xcdbf, authtype 0 Dec 2 16:00:11 OSPF rcvd LSAck 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 16:00:11 Version 2, length 144, ID 10.10.134.12, area 0.0.0.0 Dec 2 16:00:11 checksum 0x73bc, authtype 0 Dec 2 16:00:16 OSPF rcvd LSAck 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 16:00:16 Version 2, length 44, ID 10.10.134.12, area 0.0.0.0 Dec 2 16:00:16 checksum 0x8180, authtype 0
lsa-request	Link-state request packets	Dec 2 16:01:38 OSPF rcvd LSReq 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 16:01:38 Version 2, length 108, ID 10.10.134.11, area 0.0.0.0 Dec 2 16:01:38 checksum 0xe86, authtype 0

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Table 25: OSPF Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
lsa-update	Link-state update packets	**Dec 2 16:09:12 OSPF built router LSA, area 0.0.0.0** **Dec 2 16:09:12 OSPF built router LSA, area 1.0.0.0** **Dec 2 16:09:12 OSPF built router LSA, area 2.0.0.0** **Dec 2 16:09:13 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/0.0)** **Dec 2 16:09:13 Version 2, length 268, ID 10.0.0.6, area 0.0.0.0** **Dec 2 16:09:13 checksum 0x8047, authtype 0** **Dec 2 16:09:13 adv count 7** **Dec 2 16:09:13 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/1.0)** **Dec 2 16:09:13 Version 2, length 268, ID 10.0.0.6, area 0.0.0.0** **Dec 2 16:09:13 checksum 0x8047, authtype 0** **Dec 2 16:09:13 adv count 7**
packets	All OSPF packets	Not available.
packet-dump	Dump the contents of selected packet types	Not available.
spf	SPF calculations	**Dec 2 16:08:03 OSPF full SPF refresh scheduled** **Dec 2 16:08:04 OSPF SPF start, area 1.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 SPF elapsed time 0.000525s** **Dec 2 16:08:04 Stub elapsed time 0.000263s** **Dec 2 16:08:04 OSPF SPF start, area 2.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 SPF elapsed time 0.000253s** **Dec 2 16:08:04 Stub elapsed time 0.000249s** **Dec 2 16:08:04 OSPF SPF start, area 0.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 OSPF add LSA Router** 10.10.**134.11 distance 1 to SPF list** **Dec 2 16:08:04 IP nexthop so-1/1/0.0 0.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router** 10.10.**134.12 distance 1 to SPF list** **Dec 2 16:08:04 IP nexthop so-1/1/1.0 0.0.0.0**

Analyze OSPF Link-State Advertisement Packets in Detail

Action To analyze OSPF link-state advertisement packets in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocols ospf traceoptions
```

2. Configure OSPF link-state packages:

```
[edit protocols ospf traceoptions]
user@host# set flag lsa-update detail
```

3. Verify the configuration:

```
user@host# show
```


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For example:

```
[edit protocols ospf traceoptions]
user@host# show
file ospf size 5m world-readable;
flag hello detail;
flag lsa-update detail;
```

4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
user@host#  run show log ospf
```

```
Dec 2 16:23:47 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/0.0) ec 2 16:23:47
Version 2, length 196, ID 10.0.0.6, area 0.0.0.0
Dec 2 16:23:47 checksum 0xcc46, authtype 0
Dec 2 16:23:47 adv count 6 Dec 2 16:23:47 OSPF sent LSUpdate (4) -> 224.0.0.5
(so-1/1/1.0)
Dec 2 16:23:47 Version 2, length 196, ID 10.0.0.6, area 0.0.0.0 Dec 2 16:23:47
checksum 0xcc46, authtype 0
Dec 2 16:23:47 adv count 6
```

Diagnose OSPF Session Establishment Problems

Action To trace OSPF messages in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

```
[edit]
user@host# edit protocols ospf traceoptions
```

2. Configure OSPF hello messages:

```
[edit protocols ospf traceoptions]
user@host# set flag hello detail
```

3. Verify the configuration:

```
user@host# show
```

For example:

```
[edit protocols ospf traceoptions]
user@host# show
file ospf size 5m world-readable;
flag hello detail;
```

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4. Commit the configuration:

```
user@host# commit
```

5. View the contents of the file containing the detailed messages:

```
user@host# run show log filename
```

For example:

```
user@host# run show log ospf
```

```
Dec 2 16:14:24 Version 2, length 44, ID 10.0.0.6, area 1.0.0.0
Dec 2 16:14:24 checksum 0xf01a, authtype 0
Dec 2 16:14:24 mask 0.0.0.0, hello_ivl 10, opts 0x2, prio 128
Dec 2 16:14:24 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:24 OSPF sent Hello (1) -> 224.0.0.5 (so-1/1/2.0)
Dec 2 16:14:24 Version 2, length 44, ID 10.0.0.6, area 1.0.0.0
Dec 2 16:14:24 checksum 0xf01a, authtype 0
Dec 2 16:14:24 mask 0.0.0.0, hello_ivl 10, opts 0x2, prio 128
Dec 2 16:14:24 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:26 OSPF rcvd Hello 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0)
Dec 2 16:14:26 Version 2, length 48, ID 10.10.134.12, area 0.0.0.0
Dec 2 16:14:26 checksum 0x99b8, authtype 0Dec 2 16:14:26 mask 255.255.255.252,
hello_ivl 10, opts 0x2, prio 1
ec 2 16:14:26 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
Dec 2 16:14:29 OSPF rcvd Hello 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0)
Dec 2 16:14:29 Version 2, length 48, ID 10.108.134.11, area 0.0.0.0
Dec 2 16:14:29 checksum 0x99b9, authtype 0Dec 2 16:14:29 mask 255.255.255.252,
hello_ivl 10, opts 0x2, prio 1
Dec 2 16:14:29 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
```

Meaning Table 25 on page 1052 lists OSPF tracing flags and presents example output for some of the flags.

Table 26: OSPF Protocol Tracing Flags

Tracing Flags	Description	Example Output
database-descriptiion	All database description packets	Dec 2 15:44:51 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:44:51 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:44:55 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:44:55 OSPF sent DbD (2) -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:44:55 Version 2, length 32, ID 10.0.0.6, area 0.0.0.0 Dec 2 15:44:55 checksum 0xf76b, authtype 0 Dec 2 15:44:55 options 0x42, i 1, m 1, ms 1, seq 0xa009eee, mtu 4470 Dec 2 15:44:55 OSPF rcvd DbD 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:44:55 Version 2, length 32, ID 10.10.134.12, area 0.0.0.0 Dec 2 15:44:55 checksum 0x312c, authtype 0 Dec 2 15:44:55 options 0x42, i 1, m 1, ms 1, seq 0x2154, mtu 4470

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Table 26: OSPF Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
error	OSPF errored packets	Dec 2 15:49:34 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:49:44 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:49:54 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:50:04 OSPF packet ignored: no matching interface from 172.16.120.29 Dec 2 15:50:14 OSPF packet ignored: no matching interface from 172.16.120.29
event	OSPF state transitions	Dec 2 15:52:35 OSPF interface ge-2/2/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-3/1/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-3/2/0.0 state changed from DR to DR Dec 2 15:52:35 OSPF interface ge-4/2/0.0 state changed from DR to DR Dec 2 15:53:21 OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:53:21 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.29 (so-1/1/0.0) state changed from Full to Down Dec 2 15:53:21 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:53:21 RPD_OSPF_NBRDOWN: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Full to Down Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Down to Init Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:53:25 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Init to ExStart Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from ExStart to Exchange Dec 2 15:53:25 OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Exchange to Full Dec 2 15:53:25 RPD_OSPF_NBRUP: OSPF neighbor 10.10.10.33 (so-1/1/1.0) state changed from Exchange to Full
flooding	Link-state flooding packets	Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 flooding on so-1/1/0.0 Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 flooding on so-1/1/1.0 Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 on no so-1/1/2.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.218.0.0 10.0.0.6 on no so-1/1/3.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.245.0.1 10.0.0.6 on no so-1/1/2.0 rexmit lists, no flood Dec 2 15:55:21 OSPF LSA Summary 10.245.0.1 10.0.0.6 on no so-1/1/3.0 rexmit lists, no flood

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Table 26: OSPF Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
hello	Hello packets	Dec 2 15:57:25 OSPF sent Hello (1) -> 224.0.0.5 (ge-3/1/0.0) Dec 2 15:57:25 Version 2, length 44, ID 10.0.0.6, area 2.0.0.0 Dec 2 15:57:25 checksum 0xe43f, authtype 0 Dec 2 15:57:25 mask 255.255.0.0, hello_ivl 10, opts 0x2, prio 128 Dec 2 15:57:25 dead_ivl 40, DR 10.218.0.1, BDR 0.0.0.0 Dec 2 15:57:25 OSPF rcvd Hello 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 15:57:25 Version 2, length 48, ID 10.10.134.12, area 0.0.0.0 Dec 2 15:57:25 checksum 0x99b8, authtype 0 Dec 2 15:57:25 mask 255.255.255.252, hello_ivl 10, opts 0x2, prio 1 Dec 2 15:57:25 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0 Dec 2 15:57:27 OSPF sent Hello (1) -> 224.0.0.5 (ge-3/2/0.0) Dec 2 15:57:27 Version 2, length 44, ID 10.0.0.6, area 2.0.0.0 Dec 2 15:57:27 checksum 0xe4a5, authtype 0 Dec 2 15:57:27 mask 255.255.0.0, hello_ivl 10, opts 0x2, prio 128 Dec 2 15:57:27 dead_ivl 40, DR 10.116.0.1, BDR 0.0.0.0 Dec 2 15:57:28 OSPF rcvd Hello 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 15:57:28 Version 2, length 48, ID 10.10.134.11, area 0.0.0.0 Dec 2 15:57:28 checksum 0x99b9, authtype 0 Dec 2 15:57:28 mask 255.255.255.252, hello_ivl 10, opts 0x2, prio 1 Dec 2 15:57:28 dead_ivl 40, DR 0.0.0.0, BDR 0.0.0.0
lsa-ack	Link-state acknowledgment packets	Dec 2 16:00:11 OSPF rcvd LSAck 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 16:00:11 Version 2, length 44, ID 10.10.134.11, area 0.0.0.0 Dec 2 16:00:11 checksum 0xcdbf, authtype 0 Dec 2 16:00:11 OSPF rcvd LSAck 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 16:00:11 Version 2, length 144, ID 10.10.134.12, area 0.0.0.0 Dec 2 16:00:11 checksum 0x73bc, authtype 0 Dec 2 16:00:16 OSPF rcvd LSAck 10.10.10.33 -> 224.0.0.5 (so-1/1/1.0) Dec 2 16:00:16 Version 2, length 44, ID 10.10.134.12, area 0.0.0.0 Dec 2 16:00:16 checksum 0x8180, authtype 0
lsa-request	Link-state request packets	Dec 2 16:01:38 OSPF rcvd LSReq 10.10.10.29 -> 224.0.0.5 (so-1/1/0.0) Dec 2 16:01:38 Version 2, length 108, ID 10.10.134.11, area 0.0.0.0 Dec 2 16:01:38 checksum 0xe86, authtype 0
lsa-update	Link-state update packets	Dec 2 16:09:12 OSPF built router LSA, area 0.0.0.0 Dec 2 16:09:12 OSPF built router LSA, area 1.0.0.0 Dec 2 16:09:12 OSPF built router LSA, area 2.0.0.0 Dec 2 16:09:13 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/0.0) Dec 2 16:09:13 Version 2, length 268, ID 10.0.0.6, area 0.0.0.0 Dec 2 16:09:13 checksum 0x8047, authtype 0 Dec 2 16:09:13 adv count 7 Dec 2 16:09:13 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/1.0) Dec 2 16:09:13 Version 2, length 268, ID 10.0.0.6, area 0.0.0.0 Dec 2 16:09:13 checksum 0x8047, authtype 0 Dec 2 16:09:13 adv count 7
packets	All OSPF packets	Not available.
packet-dump	Dump the contents of selected packet types	Not available.

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Table 26: OSPF Protocol Tracing Flags (continued)

Tracing Flags	Description	Example Output
spf	SPF calculations	**Dec 2 16:08:03 OSPF full SPF refresh scheduled** **Dec 2 16:08:04 OSPF SPF start, area 1.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 SPF elapsed time 0.000525s** **Dec 2 16:08:04 Stub elapsed time 0.000263s** **Dec 2 16:08:04 OSPF SPF start, area 2.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 SPF elapsed time 0.000253s** **Dec 2 16:08:04 Stub elapsed time 0.000249s** **Dec 2 16:08:04 OSPF SPF start, area 0.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router 10.0.0.6 distance 0 to SPF list** **Dec 2 16:08:04 OSPF add LSA Router** 10.10.**134.11 distance 1 to SPF list** **Dec 2 16:08:04 IP nexthop so-1/1/0.0 0.0.0.0** **Dec 2 16:08:04 OSPF add LSA Router** 10.10.**134.12 distance 1 to SPF list** **Dec 2 16:08:04 IP nexthop so-1/1/1.0 0.0.0.0**

Analyze OSPF Link-State Advertisement Packets in Detail

Action To analyze OSPF link-state advertisement packets in detail, follow these steps:

1. In configuration mode, go to the following hierarchy level:

   ```
   [edit]
   user@host# edit protocols ospf traceoptions
   ```

2. Configure OSPF link-state packages:

   ```
   [edit protocols ospf traceoptions]
   user@host# set flag lsa-update detail
   ```

3. Verify the configuration:

   ```
   user@host# show
   ```

   For example:

   ```
   [edit protocols ospf traceoptions]
   user@host# show
   file ospf size 5m world-readable;
   flag hello detail;
   flag lsa-update detail;
   ```

4. Commit the configuration:

   ```
   user@host# commit
   ```

5. View the contents of the file containing the detailed messages:

   ```
   user@host# run show log filename
   ```

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For example:

```
user@host# run show log ospf
```

```
Dec 2 16:23:47 OSPF sent LSUpdate (4) -> 224.0.0.5 (so-1/1/0.0) ec 2 16:23:47
Version 2, length 196, ID 10.0.0.6, area 0.0.0.0
Dec 2 16:23:47 checksum 0xcc46, authtype 0
Dec 2 16:23:47 adv count 6 Dec 2 16:23:47 OSPF sent LSUpdate (4) -> 224.0.0.5
(so-1/1/1.0)
Dec 2 16:23:47 Version 2, length 196, ID 10.0.0.6, area 0.0.0.0 Dec 2 16:23:47
checksum 0xcc46, authtype 0
Dec 2 16:23:47 adv count 6
```

Verify Received BGP Routes

Purpose Display the routing information received on router **R6**, the ingress router for the reverse LSP **R6-to-R1**.

Action To verify that a particular BGP route is received on the egress router, enter the following Junos OS CLI operational mode command:

```
user@host> show route receive protocol bgp neighbor-address
```

Sample Output 1

```
user@R6> show route receive-protocol bgp 10.0.0.1
inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
<<< missing route
inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

__juniper_private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0
hidden)
```

Sample Output 2

```
user@R6> show route receive-protocol bgp 10.0.0.1
inet.0: 30 destinations, 46 routes (29 active, 0 holddown, 1 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24     10.0.0.1         100    I

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

__juniper_private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0
hidden)
```


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Meaning Sample Output 1 shows that ingress router **R6** (reverse LSP **R6-to-R1**) does not receive any BGP routes into the **inet.0** routing table when the BGP configurations of **R1** and **R6** are incorrect.

Sample Output 2 shows a BGP route installed in the **inet.0** routing table after the BGP configurations on **R1** and **R6** are corrected using "Taking Appropriate Action for Resolving the Network Problem" on page 967.

Verify That a Particular BGP Route Is Received on Your Router

Purpose Display the routing information as it is received through a particular BGP neighbor and advertised by the local router to the neighbor.

Action To verify that a particular BGP route is received on your router, enter the following Junos OS CLI operational mode command:

```
user@host> show route receive-protocol bgp neighbor-address
```

Sample Output

```
user@R6> show route receive-protocol bgp 10.0.0.2
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24    10.0.0.2     5   200    65001 I
* 100.100.2.0/24    10.0.0.2     5   100    65001 I
  100.100.3.0/24          10.0.0.2                     100        65001 I
  100.100.4.0/24          10.0.0.2                     100        65001 I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

user@R6> show route receive-protocol bgp 10.0.0.4
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.3.0/24          10.0.0.4                     100        65001 I
* 100.100.4.0/24          10.0.0.4                     100        65001 I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

Meaning The sample output shows four BGP routes from **R2** and two from **R4**. Of the four routes from **R2**, only two are active in the routing table, as indicated by the asterisk (*), while both routes received from **R4** are active in the routing table. All BGP routes came through AS 65001.

Verify Advertised BGP Routes

Purpose You can determine if a particular route that you have configured is being advertised to a neighbor.

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Action To verify the routing information as it has been prepared for advertisement to the specified BGP neighbor, enter the following Junos OS CLI operational mode command:

```
user@host> show route advertising-protocol bgp neighbor-address
```

Sample Output

```
user@R2> show route advertising-protocol bgp 10.0.0.4\
inet.0: 20 destinations, 22 routes (20 active, 0 holddown, 0 hidden)
  Prefix                  Nexthop              MED     Lclpref    AS path
* 100.100.1.0/24          Self                 5       200        65001 I
* 100.100.2.0/24          Self                 5       100        65001 I
* 100.100.3.0/24          Self                         100        65001 I
* 100.100.4.0/24          Self                         100        65001 I
```

Meaning The sample output shows the BGP routes advertised from **R2** to its neighbor, **10.0.0.4** (**R4**). Out of 22 total routes in the **inet.0** routing table, 20 are active destinations . No routes are **hidden** or in the **hold-down** state. Routes reside in the **hold-down** state prior to being declared active, and routes rejected by a routing policy can be placed into the **hidden** state. The information displayed reflects the routes that the routing table exported to the BGP routing protocol.

Check That BGP Traffic Is Using the LSP

Purpose At this level of the troubleshooting model, BGP and the LSP may be up, however BGP traffic might not be using the LSP to forward traffic.

Action To verify that BGP traffic is using the LSP, enter the following Junos OS command-line interface (CLI) operational mode command from the ingress router:

```
user@host> traceroute hostname
```

Sample Output

```
user@R1> traceroute 100.100.6.1
traceroute to 100.100.6.1 (100.100.6.1), 30 hops max, 40 byte packets
 1  10.1.13.2 (10.1.13.2)  0.653 ms  0.590 ms  0.543 ms
 2  10.1.36.2 (10.1.36.2)  0.553 ms !N  0.552 ms !N  0.537 ms !N

user@R6> traceroute 100.100.1.1
traceroute to 100.100.1.1 (100.100.1.1), 30 hops max, 40 byte packets
 1  10.1.36.1 (10.1.36.1)  0.660 ms  0.551 ms  0.526 ms
 2  10.1.13.1 (10.1.13.1)  0.568 ms !N  0.553 ms !N  0.536 ms !N
```

Meaning The sample output shows that BGP traffic is not using the LSP, consequently MPLS labels do not appear in the output. Instead of using the LSP, BGP traffic is using the interior gateway protocol (IGP) to reach the BGP next-hop LSP egress address for **R6**

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and **R1**. The Junos OS default is to use LSPs for BGP traffic when the BGP next hop equals the LSP egress address.

Check That BGP Traffic Is Using the LSP Again

Purpose After taking the appropriate action to correct the error, the LSP needs to be checked again to confirm that BGP traffic is using the LSP and that the problem in the BGP layer has been resolved.

Action To verify that BGP traffic is using the LSP, enter the following Junos OS CLI operational mode command from the ingress router:

```
user@host> traceroute hostname
```

Sample Output

```
user@R1> traceroute 100.100.6.1
traceroute to 100.100.6.1 (100.100.6.1), 30 hops max, 40 byte packets
 1  10.1.13.2 (10.1.13.2)  0.858 ms  0.740 ms  0.714 ms
      MPLS Label=100016 CoS=0 TTL=1 S=1
 2  10.1.36.2 (10.1.36.2)  0.592 ms !N  0.564 ms !N  0.548 ms !N

user@R6> traceroute 100.100.1.1
traceroute to 100.100.1.1 (100.100.1.1), 30 hops max, 40 byte packets
 1  10.1.36.1 (10.1.36.1)  0.817 ms  0.697 ms  0.771 ms
      MPLS Label=100000 CoS=0 TTL=1 S=1
 2  10.1.13.1 (10.1.13.1)  0.581 ms !N  0.567 ms !N  0.544 ms !N
```

Meaning The sample output shows that MPLS labels are used to forward packets through the LSP. Included in the output is a label value (**MPLS Label=100016**), the time-to-live value (**TTL=1**), and the stack bit value (**S=1**).

The **MPLS Label** field is used to identify the packet to a particular LSP. It is a 20-bit field, with a maximum value of (2^^20-1), approximately 1,000,000.

The time-to-live (TTL) value contains a limit on the number of hops that this MPLS packet can travel through the network (1). It is decremented at each hop, and if the TTL value drops below one, the packet is discarded.

The bottom of the stack bit value (**S=1**) indicates that is the last label in the stack and that this MPLS packet has one label associated with it. The MPLS implementation in the Junos OS supports a stacking depth of 3 on the M-series routers and up to 5 on the T-series routing platforms. For more information on MPLS label stacking, see RFC 3032, *MPLS Label Stack Encoding*.

MPLS labels appear in the sample output because the **traceroute** command is issued to a BGP destination where the BGP next hop for that route is the LSP egress address. The Junos OS by default uses LSPs for BGP traffic when the BGP next hop equals the LSP egress address.

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If the BGP next hop does not equal the LSP egress address, the BGP traffic does not use the LSP, and consequently MPLS labels do not appear in the output for the **traceroute** command, as indicated in the sample output in "Check BGP Sessions" on page 976.

Examine the EBGP over IBGP Selection

Purpose To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path.

Action To examine a route to determine if EBGP is selected over IBGP as the selection criteria for the single, active path, enter the following Junos OS CLI operational mode command:

```
user@host> show route destination-prefix < detail >
```

Sample Output

```
user@R4> show route 100.100.3.0 detail

inet.0: 20 destinations, 24 routes (20 active, 0 holddown, 0 hidden)
100.100.3.0/24 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Source: 10.1.45.2
                Next hop: 10.1.45.2 via so-0/0/2.0, selected
                State: <Active Ext>
                Local AS: 65002 Peer AS: 65001
                Age: 5d 0:31:25
                Task: BGP_65001.10.1.45.2+179
                Announcement bits (3): 0-KRT 3-BGP.0.0.0.0+179 4-Resolve inet.0

                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.5
        BGP     Preference: 170/-101
                Source: 10.0.0.2
                Next hop: 10.1.24.1 via so-0/0/3.0, selected
                Protocol next hop: 10.0.0.2 Indirect next hop: 8644000 277
                State: <NotBest Int Ext>
                Inactive reason: Interior > Exterior > Exterior via Interior
                Local AS: 65002 Peer AS: 65002
                Age: 2:48:18    Metric2: 10
                Task: BGP_65002.10.0.0.2+179
                AS path: 65001 I
                Localpref: 100
                Router ID: 10.0.0.2
```

Meaning The sample output shows that **R4** received two instances of the **100.100.3.0** route: one from **10.1.45.2** (**R5**) and one from **10.0.0.2** (**R2**). **R4** selected the path from **R5** as its active path, as indicated by the asterisk (*). The selection is based on a preference for routes learned from an EBGP peer over routes learned from an IBGP. **R5** is an EBGP peer.

You can determine if a path is received from an EBGP or IBGP peer by examining the **Local As** and **Peer As** fields. For example, the route from **R5** shows the local AS is 65002

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and the peer AS is 65001, indicating that the route is received from an EBGP peer. The route from **R2** shows that both the local and peer AS is 65002, indicating that it is received from an IBGP peer.

The reason that the inactive path is not selected is displayed in the **Inactive reason** field, in this case, **Interior > Exterior > Exterior via Interior**. The wording of this reason shows the order of preferences applied when the same route is received from two routers. The route received from a strictly internal source (IGP) is preferred first, the route received from an external source (EBGP) is preferred next, and any route which comes from an external source and is received internally (IBGP) is preferred last.

Verify BGP on an Internal Router

Purpose To verify the BGP configuration of an internal router.

Action To verify the BGP configuration of an internal router, enter the following Junos OS command-line interface (CLI) command:

```
user@host> show configuration
```

The following sample output is for a BGP configuration on R3, as shown in "Verify the BGP Protocol" on page 998:

Sample Output

```
user@R3> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
             family inet {
                address 10.1.23.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.3/32;
            }
            family iso {
                address 49.0002.1000.0000.0003.00;
            }
        }
```

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```
    }
}
routing-options {
    [...Output truncated...]
    router-id 10.0.0.3;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.3;
            neighbor 10.0.0.2;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}

user@R6> show configuration |
[Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.2/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.36.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.6/32;
            }
            family iso {
                address 49.0003.1000.0000.0006.00;
            }
        }
    }
}
routing-options {
    [Output truncated...]
    router-id 10.0.0.6;
    autonomous-system 65002;
```


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```
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.6;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
```

Meaning The sample output shows a basic BGP configuration on routers **R3** and **R6**. The local AS (65002) and one group (**internal**) are configured on both routers. **R3** has three internal peers—**10.0.0.2**, **10.0.0.4**, and **10.0.0.6**—included at the [**protocols bgp group *group***] hierarchy level. **R6** also has three internal peers: **10.0.0.2**, **10.0.0.3**, and **10.0.0.4**. The underlying IGP protocol is Intermediate System-to-Intermediate System (IS-IS), and relevant interfaces are configured to run IS-IS.

Note that in this configuration the router ID is manually configured to avoid any duplicate router ID problems.

Verify BGP on a Border Router

Purpose To verify the BGP configuration of a border router.

Action To verify the BGP configuration of a border router, enter the following Junos OS CLI operational mode command:

```
user@host> show configuration
```

Sample Output

The following sample output is for a BGP configuration on two border routers from AS 65002 (R2 and R4 as shown in "Verify the BGP Protocol" on page 998):

```
user@R2> show configuration
[...Output truncated...]
interfaces {
    so-0/0/0 {
        unit 0 {
            family inet {
```

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```
                address 10.1.12.2/30;
            }
            family iso;
        }
    }
    so-0/0/1 {
        unit 0 {
             family inet {
                address 10.1.23.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
             family inet {
                address 10.1.24.1/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
             family inet {
                address 10.0.0.2/32;
            }
            family iso {
                address 49.0002.1000.0000.0002.00;
            }
        }
    }
}
routing-options {
[...Output truncated...]
     router-id 10.0.0.2;
    autonomous-system 65002;
}
protocols {
     bgp {
        group internal {
            type internal;
            export next-hop-self;
            neighbor 10.0.0.3;
            neighbor 10.0.0.4;
            neighbor 10.0.0.6;
        }
        group toR1 {
            type external;
            import import-toR1;
            peer-as 65001;
            neighbor 10.1.12.1;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
```


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```
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.12.1;
            then {
                next-hop self;
            }
        }
    }
    policy-statement import-toR1 {
        term 1 {
            from {
                route-filter 100.100.1.0/24 exact;
            }
            then {
                local-preference 200;
            }
        }
    }

user@R4> show configuration
[...Output truncated...]
interfaces {
    so-0/0/1 {
        unit 0 {
            family inet {
                address 10.1.46.1/30;
            }
            family iso;
        }
    }
    so-0/0/2 {
        unit 0 {
            family inet {
                address 10.1.45.1/30;
            }
            family iso;
        }
    }
    so-0/0/3 {
        unit 0 {
            family inet {
                address 10.1.24.2/30;
            }
            family iso;
        }
    }
    lo0 {
        unit 0 {
            family inet {
                address 10.0.0.4/32;
            }
            family iso {
                address 49.0001.1000.0000.0004.00;
            }
        }
    }
}
routing-options {
```

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```
    [...Output truncated...]
    router-id 10.0.0.4;
    autonomous-system 65002;
}
protocols {
    bgp {
        group internal {
            type internal;
            local-address 10.0.0.4;
            export next-hop-self;
            neighbor 10.0.0.2;
            neighbor 10.0.0.3;
            neighbor 10.0.0.6;
        }
        group toR5 {
            type external;
            peer-as 65001;
            neighbor 10.1.45.2;
        }
    }
    isis {
        level 1 disable;
        interface all {
            level 2 metric 10;
        }
        interface lo0.0;
    }
}
policy-options {
    policy-statement next-hop-self {
        term change-next-hop {
            from neighbor 10.1.45.2;
            then {
                next-hop self;
            }
        }
    }
```

Meaning The sample output shows a basic BGP configuration on border routers **R2** and **R4**. Both routers have the AS (65002) included at the [**routing-options**] hierarchy level. Each router has two groups included at the [**protocols bgp group *group***] hierarchy level. External peers are included in the external group, either *toR1* or **toR5**, depending on the router. Internal peers are included in the **internal** group. The underlying IGP protocol is IS-IS on both routers, and relevant interfaces are configured to run IS-IS.

Note that in the configuration on both routers, the router ID is manually configured to avoid duplicate router ID problems, and the **next-hop-self** statement is included to avoid any BGP next-hop reachability problems.

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PART 15

Configuration Statements and Operational Commands

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accepted-prefix-limit

Syntax

```
accepted-prefix-limit {
  maximum number;
  teardown <percentage-threshold> idle-timeout (forever | minutes);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* protocols bgp family route-target],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family route-target],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family route-target],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family route-target],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family route-target],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family route-target],
[edit protocols bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit protocols bgp family route-target],
[edit protocols bgp group *group-name* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit protocols bgp group *group-name* family route-target],
[edit protocols bgp group *group-name* neighbor *address* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit protocols bgp group *group-name* neighbor *address* family route-target],
[edit routing-instances *routing-instance-name* protocols bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit routing-instances *routing-instance-name* protocols bgp family route-target],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family route-target],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family route-target]

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Release Information Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.

Description Configure a limit to the number of prefixes that can be accepted in a BGP peer session. When that limit is exceeded, a system log message is sent.

This statement provides the ability to log a message, reset the BGP session, or do both when the number of prefixes received from the peer and accepted by policy exceeds a preset limit. This functionality is identical to the **prefix-limit** functionality except that it operates against accepted prefixes rather than received prefixes.

Options

maximum *number*—When you set the maximum number of prefixes, a message is logged when that number is exceeded.

Range: 1 through 4,294,967,295 ($2^{32} - 1$)

teardown <*percentage*>—(Optional) If you include the **teardown** statement, the session is torn down when the maximum number of prefixes is reached. If you specify a percentage, messages are logged when the number of prefixes exceeds that percentage. After the session is torn down, it is reestablished in a short time unless you include the **idle-timeout** statement. Then the session can be kept down for a specified amount of time, or forever. If you specify **forever**, the session is reestablished only after you issue a **clear bgp neighbor** command.

If the **teardown** statement is not configured, a message is logged when the number of prefixes exceeds the value configured for the **maximum** option.

Range: 1 through 100

idle-timeout (forever | *timeout-in-minutes*)—(Optional) If you include the **idle-timeout** statement, the session is torn down for a specified amount of time, or forever. If you specify a period of time, the session is allowed to reestablish after this timeout period. If you specify **forever**, the session is reestablished only after you intervene with a **clear bgp neighbor** command.

Range: 1 through 2400

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- prefix-limit on page 1310
- Limiting the Number of Prefixes Accepted on a BGP Peer Session on page 660

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accept-remote-nexthop

Syntax

```
accept-remote-nexthop;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify that a single-hop EBGP peer accepts a remote next hop with which it does not share a common subnet. Configure a separate import policy on the EBGP peer to specify the remote next hop.

For Junos OS Release 13.3 and later releases, specify that a multihop EBGP peer accepts a remote next hop with which it does not share a common subnet. This allows working around current resolver limitations to realize multipath forwarding in recursive next-hop resolution scenarios.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Single-Hop EBGP Peers to Accept Remote Next Hops on page 434
- Configuring Routing Policies to Control BGP Route Advertisements on page 328
- multipath on page 1266

add-path

Syntax

```
add-path {
  receive;
  send {
       path-selection-mode {
         all-paths;
         equal-cost-paths
       }
    include-backup-path backup_path_number
    multipath;
    allow-ebgp
    path-count number;
    prefix-policy [ policy-names ];
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family family],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family],
[edit protocols bgp group group-name family family],
[edit protocols bgp group group-name neighbor address family family]
```

Release Information

Statement introduced in Junos OS Release 11.3.
path-selection-mode option and **include-backup-path** *backup_path_num* introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description

Enable advertisement and/or reception of multiple paths to a destination to/from the same BGP peer, instead of advertising/receiving only the active path to/from the same BGP peer.

The remaining statements are explained separately. See CLI Explorer.

NOTE: The minimum configuration for the send side is **add-path send path-count <n>**. The configuration for the receive side is **add-path send receive**.

You cannot just configure **add-path**. You must configure at least one **send/receive**. (If you attempt to configure only **add-path**, it will fail.) If only **send/receive** is configured, the corresponding support is enabled: **send** for advertisement of add-path routes and **receive** for reception of add-path routes.

NOTE: The effective **rx/tx add-path** state of a bgp-session depends on the addpath-capability advertisement from both the ends. That is, if R1 configures **send**, but R2 doesn't configure **receive**, then R1 will not send **add-path** to R2.

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 468
- Example: Advertising Multiple Paths in BGP on page 470

add-path-display-ipv4-address

Syntax
```
add-path-display-ipv4-address { ... }
```

Hierarchy Level
```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit protocols bgp],
[edit protocols bgp group group-name]
```

Release Information
Statement introduced in Junos OS Release 16.1.

Description
Enable the display of external BGP (EBGP) *path-id* in IPv4 Address format.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 468
- Example: Advertising Multiple Paths in BGP on page 470
- *Example: Configuring EBGP Multihop*

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advertise-bgp-static

Syntax

```
advertise-bgp-static {
  policy policy-expression;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 14.2.

Description

Include this statement to always advertise a BGP-static route, even if it is not the active route for a prefix. You can configure this statement globally to advertise the BGP-static routes to all neighbors. You can also configure this statement to advertise BGP-static routes in a BGP group or to a specific neighbor in a BGP group.

Options

policy ***policy-expression***—Specify an additional export policy to control whether or not a given BGP-static route is to be advertised in preference to the active route for a prefix. The policy is applied to the BGP-static route and not to the active route. Only the accept or reject result of the policy expression is observed, and any side-effects, such as, modifying communities, are ignored.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- bgp-static on page 1123
- Configuring BGP-Static Routes for Preventing Route Flaps on page 877
- Example: Configuring BGP-Static Routes to Prevent Route Flaps on page 863
- Understanding BGP-Static Routes for Preventing Route Flaps on page 862

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advertise-external

Syntax

```
advertise-external {conditional};
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-address*]

Release Information

Statement introduced in Junos OS Release 9.3.
Statement introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify BGP to advertise the best external route into an IBGP mesh group, a route reflector cluster, or an AS confederation even if the best route is an internal route.

In general, deployed BGP implementations do not advertise the external route with the highest local preference value to internal peers unless it is the best route. Although this behavior was required by an earlier version of the BGP version 4 specification, RFC 1771, it was typically not followed in order to minimize the amount of advertised information and to prevent routing loops. However, there are scenarios in which advertising the best external route is beneficial, in particular, situations that can result in IBGP route oscillation.

The **advertise-external** statement is supported at both the group and neighbor level. If you configure the statement at the neighbor level, you must configure it for all neighbors in a group. Otherwise, the group is automatically split into different groups.

In a confederation, when advertising a route to a confederation border router, any route from a different confederation sub-AS is considered external. When configuring the **advertise-external** statement for an AS confederation, it is recommended that EBGP peers belonging to different autonomous systems are configured in a separate EBGP peer group. This ensures consistency while BGP sends the best external route to peers in the configured peer group.

To configure the **advertise-external** statement on a route reflector, you must disable intracluster reflection with the **no-client-reflect** statement.

When a routing device is configured as a route reflector for a cluster, a route advertised by the route reflector is considered internal if it is received from an internal peer with the same cluster identifier or if both peers have no cluster identifier configured. A route

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received from an internal peer that belongs to another cluster, that is, with a different cluster identifier, is considered external.

The **conditional** option causes BGP to advertise the external route only if the route selection process reaches the point where the multiple exit discriminator (MED) metric is evaluated. As a result, an external route with an AS path longer than that of the active path is not advertised.

Junos OS also provides support for configuring a BGP export policy that matches on the state of an advertised route. You can match on either active or inactive routes.

Default BGP does not advertise the external route with the highest local preference value to internal peers unless it is the best route.

Options

conditional—(Optional) Advertise the best external path only if the route selection process reaches the point at which the multiple exit discriminator (MED) metric is evaluated. The **conditional** option restricts advertisement to when the best external path and the active path are equal until the MED step of the route selection process. This implies that external routes with a longer AS path length than the active path, for instance, are not advertised. The criteria used for selecting the best external path is the same whether or not the **conditional** option is configured.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring a Routing Policy to Advertise the Best External Route to Internal Peers on page 333
- advertise-inactive on page 1088

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advertise-from-main-vpn-tables

Syntax

```
advertise-from-main-vpn-tables;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit protocols bgp],
[edit routing-instances routing-instance-name protocols bgp],
```

Release Information Statement introduced in Junos OS Release 12.3.

Description Advertise VPN routes from the main VPN tables in the master routing instance (for example, bgp.l3vpn.0, bgp.mvpn.0) instead of advertising VPN routes from the tables in the VPN routing instances (for example, *instance-name*.inet.0, *instance-name*.mvpn.0). Enable nonstop active routing (NSR) support for BGP multicast VPN (MVPN).

When this statement is enabled, before advertising a route for a VPN prefix, the path selection algorithm is run on all routes (local and received) that have the same route distinguisher (RD).

NOTE: Adding or removing this statement causes all BGP sessions that have VPN address families to be removed and then added again. On the other hand, having this statement in the configuration prevents BGP sessions from going down when route reflector (RR) or autonomous system border router (ASBR) functionality is enabled or disabled on a routing device that has VPN address families configured.

Default If you do not include this statement, VPN routes are advertised from the tables in the VPN routing instances.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Understanding Junos OS Routing Tables*
- *Types of VPNs*

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advertise-inactive

Syntax

```
advertise-inactive;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the routing table to export to BGP the best route learned by BGP even if Junos OS did not select this route to be an active route.

One way to achieve multivendor compatibility is to include the **advertise-inactive** statement in the external BGP (EBGP) configuration. By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers. The **advertise-inactive** statement causes Junos OS to advertise the best BGP route that is inactive because of IGP preference. When you use the **advertise-inactive** statement, the Junos OS device uses, for example, the OSPF route for forwarding, and the other vendor's device uses the EBGP route for forwarding. However, from the perspective of an EBGP peer in a neighboring AS, both vendors' devices appear to behave the same way.

NOTE: When BGP advertises a network layer reachability information (NLRI) with a label, and the advertised route resides in xxx.xxx.3 routing table such as inet.3, Junos OS automatically advertises such inactive routes even if you have not configured the advertise-inactive statement.

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Default By default, BGP stores the route information it receives from update messages in the Junos OS routing table, and the routing table exports only active routes into BGP, which BGP then advertises to its peers.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP to Advertise Inactive Routes on page 241
- Example: Configuring the Preference Value for BGP Routes on page 235
- *Example: Configuring BGP Route Preference (Administrative Distance)*
- **advertise-external on page 1085**

advertise-peer-as

Syntax

```
advertise-peer-as;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Disable the default behavior of suppressing AS routes.

If you include the **advertise-peer-as** statement in the configuration, BGP advertises routes learned from one external BGP (EBGP) peer back to another EBGP peer in the same autonomous system (AS) but not back to the originating peer.

Another way to disable the route suppression default behavior is with the **as-override** statement. If you include both the as-override and **no-advertise-peer-as** statements in the configuration, the **no-advertise-peer-as** statement is ignored.

Default

By default, Junos OS does not advertise the routes learned from one EBGP peer back to the same external BGP (EBGP) peer. In addition, the software does not advertise those routes back to any EBGP peers that are in the same AS as the originating peer, regardless of the routing instance.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP Route Advertisements on page 171
- *Example: Configuring a Layer 3 VPN with Route Reflection and AS Override*

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- no-advertise-peer-as on page 1279

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advertise-to-non-llgr-neighbor (Graceful Restart for BGP Helper)

Syntax

```
advertise-to-non-llgr-neighbor {
  omit-no-export;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart long-lived],
[edit protocols bgp group *group-name* graceful-restart long-lived],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart long-lived]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Enable the BGP long-lived graceful restart (LLGR) stale routes to be advertised to neighbors that do not advertise the LLGR capability. This setting applies to both routes that were marked LLGR-stale by this router, and LLGR-stale routes received from neighbors. Ideally, all routers in an autonomous system support the IETF draft specification before it was enabled. However, to facilitate incremental deployment, stale routes might be required to be advertised to neighbors that have not advertised the long-lived graceful restart capability under the following conditions: The neighbors must be internal (IBGP or Confederation) neighbors. The NO_EXPORT community must be attached to the stale routes. The stale routes must have their LOCAL_PREF attribute set to zero. If this technique for partial deployment is used, you must set LOCAL_PREF to zero for all LLGR routes throughout the autonomous system. This configuration trades off a small reduction in flexibility (ordering may not be preserved between competing LLGR routes) for consistency between routers that support and do not support this specification. Because consistency of route selection can be important for preventing forwarding loops, the latter consideration of routers that do not support this specification precedes.

Options

The remaining statement is explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

aggregate-label

Syntax

```
aggregate-label {
  community community-name;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family inet labeled-unicast],
[edit logical-systems logical-system-name protocols bgp family inet6 labeled-unicast],
[edit logical-systems logical-system-name protocols bgp family inet-vpn unicast],
[edit logical-systems logical-system-name protocols bgp family inet-vpn6 unicast],
[edit protocols bgp family inet labeled-unicast],
[edit protocols bgp family inet6 labeled-unicast],
[edit protocols bgp family inet-vpn unicast],
[edit protocols bgp family inet6-vpn unicast]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Specify matching criteria (in the form of a community) such that all routes which match are assigned the same VPN label, selected from one of the several routes in the set defined by this criteria. This reduces the number of VPN labels that the router must consider, and aggregates the received labels.

Options

community *community-name*—Specify the name of the community to which to apply the aggregate label.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Aggregate Labels for VPNs*

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aigp

Syntax

```
aigp [disable];
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit protocols bgp family inet labeled-unicast],
[edit protocols bgp family inet6 labeled-unicast],
[edit protocols bgp group *group-name* family inet labeled-unicast] ,
[edit protocols bgp group *group-name* family inet6 labeled-unicast] ,
[edit protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp family inet6 labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast]

Release Information

Statement introduced in Junos OS Release 12.1.

Description

Enable the accumulated interior gateway protocol (AIGP) BGP attribute on a protocol family. Configuring AIGP on a particular family enables sending and receiving of the AIGP attribute on that family.

The AIGP attribute enables deployments in which a single administration can run several contiguous BGP autonomous systems (ASs). Such deployments allow BGP to make

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routing decisions based on the IGP metric. With AIGP enabled, BGP can select paths based on IGP metrics. This enables BGP to choose the shortest path between two nodes, even though the nodes might be in different ASs. The AIGP attribute is particularly useful in networks that use tunneling to deliver a packet to its BGP next hop. Such is the case with MPLS label-switched paths.

Options

disable—Explicitly disables AIGP.

Default: Disabled, meaning that the device does not send an AIGP attribute and silently discards a received AIGP attribute.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Accumulated IGP Attribute for BGP*
- aigp-originate on page 1096

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aigp-originate

Syntax aigp-originate *distance*;

Hierarchy Level
[edit logical-systems *logical-system-name* policy-options policy-statement *policy-name* term *term-name* then],
[edit logical-systems *logical-system-name* policy-options policy-statement *policy-name* then],
[edit policy-options policy-statement *policy-name* term *term-name* then],
[edit policy-options policy-statement *policy-name* then]

Release Information Statement introduced in Junos OS Release 12.1.

Description Originate an accumulated interior gateway protocol (AIGP) BGP attribute for a given prefix by export policy, using the **aigp-originate** policy action.

To originate an AIGP attribure, you need configure the policy action on only one node. The AIGP attribute is readvertised if the neighbors are AIGP enabled with the **aigp** statement in the BGP configuration.

Default If you omit the **aigp-originate** policy action, the node still readvertises the AIGP BGP attribute if AIGP is enabled in the BGP configuration. However, the node does not originate its own AIGP attribute for local prefixes.

As the route is readvertised by downstream nodes, the cost of the AIGP attribute reflects the IGP distance to the prefix (zero + IGP distance or configured distance + IGP distance).

Options ***distance***—(Optional) Associate an initial cost when advertising a local prefix with the AIGP BGP attribute.

Range: 0 through 4,294,967,295

Default: The initial cost associated with the AIGP attribute for a local prefix is zero. The ***distance*** option overrides the default zero value for the initial cost.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring the Accumulated IGP Attribute for BGP*
- aigp on page 1094

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algorithm (BGP BFD Authentication)

Syntax

algorithm *algorithm-name*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp bgp bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the algorithm used to authenticate the specified BFD session.

Options

algorithm-name—Authentication algorithm name: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**.

simple-password—Plain-text password. One to 16 bytes of plain text are used to authenticate the BFD session. One or more passwords can be configured. This method is the least secure and should be used only when BFD sessions are not subject to packet interception.

keyed-md5—Keyed Message Digest 5 hash algorithm for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed MD5 uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater

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than or equal to the last sequence number received. Although more secure than a simple password, this method is vulnerable to replay attacks. Increasing the rate at which the sequence number is updated can reduce this risk.

meticulous-keyed-md5—Meticulous keyed Message Digest 5 hash algorithm. This method works in the same manner as keyed MD5, but the sequence number is updated with every packet. Although more secure than keyed MD5 and simple passwords, this method can take additional time to authenticate the session.

keyed-sha-1—Keyed Secure Hash Algorithm I for sessions with transmit and receive intervals greater than 100 ms. To authenticate the BFD session, keyed SHA uses one or more secret keys (generated by the algorithm) and a sequence number that is updated periodically. The key is not carried within the packets. With this method, packets are accepted at the receiving end of the session if one of the keys matches and the sequence number is greater than the last sequence number received.

meticulous-keyed-sha-1—Meticulous keyed Secure Hash Algorithm I. This method works in the same manner as keyed SHA, but the sequence number is updated with every packet. Although more secure than keyed SHA and simple passwords, this method can take additional time to authenticate the session.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BFD Authentication for Securing Static Routes*
- *Example: Configuring BGP Route Authentication*
- Example: Configuring EBGP Multihop Sessions on page 300
- authentication on page 1103
- bfd-liveness-detection on page 1116
- key-chain on page 1222
- loose-check on page 1248

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allow

Syntax

```
allow (all | [ network/mask-length ]);
```

Hierarchy Level

```
[edit logical-systems name protocols bgp group name],
[edit logical-systems name routing-instances name protocols bgp group name],
[edit protocols bgp group name],
[edit routing-instances name protocols bgp group name],
[edit logical-systems name protocols bgp group name dynamic-neighbor dyn-name],
[edit logical-systems name routing-instances name protocols bgp group name
  dynamic-neighbor dyn-name],
[edit logical-systems name tenants name routing-instances name protocols bgp group name
  dynamic-neighbor dyn-name],
[edit protocols bgp group name dynamic-neighbor dyn-name],
[edit routing-instances name protocols bgp group name dynamic-neighbor dyn-name]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced under **[edit protocols bgp group *group-name* dynamic-neighbor *dyn-name*]** hierarchy in Junos OS Release 19.1.

Description

Implicitly configure BGP peers, allowing peer connections from any of the specified networks or hosts. To configure multiple BGP peers, configure one or more networks and hosts within a single **allow** statement or include multiple **allow** statements.

You can configure authentication for all implicitly configured peers at **[edit protocols bgp group]** level and to configure different authentication values for each prefix, you must configure **allow** under **dynamic-neighbor *dyn-name*** hierarchy.

NOTE: When **set protocols bgp group *group-name* allow network** is configured to accept dynamic BGP sessions, **unconfigured-peer-graceful-restart** statement should be configured to avoid traffic drop during graceful restart or graceful Routing Engine switchover.

Options

all—Allow all addresses, which is equivalent to **0.0.0.0/0** (or **::/0**).

network/mask-length—IPv6 or IPv4 network number of a single address or a range of allowable addresses for BGP peers, followed by the number of significant bits in the subnet mask.

NOTE: You cannot define a BGP group with dynamic peers with authentication enabled.

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- neighbor on page 1272

allow-ebgp

Syntax
```
allow-ebgp;
```

Hierarchy Level
```
[edit logical-systems logical-system-name protocols bgp group group-name family family
  add-path send],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family add-path send],
[edit protocols bgp group group-name family family add-path send],
[edit protocols bgp group group-name family family add-path neighbor address family family
  add-path send]
```

Release Information
Statement introduced in Junos OS Release 18.4R1.

Description
Specify to enable BGP add-path under EBGP group.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Advertising Multiple BGP Paths to a Destination*
- prefix-policy on page 1312
- path-count on page 1297

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apply-groups

Syntax

```
apply-groups [ group-names ];
```

Hierarchy Level All hierarchy levels

Release Information Statement introduced before Junos OS Release 7.4.

Description Apply a configuration group to a specific hierarchy level in a configuration, to have a configuration inherit the statements in the configuration group.

You can specify more than one group name. You must list them in order of inheritance priority. The configuration data in the first group takes priority over the data in subsequent groups.

Options ***group-names***—One or more names specified in the **groups** statement.

Required Privilege Level configure—To enter configuration mode, but other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- *Applying a Junos OS Configuration Group*
- *groups*

apply-groups-except

Syntax

```
apply-groups-except [ group-names ];
```

Hierarchy Level All hierarchy levels except the top level

Release Information Statement introduced before Junos OS Release 7.4.

Description Disable inheritance of a configuration group.

Options ***group-names***—One or more names specified in the **groups** statement.

Required Privilege Level configure—To enter configuration mode, but other required privilege levels depend on where the statement is located in the configuration hierarchy.

Related Documentation

- *groups*
- *Disabling Inheritance of a Junos OS Configuration Group*

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as-override

Syntax

```
as-override;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Compare the AS path of an incoming advertised route with the AS number of the BGP peer under the group and replace all occurrences of the peer AS number in the AS path with its own AS number before advertising the route to the peer.

NOTE: The **as-override** statement is specific to a particular BGP group. This statement does not affect peers from the same remote AS configured in different groups.

Enabling the AS override feature allows routes originating from an AS to be accepted by a router residing in the same AS. Without AS override enabled, the routing device refuses the route advertisement once the AS path shows that the route originated from its own AS. This is done by default to prevent route loops. The **as-override** statement overrides this default behavior.

Note that enabling the AS override feature may result in routing loops. Use this feature only for specific applications that require this type of behavior, and in situations with strict network control. One application is the IGP protocol between the provider edge routing device and the customer edge routing device in a virtual private network.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring a Layer 3 VPN with Route Reflection and AS Override*
- *Junos OS VPNs Library for Routing Devices*

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authentication (BGP BFD Liveness Detection)

Syntax

```
authentication {
  algorithm algorithm-name;
  key-chain key-chain-name;
  loose-check ;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the router and route authentication to mitigate the risk of being attacked by a machine or router that has been configured to share incorrect routing information with another router. Router and route authentication enables routers to share information only if they can verify that they are talking to a trusted source, based on a password (key). In this method, a hashed key is sent along with the route being sent to another router. The receiving router compares the sent key to its own configured key. If they are the same, the receiving router accepts the route.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- *Example: Configuring BFD Authentication for Securing Static Routes*
- *Example: Configuring BGP Route Authentication*
- algorithm on page 1097
- bfd-liveness-detection on page 1116
- key-chain on page 1222
- loose-check on page 1248

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authentication-algorithm

Syntax

authentication-algorithm *algorithm*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* protocols ldp session *session-address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols ldp session *session-address*],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit protocols ldp session *session-address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols ldp session *session-address*],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 7.6.
Statement introduced for BGP in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.3X50 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure an authentication algorithm type.

NOTE: Keep the following points in mind when you configure the authentication algorithm in an IPsec proposal:

- When both ends of an IPsec VPN tunnel contain the same IKE proposal but different IPsec proposals, an error occurs and the tunnel is not established in this scenario. For example, if one end of the tunnel contains router 1 configured with the authentication algorithm as hmac-sha-256-128 and the other end of the tunnel contains router 2 configured with the

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authentication algorithm as hmac-md5-96, the VPN tunnel is not established.

- When both ends of an IPsec VPN tunnel contain the same IKE proposal but different IPsec proposals, and when one end of the tunnel contains two IPsec proposals to check whether a less secure algorithm is selected or not, an error occurs and the tunnel is not established. For example, if you configure two authentication algorithms for an IPsec proposal as hmac-sha-256-128 and hmac-md5-96 on one end of the tunnel, router 1, and if you configure the algorithm for an IPsec proposal as hmac-md5-96 on the other end of the tunnel, router 2, the tunnel is not established and the number of proposals mismatch.
- When you configure two IPsec proposals at both ends of a tunnel, such as the **authentication-algorithm hmac-sha-256-128** and **authentication- algorithm hmac-md5-96** statements at the **[edit services ipsec-vpn ipsec proposal** *proposal-name*] hierarchy level on one of the tunnel, router 1 (with the algorithms in two successive statements to specify the order), and the **authentication-algorithm hmac-md5-96** and **authentication- algorithm hmac-sha-256-128** statements at the **[edit services ipsec-vpn ipsec proposal** *proposal-name*] hierarchy level on one of the tunnel, router 2 (with the algorithms in two successive statements to specify the order, which is the reverse order of router 1), the tunnel is established in this combination as expected because the number of proposals is the same on both ends and they contain the same set of algorithms. However, the authentication algorithm selected is hmac-md5-96 and not the stronger algorithm of hmac-sha-256-128. This method of selection of the algorithm occurs because the first matching proposal is selected. Also, for a default proposal, regardless of whether the router supports the Advanced Encryption Standard (AES) encryption algorithm, the 3des-cbc algorithm is chosen and not the aes-cfb algorithm, which is because of the first algorithm in the default proposal being selected. In the sample scenario described here, on router 2, if you reverse the order of the algorithm configuration in the proposal so that it is the same order as the one specified on router 1, hmac-sha-256-128 is selected as the authentication method.
- You must be aware of the order of proposals in an IPsec policy at the time of configuration if you want the matching of proposals to happen in a certain order of preference, such as the strongest algorithm to be considered first when a match is made when both policies from the two peers have a proposal.

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Options ***algorithm***—Specify one of the following types of authentication algorithms:

- **aes-128-cmac-96**—Cipher-based message authentication code (AES128, 96 bits).
- **hmac-sha-1-96**—Hash-based message authentication code (SHA1, 96 bits).
- **md5**—Message digest 5.

Default: hmac-sha-1-96

NOTE: **The default is not displayed in the output of the show bgp bmp command unless a key or key-chain is also configured.**

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Router Authentication for BGP on page 774
- Configuring BGP Monitoring Protocol Version 3 on page 946

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authentication-key (Protocols BGP and BMP)

Syntax

```
authentication-key key;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address],
[edit routing-options bmp],
[edit routing-options bmp station station-name]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP version 3 in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure an MD5 authentication key (password). Neighboring routing devices use the same password to verify the authenticity of BGP packets sent from this system.

Options

key—Authentication password. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Router Authentication for BGP on page 774
- Configuring BGP Monitoring Protocol Version 3 on page 946

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authentication-key-chain (Protocols BGP and BMP)

Syntax

```
authentication-key-chain key-chain;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address],
[edit routing-options bmp],
[edit routing-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 8.0.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Apply and enable an authentication keychain to the routing device. Note that the referenced key chain must be defined. When configuring the authentication key update feature for BGP, you cannot commit the **0.0.0.0/allow** statement with authentication keys or key chains. The CLI issues a warning and fails to commit the configuration.

Options

key-chain—Authentication keychain name. It can be up to 126 characters. Characters can include any ASCII strings. If you include spaces, enclose all characters in quotation marks (“ ”).

NOTE: For BGP, you must also configure an authentication algorithm by including the **authentication-algorithm** *algorithm* **statement.**

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Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Router Authentication for BGP on page 774
- *Example: Configuring BFD Authentication for Securing Static Routes*
- *Configuring the Authentication Key Update Mechanism for BGP and LDP Routing Protocols*
- Configuring BGP Monitoring Protocol Version 3 on page 946
- **authentication-algorithm on page 1105**

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auto-discovery-only

Syntax

```
auto-discovery-only;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family l2vpn],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family l2vpn],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family l2vpn],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp family l2vpn],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* family l2vpn],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family l2vpn],
[edit protocols bgp family l2vpn],
[edit protocols bgp group *group-name* family l2vpn],
[edit protocols bgp group *group-name* neighbor *address* family l2vpn],
[edit routing-instances *instance-name* protocols bgp family l2vpn],
[edit routing-instances *instance-name* protocols bgp group *group-name* family l2vpn],
[edit routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family l2vpn]

Release Information

Statement introduced in Junos OS Release 10.4R2.

Description

Enable the router to process only the autodiscovery network layer reachability information (NLRI) update messages for VPWS and LDP-based Layer 2 VPN and VPLS update messages (BGP_L2VPN_AD_NLRI) (FEC 129).

Specifically, the **auto-discovery-only** statement notifies the routing process (rpd) to expect autodiscovery-related NLRI messages so that information can be deciphered and used by LDP, VPLS, and VPWS.

The **auto-discovery-only** statement must be configured on all provider edge (PE) routers in a VPLS or in a VPWS. If you configure route reflection, the **auto-discovery-only** statement is also required on provider (P) routers that act as the route reflector in supporting FEC 129-related updates.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP Autodiscovery for LDP VPLS*
- *Example: Configuring BGP Autodiscovery for LDP VPLS with User-Defined Mesh Groups*
- *Example: Configuring FEC 129 BGP Autodiscovery for VPWS*

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autonomous-system

Syntax

```
autonomous-system autonomous-system <asdot-notation> <loops number> {
  independent-domain <no-attrset>;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
  routing-options],
[edit logical-systems logical-system-name routing-options],
[edit routing-instances routing-instance-name routing-options],
[edit routing-options]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
asdot-notation option introduced in Junos OS Release 9.3.
asdot-notation option introduced in Junos OS Release 9.3 for EX Series switches.
no-attrset option introduced in Junos OS Release 10.4.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the routing device's AS number.

An autonomous system (AS) is a set of routing devices that are under a single technical administration and that generally use a single interior gateway protocol (IGP) and metrics to propagate routing information within the set of routing devices. An AS appears to other ASs to have a single, coherent interior routing plan and presents a consistent picture of what destinations are reachable through it. ASs are identified by a number that is assigned by the Network Information Center (NIC) in the United States (http://www.isi.edu).

If you are using BGP on the routing device, you must configure an AS number.

The AS path attribute is modified when a route is advertised to an EBGP peer. Each time a route is advertised to an EBGP peer, the local routing device prepends its AS number to the existing path attribute, and a value of 1 is added to the AS number.

In Junos OS Release 9.1 and later, the numeric range is extended to provide BGP support for 4-byte AS numbers as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers. RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893. All releases of Junos OS support 2-byte AS numbers.

In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value*

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in decimal>.<*16-bit low-order value in decimal*>. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format.

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Options ***autonomous-system***—AS number. Use a number assigned to you by the NIC.

Range: 1 through 4,294,967,295 ($2^{32} - 1$) in plain-number format for 4-byte AS numbers

In this example, the 4-byte AS number 65,546 is represented in plain-number format:

```
[edit]
routing-options {
  autonomous-system 65546;
}
```

Range: 0.0 through 65535.65535 in AS-dot notation format for 4-byte numbers

In this example, 1.10 is the AS-dot notation format for 65,546:

```
[edit]
routing-options {
  autonomous-system 1.10;
}
```

Range: 1 through 65,535 in plain-number format for 2-byte AS numbers (this is a subset of the 4-byte range)

In this example, the 2-byte AS number 60,000 is represented in plain-number format:

```
[edit]
routing-options {
  autonomous-system 60000;
}
```

asdot-notation—(Optional) Display the configured 4-byte autonomous system number in the AS-dot notation format.

Default: Even if a 4-byte AS number is configured in the AS-dot notation format, the default is to display the AS number in the plain-number format.

loops ***number***—(Optional) Specify the number of times detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

Range: 1 through 10

Default: 1

NOTE: When you specify the same AS number in more than one routing instance on the local routing device, you must configure the same number of loops for the AS number in each instance. For example, if you configure a value of 3 for the **loops** statement in a VRF routing instance that uses the same AS number as that of the master instance, you must also configure a value of 3 loops for the AS number in the master instance.

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Use the independent-domain option if the loops statement must be enabled only on a subset of routing instances.

The remaining statement is explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Examples: Configuring External BGP Peering*
- *Examples: Configuring Internal BGP Peering*

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bfd-liveness-detection (Protocols BGP)

Syntax

```
bfd-liveness-detection {
  authentication {
    algorithm algorithm-name;
    key-chain key-chain-name;
    loose-check;
  }
  detection-time {
    threshold milliseconds;
  }
  hold-down-interval milliseconds;
  minimum-interval milliseconds;
  minimum-receive-interval milliseconds;
  multiplier number;
  no-adaptation;
  session-mode (automatic | multihop | single-hop);
  transmit-interval {
    minimum-interval milliseconds;
    threshold milliseconds;
  }
  version (1 | automatic);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
detection-time threshold and **transmit-interval threshold** options introduced in Junos OS Release 8.2
Support for logical routers introduced in Junos OS Release 8.3.
Support for IBGP and multihop EBGP sessions introduced in Junos OS Release 8.3.
holddown-interval statement introduced in Junos OS Release 8.5. You can configure this statement only for EBGP peers at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.

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no-adaptation statement introduced in Junos OS Release 9.0.
Support for BFD authentication introduced in Junos OS Release 9.6.
Support for BFD on IPv6 interfaces with BGP introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Configure bidirectional failure detection (BFD) timers and authentication for BGP.

For IBGP and multihop EBGP support, configure the **bfd-liveness-detection** statement at the global **[edit bgp protocols]** hierarchy level. You can also configure IBGP and multihop support for a routing instance or a logical system.

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Options

authentication algorithm ***algorithm-name*** (Optional)—Configure the algorithm used to authenticate the specified BFD session: **simple-password**, **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**.

authentication key-chain ***key-chain-name*** (Optional)—Associate a security key with the specified BFD session using the name of the security keychain. The keychain name must match one of the keychains configured in the **authentication-key-chains key-chain** statement at the **[edit security]** hierarchy level.

authentication loose-check—(Optional) Configure loose authentication checking on the BFD session. Use only for transitional periods when authentication may not be configured at both ends of the BFD session.

detection-time threshold ***milliseconds*** (Optional)—Configure a threshold. When the BFD session detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

holddown-interval ***milliseconds*** (Optional)—Configure an interval specifying how long a BFD session must remain up before a state change notification is sent. When you configure the hold-down interval for the BFD protocol for EBGP, the BFD session is unaware of the BGP session during this time. In this case, if the BGP session goes down during the configured hold-down interval, BFD already assumes it is down and does not send a state change notification. The **holddown-interval** statement is supported only for EBGP peers at the **[edit protocols bgp group** ***group-name*** **neighbor** ***address*****]** hierarchy level. If the BFD session goes down and then comes back up during the configured hold-down interval, the timer is restarted. You must configure the hold-down interval on both EBGP peers. If you configure the hold-down interval for a multihop EBGP session, you must also configure a local IP address by including the **local-address** statement at the **[edit protocols bgp group** ***group-name*****]** hierarchy level.

Range: 0 through 255,000

Default: 0

minimum-interval ***milliseconds*** (Required)—Configure the minimum intervals at which the local routing device transmits hello packets and then expects to receive a reply from a neighbor with which it has established a BFD session. This value represents the minimum interval at which the local routing device transmits hello packets as well as the minimum interval that the routing device expects to receive a reply from a neighbor with which it has established a BFD session. You can configure a value in the range from 1 through 255,000 milliseconds. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately (using the **minimum-receive-interval** and **transmit-interval minimal-interval** statements).

Range: 1 through 255,000

minimum-receive-interval ***milliseconds*** (Optional)— Configure only the minimum interval at which the local routing device expects to receive a reply from a neighbor with which it has established a BFD session.

Range: 1 through 255,000

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multiplier ***number*** (Optional)—Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Range: 1 through 255

Default: 3

no-adaptation (Optional)—Configure BFD sessions not to adapt to changing network conditions. We recommend that you not disable BFD adaptation unless it is preferable to not to have BFD adaptation enabled in your network.

transmit-interval threshold ***milliseconds*** (Optional)—Configure a threshold. When the BFD session transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent. The interval threshold must be greater than the minimum transmit interval.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

transmit-interval minimum-interval ***milliseconds*** (Optional)—Configure only the minimum interval at which the local routing device transmits hello packets to a neighbor with which it has established a BFD session.

Range: 1 through 255,000

version (Optional)—Configure the BFD version to detect.

Range: **1** or **automatic** (autodetect the BFD version)

Default: **automatic**

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- *Example: Configuring BFD Authentication for Securing Static Routes*
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- Example: Configuring BFD Authentication for BGP on page 416
- Understanding BFD for BGP on page 403

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bgp

Syntax

```
bgp { ... }
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit protocols],
[edit routing-instances routing-instance-name protocols]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Enable BGP on the routing device or for a routing instance.

Default

BGP is disabled.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *BGP Feature Guide*

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bgp-error-tolerance (Protocols BGP)

Syntax

```
bgp-error-tolerance {
  malformed-route-limit number;
  malformed-update-log-interval seconds;
  no-malformed-route-limit;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 13.2.

Description

Enable error handling for BGP update messages.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Error Handling for BGP Update Messages on page 879
- Example: Configuring Error Handling for BGP Update Messages on page 881

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bgp-orf-cisco-mode

Syntax

```
bgp-orf-cisco-mode;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* outbound-route-filter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter,
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit logical-systems *logical-system-name* routing-options outbound-route-filter],
[edit protocols bgp outbound-route-filter],
[edit protocols bgp group *group-name* outbound-route-filter],
[edit protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* outbound-route-filter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* outbound-route-filter],
[edit routing-instances *routing-instance-name* routing-options outbound-route-filter],
[edit routing-options outbound-route-filter]

Release Information

Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.2.
Support for the BGP group and neighbor hierarchy levels introduced in Junos OS Release 9.3 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Enable interoperability with routing devices that use the vendor-specific outbound route filter compatibility code of 130 and code type of 128.

NOTE: To enable interoperability for all BGP peers configured on the routing device, include the statement at the **[edit routing-options outbound-route-filter]** hierarchy level.

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Default Disabled

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 342

bgp-static

Syntax

```
bgp-static {
  route destination-prefix/prefix-length {
    as-path <as-path> <origin (egp | igp | incomplete)> <atomic-aggregate> <aggregator
      as-number in-address>;
    community [ community-ids ];
    (metric | metric2 | metric3 | metric4) value <type type>;
    (preference | preference2 | color | color2) preference <type type>;
    (tag | tag2) metric type number;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options],
[edit logical-systems logical-system-name routing-options rib routing-table-name],
[edit routing-options],
[edit routing-options rib routing-table-name]
```

Release Information Statement introduced in Junos OS Release 14.2.

Description Specify a BGP-static route. You can specify any number of routes within a single BGP-static statement, and you can specify any number of BGP-static options in the configuration.

Options

route *destination-prefix/prefix-length*—*destination-prefix* is the network portion of the IP address, and *prefix-length* is the destination prefix length.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- advertise-bgp-static on page 1084
- Configuring BGP-Static Routes for Preventing Route Flaps on page 877
- Example: Configuring BGP-Static Routes to Prevent Route Flaps on page 863
- Understanding BGP-Static Routes for Preventing Route Flaps on page 862

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bmp

Syntax

```
bmp {
  authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
  authentication-key key;
  authentication-key-chain authentication-key-chain;
  connection-mode (active | passive);
  hold-down {
    seconds;
    flaps flaps;
    period seconds;
  }
  initiation-message text;
  local-address address;
  local-port port;
  monitor (disable | enable);
  priority (high | low | medium);
  route-monitoring {
    none;
    post-policy {
      exclude-non-eligible;
    }
    pre-policy {
      exclude-non-feasible;
    }
  }
  routing-instance routing-instance-name;
  station station-name {
    authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
    authentication-key key;
    authentication-key-chain authentication-key-chain;
    connection-mode (active | passive);
    hold-down {
      seconds;
      flaps flaps;
      period seconds;
    }
    initiation-message text;
    local-address address;
    local-port port;
    monitor (disable | enable);
    priority (high | low | medium);
    routing-instance routing-instance-name;
    route-monitoring {
      none;
      post-policy {
        exclude-non-eligible;
      }
      pre-policy {
        exclude-non-feasible;
      }
    }
    station-address (ip-address | name);
```


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```
    station-port port-number;
    statistics-timeout seconds;
    traceoptions {
      file filename <files number> <size size> <world-readable | no-world-readable>;
      flag flag <flag-modifier>;
    }
  }
  station-address (ip-address | name);
  station-port port-number;
  statistics-timeout seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier>;
  }
}
```

Hierarchy Level

```
[edit routing-options]
[edit logical-systems logical-system-name routing-options],
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
```

NOTE: 1. Complete BMP configuration, as mentioned in the syntax, can be done under the first two hierarchy levels only

2. Under other hierarchy levels, only the following configurations are supported:

- Either we can inherit or not inherit the configuration data
- Enable/disable monitoring
- Control route monitoring settings

Release Information

Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.
Support for BMP version 3 introduced in Junos OS Release 13.3.

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Description Configure the BGP Monitoring Protocol (BMP), which enables the routing device to collect data from the BGP Adjacency-RIB-In routing tables and periodically send that data to a monitoring station.

NOTE: When BMP is configured at multiple hierarchy levels, the order of preference from highest to lowest is as follows:

1. **[edit protocols bgp group *group-name* neighbor *address*]**
2. **[edit protocols bgp group *group-name*]**
3. **[edit protocols bgp bmp]**
4. **[edit routing-options bmp-station *station-name*]**
5. **[edit routing-options bmp]**

For example, if BMP is configured at both **[edit routing-options]** and **[edit protocols bgp]** hierarchy levels, the configuration at the protocols BGP level takes precedence over the routing options configuration.

Options The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring the BGP Monitoring Protocol on page 943

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cluster

Syntax

cluster *cluster-identifier*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the cluster identifier to be used by the route reflector cluster in an internal BGP group.

CAUTION:

If you configure both route reflection and VPNs on the same routing device, the following modifications to the route reflection configuration cause current BGP sessions to be reset:

- Adding a cluster ID—If a BGP session shares the same AS number with the group where you add the cluster ID, all BGP sessions are reset regardless of whether the BGP sessions are contained in the same group.
- Creating a new route reflector—If you have an IBGP group with an AS number and create a new route reflector group with the same AS number, all BGP sessions in the IBGP group and the new route reflector group are reset.

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NOTE: If you change the address family specified in the **[edit protocols bgp family]** hierarchy level, all current BGP sessions on the routing device are dropped and then reestablished.

Options ***cluster-identifier***—4-byte number (such as an IPv4 address).

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP Route Reflectors*
- Understanding External BGP Peering Sessions on page 23
- no-client-reflect on page 1281

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community (Routing Options)

Syntax

```
community ([ community-ids ] | no-advertise | no-export | no-export-subconfed | none |
    llgr-stale | no-llgr);
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances routing-instance-name
    routing-options (aggregate | generate | static) (defaults | route)],
[edit logical-systems logical-system-name routing-instances routing-instance-name
    routing-options rib routing-table-name (aggregate | generate | static) (defaults | route)],
[edit logical-systems logical-system-name routing-options (aggregate | generate | static)
    (defaults | route)],
[edit logical-systems logical-system-name routing-options rib routing-table-name (aggregate |
    generate | static) (defaults | route)],
[edit routing-instances routing-instance-name routing-options (aggregate | generate | static)
    (defaults | route)],
[edit routing-instances routing-instance-name routing-options rib routing-table-name
    (aggregate | generate | static) (defaults | route)],
[edit routing-options (aggregate | generate | static) (defaults | route)],
[edit routing-options rib routing-table-name (aggregate | generate | static) (defaults | route)]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
llgr-stale and **no-llgr** options added in Junos OS Release 15.1.
Support for BGP large community introduced in Junos OS Release 17.3 for MX Series, PTX Series, and QFX Series.

Description

Associate BGP community information with a static, aggregate, or generated route.

NOTE: BGP large community is available only for static routes.

Default

No BGP community information is associated with static routes.

Options

community-ids—One or more community identifiers. The ***community-ids*** format varies according to the type of attribute that you use.

The BGP community attribute format is ***as-number:community-value***:

- ***as-number***—AS number of the community member. It can be a value from 1 through 65,535. The AS number can be a decimal or hexadecimal value.
- ***community-value***—Identifier of the community member. It can be a number from 0 through 65,535.

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For more information about BGP community attributes, see the "Configuring the Extended Communities Attribute" section in the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*.

For specifying the BGP community attribute only, you also can specify ***community-ids*** as one of the following well-known community names defined in RFC 1997:

- **no-advertise**—Routes containing this community name are not advertised to other BGP peers.
- **no-export**—Routes containing this community name are not advertised outside a BGP confederation boundary.
- **no-export-subconfed**—Routes containing this community are advertised to IBGP peers with the same AS number, but not to members of other confederations.
- **llgr-stale**—Adds a community to a long-lived stale route when it is readvertised.
- **no-llgr**—Marks routes which a BGP speaker does not want to be retained by LLGR. The Notification message feature does not have any associated configuration parameters.

NOTE: Extended community attributes are not supported at the **[edit routing-options]** hierarchy level. You must configure extended communities at the **[edit policy-options]** hierarchy level. For information about configuring extended communities, see the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*.

As defined in RFC 8092, BGP large community uses 12-byte encoding and the format for BGP large ***community-ids*** is:

```
large: global-administrator:assigned-number:assigned-number
```

large indicates BGP large community.

global-administrator is the administrator. It is a 4-byte AS number.

assigned-number is a 4-byte value used to identify the local provider. BGP large community uses two 4-byte assigned number to identify the local provider.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Summarizing Static Routes Through Route Aggregation*
- *aggregate*
- *generate*
- *static*

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connection-mode

Syntax

```
connection-mode (active | passive);
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced for BMP in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced for BMP in Junos OS Release 13.3.

Description

Specifies whether the BMP station connection is **active** or **passive**.

Options

active—BMP initiates the connection to the BMP station.

passive—BMP does not initiate a connection the BMP station. However, it does listen for a connection request from active BMP stations and will connect if a station is available.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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damping (Protocols BGP)

Syntax

```
damping;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp family family],
[edit logical-systems logical-system-name protocols bgp family family],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name family family],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address family family],
[edit protocols bgp],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name family family],
[edit protocols bgp group group-name neighbor address],
[edit protocols bgp group group-name neighbor address family family],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp family family],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name family family],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address family family]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for flap damping at the address family level introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

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Description Enable route flap damping. BGP route flapping describes the situation in which BGP systems send an excessive number of update messages to advertise network reachability information. Flap damping reduces the number of update messages sent between BGP peers, thereby reducing the load on these peers, without adversely affecting the route convergence time for stable routes.

You typically apply flap damping to external BGP (EBGP) routes (that is, to routes in different ASs). You can also apply it within a confederation, between confederation member ASs. Because routing consistency within an AS is important, do not apply flap damping to internal BGP (IBGP) routes. (If you do, it is ignored.) The exception to this rule is when flap damping is applied at the address family level. When you apply flap damping at the address family level, it works for both IBGP and EBGP.

Default Flap damping is disabled on the routing device.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Examples: Configuring BGP Flap Damping*
- Example: Configuring BGP Route Flap Damping Based on the MBGP MVPN Address Family on page 850

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defer-initial-multipath-build

Syntax

```
defer-initial-multipath-build {
  maximum-delay maximum-delay;
}
```

Hierarchy Level

[edit fabric protocols bgp family inet unicast],
[edit fabric protocols bgp family inet inet6 unicast],
[edit fabric protocols bgp group *name* family inet unicast],
[edit fabric protocols bgp group *name* family inet inet6 unicast],
[edit fabric protocols bgp group *name* neighbor *name* family inet unicast],
[edit fabric protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit logical-systems *name* protocols bgp family inet unicast],
[edit logical-systems *name* protocols bgp family inet inet6 unicast],
[edit logical-systems *name* protocols bgp group *name* family inet unicast],
[edit logical-systems *name* protocols bgp group *name* family inet inet6 unicast],
[edit logical-systems *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit logical-systems *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit protocols bgp family inet unicast],
[edit protocols bgp family inet inet6 unicast],
[edit protocols bgp group *name* family inet unicast],
[edit protocols bgp group *name* family inet inet6 unicast],
[edit protocols bgp group *name* neighbor *name* family inet unicast],
[edit protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit routing-instances *name* protocols bgp family inet unicast],
[edit routing-instances *name* protocols bgp family inet inet6 unicast],
[edit routing-instances *name* protocols bgp group *name* family inet unicast],
[edit routing-instances *name* protocols bgp group *name* family inet inet6 unicast],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast]

Release Information

Statement introduced in Junos OS Release 18.1R1.

Description

Defer initial multipath calculation until all BGP routes are received. When multipath is enabled, BGP inserts the route into the multipath queue each time a new route is added or whenever an existing route changes. When multiple paths are received through BGP add-path feature, BGP might calculate one multipath route multiple times. This slows down the BGP RIB (also known as the routing table) learning rate. With this feature

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enabled the router does not start BGP multipath calculation until end-of-RIB marker is received. Configure this option to delay multipath calculation.

Alternatively to delay the multipath calculation the BGP multipath job priority can be modified using multipath-build-priority configuration statement at **[edit protocols bgp]** hierarchy level.

Options

maximum-delay— Specify a value in seconds to indicate the maximum time that a device must delay the multipath calculation after a peer is up.

Range: 1 through **3600** seconds

Required Privilege Level

routing

Related Documentation

- multipath-build-priority on page 1269
- Understanding BGP Multipath on page 424

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delay-route-advertisements

Syntax

```
delay-route-advertisements {
  minimum-delay {
    routing-uptime routing-uptime;
    inbound-convergence inbound-convergence;
  }
  maximum-delay {
    route-age routing-age;
    routing-uptime routing-uptime;
  }
  always-wait-for-krt-drain;
}
```

Hierarchy Level

[edit logical-systems *name* protocols bgp family *name*],
[edit logical-systems *name* protocols bgp group *name* family *name*],
[edit logical-systems *name* protocols bgp group *name* neighbor *ip-address* family *name*],
[edit logical-systems *name* routing-instances *name* protocols bgp family *name*],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* family *name*],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* neighbor *ip-address* family *name*],
[edit protocols bgp family*name*],
[edit protocols bgp group *name* family *name*],
[edit protocols bgp group *name* neighbor *ip-address* family*name*],
[edit routing-instances *name* protocols bgp family *name*],
[edit routing-instances *name* protocols bgp group *name* family *name*],
[edit routing-instances *name* protocols bgp neighbor *ip-address* family *name*]

Release Information

Statement introduced in Junos OS Release 15.1F6 for the MX Series.

Description

Configure this option to delay route updates for a specified family until the forwarding table is synchronized. When a device starts up, BGP establishes peering sessions with its neighbors and receives route updates. These route updates are then readvertised as more specific BGP routes or less specific aggregates. Advertising routes prematurely, that is, before all the available routes are installed in the forwarding table, might result in traffic loss.

In multihomed networks, this behavior might cause unnecessary loss of service when a BGP session at the primary provider edge comes up. This problem is more pronounced when the primary provider edge device advertises route aggregates, because few aggregate prefixes can be announced more quickly to the network peers than a full routing table with thousands of more specific prefixes to the forwarding table. In order to avoid this problem, the device must delay a BGP route advertisement until the associated forwarding state is installed into the forwarding table. This feature allows a Junos OS device to do so, and allows you to configure the minimum and maximum delay periods.

Options

minimum-delay—(Optional) Specify a minimum delay, in seconds, in advertising the routes.

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inbound-convergence ***inbound-convergence***—(Optional) Specify a minimum delay in route advertisement after the source peer has sent all route updates. The device waits at least for the configured duration after inbound convergence has completed at the source of the route. For BGP routes, the source peer sends the initial route updates, for example after end-of-rib is received.

Default: 120 seconds

Range: 1 through 36000 seconds

routing-uptime ***routing-uptime***—(Optional) Specify the minimum delay, in seconds, before sending a route advertisement after the routing protocol process (rpd) starts. The device waits for at least the configured duration before sending out route advertisements to its peers.

Default: 0 seconds

Range: 1 through 36000 seconds

maximum-delay—(Optional) Specify a maximum delay, in seconds, before advertising routes to peers.

route-age ***routing-age***—(Optional) Specify a maximum delay in sending a route advertisement after route aggregates have been created, that is, the route age. The device suspends waiting for the routes to be downloaded to the forwarding table at the configured route age and starts sending route advertisements to its peers.

Default: 0 seconds

Range: 1 through 36000 seconds

routing-uptime ***routing-uptime***—(Optional) Specify the maximum delay in seconds before sending a route advertisement after the routing protocol process (rpd) starts. The device does not wait more than the configured duration before sending out route advertisements to its peers.

Default: 0 seconds

Range: 1 through 36000 seconds

always-wait-for-krt-drain—Delay route advertisement until KRT queue is drained.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- routing-instances on page 1338

description (Protocols BGP)

Syntax

```
description text-description;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Provide a description of the global, group, or neighbor configuration. If the text includes one or more spaces, enclose it in quotation marks (" "). The test is displayed in the output of the **show** command and has no effect on the configuration.

Options

text-description—Text description of the configuration. It is limited to 255 characters.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *BGP Feature Guide*

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detection-time (BFD Liveness Detection)

Syntax

```
detection-time {
  threshold milliseconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPNs and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Enable BFD failure detection. The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value

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if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

The remaining statement is explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD for BGP on page 403
- bfd-liveness-detection on page 1116
- threshold on page 1368

disable (Protocols BGP)

Syntax
```
disable;
```

Hierarchy Level
```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit protocols bgp],
[edit routing-instances routing-instance-name protocols bgp]
```

Release Information
Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description
Disable BGP on the system.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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allow-protection (Multipath)

Syntax

```
allow-protection;
```

Hierarchy Level

```
[edit fabric protocols bgp group name multipath],
[edit logical-systems name protocols bgp multipath],
[edit logical-systems name protocols bgp group name neighbor ip-address multipath],
[edit logical-systems name routing-instances name protocols bgp multipath],
[edit logical-systems name routing-instances name protocols bgp group name neighbor
  ip-address multipath],
[edit logical-systems name protocols bgp group name multipath],
[edit logical-systems name routing-instances name protocols bgp group name multipath],
[edit protocols bgp group name multipath],
[edit routing-instances name protocols bgp group name multipath]
[edit routing-instances name protocols bgp multipath],
[edit routing-instances name protocols bgp group neighbor ip-address multipath]
[edit protocols bgp multipath],
[edit protocols bgp group name neighbor ip-address multipath]
```

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description

Allows the BGP multipath and protection to co-exist. When **allow-protection** is configured there may be a change in **show route** output: N+1 nexthop formation (N ecmp plus 1 backup paths).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- multipath on page 1266

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disable (BGP Graceful Restart)

Syntax

```
disable;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group group-name graceful-restart],
[edit protocols bgp group group-name neighbor address graceful-restart]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Disable graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition.

NOTE: When you disable graceful restart at one level in the configuration statement hierarchy, it is also disabled at lower levels in the same hierarchy. For example, if you disable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level, it is disabled for all the peers in the group. Therefore, if you want to enable graceful restart for some peers in a group and disable it for others, enable graceful restart at the **[edit protocols bgp group *group-name*]** hierarchy level and disable graceful restart for each peer at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- graceful-restart on page 1185
- restart-time on page 1327
- stale-routes-time on page 1355

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disable (Long-Lived Graceful Restart for BGP Restarter)

Syntax

```
disable;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter]

NOTE: Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

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Release Information Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description Disable the long-lived graceful restart capability for BGP sessions on the restarting router. A hidden **enable** attribute can be used to override an inherited disable attribute. Configuring graceful-restart long-lived restarter at the neighbor level (when it is not configured at the containing group level or globally) causes an internal group to be split.

When LLGR restarter is enabled or disabled for a family or the stale- time is changed, the session is reset so that the new capability can be sent to the neighbor.

The stanzas in the per-family graceful-restart long-lived restarter configuration section enables LLGR restarter mode negotiation for BGP globally, or for a group or neighbor. The values are inherited by groups from the global configuration, and by neighbors from the group configuration. The disable attribute is used to override configuration inherited from a higher level. It does not disable LLGR receiver mode; you must disable LLGR receiver mode explicitly for all families as necessary.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

disable (Multipath)

Syntax

```
disable;
```

Hierarchy Level

```
[edit fabric protocols bgp group name multipath],
[edit logical-systems name protocols bgp group name multipath],
[edit logical-systems name routing-instances name protocols bgp group name multipath],
[edit protocols bgp group name multipath],
[edit routing-instances name protocols bgp group name multipath]
```

Release Information Statement introduced in Junos OS Release 18.1R1 for the MX Series and PTX Series.

Description Disable Multipath option for a specific group or neighbor and allow multipath for other groups or neighbors. Ensure that you have enabled multipath at the global level at **[edit protocols bgp]** hierarchy level before disabling it for specific groups or neighbors.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- multipath on page 1266

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disable-notification-extensions (BGP Graceful Restart)

Syntax

```
disable-notification-extensions {
  omit-no-export;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Disables the transmission of the N flag in the graceful restart capability negotiation, but in addition, it disables the new rules for invoking graceful restart receiver mode as specified in the IETF bgp-gr-notification draft, and disables the transmission of the Hard Reset subcode. The Hard Reset subcode is continued to be observed when received in a Notify or a Cease message. The BGP protocol sends a notification NOTIFICATION message and reset the peering session to handle the error condition. BGP graceful restart that permits the operational procedures to be performed when the BGP speaker receives a notification message.

You can define this setting at the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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disable-notification-flag (BGP Graceful Restart)

Syntax

```
disable-notification-flag {
  omit-no-export;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Disables the transmission of the notification (N) flag in the graceful restart capability negotiation. The BGP protocol sends a notification NOTIFICATION message and reset the peering session to handle the error condition. BGP graceful restart that permits the operational procedures to be performed when the BGP speaker receives a notification message. This behavior permits the BGP speaker to avoid flapping reachability and continue forwarding while the BGP speaker restarts the session to handle errors detected in the BGP protocol. You can define this setting at the **[edit protocols bgp graceful-restart]**, **[edit protocols bgp group *group-name* graceful-restart]**, or **[edit protocols bgp group *group-name* neighbor *neighbor-address* graceful-restart]** hierarchy level.

Disables the transmission of the N flag in the graceful restart capability negotiation, but in addition, it disables the new rules for invoking graceful restart receiver mode as specified in the IETF bgp-gr-notification draft, and disables the transmission of the Hard Reset subcode. The Hard Reset subcode is continued to be observed when received in a Notify or a Cease message.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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discard-action-for-unresolved-redir-addr

Syntax

```
discard-action-for-unresolved-redir-addr;
```

Hierarchy Level

```
[edit routing-instances name routing-options flow],
[edit routing-options flow]
```

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description

Configure the discard action for BGP flow specification routes that were not resolved using the redirect to IP action. If you do not configure this option, then Junos OS by default accepts the unresolved redirect to IP addresses.

Required Privilege Level

routing

Related Documentation

- legacy-redirect-ip-action on page 1226
- Configuring BGP Flow Specification Action Redirect to IP to Filter DDoS Traffic on page 714
- Understanding BGP Flow Routes for Traffic Filtering on page 683

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dynamic-tunnel-reassembly

Syntax

```
dynamic-tunnel-reassembly (off | on);
```

Hierarchy Level

```
[edit logical-systems name routing-instances name routing-options dynamic-tunnels
  tunnel-attributes],
[edit logical-systems name routing-options dynamic-tunnels tunnel-attributes],
[edit logical-systems name tenants name routing-instances name routing-options
  dynamic-tunnels tunnel-attributes],
[edit routing-instances name routing-options dynamic-tunnels tunnel-attributes],
[edit routing-options dynamic-tunnels tunnel-attributes],
[edit tenants name routing-instances name routing-options dynamic-tunnels
  tunnel-attributes]
```

Release Information Statement introduced in Junos OS Release 19.2R1.

Description Enable or Disable reassembly check.

Options **off**—Disable reassembly check

on—Enable reassembly check. By default, this is disabled.

Required Privilege Level routing

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ecmp-fast-reroute

Syntax

```
ecmp-fast-reroute;
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options forwarding-table],
[edit routing-options forwarding-table]

Release Information

Command introduced before Junos OS Release 17.4.

Description

Enables equal-cost multipath (ECMP) fast reroute protection. If a link fails, ECMP uses fast reroute protection to shift packet forwarding to operational links to reduce packet loss. Fast reroute protection updates ECMP information for the interface without waiting for route table updates. When the next route table update occurs, a new set of ECMP interfaces are added with fewer links, or the route points to a single next hop.

Without ECMP fast reroute protection, upon link failure the creation of the new ECMP set is delayed while the routing table information is updated. Once the new ECMP set is created, the hashing algorithm calculates new paths. Enabling the **ecmp-fast-reroute** option eliminates the routing table convergence delay.

NOTE: ECMP works differently with indirect next hops. Please see *ECMP Flow-Based Forwarding* for more information.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *ECMP Flow-Based Forwarding*

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egress-te

Syntax

```
egress-te {
  backup-path backup-path;
  import;
  install-address address;
  no-install;
  rib (inet.0 | inet6.0);
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 14.2R4 for the MX Series and PTX Series.

Description

Enable egress peer engineering to direct core service traffic such as MPLS RSVP to a specific single-hop egress BGP peer. The ingress BGP peer can traffic-engineer the core inet unicast and inet6 unicast service traffic using BGP labeled unicast towards a specific egress BGP peer, which is also the AS boundary router.

You can enable MPLS fast reroute (FRR) on the egress BGP peer, which has traffic engineering enabled. The AS boundary router switches to the backup path when the primary link fails. Specify a predefined template with one or more backup paths. You can define a template using the egress-te-backup-paths configuration statement and configure one or more backup path for MPLS FRR. The backup paths specified in the template must belong to the same address family as the BGP peer.

Options

none—Enable traffic engineering on the egress peer.

backup-path *backup-path* —(Optional) Specify a predefined template that has the configured backup path for MPLS fast reroute.

import—Import policy to set attributes on the egress-te created route.

install-address—Host (/32 or /128) address to install egress-te route in inet[6].3 table.

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no-install—Avoid installation to FIB or resolving over egress-te route.

rib (inet.0 | inet6.0)—Install egress-te route in inet[6].0 instead of inet[6].3

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-backup-paths on page 1153
- Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute on page 893
- Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview on page 896
- Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast on page 897

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egress-te-adj-segment

Syntax

```
egress-te-adj-segment name {
  egress-te-backup-segment
  egress-te-set
  label label-value;
  next-hop next-hop-addr;
}
```

Hierarchy Level

[edit fabric protocols bgp group *name* neighbor],
[edit protocols bgp group *name* neighbor],
[edit routing-instances *name* protocols bgp group *name* neighbor]

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify a BGP peer adjacency segment for only multihop EBGP peers. You can specify a segment set so that the packet is sent to any member in the set, which is the equal-cost multipath next hop. You can include an adjacent segment or a node segment to the same peer segment set. You must configure egress-te-node-segment before configuring the BGP peer adjacency segment.

Options

name— Specify a name for the peer adjacency segment.

label *label-value*— Specify a label from the static label range for the peer adjacency segment.

next-hop *next-hop-addr*— Specify a directly connected next-hop address for the peer adjacency segment.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-node-segment on page 1156
- egress-te-set-segment on page 1158

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egress-te-backup-paths

Syntax

```
egress-te-backup-paths {
  template path-name {
    ip-forward rti-name;
    peer peer-addr;
    remote-nexthop remote-nh-addr;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical system name protocols bgp],
[edit logical-systems logical system name protocols bgp group group-name],
[edit protocols bgp],
[edit protocols bgp group group-name]
```

Release Information Statement introduced in Junos OS Release 14.2 R4 for the MX Series and PTX Series.

Description Specify backup paths for MPLS fast reroute (FRR) on an egress peer, which has traffic engineering enabled. Egress peer engineering directs core service traffic such as MPLS RSVP to a specific egress BGP peer. The ingress BGP peer can traffic-engineer the core inet unicast and inet6 unicast service traffic using BGP labeled unicast towards a specific egress BGP peer, which is also the AS boundary router.

Specify a backup path through another directly connected external BGP peer. The configured backup path provides MPLS fast reroute when the primary link fails, and the AS boundary router redirects the traffic received from the core to the this backup path. You can configure more than one backup path on the egress BGP peer. The specified backup paths are automatically installed into the MPLS forwarding table of the egress BGP peer configured with the egress traffic engineering feature.

Options

template *path-name*—Define a template that can be reused by multiple BGP groups or peers. All addresses listed in one template must belong to the same IP address family as the protected device that is the egress BGP peer.

ip-forward *rti-name*—(Optional) Configure this option if you want the egress peer to perform an IP look up in the **inet6.0** table for backup path that egress BGP peer must use for faster reroute You can optionally specify a routing instance. If you do not specify a routing instance, the device configures the backup path for the master instance.

You cannot use this option with the **remote-nexthop** option.

CAUTION: **ip-forward** option might cause forwarding loops if the IP route chooses an internal path. To avoid forwarding loops configure a virtual routing and forwarding (VRF) instance with leaked external routes only, and use this VRF instance with the **ip-forward** option.

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peer *peer-addr*—(Optional) Specify another directly connected external BGP peer that the device must use for faster reroute when the primary link fails. Each template can specify one or more external BGP peers.

remote-nexthop *remote-nh-addr*—(Optional) Specify a remote next-hop address if transit peering is not available locally to tunnel traffic to another AS boundary router in the local AS that has transit connectivity. The specified remote next-hop address must have the ability to forward this redirected traffic to its destination. This option does not support multiple routing instances; therefore, do not use this option with the **ip-forward** option.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te on page 1150
- Configuring Egress Peer Traffic Engineering by Using BGP Labeled Unicast and Enabling MPLS Fast Reroute on page 893
- Egress Peer Traffic Engineering Using BGP Labeled Unicast Overview on page 896
- Example: Configuring Egress Peer Traffic Engineering Using BGP Labeled Unicast on page 897

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egress-te-backup-segment

Syntax

```
egress-te-backup-segment label label-value;
```

Hierarchy Level

```
[edit fabric protocols bgp egress-te-set-segment],
[edit protocols bgp egress-te-set-segment],
[edit fabric protocols bgp group name neighbor egress-te-node-segment],
[edit protocols bgp group name neighbor egress-te-node-segment],
[edit fabric protocols bgp group name neighbor egress-te-adj-segment],
[edit protocols bgp group name neighbor egress-te-adj-segment],
[edit routing-instances name protocols bgp group name neighbor]
[edit routing-instances name protocols bgp group name neighbor]
[edit routing-instances name protocols bgp egress-te-set-segment]
```

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify the backup label value for a segment for MPLS fast reroute. The label must already be associated with a segment and must be different from the protected segment specified in egress-te-node-segment or in egress-te-adj-segment.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-adj-segment on page 1152
- egress-te-node-segment on page 1156
- egress-te-set-segment on page 1158

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egress-te-node-segment

Syntax

```
egress-te-node-segment {
  egress-te-backup-segment
  egress-te-set
}
```

Hierarchy Level

[edit fabric protocols bgp group *name* neighbor],
[edit protocols bgp group *name* neighbor],
[edit routing-instances *name* protocols bgp group *name* neighbor]

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify a BGP peer node segment for both single hop and multihop EBGP peers. You can configure a node segment as a member of a segment set so that the packet is sent to any member that is the ECMP next hop in the set. Before configuring a node segment as a member of a segment set, you must create a segment set first. If you fail to create the segment set before assigning a node segment, the commit might fail.

This configuration enables egress peer engineering using BGP link-state distribution in a network configured with segment routing. The egress router advertises the peer node SID label for all its peers and the controller advertises these SID labels to the ingress router.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-adj-segment on page 1152
- egress-te-set-segment on page 1158

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egress-te-set

Syntax

```
egress-te-set set-name weight weight;
```

Hierarchy Level

```
[edit fabric protocols bgp group name neighbor name egress-te-node-segment],
[edit protocols bgp group name neighbor name egress-te-node-segment],
[edit routing-instances name protocols bgp group name neighbor name
  egress-te-node-segment]
```

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify the members of the segment set configured with egress-te-set-segment. You can include both node segments and adjacency segments in the same segment set. The egress router advertises the peer node SID label for all its peers including the EBGP peers and the controller advertises these SID labels to the ingress router.

Options

set-name— Specify a unique name for the segment set.

weight— Specify weight for the segment set.

Range: 1 through 255

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-adj-segment on page 1152
- egress-te-set-segment on page 1158
- egress-te-node-segment on page 1156

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egress-te-set-segment

Syntax

```
egress-te-set-segment name {
  egress-te-backup-segment
  label label-value;
}
```

Hierarchy Level

[edit fabric protocols bgp],
[edit protocols bgp],
[edit routing-instances *name* protocols bgp]

Release Information

Statement introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify a segment set that can include adjacency segments or node segments, or a combination of both as members. You can assign a label, which is represented as equal-cost multipath next hop to send a packet to any member in the set.

Options

name— Specify a unique name for the BGP peer segment set.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- egress-te-adj-segment on page 1152
- egress-te-node-segment on page 1156

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enforce-first-as

Syntax

```
enforce-first-as;
```

Hierarchy Level

[edit fabric protocols bgp],
[edit fabric protocols bgp group *group_name*],
[edit fabric protocols bgp group *group_name* neighbor *address*],
[edit logical-systems *name*],
[edit logical-systems *name* protocols bgp],
[edit logical-systems *name* protocols bgp group *group_name*],
[edit logical-systems *name* protocols bgp group *group_name* neighbor *address*],
[edit logical-systems *name* routing-instances *instance_name* protocols bgp],
[edit logical-systems *name* routing-instances *instance_name* protocols bgp group *group_name*],
[edit logical-systems *name* routing-instances *instance_name* protocols bgp group *group_name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *neighbor-address*],
[edit routing-instances *instance_name* protocols bgp],
[edit routing-instances *instance_name* protocols bgp group *group_name*],
[edit routing-instances *instance_name* protocols bgp group *group_name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 15.1 for the M Series, MX Series, T Series, and PTX Series.

Description

Enforce that the first (left-most) autonomous system number (ASN) in AS-path is the previous neighbor's ASN. When configured, this statement enforces that as the domain is transited, the routes received from an EBGP peer have the peer's ASN in the left-most position of the AS path.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Prepending 4-Byte AS Numbers in an AS Path on page 201
- Example: Enforcing Correct Autonomous System Number in AS-Path in BGP Network on page 212

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entropy-label

Syntax

```
entropy-label {
  import policy-name;
  no-next-hop-validation;
}
```

Hierarchy Level

```
[edit logical-systems logical-system name protocols bgp family inet labeled-unicast],
[edit logical-systems logical-system name protocols bgp group group-name family inet
  labeled-unicast],
[edit logical-systems logical-system name protocols bgp group group-name neighbor address
  labeled-unicast],
[edit protocols bgp family inet labeled-unicast],
[edit protocols bgp group group-name family inet labeled-unicast],
[edit protocols bgp group group-name neighbor address labeled-unicast]
```

Release Information

Statement introduced in Junos OS Release 15.1.
Statement introduced in Junos OS Release 17.2R1 for QFX10000 Series switches.

Description

Insert the entropy label into the BGP labeled unicast LSP packets, which assists the transit router in load-balancing BGP traffic across equal-cost multipaths or link aggregation groups. The ingress label edge router inspects the flow information of a packet and maps it to an entropy label, which is inserted into the BGP label stack. LSRs in the core use this entropy label as the key to hash the packet and direct it to the correct path.

Options

import *policy-name*— (Optional) Specify a policy that lists the routes that allow the use of entropy labels.

no-next-hop-validation—(Optional) Do not validate the next-hop field in the entropy label capability attribute against the route next hop.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- labeled-unicast on page 1224
- *policy-statement*
- Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 533
- Example: Configuring an Entropy Label for a BGP Labeled Unicast LSP on page 534
- Understanding Entropy Label for BGP Labeled Unicast LSP on page 530

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explicit-null (Protocols BGP)

Syntax

```
explicit-null;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols mpls],
[edit logical-systems *logical-system-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* protocols ldp],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols ldp],
[edit protocols mpls],
[edit protocols bgp family inet labeled-unicast],
[edit protocols bgp family inet6 labeled-unicast],
[edit protocols bgp group *group-name* family inet labeled-unicast],
[edit protocols bgp group *group-name* family inet6 labeled-unicast],
[edit protocols bgp group *group-name* neighbor *address* family inet labeled-unicast]
[edit protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit protocols ldp],
[edit routing-instances *instance-name* protocols bgp family inet labeled-unicast],
[edit routing-instances *instance-name* protocols bgp family inet6 labeled-unicast],
[edit routing-instances *instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit routing-instances *instance-name* protocols bgp group *group-name* family inet6 labeled-unicast],
[edit routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* family inet6 labeled-unicast],
[edit routing-instances *instance-name* protocols ldp]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

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Statement introduced in Junos OS Release 14.1X53-D30 for QFX Series switches.

Description Advertise label 0 to the egress routing device of an LSP.

Default If you do not include the **explicit-null** statement in the configuration, label 3 (implicit null) is advertised.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Advertising Explicit Null Labels to BGP Peers*

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export (Protocols BGP)

Syntax

```
export [ policy-names ];
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Apply one or more policies to routes being exported from the routing table into BGP.

If you specify more than one policy, they are evaluated in the order specified, from left to right, and the first matching filter is applied to the route. If no routes match the filters, the routing table exports into BGP only the routes that it learned from BGP. If an action specified in one of the policies manipulates a route characteristic, the policy framework software carries the new route characteristic forward during the evaluation of the remaining policies. For example, if the action specified in the first policy of a chain sets a route's metric to 500, this route matches the criterion of **metric 500** defined in the next policy.

Options

policy-names—Name of one or more policies.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Routing Policies to Control BGP Route Advertisements on page 328
- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- import on page 1204

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extended-nexthop

Syntax

```
extended-nexthop;
```

Hierarchy Level

[edit fabric protocols bgp family inet unicast],
[edit fabric protocols bgp family inet inet6 unicast],
[edit fabric protocols bgp group *name* family inet unicast],
[edit fabric protocols bgp group *name* family inet inet6 unicast],
[edit fabric protocols bgp group *name* neighbor *name* family inet unicast],
[edit fabric protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit logical-systems *name* protocols bgp family inet unicast],
[edit logical-systems *name* protocols bgp family inet inet6 unicast],
[edit logical-systems *name* protocols bgp group *name* family inet unicast],
[edit logical-systems *name* protocols bgp group *name* family inet inet6 unicast],
[edit logical-systems *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit logical-systems *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* family inet inet6 unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit logical-systems *name* routing-instances *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit protocols bgp family inet unicast],
[edit protocols bgp family inet inet6 unicast],
[edit protocols bgp group *name* family inet unicast],
[edit protocols bgp group *name* family inet inet6 unicast],
[edit protocols bgp group *name* neighbor *name* family inet unicast],
[edit protocols bgp group *name* neighbor *name* family inet inet6 unicast],
[edit routing-instances *name* protocols bgp family inet unicast],
[edit routing-instances *name* protocols bgp family inet inet6 unicast],
[edit routing-instances *name* protocols bgp group *name* family inet unicast],
[edit routing-instances *name* protocols bgp group *name* family inet inet6 unicast],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet unicast],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet inet6 unicast]

Release Information

Statement introduced in Junos OS Release 17.3R1 on the MX Series.

Description

Configure extended next-hop encoding for BGP groups with IPv6 peers to route IPv4 address families over an IPv6 session. Configure dynamic IPv4-over-IPv6 tunnels and define their attributes to forward IPv4 traffic over an IPv6-only network.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *dynamic-tunnels*
- tunnel-attributes on page 1386
- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676

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family (Protocols BGP)

Syntax

```
family {
  (inet | inet6 | inet-vpn | inet6-vpn | iso-vpn) {
    (any | flow | labeled-unicast | multicast | unicast | segment-routing-te) {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage-threshold> idle-timeout (forever | minutes);
      }
      add-path {
        send {
          path-count number;
          prefix-policy [ policy-names ];
          }
        receive;
      }
      aigp [disable];
      loops number;
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      protection;
    rib-group group-name;
      topology name {
        community {
          target identifier;
        }
      }
    flow {
      no-install;
      no-validate policy-name;
    }
    labeled-unicast {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      aggregate-label {
        community community-name:
      }
      explicit-null {
        connected-only;
      }
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      resolve-vpn;
      rib (inet.3 | inet6.3);
      rib-group group-name;
      traffic-statistics {
        file filename <world-readable | no-world-readable>;
```


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```
        interval seconds;
      }
    }
  }
  route-target {
    accepted-prefix-limit {
      maximum number;
      proxy-generate <route-target-policy route-target-policy-name>;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
    advertise-default;
    external-paths number;
    prefix-limit {
      maximum number;
      teardown <percentage> <idle-timeout (forever | minutes)>;
    }
  }
  (evpn | inet-mdt | inet-mvpn | inet6-mvpn | l2vpn) {
    signaling {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage-threshold> idle-timeout (forever | minutes);
      }
      add-path {
        send {
          path-count number;
          prefix-policy [ policy-names ];
          }
        receive;
      }
      aigp [disable];
      damping;
      loops number;
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      rib-group group-name;
    }
  }
  traffic-engineering;
}
```

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Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 14.1X53-D30 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
inet-mvpn and **inet6-mpvn** statements introduced in Junos OS Release 8.4.
inet-mdt statement introduced in Junos OS Release 9.4.
Support for the **loops** statement introduced in Junos OS Release 9.6.
evpn statement introduced in Junos OS Release 13.2.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
traffic-engineering statement introduced in Junos OS Release 14.2.
segment-routing-te option introduced in Junos OS Release 17.4R1 for QFX Series, MX Series, and PTX Series with FPC-PTX-P1-A.

Description

Enable multiprotocol BGP (MP-BGP) by configuring BGP to carry network layer reachability information (NLRI) for address families other than unicast IPv4, to specify MP-BGP to carry NLRI for the IPv6 address family, or to carry NLRI for VPNs.

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Options

any—Configure the family type to be both unicast and multicast.

evpn—Configure NLRI parameters for Ethernet VPNs (EVPNs).

inet—Configure NLRI parameters for IPv4.

inet6—Configure NLRI parameters for IPv6.

inet-mdt—Configure NLRI parameters for the multicast distribution tree (MDT) subaddress family identifier (SAFI) for IPv4 traffic in Layer 3 VPNs.

inet-mvpn—Configure NLRI parameters for IPv4 for multicast VPNs.

inet6-mvpn—Configure NLRI parameters for IPv6 for multicast VPNs.

inet-vpn—Configure NLRI parameters for IPv4 for Layer 3 VPNs.

inet6-vpn—Configure NLRI parameters for IPv6 for Layer 3 VPNs.

inet6-vpn—Configure NLRI parameters for IPv6 for Layer 3 VPNs.

iso-vpn—Configure NLRI parameters for IS-IS for Layer 3 VPNs.

l2vpn—Configure NLRI parameters for IPv4 for MPLS-based Layer 2 VPNs and VPLS.

labeled-unicast—Configure the family type to be labeled-unicast. This means that the BGP peers are being used only to carry the unicast routes that are being used by labeled-unicast for resolving the labeled-unicast routes. This statement is supported only with inet and inet6.

multicast—Configure the family type to be multicast. This means that the BGP peers are being used only to carry the unicast routes that are being used by multicast for resolving the multicast routes.

unicast—Configure the family type to be unicast. This means that the BGP peers only carry the unicast routes that are being used for unicast forwarding purposes. The default family type is unicast.

segment-routing-te—Configure the family type to be segment routing traffic engineering. This means that BGP peers only carry segment routing policies for traffic steering.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring IBGP Sessions Between PE Routers in VPNs*
- Understanding Multiprotocol BGP on page 655
- autonomous-system on page 1112
- local-as on page 1231

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file (Tracing for Origin AS Validation)

Syntax

```
file filename <files number> <size size> <world-readable | no-world-readable>;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation traceoptions],
[edit logical-systems logical-system-name routing-options validation traceoptions],
[edit routing-instances instance-name routing-options validation traceoptions],
[edit routing-options validation traceoptions]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure the file settings for tracing resource public key infrastructure (RPKI) BGP route validation.

Options

filename —Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**.

files *number*—(Optional) Maximum number of trace files. When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached (***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify gigabytes), at which point the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 3 files

no-world-readable—(Optional) Restrict file access to the user who created the file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named **trace-file** reaches its maximum size, it is renamed **trace-file.0**, then **trace-file.1**, and so on, until the maximum number of trace files is reached. Then the oldest trace file is overwritten. If you specify a maximum number of files, you also must specify a maximum file size with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through 1 GB

Default: 128 KB

world-readable—(Optional) Enable unrestricted file access.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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flag (Tracing for Origin AS Validation)

Syntax

```
flag flag;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation traceoptions],
[edit logical-systems logical-system-name routing-options validation traceoptions],
[edit routing-instances instance-name routing-options validation traceoptions],
[edit routing-options validation traceoptions]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure the flags for tracing resource public key infrastructure (RPKI) BGP route validation.

Options *flag*—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

RPKI BGP Route Validation Tracing Flags

- **all**—Trace all events.
- **error**—Trace errored packets.
- **keepalive**—RPKI-to-router protocol keepalive messages. If you enable the BGP **update** flag only, received keepalive messages do not generate a trace message.
- **nsr-synchronization**—Nonstop routing synchronization events.
- **packets**—All incoming and outgoing packets.
- **state**—State transitions.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.
- **update**—Update packets. These packets provide routing updates to BGP systems. If you enable only this flag, received keepalive messages do not generate a trace message. Use the **keepalive** flag to generate a trace message for keepalive messages.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Origin Validation for BGP on page 810
- Understanding Origin Validation for BGP on page 804
- Use Case and Benefit of Origin Validation on page 803

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flow

Syntax

```
flow {
  no-validate policy-name;
  secondary-independent-resolution;
}
```

Hierarchy Level

```
[edit protocols bgp group group-name family (inet | inet-vpn | inet6 | inet6-vpn)],
[edit protocols bgp group group-name neighbor address family (inet | inet-vpn | inet6 |
  inet6-vpn)],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet-vpn | inet6 | inet6-vpn)],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address family (inet | inet-vpn | inet6 | inet6-vpn)]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
secondary-independent-resolution option introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description

Enables BGP to support flow routes.

NOTE: This statement is supported for the default instance, VRF instance, and virtual-router instance only. It is configured with the **instance-type** statement at the **[edit routing-instance *instance-name*]** hierarchy level. For VPNs, this statement is supported for the default instance only.

The remaining statements are explained separately. See CLI Explorer.

Options

secondary-independent-resolution— Configure to resolve flow specification routes in the VRF table independent of VPN flow route. This option is currently supported for inet and inet-vpn families only.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP to Carry Flow-Specification Routes on page 688

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flow (IPv6)

Syntax

```
flow {
  route name {
    match {
      destination {
        ipv6-prefix;
        prefix-offset number;
      }
      destination-port destination-port-names;
      dscp value;
      flow-label numeric-expression;
      fragment fragment-value;
      icmp6-code icmp6-code-value;
      icmp6-type icmp6-type-value;
      packet-length packet-length;
      port port-names;
      protocol number;
      source {
        ipv6-prefix;
        prefix-offset number;
      }
      source-port source-port-names;
      tcp-flags tcp-flags;
    }
    then {
      accept;
      community name;
      discard;
      mark value;
      next-term;
      rate-limit rate-limit;
      routing-instance route-target-extended-community;
      sample;
    }
  }
}
```

Hierarchy Level

[edit routing-options rib inet6.0],
[edit routing-instances *routing-instance-name* routing-options rib inet6.0]

Release Information

Statement introduced in Junos OS Release 16.1 for the MX Series.

Description

Configure the BGP flow specification for the IPv6 address family to automate coordination of traffic filtering rules and to allow propagation of traffic flow specification rules for IPv6 and IPv6 VPN in order to mitigate distributed denial-of-service attacks. Flow specification provides protection against denial-of-service attacks and restricts bad traffic that consumes bandwidth and stops it near the source.

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NOTE: To propagate IPv6 flow specification routes through BGP, enable family **inet6 flow** or **inet6-vpn flow** at the **[edit protocols bgp family]** hierarchy level on BGP routers in the network.

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Options

destination *ipv6-prefix*—IP destination address field.

destination-port *destination-port-names*—TCP or User Datagram Protocol (UDP) destination port field. You cannot specify both the **port** and **destination-port** match conditions in the same term.

In place of the numeric value, you can specify one of the following text synonyms (the port numbers are also listed): **afs** (1483), **bgp** (179), **biff** (512), **bootpc** (68), **bootps** (67), **cmd** (514), **cvspserver** (2401), **dhcp** (67), **domain** (53), **eklogin** (2105), **ekshell** (2106), **exec** (512), **finger** (79), **ftp** (21), **ftp-data** (20), **http** (80), **https** (443), **ident** (113), **imap** (143), **kerberos-sec** (88), **klogin** (543), **kpasswd** (761), **krb-prop** (754), **krbupdate** (760), **kshell** (544), **ldap** (389), **login** (513), **mobileip-agent** (434), **mobilip-mn** (435), **msdp** (639), **netbios-dgm** (138), **netbios-ns** (137), **netbios-ssn** (139), **nfsd** (2049), **nntp** (119), **ntalk** (518), **ntp** (123), **pop3** (110), **pptp** (1723), **printer** (515), **radacct** (1813), **radius** (1812), **rip** (520), **rkinit** (2108), **smtp** (25), **snmp** (161), **snmptrap** (162), **snpp** (444), **socks** (1080), **ssh** (22), **sunrpc** (111), **syslog** (514), **tacacs-ds** (65), **talk** (517), **telnet** (23), **tftp** (69), **timed** (525), **who** (513), **xdmcp** (177), **zephyr-clt** (2103), or **zephyr-hm** (2104).

dscp *value*—Differentiated Services code point (DSCP). The DiffServ protocol uses the type-of-service (ToS) byte in the IP header. The most significant six bits of this byte form the DSCP.

Range: You can specify DSCP in hexadecimal or decimal form from 0 through 63.

flow-label *numeric-expression*—The value of this field ranges from 0 through 1048575.

This match condition is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.

fragment *fragment-value*—The keywords are grouped by the fragment type with which they are associated:

- **first-fragment**
- **is-fragment**
- **last-fragment**
- **not-a-fragment**

This match condition is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.

icmp6-code *icmp6-code-value*—ICMP6 code field. This value or keyword provides more specific information than **icmp6-type**. Because the value's meaning depends on the associated **icmp6-type** value, you must specify **icmp6-type** along with **icmp6-code**.

In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed). The keywords are grouped by the ICMP type with which they are associated:

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- parameter-problem: **ip-header-bad** (0), **required-option-missing** (1)
- redirect: **redirect-for-host** (1), **redirect-for-network** (0), **redirect-for-tos-and-host** (3), **redirect-for-tos-and-net** (2)
- time-exceeded: **ttl-eq-zero-during-reassembly** (1), **ttl-eq-zero-during-transit** (0)
- unreachable: **communication-prohibited-by-filtering** (13), **destination-host-prohibited** (10), **destination-host-unknown** (7), **destination-network-prohibited** (9), **destination-network-unknown** (6), **fragmentation-needed** (4), **host-precedence-violation** (14), **host-unreachable** (1), **host-unreachable-for-TOS** (12), **network-unreachable** (0), **network-unreachable-for-TOS** (11), **port-unreachable** (3), **precedence-cutoff-in-effect** (15), **protocol-unreachable** (2), **source-host-isolated** (8), **source-route-failed** (5)

icmp6-type *icmp6-type-value*—ICMP6 packet type field. Normally, you specify this match in conjunction with the **protocol** match statement to determine which protocol is being used on the port.

In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): **echo-reply** (0), **echo-request** (8), **info-reply** (16), **info-request** (15), **mask-request** (17), **mask-reply** (18), **parameter-problem** (12), **redirect** (5), **router-advertisement** (9), **router-solicit** (10), **source-quench** (4), **time-exceeded** (11), **timestamp** (13), **timestamp-reply** (14), or **unreachable** (3).

packet-length *packet-length*—Total IP packet length value can range from 0 through 65535.

port *port-names*—TCP or UDP source or destination port field. You cannot specify both the **port** match condition and either the **destination-port** or **source-port** match condition in the same term.

In place of the numeric value, you can specify one of the text synonyms listed under **destination-port**.

prefix-offset *number*—(Optional) Specify the number of bits that must be skipped before Junos OS starts matching the prefix.

This match condition is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.

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protocol *number*—For IPv6, the IP protocol field is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode. In place of the numeric value, you can specify one of the following text synonyms (the field values are also listed): **ah** (51), **egp** (8), **esp** (50), **gre** (47), **icmp** (1), **igmp** (2), **ipip** (4), **ipv6** (41), **ospf** (89), **pim** (103), **rsvp** (46), **tcp** (6), or **udp** (17).

source *ipv6-prefix*—IP source address field.

source-port *source-port-names*—TCP or UDP source port field. You cannot specify the **port** and **source-port** match conditions in the same term.

In place of the numeric field, you can specify one of the text synonyms listed under **destination-port**.

tcp-flags *tcp-flags*—TCP header format.

accept—Accept a packet. This is the default value.

community *name*—Replace any communities in the route with the specified communities.

discard—Discard a packet silently, without sending an Internet Control Message Protocol (ICMP) message.

mark *value*—Set a DSCP value for traffic that matches this flow. Specify a value from 0 through 63.

This action is supported only on Junos Trio chipset-based devices that are configured for **enhanced-ip** mode.

NOTE: Junos OS supports traffic marking extended BGP community filtering action. For IPv4 traffic, Junos OS modifies the DiffServ code point (DSCP) bits of a transiting IPv4 packet to the corresponding value of the extended community. For IPv6 packets, Junos OS modifies the first six bits of the traffic class field of the transmitting IPv6 packet to the corresponding value of the extended community.

next-term—Continue to the next match condition for evaluation.

rate-limit *rate-limit*—Limit the bandwidth on the flow route. Express the limit in bits per second (bps).

routing-instance *route-target-extended-community*—Specify a routing instance to which packets are forwarded.

sample—Sample the traffic on the flow route.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Example: Configuring BGP to Carry IPv6 Flow Specification Routes on page 704
- Example: Enabling BGP to Carry Flow-Specification Routes on page 688
- Understanding BGP Flow Routes for Traffic Filtering on page 683

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forwarding-state-bit (Per Family for BGP Graceful Restart)

Syntax

```
forwarding-state-bit (as-rr-client | from-fib);
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  graceful-restart],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  graceful-restart],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  group group-name graceful-restart],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  group group-name neighbor address graceful-restart],
[edit routing-instances routing-instance-name protocols bgp graceful-restart],
[edit routing-instances routing-instance-name protocols bgp group group-name
  graceful-restart],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group group-name graceful-restart],
[edit protocols bgp group group-name neighbor address graceful-restart]
```

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the forwarding-state bit flag negotiation for BGP for individual address families. In addition to the global setting for the Forwarding State bit, the Forwarding State bit behavior can be specified for individual families. Changing the forwarding-state-bit setting has no effect on any existing sessions. Per-family BGP configuration options are added to control the Forwarding State bit in graceful restart and long-lived graceful restart capability advertisements. They can be specified for the default logical system or for a specific logical system, and for the master routing instance or a specific routing instance. The **per-family forwarding-state-bit** attribute overrides the default rules or the global configuration for setting the Forwarding State bit.

The setting of the F bit (and the "Forwarding State" bit of the accompanying GR capability) depends in part on deployment considerations. The F bit can be interpreted to indicate the helper router needs to flush associated routes (if the bit is left clear). An important scenario in which LLGR is used is for routes that are more similar to configuration than to traditional routing (hop-by-hop forwarding instead of tunnel-based routing). For such routes, it might be useful to always set the F bit, regardless of other considerations. Similarly, for control-plane-only entities such as dedicated route reflectors, that do not participate in the forwarding plane, it is preferred that the F bit be always set. Overall, the guideline to be adopted is that if loss of state on the restarting router can reasonably be expected to cause a forwarding loop or black hole, the F bit must be set judiciously, depending on whether state has been retained. You can determine whether the F bit needs to be set or not, based on your deployment needs and configured settings. It might

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be necessary to advertise stale routes to a CE in some VPN deployments, even if the CE does not support this specification. In such a scenario, the network operator configuring their PE to advertise such routes must notify the operator of the CE receiving the routes, and the CE must be configured to depreference the routes. Typically, BGP implementations perform this behavior by matching on the LLGR_STALE community, and setting the LOCAL_PREF for matching routes to zero.

Options

set—Causes the value to be set according to the state of the associated FIB. Changing the per-family forwarding-state-bit setting has no effect on any existing sessions.

from-fib—Forces the Forwarding State bit to be set to 1.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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forwarding-state-bit (Long-Lived Graceful Restart for BGP Restarter)

Syntax

```
forwarding-state-bit (from-fib | set);
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family address-family
  subsequent-address-family graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name family
  address-family subsequent-address-family graceful-restart],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family address-family subsequent-address-family graceful-restart],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family address-family subsequent-address-family graceful-restart],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family address-family subsequent-address-family graceful-restart],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address family address-family subsequent-address-family
  graceful-restart],
[edit routing-instances routing-instance-name protocols bgp family address-family
  subsequent-address-family graceful-restart],
[edit routing-instances routing-instance-name protocols bgp group group-name family
  address-family subsequent-address-family graceful-restart],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family address-family subsequent-address-family graceful-restart],
[edit protocols bgp family address-family subsequent-address-family graceful-restart],
[edit protocols bgp group group-name family address-family subsequent-address-family
  graceful-restart],
[edit protocols bgp group group-name neighbor address family address-family
  subsequent-address-family graceful-restart]
```

NOTE: Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI).

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the forwarding-state bit flag negotiation for BGP for all address families. In addition to the global setting for the Forwarding State bit, the Forwarding State bit behavior can be specified for individual families. Changing the forwarding-state-bit setting has no effect on any existing sessions. Per-family BGP configuration options are added to control the Forwarding State bit in graceful restart and long-lived graceful restart capability advertisements. They can be specified for the default logical system or for a specific logical system, and for the master routing instance or a specific routing instance.

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The **per-family forwarding-state-bit** attribute overrides the default rules or the global configuration for setting the Forwarding State bit.

The setting of the F bit (and the "Forwarding State" bit of the accompanying GR capability) depends in part on deployment considerations. The F bit can be interpreted to indicate the helper router needs to flush associated routes (if the bit is left clear). An important scenario in which LLGR is used is for routes that are more similar to configuration than to traditional routing (hop-by-hop forwarding instead of tunnel-based routing). For such routes, it might be useful to always set the F bit, regardless of other considerations. Similarly, for control-plane-only entities such as dedicated route reflectors, that do not participate in the forwarding plane, it is preferred that the F bit be always set. Overall, the guideline to be adopted is that if loss of state on the restarting router can reasonably be expected to cause a forwarding loop or black hole, the F bit must be set judiciously, depending on whether state has been retained. You can determine whether the F bit needs to be set or not, based on your deployment needs and configured settings. It might be necessary to advertise stale routes to a CE in some VPN deployments, even if the CE does not support this specification. In such a scenario, the network operator configuring their PE to advertise such routes must notify the operator of the CE receiving the routes, and the CE must be configured to depreference the routes. Typically, BGP implementations perform this behavior by matching on the LLGR_STALE community, and setting the LOCAL_PREF for matching routes to zero.

Options

set—Causes the value to be set according to the state of the associated FIB. Changing the per-family forwarding-state-bit setting has no effect on any existing sessions.

from-fib—Forces the Forwarding State bit to be set to 1.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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forwarding-context (Protocols BGP)

Syntax

```
forwarding-context;
```

Hierarchy Level

```
[edit protocols bgp],
[edit protocols bgp group group-name ],
[edit protocols bgp group group-name neighbor address],
```

Release Information

Statement introduced in Junos OS Release 16.1 for the M Series, MX Series, and T Series.

Description

Routing instance used for data forwarding and transport session. Use this statement in conjunction with **mpls-forwarding**, to protect against label spoofing across AS boundary routers in the context of Inter-AS VPN Option B AS boundary routers. If **forwarding-context** is not set for a VPN BGP peer, both the routing instance and forwarding context are provided by the master routing instance.

Setting a neighbor interface as a forwarding context can be useful, for example, when configuring a common AS boundary router so that it only accepts MPLS packets from a peer AS boundary router whose labels were explicitly advertised to the common AS boundary router. The action creates a special routing instance (MFI) that is used to form a transport session with peer and to perform forwarding functions for traffic from the peer. Spoof checking is performed for peers with different MFI forwarding contexts. Because peers with the same forwarding context share the same **MFI.mpls.0** table, there is no need for spoof checking on these peers. Thus, in **foo.mpls.0**, BGP installs only VPN labels that have been advertised to the VPN AS boundary router peers using the MFI **foo** as the forwarding context. This ensures that only MPLS packets from the VPN AS boundary router that also have the advertised label are accepted.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Preventing BGP Session Resets*
- *Junos OS Administration Library*

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graceful-restart (Protocols BGP)

Syntax

```
graceful-restart {
  disable;
  restart-time seconds;
  stale-routes-time seconds;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure graceful restart for BGP. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. Graceful restart is disabled by default. However, helper mode, the ability to assist a neighboring router attempting a graceful restart, is enabled by default.

To configure the duration of the BGP graceful restart period, include the **restart-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level. To set the length of time the router waits to receive messages from restarting neighbors before declaring them down, include the **stale-routes-time** statement at the **[edit protocols bgp graceful-restart]** hierarchy level.

NOTE: If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

Enable graceful restart mode for BGP (and other protocols) by configuring graceful-restart at the routing-options level. Note that you cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally.

For example, this configuration is required to enable graceful restart:

```
routing-options {
  graceful-restart
}
```

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If you want to disable graceful restart for some protocols, you can do this at the protocol's graceful-restart command. The following configuration along with the configuration above will keep graceful restart for all protocols but BGP.

```
protocols{
   bgp{
   graceful-restart; {
   disable;
}
```

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *Configuring Graceful Restart for QFabric Systems*
- *High Availability Feature Guide*

get-route-range

Syntax

```
get-route-range;
```

Hierarchy Level

```
[edit logical-systems name policy-options policy-statement name from route-filter],
[edit logical-systems name policy-options policy-statement name term name from
   route-filter],
[edit policy-options policy-statement name from route-filter],
[edit policy-options policy-statement name term name from route-filter]
```

Release Information

Statement introduced in Junos OS Release 19.2R1

Description

Get the range of IPv4 prefixes that goes over a particular tunnel.

Required Privilege Level

routing

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graceful-restart (Long-Lived for BGP Restarter)

Syntax

```
graceful-restart {
  disable-notification-flag;
  disable-notification-extensions {
    omit-no-export;
  }
  forwarding-state-bit (from-fib | set); /* Configurable to be common for all address families
    */
  forwarding-state-bit (as-rr-client | from-fib); /* Configurable for each address family */
  long-lived {
    restarter {
      disable;
      stale-time interval;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow)]
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow)],

NOTE: Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

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Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the graceful restart capability for long-lived BGP sessions on the restarting router to enable BGP routing details to be retained for a longer period. It in important to retain BGP data for a longer period when the BGP control plane fails for some reason for slowly-restarting routers for a longer duration. You can define the time period for which the stale routes need to be maintained.

You can also configure the BGP long-lived graceful restarter mode negotiation mechanism for a particular address family instead of configuring this capability for all address families in a system, logical system, or routing instance.

When LLGR restarter is enabled or disabled for a family or the stale- time is changed, the session is reset so that the new capability can be sent to the neighbor.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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graceful-restart (Long-Lived for BGP Helper)

Syntax

```
graceful-restart {
  long-lived {
    receiver {
      enable:
      disable;
    }
    advertise-to-non-llgr-neighbor {
      omit-no-export;
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the graceful restart capability for long-lived BGP sessions to enable BGP routing details to be retained for a longer period. It in important to retain BGP data for a longer period when the BGP control plane fails for some reason for slowly-restarting routers for a longer duration. Graceful restart allows a routing device undergoing a restart to inform its adjacent neighbors and peers of its condition. Graceful restart is disabled by default.

When nonstop routing (NSR) and long-lived graceful restart (LLGR) are configured together, the router negotiates the LLGR capability in the usual, regular manner, including a long-lived stale time to trigger LLGR receiver mode in its peers. However, full LLGR restarter functionality (delaying the transmission of End of RIB (EoR) markers until EoRs are received from all peers) does not function under NSR. During a full system (both Routing Engines) restart, the routing protocol daemon (rpd) does not wait for EoRs from other peers before sending its own EoR. It transmits the EoR as soon as it has transmitted the current RIB contents. This condition can cause transient outages when the network reconverges. NSR is considered to be adequate to handle all single-Routing Engine restart scenarios. The restarter mode restriction effects only scenarios where both Routing Engines (or both copies of rpd) restart simultaneously. Ordinary restarter mode configuration is not enabled with NSR. Long-lived graceful restart receiver mode is enabled by default, unless ordinary graceful restart receiver mode is disabled.

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NOTE: If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

Configure graceful restart globally at the **[edit routing-options]** or **[edit routing-instances *instance-name* routing-options]** hierarchy level to enable the feature. You cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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graceful-shutdown (Protocols BGP)

Syntax

```
graceful-shutdown {
  sender {
    local-preference <value>;
  }
  receiver {
    disable;
    local-preference <value>;
  }
}
```

Hierarchy Level

[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 19.1.

Description

Configure graceful shutdown feature for BGP. Graceful shutdown migrates traffic from one BGP next-hop to another without interrupting the traffic flow. This feature can be enabled for both IBGP and EBGP.

NOTE: The BGP neighbor device must support graceful shutdown feature, without any additional configuration.

NOTE: Graceful shutdown feature must be disabled, once the maintenance window is complete.

Default

Graceful shutdown is disabled.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- shutdown (Protocols BGP) on page 1346

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group (Origin Validation for BGP)

Syntax

```
group group-name {
  max-sessions number;
  session address {
    hold-time seconds;
    local-address local-ip-address;
    port port-number;
    preference number;
    record-lifetime seconds;
    refresh-time seconds;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation],
[edit logical-systems logical-system-name routing-options validation],
[edit routing-instances instance-name routing-options validation],
[edit routing-options validation]
```

Release Information

Statement introduced in Junos OS Release 12.2.

Description

Configure the number of concurrent sessions for each group.

Caches are organized in groups. The Junos OS implementation supports up to 63 sessions per group and both IPv4 and IPv6 address families.

If the number of sessions in a group exceeds the **max-sessions** value, the connections are established in order by preference value. A numerically higher preference results in a higher probability for session establishment. The order of session establishment is random among sessions with equal preferences.

Options

group-name—Name of the validation group.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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group (Protocols BGP)

Syntax

```
group group-name {
  advertise-bgp-static
  advertise-inactive;
  allow [ network/mask-length ];
  authentication-key key;
  cluster cluster-identifier;
  damping;
  description text-description;
  enforce-first-as;
  export [ policy-names ];
  family {
    (inet | inet6 | inet-vpn | inet6-vpn | l2-vpn) {
      (any | multicast | unicast | signaling) {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        add-path {
          send {
            path-count number;
            prefix-policy [ policy-names ];
            }
          receive;
        }
        aigp [disable];
        damping;
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        rib-group group-name;
        topology name {
          community {
            target identifier;
          }
        }
      }
      flow {
        no-validate policy-name;
      }
      labeled-unicast {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        explicit-null {
          connected-only;
        }
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
```

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```
        }
        resolve-vpn;
        rib inet.3;
        rib-group group-name;
      }
    }
    route-target {
      accepted-prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      advertise-default;
      external-paths number;
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
    }
}
graceful-restart {
    long-lived {
      receiver {
        enable:
        disable;
      }
      advertise-to-non-llgr-neighbor {
        omit-no-export;
      }
    }
}
graceful-restart {
    long-lived {
      disable-notification-flag;
      disable-notification-extensions {
        omit-no-export;
      }
      forwarding-state-bit (from-fib | set); /* Configurable to be common for all address
        families */
      forwarding-state-bit (as-rr-client | from-fib); /* Configurable for each address family
        */
      restarter {
        disable;
        stale-time interval;
      }
    }
}
hold-time seconds;
import [ policy-names ];
ipsec-sa ipsec-sa;
keep (all | none);
local-address address;
local-as autonomous-system <private>;
local-preference local-preference;
log-updown;
metric-out metric;
```


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```
  multihop <ttl-value>;
  multipath {
    multiple-as;
  }
  mvpn-iana-rt-import;
  no-aggregator-id;
  no-client-reflect;
  out-delay seconds;
  passive;
  peer-as autonomous-system;
  preference preference;
  remove-private;
  rfc6514-compliant-safi129;
  tcp-aggressive-transmission;
  tcp-mss segment-size;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  type type;
  neighbor address {
    ... peer-specific-options ...
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit protocols bgp],
[edit routing-instances routing-instance-name protocols bgp]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Define a BGP peer group. BGP peer groups share a common type, peer autonomous system (AS) number, and cluster ID, if present. To configure multiple BGP groups, include multiple **group** statements.

By default, the group's options are identical to the global BGP options. To override the global options, include group-specific options within the **group** statement.

The **group** statement is one of the statements you must include in the configuration to run BGP on the routing device.

Each group must contain at least one peer.

Options

group-name—Name of the BGP group.

The remaining statements are explained separately. See CLI Explorer.

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide*

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hold-down

Syntax

```
hold-down {
  seconds;
  flaps number;
  period seconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

If the connection to a BMP station flaps and the **hold-down** statement is configured, the station is prevented from reconnecting to the device for the specified period of time. A flap is when the TCP session unexpectedly switches from established to non-established. If you alter the configuration of the **hold-down** statement, the hold down timer and flap counter are reset.

You can effectively disable the **hold-down** statement by setting the **flaps** option to 10 and the **period** option to 30 seconds.

Options

seconds—Specify the time in seconds to wait before allowing the BMP station to reconnect to the device.

Default: 600 seconds

Range: 30 through 65,535 seconds

flaps *number*—Specify the number of BMP station flaps allowed before terminating the connection to the BMP station and triggering the hold down timer.

Default: 3 flaps

Range: 2 to 10 flaps

period *seconds*—Specify the time in seconds for the BGP station flaps (specified using the **flaps** option) to occur before triggering the hold down timer. Every time a flap occurs, the number of flaps in the last time period is checked to see if the criteria is met.

For example, if you defined the **period** as 60 seconds and the **flaps** as 4 and the BGP station flaps just 2 times in a 60 second period, the hold down timer would not be triggered. However, if the BGP station flaps 4 times in a 60 second period, the hold down timer would be triggered.

Default: 300 seconds

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Range: 30 through 65,535 seconds

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring BGP Monitoring Protocol Version 3 on page 946

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hold-down-interval (BGP BFD Liveness Detection)

Syntax

holddown-interval *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure an interval specifying how long a BFD session must remain up before a state change notification is sent.

When you configure the hold-down interval for the BFD protocol for EBGP, the BFD session is unaware of the BGP session during this time. In this case, if the BGP session goes down during the configured hold-down interval, BFD already assumes the BGP session is down and does not send a state change notification. The **holddown-interval** statement is supported only for EBGP peers at the **[edit protocols bgp group *group-name* neighbor *address*]** hierarchy level. If the BFD session goes down and then comes back up during the configured hold-down interval, the timer is restarted. You must configure the hold-down interval on both EBGP peers. If you configure the hold-down interval for a multihop EBGP session, you must also configure a local IP address by including the **local-address** statement at the **[edit protocols bgp group *group-name*]** hierarchy level.

Options

milliseconds—Specify the hold-down interval value.

Range: 0 through 255,000

Default: 0

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116

hold-time (Origin Validation for BGP)

Syntax
```
hold-time seconds;
```

Hierarchy Level
```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address][edit routing-options validation group group-name session
  server-ip-address]
```

Release Information
Statement introduced in Junos OS Release 12.2.

Description
Specify the length of time in seconds that the session between the routing device and the cache server is to be considered operational without any activity. After the hold time expires, the session is dropped.

Reception of any protocol data unit (PDU) from the cache server resets the hold timer. The hold time must be configured to be at least 2 x the refresh-time. If the hold time expires, the session is considered to be down. This, in turn, triggers a session restart event. During a session restart, the routing device attempts to start a session with the cache server that has the numerically highest preference.

Options
seconds—Time after which the session is declared down.
Range: 10 through 3600
Default: 600

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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hold-time (Protocols BGP)

Syntax

```
hold-time seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for QFX switches.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the hold-time value to use when negotiating a connection with the peer. The hold-time value is advertised in open packets and indicates to the peer the length of time that it should consider the sender valid. If the peer does not receive a keepalive, update, or notification message within the specified hold time, the BGP connection to the peer is closed and routing devices through that peer become unavailable.

The hold time is three times the interval at which keepalive messages are sent.

BGP on the local routing device uses the smaller of either the local hold-time value or the peer's hold-time value received in the open message as the hold time for the BGP connection between the two peers.

Starting in Junos OS Release 12.3, the BGP hold-time value can be zero (0). This implies that the speaker does not expect keepalive messages from its peer to maintain the BGP session. When negotiating between two peers, if one side requests a nonzero hold time and the other requests a zero hold time, the negotiation settles on the nonzero value and keepalive intervals are determined accordingly. Both sides must be set to zero for keepalive messages to stop being sent.

Options

seconds—Hold time.

Range: 3 through 65,535 seconds (or 0 for infinite hold time)

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Range: 10 through 65,535 seconds for EX Series switches.

Default: 90 seconds

TIP: When you set a hold-time value of 3 through 19 seconds, we recommend that you also configure the BGP **precision-timers** statement. The **precision-timers** statement ensures that if scheduler slip messages occur, the routing device continues to send keepalive messages. When the **precision-timers** statement is included, keepalive message generation is performed in a dedicated kernel thread, which helps to prevent BGP session flaps.

Starting in Junos OS Release 17.3R1, the **precision-timers** statement is supported on QFX Series switches.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- BGP Messages Overview on page 11
- precision-timers on page 1306

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idle-after-switch-over

Syntax

```
idle-after-switch-over (forever | seconds);
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 9.5.
Statement introduced in Junos OS Release 9.5 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Configure the routing device so that it does not automatically reestablish BGP peer sessions after a nonstop active routing (NSR) switchover. This feature is particularly useful if you are using dynamic routing policies because the dynamic database is not synchronized with the backup Routing Engine when NSR is enabled.

Options

forever—Do not reestablish a BGP peer session after an non-stop routing switchover until the **clear bgp neighbor** command is issued.

seconds—Do not reestablish a BGP peer session after an non-stop routing switchover until after the specified period.

Range: 1 through 4,294,967,295 ($2^{32} - 1$)

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Preventing Automatic Reestablishment of BGP Peer Sessions After NSR Switchovers*
- *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- *High Availability Feature Guide*

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import

Syntax

```
import [ policy-names ];
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Apply one or more routing policies to routes being imported into the Junos OS routing table from BGP.

If you specify more than one policy, they are evaluated in the order specified, from left to right, and the first matching filter is applied to the route. If no match is found, BGP places into the routing table only those routes that were learned from BGP routing devices. The policy framework software evaluates the routing policies in a chain sequentially. If an action specified in one of the policies manipulates a route characteristic, the policy framework software carries the new route characteristic forward during the evaluation of the remaining policies. For example, if the action specified in the first policy of a chain sets a route's metric to 500, this route matches the criterion of **metric 500** defined in the next policy.

It is also important to understand that in Junos OS, although an import policy (inbound route filter) might reject a route, not use it for traffic forwarding, and not include it in an advertisement to other peers, the router retains these routes as hidden routes. These hidden routes are not available for policy or routing purposes. However, they do occupy memory space on the router. A service provider filtering routes to control the amount of information being kept in memory and processed by a router might want the router to entirely drop the routes being rejected by the import policy.

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Hidden routes can be viewed by using the **show route receive-protocol bgp *neighbor-address* hidden** command. The hidden routes can then be retained or dropped from the routing table by configuring the **keep all | none** statement at the **[edit protocols bgp]** or **[edit protocols bgp group *group-name*]** hierarchy level.

The rules of BGP route retention are as follows:

- By default, all routes learned from BGP are retained, except those where the AS path is looped. (The AS path includes the local AS.)
- By configuring the **keep all** statement, all routes learned from BGP are retained, even those with the local AS in the AS path.
- By configuring the **keep none** statement, all routes received are discarded. When this statement is configured and the inbound policy changes, Junos OS re-advertises all the routes advertised by the peer.

Options

policy-names—Name of one or more policies.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP Interactions with IGPs*
- Configuring Routing Policies to Control BGP Route Advertisements on page 328
- Understanding Routing Policies on page 315
- export on page 1163

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include-backup-path

Syntax

include-backup-path *include-backup-path*;

Hierarchy Level

[edit protocols bgp family atmvpn auto-discovery-only add-path send],
[edit protocols bgp family bridge auto-discovery-only add-path send],
[edit protocols bgp family bridge-vpn unicast add-path send],
[edit protocols bgp family evpn auto-discovery-only add-path send],
[edit protocols bgp family fabric auto-discovery-only add-path send],
[edit protocols bgp family fabric-vpn unicast add-path send],
[edit protocols bgp family inet auto-discovery-only add-path send],
[edit protocols bgp family inet flow add-path send],
[edit protocols bgp family inet labeled-unicast add-path send],
[edit protocols bgp family inet auto-discovery-only add-path send],
[edit protocols bgp family inet unicast add-path send],
[edit protocols bgp family inet-mdt auto-discovery-only add-path send],
[edit protocols bgp family inet-mvpn auto-discovery-only add-path send],
[edit protocols bgp family inet-vpn any add-path send],
[edit protocols bgp family inet-vpn flow add-path send],
[edit protocols bgp family inet-vpn multicast add-path send],
[edit protocols bgp family inet-vpn unicast add-path send],
[edit protocols bgp family inet6 auto-discovery-only add-path send],
[edit protocols bgp family inet6 flow add-path send],
[edit protocols bgp family inet6 labeled-unicast add-path send],
[edit protocols bgp family inet6 auto-discovery-only add-path send],
[edit protocols bgp family inet6 unicast add-path send],
[edit protocols bgp family inet6-mvpn auto-discovery-only add-path send],
[edit protocols bgp family inet6-vpn any add-path send],
[edit protocols bgp family inet6-vpn flow add-path send],
[edit protocols bgp family inet6-vpn multicast add-path send],
[edit protocols bgp family inet6-vpn unicast add-path send],
[edit protocols bgp family iso auto-discovery-only add-path send],
[edit protocols bgp family iso-vpn unicast add-path send],
[edit protocols bgp family l2vpn auto-discovery-only add-path send],
[edit protocols bgp family l2vpn auto-discovery-only add-path send],
[edit protocols bgp family l2vpn signaling add-path send],
[edit protocols bgp family traffic-engineering auto-discovery-only add-path send],
[edit protocols bgp group *name* family atmvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family bridge auto-discovery-only add-path send],
[edit protocols bgp group *name* family bridge-vpn unicast add-path send],
[edit protocols bgp group *name* family evpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family fabric auto-discovery-only add-path send],
[edit protocols bgp group *name* family fabric-vpn unicast add-path send],
[edit protocols bgp group *name* family inet auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet flow add-path send],
[edit protocols bgp group *name* family inet labeled-unicast add-path send],
[edit protocols bgp group *name* family inet auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet unicast add-path send],
[edit protocols bgp group *name* family inet-mdt auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet-mvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet-vpn any add-path send],
[edit protocols bgp group *name* family inet-vpn flow add-path send],

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[edit protocols bgp group *name* family inet-vpn multicast add-path send],
[edit protocols bgp group *name* family inet-vpn unicast add-path send],
[edit protocols bgp group *name* family inet6 auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet6 flow add-path send],
[edit protocols bgp group *name* family inet6 labeled-unicast add-path send],
[edit protocols bgp group *name* family inet6 auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet6 unicast add-path send],
[edit protocols bgp group *name* family inet6-mvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family inet6-vpn any add-path send],
[edit protocols bgp group *name* family inet6-vpn flow add-path send],
[edit protocols bgp group *name* family inet6-vpn multicast add-path send],
[edit protocols bgp group *name* family inet6-vpn unicast add-path send],
[edit protocols bgp group *name* family iso auto-discovery-only add-path send],
[edit protocols bgp group *name* family iso-vpn unicast add-path send],
[edit protocols bgp group *name* family l2vpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family l2vpn auto-discovery-only add-path send],
[edit protocols bgp group *name* family l2vpn signaling add-path send],
[edit protocols bgp group *name* family traffic-engineering auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family atmvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family bridge auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family bridge-vpn unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family evpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family fabric auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family fabric-vpn unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet flow add-path send],
[edit protocols bgp group *name* neighbor *name* family inet labeled-unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-mdt auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-mvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-vpn any add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-vpn flow add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-vpn multicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet-vpn unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6 auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6 flow add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6 labeled-unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6 auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6 unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6-mvpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6-vpn any add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6-vpn flow add-path send],

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[edit protocols bgp group *name* neighbor *name* family inet6-vpn multicast add-path send],
[edit protocols bgp group *name* neighbor *name* family inet6-vpn unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family iso auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family iso-vpn unicast add-path send],
[edit protocols bgp group *name* neighbor *name* family l2vpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family l2vpn auto-discovery-only add-path send],
[edit protocols bgp group *name* neighbor *name* family l2vpn signaling add-path send],
[edit protocols bgp group *name* neighbor *name* family traffic-engineering auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family atmvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family bridge auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family bridge-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp family evpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family fabric auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family fabric-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet flow add-path send],
[edit routing-instances *name* protocols bgp family inet labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet unicast add-path send],
[edit routing-instances *name* protocols bgp family inet-mdt auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet-mvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet-vpn any add-path send],
[edit routing-instances *name* protocols bgp family inet-vpn flow add-path send],
[edit routing-instances *name* protocols bgp family inet-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp family inet-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet6 flow add-path send],
[edit routing-instances *name* protocols bgp family inet6 labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet6 unicast add-path send],
[edit routing-instances *name* protocols bgp family inet6-mvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family inet6-vpn any add-path send],
[edit routing-instances *name* protocols bgp family inet6-vpn flow add-path send],
[edit routing-instances *name* protocols bgp family inet6-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp family inet6-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp family iso auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family iso-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp family l2vpn signaling add-path send],

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[edit routing-instances *name* protocols bgp family traffic-engineering auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family atmvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family bridge auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family bridge-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family evpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family fabric auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family fabric-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet flow add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-mdt auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-mvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-vpn any add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-vpn flow add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6 flow add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6 labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6 unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6-mvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6-vpn any add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6-vpn flow add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family inet6-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* family iso auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family iso-vpn unicast add-path send],

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[edit routing-instances *name* protocols bgp group *name* family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* family l2vpn signaling add-path send],
[edit routing-instances *name* protocols bgp group *name* family traffic-engineering auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family atmvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family bridge auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family bridge-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family evpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family fabric auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family fabric-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet flow add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-mdt auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-mvpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-vpn any add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-vpn flow add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6 flow add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6 labeled-unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6 auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6 unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6-mvpn auto-discovery-only add-path send],

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[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6-vpn any add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6-vpn flow add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6-vpn multicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family inet6-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family iso auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family iso-vpn unicast add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family l2vpn auto-discovery-only add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family l2vpn signaling add-path send],
[edit routing-instances *name* protocols bgp group *name* neighbor *name* family traffic-engineering auto-discovery-only add-path send]

Release Information Statement introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description Configure the number of backup paths that BGP must advertise. Do not configure this option if you have configured **all-paths** at the **[edit protocols bgp group *name* family *name* add-path send]** hierarchy level.

Options ***include-backup-path***— Specify the number of backup paths to advertise.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- add-path on page 1082
- path-selection-mode on page 1300
- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 468

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include-mp-next-hop

Syntax

```
include-mp-next-hop;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Enable multiprotocol updates to contain next-hop reachability information.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IPv6 BGP Routes over IPv4 Transport on page 661
- Enabling Layer 2 VPN and VPLS Signaling on page 682
- Understanding Multiprotocol BGP on page 655

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inet-mdt (Signaling)

Syntax

```
signaling {
  accepted-prefix-limit {
    maximum number;
    teardown <percentage-threshold> idle-timeout (forever | minutes);
  }
  add-path {
    send {
      path-count number;
      prefix-policy [ policy-names ];
      }
    receive;
  }
  aigp [disable];
  loops number;
  prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | minutes)>;
  }
  rib-group group-name;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family],
[edit logical-systems logical-system-name protocols bgp group group-name family],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor
  address family],
[edit protocols bgp family],
[edit protocols bgp group group-name family],
[edit protocols bgp group group-name neighbor address family],
[edit routing-instances instance-name protocols bgp family],
[edit routing-instances instance-name protocols bgp group group-name family],
[edit routing-instances instance-name protocols bgp group group-name neighbor address
  family]
```

Release Information Statement introduced in Junos OS Release 9.4.

Description For draft-rosen 7, on the provider edge router enable BGP intra-AS auto-discovery using MDT-SAFI.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Source-Specific Multicast for Draft-Rosen Multicast VPNs*

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initiation-message

Syntax initiation-message *text*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description (Optional) Allows you to specify an initiation message for a type 0 TLV to be sent to the BMP station. The message is transmitted when a BMP station establishes a connection to the device. You can provide some information to the BMP station system administrator (for example, a contact phone number). The initiation message includes a type 1 TLV containing the SNMP sysDescr value specified in RFC 1213 *Management Information Base for Network Management of TCP/IP-based internets: MIB-II* and a type 2 TLV containing the SNMP sysName value also from RFC 1213. The string in the initiation-message message is UTF-8.

The normal time for sending an initiation message is when the BMP session is first established. However, an initiation message change also triggers the transmission of an initiation message to current BMP sessions.

Another event that triggers the transmission of an initiation message is when you change in the sysName or sysDescr values in the SNMP configuration. The initiation message is sent to current BMP sessions.

Options ***text***—Specify a character string for a type 0 TLV to send with the initiation message.

Range: 1 through 255 characters

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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ipsec-sa (Protocols BGP)

Syntax

```
ipsec-sa ipsec-sa;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information Statement introduced before Junos OS Release 7.4.

Description Specify a security association to BGP peers. You can apply the security association globally for all BGP peers, to a group of peers, or to an individual peer.

Options ***ipsec-sa***—Security association name.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Using IPsec to Protect BGP Traffic on page 781

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ipv4-prefix

Syntax

```
ipv4-prefix {
  as as;
  router-id router-id;
  prefix prefix;
  system-id system-id;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name policy-options policy-statement policy-name
  term term-name from traffic-engineering],
[edit policy-options policy-statement policy-name term term-name from traffic-engineering]
```

Release Information

Statement introduced in Junos OS Release 17.2R1 on MX Series and PTX Series and QFX5100 and QFX10000 switches.
Statement introduced in Junos OS Release 17.3R1 for QFX5110 and QFX5200 switches.

Description

Configure filter options for a traffic engineering policy to filter traffic based on IPv4 prefix addresses. You can specify additional parameters, such as autonomous system (AS), prefix, router ID, and system ID for filtering IPv4 traffic. If you do not specify the additional parameters, the policy matches all IPv4-prefix network layer reachability information (NLRI) subtypes. You cannot apply these filters along with other NLRI filters.

Options

as *as*—Specify an AS to filter traffic.

router-id *router-id*—Specify an IP prefix to match the router-ID against.

prefix—Specify an IPv4 prefix to match against.

system-id *system-id*—Specify an ISO address for the node.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *policy-statement*
- show route table on page 1687

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interface-group group-id exclude (Routing Options)

Syntax interface-group *group-id* exclude;

Hierarchy Level [edit routing-options flow]

Release Information Statement introduced in Junos OS Release 16.1.

Description Exclude applying flowspec filter to traffic received on specific interfaces.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring MPLS-Signaled LSPs to Use GRE Tunnels*
- Understanding BGP Flow Routes for Traffic Filtering on page 683

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iso-vpn

Syntax

```
iso-vpn {
  unicast {
    prefix-limit number;
    rib-group group-name;
  }
}
```

Hierarchy Level

[edit protocols bgp family],
[edit protocols bgp group *group-name* family],
[edit protocols bgp group *group-name* neighbor *address*family],
[edit routing-instances *routing-instance-name* protocols bgp family],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

Enable BGP to carry ISO VPN NLRI messages between PE routes connecting a VPN.

The remaining statements are explained separately in this chapter.

Default

Disabled.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP for CLNS VPNs on page 720
- Understanding BGP for CLNS VPNs on page 719

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keep

Syntax

```
keep (all | none);
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Control whether or not Junos OS keeps in memory and hides certain routes.

If the **keep none** statement is used, Junos OS does not retain in memory and hide routes that are rejected because of a BGP import policy. Nor does BGP keep in memory and hide routes that are declared unfeasible due to BGP sanity checks. The **keep none** statement causes Junos OS to discard from memory the routes that are rejected due to BGP-specific logic or BGP evaluation. When a route is rejected because of some non-BGP-specific reason, the **keep none** statement has no effect on this route. This rejected route is retained in memory and hidden even though **keep none** is configured. An example of this type of hidden route is a route for which the protocol nexthop is unresolved.

The routing table can retain the route information learned from BGP in one of the following ways:

- Default (omit the **keep** statement)—Keep all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.
- **keep all**—Keep all route information that was learned from BGP.
- **keep none**—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking, such as AS path or next hop. When you configure

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keep none for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

In an AS path healing situation, routes with looped paths theoretically could become usable during a soft reconfiguration when the AS path loop limit is changed. However, there is a significant memory usage difference between the default and **keep all**.

Consider the following scenarios:

- A peer readvertises routes back to the peer from which it learned them.

  This can happen in the following cases:

  - Another vendor's routing device advertises the routes back to the sending peer.
  - The Junos OS peer's default behavior of not readvertising routes back to the sending peer is overridden by configuring **advertise-peer-as**.

- A provider edge (PE) routing device discards any VPN route that does not have any of the expected route targets.

When **keep all** is configured, the behavior of discarding routes received in the above scenarios is overridden.

CAUTION: If you add or remove **keep all** or **keep none** and the peer does not support session restart, the associated BGP sessions are restarted (flapped). To determine if a peer supports refresh, check for **Peer supports Refresh capability** in the output of the **show bgp neighbor** command.

Default By default, BGP retains incoming rejected routes in memory and hides them. If you do not include the **keep** statement, most routes are retained in the routing table. BGP keeps all route information that was learned from BGP, except for routes whose AS path is looped and whose loop includes the local AS.

Options **all**—Retain all routes.

none—Discard routes that were received from a peer and that were rejected by import policy or other sanity checking. When **keep none** is configured for the BGP session and the inbound policy changes, Junos OS forces readvertisement of the full set of routes advertised by the peer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Configuring How Often BGP Exchanges Routes with the Routing Table on page 331
- **out-delay on page 1292**
- *Interprovider VPN Example—MP-EBGP Between ISP Peer Routers*
- Example: Configuring a Routing Policy for Conditional Advertisement Enabling Conditional Installation of Prefixes in a Routing Table on page 355

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key-chain (BGP BFD Authentication)

Syntax

```
key-chain key-chain-name;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp bfd-liveness-detection
  authentication],
[edit logical-systems logical-system-name protocols bgp group group-name
  bfd-liveness-detection authentication],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  bfd-liveness-detection authentication],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp bfd-liveness-detection authentication],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name bfd-liveness-detection authentication],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group group-name bgp bfd-liveness-detection authentication],
[edit protocols bgp group group-name neighbor address bfd-liveness-detection
  authentication],
[edit routing-instances routing-instance-name protocols bgp bfd-liveness-detection
  authentication],
[edit routing-instances routing-instance-name protocols bgp group group-name
  bfd-liveness-detection authentication],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address bfd-liveness-detection authentication]
```

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Associate a security key with the specified BFD session using the name of the security keychain. Each key has a unique start time within the keychain. Keychain authentication allows you to change the password information periodically without bringing down peering sessions. This keychain authentication method is referred to as *hitless* because the keys roll over from one to the next without resetting any peering sessions or interrupting the routing protocol.

Options

key-chain-name—Name of the authentication keychain. The keychain name must match one of the keychains configured with the **key-chain *key-chain-name*** statement at the **[edit security authentication-key-chain]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- *Example: Configuring BFD Authentication for Securing Static Routes*
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- *Example: Configuring BGP Route Authentication*
- Example: Configuring EBGP Multihop Sessions on page 300

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labeled-unicast (Protocols BGP)

Syntax

```
labeled-unicast {
  accepted-prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | minutes)>;
  }
  aggregate-label {
    community community-name;
  }
  entropy-label {
    import policy-name;
    no-next-hop-validation;
  }
  explicit-null {
    connected-only;
  }
  prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | minutes)>;
  }
  protection;
  resolve-vpn;
  rib (inet.3 | inet6.3);
  rib-group group-name;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (inet | inet6)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (inet | inet6)],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (inet | inet6)],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6)],
[edit protocols bgp family (inet | inet6)],
[edit protocols bgp group *group-name* family (inet | inet6)],
[edit protocols bgp group *group-name* neighbor *address* family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols bgp family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (inet | inet6)],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (inet | inet6)]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

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Description Configure the family type to be labeled-unicast.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IPv6 BGP Routes over IPv4 Transport on page 661
- Enabling Layer 2 VPN and VPLS Signaling on page 682
- Understanding Multiprotocol BGP on page 655

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legacy-redirect-ip-action

Syntax

```
legacy-redirect-ip-action {
  send;
  receive;
}
```

Hierarchy Level

```
[edit protocols bgp group group-name family (inet | inet-vpn) flow],
[edit protocols bgp group group-name neighbor address family (inet | inet-vpn) flow],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet-vpn) flow],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address family (inet | inet-vpn) flow]
```

Release Information Statement introduced in Junos OS Release 18.4R1 for the MX Series and PTX Series.

Description Configure the legacy redirect to IP action for flow specification routes to provide traffic filtering options for DDos mitigation in service provider networks. You can choose to accept legacy redirect to IP action as specified in the Internet draft draft-ietf-idr-flowspec-redirect-ip-00.txt, *BGP Flow-Spec Extended Community for Traffic Redirect to IP Next Hop,* . You can also configure BGP to advertise the redirect to IP action as a legacy redirect attribute.

NOTE: If legacy encoding configuration is modified, then use the clear bgp neighbor soft command to reevaluate the routes and for legacy encoding to take effect.

Options

send— Advertise the redirect action as legacy redirect attribute. Specify this option to encode redirect to IP action as flow spec redirect to IP next-hop attribute and advertise the next-hop attribute with the redirect address.

receive— Accept legacy encoded redirect-to-ip action attribute. The legacy encoded redirect to IP action is ignored. Specify this option to accept and process the legacy encoded redirect to IP and to generate the redirect-to-ip community for sending to peers that support only new encoding of redirect to IP action.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- discard-action-for-unresolved-redir-addr on page 1147
- Configuring BGP Flow Specification Action Redirect to IP to Filter DDoS Traffic on page 714

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- Understanding BGP Flow Routes for Traffic Filtering on page 683

local-address (Origin Validation for BGP)

Syntax

```
local-address local-ip-address;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address],
[edit routing-options validation group group-name session server-ip-address]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure a local IP address of the session. If the local cache server has inbound firewall filtering, it might be necessary to specify a local IP address to use for this session.

Options ***local-ip-address***—Local IP address to be used for the outgoing connection to the cache server.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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local-address (Protocols BGP)

Syntax

local-address *address*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the address of the local end of a BGP session. This address is used to accept incoming connections to the peer and to establish connections to the remote peer. When none of the operational interfaces are configured with the specified local address, a session with a BGP peer is placed in the idle state.

You generally configure a local address to explicitly configure the system's IP address from BGP's point of view. This IP address can be either an IPv6 or IPv4 address. Typically, an IP address is assigned to a loopback interface, and that IP address is configured here.

For internal BGP (IBGP) peering sessions, generally the loopback interface (lo0) is used to establish connections between the IBGP peers. The loopback interface is always up as long as the device is operating. If there is a route to the loopback address, the IBGP peering session stays up. If a physical interface address is used instead and that interface goes up and down, the IBGP peering session also goes up and down. Thus, the loopback interface provides fault tolerance in case the physical interface or the link goes down, if the device has link redundancy.

When a device peers with a remote device's loopback interface address, the local device expects BGP update messages to come from (be sourced by) the remote device's loopback interface address. The **local-address** statement enables you to specify the source information in BGP update messages. If you omit the **local-address** statement, the expected source of BGP update messages is based on the device's source address

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selection rules, which normally result in the egress interface address being the expected source of update messages. When this happens, the peering session is not established because a mismatch exists between the expected source address (the egress interface of the peer) and the actual source (the loopback interface of the peer). To ensure that the expected source address matches the actual source address, specify the loopback interface address in the **local-address** statement.

NOTE: Although a BGP session can be established when only one of the paired routing devices has **local-address** configured, we strongly recommend that you configure **local-address** on both paired routing devices for IBGP and multihop EBGP sessions. The **local-address** statement ensures that deterministic fixed addresses are used for the BGP session end-points.

If you include the **default-address-selection** statement in the configuration, the software chooses the system default address as the source for most locally generated IP packets. For protocols in which the local address is unconstrained by the protocol specification, for example IBGP and multihop EBGP, if you do not configure a specific local address when configuring the protocol, the local address is chosen using the same methods as other locally generated IP packets.

Default If you do not configure a local address, BGP uses the routing device's source address selection rules to set the local address.

Options ***address***—IPv6 or IPv4 address of the local end of the connection.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Internal BGP Peering Sessions on Logical Systems on page 63
- Example: Configuring Internal BGP Peer Sessions on page 51
- Understanding Internal BGP Peering Sessions on page 49
- *router-id*

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local-address (Protocols BMP)

Syntax

```
local-address address;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit routing-options bmp],
[edit rouiting-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

(Optional) Specifies the IPv4 or IPv6 address for the BMP connection on the device. We recommend that you configure a local address. For both active and passive modes, configure a loopback local address. This provides a consistent local endpoint, is useful for debugging, and assures greater reliability for the BMP connection since it is not tied to a single router interface.

For passive mode, specifying a local address is required. It also provides some security against a malicious BMP connection. For active mode, we also recommend configuring a local address to help ensure reliability.

If you change the local address, the BMP station connection flaps when you commit the configuration.

Options

address—Specify the IPv4 or IPv6 address for the BMP connection on the local device.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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local-as

Syntax

```
local-as autonomous-system <loops number> <private | alias> <no-prepend-global-as>;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
alias option introduced in Junos OS Release 9.5.
no-prepend-global-as option introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the local autonomous system (AS) number. An AS is a set of routing devices that are under a single technical administration and generally use a single interior gateway protocol (IGP) and metrics to propagate routing information within the set of routing devices.

Internet service providers (ISPs) sometimes acquire networks that belong to a different AS. When this occur, there is no seamless method for moving the BGP peers of the acquired network to the AS of the acquiring ISP. The process of configuring the BGP peers with the new AS number can be time-consuming and cumbersome. In this case, it might not be desirable to modify peer arrangements or configuration. During this kind of transition period, it can be useful to configure BGP-enabled devices in the new AS to use the former AS number in BGP updates. This former AS number is called a *local AS*.

NOTE: If you are using BGP on the routing device, you must configure an AS number before you specify the local as number.

In Junos OS Release 9.1 and later, the AS numeric range in plain-number format is extended to provide BGP support for 4-byte AS numbers, as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*.

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In Junos OS Release 9.3 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: <*16-bit high-order value in decimal*>.<*16-bit low-order value in decimal*>. For example, the 4-byte AS number of 65546 in plain-number format is represented as 1.10 in the AS-dot notation format.

The auto route target feature does not support the local AS number for BGP neighbors associated with the Ethernet Virtual Private Network Instance (EVI).

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Options

alias—(Optional) Configure the local AS as an alias of the global AS number configured for the router at the **[edit routing-options]** hierarchy level. As a result, a BGP peer considers any local AS to which it is assigned as equivalent to the primary AS number configured for the routing device. When you use the **alias** option, only the AS (global or local) used to establish the BGP session is prepended in the AS path sent to the BGP neighbor.

autonomous-system—AS number.

Range: 1 through 4,294,967,295 ($2^{32} - 1$) in plain-number format

Range: 0.0 through 65535.65535 in AS-dot notation format

loops *number*—(Optional) Specify the number of times detection of the AS number in the AS_PATH attribute causes the route to be discarded or hidden. For example, if you configure **loops 1**, the route is hidden if the AS number is detected in the path one or more times. This is the default behavior. If you configure **loops 2**, the route is hidden if the AS number is detected in the path two or more times.

NOTE: If you configure the local AS values for any BGP group, the detection of routing loops is performed using both the AS and the local AS values for all BGP groups.

If the local AS for the EBGP or IBGP peer is the same as the current AS, do not use the **local-as** statement to specify the local AS number.

When you configure the local AS within a VRF, this impacts the AS path loop-detection mechanism. All of the **local-as** statements configured on the device are part of a single AS domain. The AS path loop-detection mechanism is based on looking for a matching AS present in the domain.

Range: 1 through 10

Default: 1

no-prepend-global-as—(Optional) Specify to strip the global AS and to prepend only the local AS in AS paths sent to external peers.

private—(Optional) Configure to use the local AS only during the establishment of the BGP session with a BGP neighbor but to hide it in the AS path sent to external BGP peers. Only the global AS is included in the AS path sent to external peers.

NOTE: The **private** and **alias** options are mutually exclusive. You cannot configure both options with the same **local-as** statement.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *Examples: Configuring BGP Local AS*
- Example: Configuring a Local AS for EBGP Sessions on page 100
- autonomous-system on page 1112
- family on page 1166

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local-interface (IPv6)

Syntax

```
local-interface interface-name;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor ipv6-link-local-address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor ipv6-link-local-address],
[edit protocols bgp group group-name neighbor ipv6-link-local-address],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor ipv6-link-local-address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.

Description

Specify the interface name of the EBGP peer that uses IPv6 link-local addresses. This peer is link-local in scope.

TIP: Configure a local interface only if you need to use the IPv6 link-local addresses as BGP endpoints for an IPv6 BGP session.

NOTE: The local interface option does not work if you have configured the **allow** option at the **[edit protocols bgp group group-name]** hierarchy level. You need to configure a BGP neighbor with an IPv6 link-local address if you have implicitly allowed peer connections from specified networks or hosts.

Options

interface-name—Interface name of the EBGP IPv6 peer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring Internal BGP Peering Sessions on Logical Systems on page 63
- Example: Configuring Internal BGP Peer Sessions on page 51
- Example: Configuring External BGP on Logical Systems with IPv6 Interfaces on page 31
- Understanding Internal BGP Peering Sessions on page 49

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local-port

Syntax local-port *port*;

Hierarchy Level [edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Specifies the listening port for the BMP station connection.

If you configure the connection-mode statement as **active**, do not configure the **local-port** statement. If you configure the connection-mode statement as **passive**, you must configure **local-port** statement.

If you change the local port, the BMP station connection flaps when you commit the configuration.

Options *port*—Specify the local port for the BMP station connection.

Range: 1 through 65,535

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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local-preference

Syntax

local-preference *local-preference*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Modify the value of the **LOCAL_PREF** path attribute, which is a metric used by IBGP sessions to indicate the degree of preference for an external route. The route with the highest local preference value is preferred.

The **LOCAL_PREF** path attribute always is advertised to internal BGP peers and to neighboring confederations. It is never advertised to external BGP peers.

Default

If you omit this statement, the **LOCAL_PREF** path attribute, if present, is not modified.

Options

local-preference—Preference to assign to routes that are advertised to the group or peer.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

Default: If the **LOCAL_PREF** path attribute is present, do not modify its value. If a BGP route is received without a **LOCAL_PREF** attribute, the route is handled locally (it is stored in the routing table and advertised by BGP) as if it were received with a **LOCAL_PREF** value of 100. By default, non-BGP routes that are advertised by BGP are advertised with a **LOCAL_PREF** value of 100.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Example: Configuring the Local Preference Value for BGP Routes on page 220
- Understanding Internal BGP Peering Sessions on page 49
- preference on page 1308

local-ipv4-address

Syntax

```
local-ipv4-address local ipv4 address;
```

Hierarchy Level

```
[edit logical systems logical-system-name protocols bgp family address-family],
[edit logical systems logical-system-name protocols bgp group group-name family
  address-family],
[edit logical systems logical-system-name protocols bgp group group-name neighbor address
  family address-family],
[edit protocols bgp family address-family],
[edit protocols bgp group group-name family address-family],
[edit protocols bgp group group-name neighbor address family address-family]
```

Release Information

Statement introduced in Junos OS Release 16.1 for the MX Series, PTX Series, and T Series.

Description

Specify the local IPv4 address of a device that is also configured with an IPv6 address in a dual-stack environment. This enables BGP to advertise IPv4 unicast reachability with IPv4 next hop to remote IPv4 hosts over an IPv6 BGP session.

BGP advertises IPv4 unicast reachability with IPv4 next hop over an IPv6 BGP session only where IPv4 is configured at both endpoints. You cannot configure this feature for the inet6 unicast, inet6 multicast, or inet6 labeled-unicast address families because BGP already has the capability to advertise these address families over an IPv6 BGP session.

The configured **local-ipv4-address** is used only when BGP advertises routes with self-next hop. When IBGP advertises routes learned from EBGP peers, or the route reflector advertises BGP routes to its clients, BGP does not change the route next hop and ignores the configured **local-ipv4-address** and uses the original IPv4 next hop.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Advertising IPv4 Routes over BGP IPv6 Sessions Overview on page 668
- Example: Advertising IPv4 Routes over IPv6 BGP Sessions on page 669

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logical-systems

Syntax

```
logical-systems {
  logical-system-name {
    ...logical-system-configuration...
  }
}
```

Hierarchy Level

[edit]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement name changed from **logical-routers** in Junos OS Release 9.3.

Description

Configure a logical system.

Options

logical-system-name—Name of the logical system.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Logical Systems Feature Guide for Routers and Switches*

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log-updown

Syntax

```
log-updown;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify to generate a log message whenever a BGP peer makes a state transition. Messages are logged using the system logging mechanism located at the **[edit system syslog]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Preventing BGP Session Resets*
- traceoptions on page 1374

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long-lived (Graceful Restart for BGP Restarter)

Syntax

```
long-lived {
  restarter {
    disable;
    stale-time interval;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | unicast | multicast) graceful-restart],
[edit protocols bgp family inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit protocols bgp group *group-name* family inet (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit protocols bgp group *group-name* neighbor *address* family inet (labeled-unicast | flow) graceful-restart long-lived restarter]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the long-lived graceful restart mechanism on the restarter router to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality. Long-lived graceful restart restarter mode is enabled by default, unless ordinary graceful restart on the restarter router is disabled.

NOTE: If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

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Configure graceful restart globally at the **[edit routing-options]** or **[edit routing-instances *instance-name* routing-options]** hierarchy level to enable the feature. You cannot enable graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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long-lived (Graceful Restart for BGP Helper)

Syntax

```
long-lived {
  receiver {
    enable:
    disable;
  }
  advertise-to-non-llgr-neighbor {
    omit-no-export;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* graceful-restart],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart],
[edit protocols bgp group *group-name* graceful-restart],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Configure the long-lived graceful restart mechanism to preserve BGP routing details for a longer period from a failed BGP peer than the duration for which such routing information is maintained using the BGP graceful restart functionality. Long-lived graceful restart receiver or helper mode is enabled by default, unless ordinary graceful restart receiver or helper mode is disabled.

The **long-lived receiver enable** overrides a disable option inherited from a higher level in the configuration. It does not enable long-lived graceful restart restarter mode for all families—restarter mode must be configured explicitly for each family. When the LLGR receiver or helper mode is enabled or disabled, the session is reset. This behavior enables the new capability value to be sent to the neighbor.

NOTE: If you configure graceful restart after a BGP session has been established, the BGP session restarts and the peers negotiate graceful restart capabilities.

Configure graceful restart globally at the **[edit routing-options]** or **[edit routing-instances *instance-name* routing-options]** hierarchy level to enable the feature. You cannot enable

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graceful restart for specific protocols unless graceful restart is also enabled globally. You can, optionally, modify the global settings at the individual protocol level.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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loops (Autonomous System)

Syntax

```
loops number;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp local-as],
[edit logical-systems logical-system-name protocols bgp group group-name local-as],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  local-as],
[edit logical-systems logical-system-name routing-options autonomous-system as-number],
[edit protocols bgp local-as],
[edit protocols bgp group group-name local-as],
[edit protocols bgp group group-name neighbor address local-as],
[edit routing-options autonomous-system as-number]
```

Release Information Statement introduced in Junos OS Release 9.6.

Description Globally, for the local-AS BGP attribute, allow the local device's AS number to be in the received AS paths, and specify the number of times detection of the local device's AS number in the AS_PATH attribute causes the route to hidden. For example, if you configure **loops 1**, the route is hidden if the local device's AS number is detected in the path one or more times. This prevents routing loops and is the default behavior. If you configure **loops 2**, the route is hidden if the local device's AS number is detected in the path two or more times.

NOTE: The behavior of this statement is slightly different from the loops (BGP Address Family) statement.

Options *number*—Number of times detection of the AS number in the AS_PATH attribute causes the route to be hidden.

Range: 1 through 10

Default: 1

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP Route Advertisements on page 171
- autonomous-system on page 1112
- family on page 1166
- local-as on page 1231
- loops on page 1246

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loops (BGP Address Family)

Syntax

```
loops number;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family address-family],
[edit logical-systems logical-system-name protocols bgp group group-name family
  address-family],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family address-family],
[edit protocols bgp family address-family],
[edit protocols bgp group group-name family address-family],
[edit protocols bgp group group-name neighbor address family address-family]
```

Release Information Statement introduced in Junos OS Release 9.6.

Description For the specified BGP address family, allow the local device's AS number in the received AS paths and specify the number of times the detection of the local device's AS in the AS_PATH attribute is allowed. If the count exceeds the specified loop count, the system discards this route. For example, if you configure **loops 1**, the route is discarded if the neighbor's local AS is detected in the path more than once. This prevents routing loops and is the default behavior. If you configure **loops 2**, the route is discarded if the neighbor's local AS is detected more than 2 times.

For debugging, you can configure the **keep all** option If you want to hide this route.

Some examples of BGP address families are as follows:

- **inet unicast**
- **inet-vpn multicast**
- **inet6 any**
- **l2vpn auto-discovery-only**
- ...

This list is truncated for brevity. For a complete list of protocol families for which you can specify the **loops** statement, enter the **help apropos loops** configuration command at the **[edit protcols bgp]** hierarchy level on your device.

[edit protocols bgp]
`user@host#` **help apropos loops**

```
set family inet unicast loops
    Allow local AS in received AS paths
set family inet unicast loops <loops>
    AS-Path loop count
set family inet multicast loops
    Allow local AS in received AS paths
set family inet multicast loops <loops>
    AS-Path loop count
```


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```
set family inet flow loops
    Allow local AS in received AS paths
set family inet flow loops <loops>
    AS-Path loop count
set family inet any loops
    Allow local AS in received AS paths
set family inet any loops <loops>
    AS-Path loop count
set family inet labeled-unicast loops
    Allow local AS in received AS paths
...
```

NOTE: The behavior of this statement is slightly different from the loops (Autonomous System) statement.

Options

number—Maximum number of times that the local device's AS number is allowed in the AS_PATH attribute to accept the route.

Range: 1 through 10

Default: None. The system does not take any action unless the **loops (BGP Address Family)** statement is configured.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP Route Advertisements on page 171
- autonomous-system on page 1112
- family on page 1166
- local-as on page 1231
- loops (Autonomous System) on page 1245

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loose-check (BGP BFD Authentication)

Syntax

```
loose-check ;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit protocols bgp bgp bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection authentication],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection authentication]

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify loose authentication checking on the BFD session. Use loose authentication for transitional periods only when authentication might not be configured at both ends of the BFD session.

By default, strict authentication is enabled and authentication is checked at both ends of each BFD session. Optionally, to smooth migration from nonauthenticated sessions to authenticated sessions, you can configure *loose checking*. When loose checking is configured, packets are accepted without authentication being checked at each end of the session.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- *Example: Configuring BFD Authentication for Securing Static Routes*

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- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- *Example: Configuring BGP Route Authentication*
- Example: Configuring EBGP Multihop Sessions on page 300

malformed-route-limit (Protocols BGP)

Syntax

```
malformed-route-limit number;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name
  bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  bgp-error-tolerance],
[edit protocols bgp bgp-error-tolerance],
[edit protocols bgp group group-name bgp-error-tolerance],
[edit protocols bgp group group-name neighbor address bgp-error-tolerance]
```

Release Information Statement introduced in Junos OS Release 13.2.

Description Configure a limit on the number of malformed hidden routes stored in memory.

NOTE: When the value of **malformed-route-limit** is reduced, only new malformed BGP update messages are affected and the existing malformed routes are retained.

Options ***number***—Configure a limit on the number of malformed hidden routes stored in memory.

Default: 1000

Range: 0 through 4294967295

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Error Handling for BGP Update Messages on page 879
- Example: Configuring Error Handling for BGP Update Messages on page 881

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malformed-update-log-interval (Protocols BGP)

Syntax

```
malformed-update-log-interval seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name
  bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  bgp-error-tolerance],
[edit protocols bgp bgp-error-tolerance],
[edit protocols bgp group group-name bgp-error-tolerance],
[edit protocols bgp group group-name neighbor address bgp-error-tolerance]
```

Release Information Statement introduced in Junos OS Release 13.2.

Description Configure the duration for which the logging of malformed BGP update messages are suppressed.

On configuring the malformed update log interval:

1. The first malformed BGP update message is logged.
2. All subsequent malformed update messages are suppressed until the log interval expires.
3. On log interval expiry, the total number of malformed attributes received during the interval are logged.

This process repeats when the next malformed update message is received.

Options ***seconds***—Configure the duration for which the logging of malformed BGP update messages are suppressed.

Default: 300 seconds

Range: 10 through 65535 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Error Handling for BGP Update Messages on page 879
- Example: Configuring Error Handling for BGP Update Messages on page 881

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maximum-length (Origin Validation for BGP)

Syntax

```
maximum-length prefix-length {
  origin-autonomous-system as-number {
    validation-state (invalid | valid);
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation static record destination],
[edit logical-systems logical-system-name routing-options validation static record
  destination],
[edit routing-instances instance-name routing-options validation static record destination],
[edit routing-options validation static record destination]
```

Release Information

Statement introduced in Junos OS Release 12.2.

Description

Configure the maximum prefix-length for a route validation (RV) record. This is a required statement.

Options

prefix-length—Maximum prefix-length range for a given RV entry.

Range: 1 through 128

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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max-sessions (Origin Validation for BGP)

Syntax

```
max-sessions number;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name],
[edit logical-systems logical-system-name routing-options validation group group-name],
[edit routing-instances instance-name routing-options validation group group-name],
[edit routing-options validation group group-name]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure the number of concurrent sessions for each group.

If the number of sessions in a group exceeds the **max-sessions** value, the connections are established in order by preference value. A numerically higher preference results in a higher probability for session establishment. The order of session establishment is random among sessions with equal preferences.

Options *number*—Maximum number of sessions per group.

Range: 1 through 63

Default: 2

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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metric-out

Syntax

metric-out (*metric* | minimum-igp *offset* | igp (delay-med-update | *offset*);

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Option **delay-med-update** introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the metric for all routes sent using the multiple exit discriminator (MED, or **MULTI_EXIT_DISC**) path attribute in update messages. This path attribute is used to discriminate among multiple exit points to a neighboring AS. If all other factors are equal, the exit point with the lowest metric is preferred.

You can specify a constant metric value by including the ***metric*** option. For configurations in which a BGP peer sends third-party next hops that require the local system to perform next-hop resolution—IBGP configurations, configurations within confederation peers, or EBGP configurations that include the **multihop** command—you can specify a variable metric by including the **minimum-igp** or **igp** option.

You can increase or decrease the variable metric calculated from the IGP metric (either from the **igp** or **minimum-igp** statement) by specifying a value for ***offset***. The metric is increased by specifying a positive value for ***offset***, and decreased by specifying a negative value for ***offset***.

In Junos OS Release 9.0 and later, you can specify that a BGP group or peer not advertise updates for the MED path attributes used to calculate IGP costs for BGP next hops unless the MED is lower. You can also configure an interval to delay when MED updates are sent by including the **med-igp-update-interval** ***minutes*** statement at the **[edit routing-options]** hierarchy level.

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Options

delay-med-update—Specify that a BGP group or peer configured with the **metric-out igp** statement not advertise MED updates unless the current MED value is lower than the previously advertised MED value, or another attribute associated with the route has changed, or the BGP peer is responding to a refresh route request.

NOTE: You cannot configure the **delay-med–update** statement at the global BGP level.

igp—Set the metric to the most recent metric value calculated in the IGP to get to the BGP next hop. Routes learned from an EBGP peer usually have a next hop on a directly connected interface and thus the IGP value is equal to zero. This is the value advertised.

metric—Primary metric on all routes sent to peers.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

Default: No metric is sent.

minimum-igp—Set the metric to the minimum metric value calculated in the IGP to get to the BGP next hop. If a newly calculated metric is greater than the minimum metric value, the metric value remains unchanged. If a newly calculated metric is lower, the metric value is lowered to that value. When you change a neighbor's export policy from any configuration to a configuration that sets the minimum IGP offset on an exported route, the advertised MED is not updated if the value would increase as a result, even if the previous configuration does not use a minimum IGP-based MED value. This behavior helps to prevent unnecessary route flapping when an IGP cost changes, by not forcing a route update if the metric value increases past the previous lowest known value.

offset—Increases or decreases the metric by this value.

Range: -2^{31} through $2^{31} - 1$

Default: None

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Associating the MED Path Attribute with the IGP Metric and Delaying MED Updates on page 286
- *Examples: Configuring BGP MED*
- Example: Configuring the MED Attribute That Determines the Exit Point in an AS on page 258
- Understanding the MED Attribute That Determines the Exit Point in an AS on page 255
- *med-igp-update-interval*

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minimum-interval (BFD Liveness Detection)

Syntax

minimum-interval *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the minimum interval after which the local routing device transmits hello packets and then expects to receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can specify the minimum transmit and receive intervals separately using the minimum-interval (specified under the **transmit-interval** statement) and minimum-receive-interval statements.

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Options

milliseconds—Specify the minimum interval value for BFD liveliness detection.

Range: 1 through 255,000

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116
- minimum-receive-interval on page 1259
- transmit-interval on page 1381

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minimum-interval (transmit-interval)

Syntax

minimum-interval *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval],
[edit protocols bgp bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

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Description Configure the minimum interval at which the local routing device transmits hello packets to a neighbor with which it has established a BFD session. Optionally, instead of using this statement at this hierarchy level, you can configure the minimum transmit interval using the minimum-interval statement at the **bfd-liveness-detection** hierarchy level.

Options ***milliseconds***—Minimum transmit interval value.

Range: 1 through 255,000

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116
- minimum-interval on page 1255
- threshold on page 1370

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minimum-receive-interval (BFD Liveness Detection)

Syntax

minimum-receive-interval *milliseconds*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the minimum interval after which the local routing device must receive a reply from a neighbor with which it has established a BFD session. Optionally, instead of using this statement, you can configure the minimum receive interval using the **minimum-interval** statement.

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Options

milliseconds—Specify the minimum receive interval value.

Range: 1 through 255,000

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116
- minimum-interval on page 1255
- transmit-interval on page 1381

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monitor (Protocols BMP)

Syntax

```
monitor (enable | disable);
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp bmp],
[edit logical-systems logical-system-name protocols bgp group group-name bmp],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  bmp],
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit protocols bgp bmp],
[edit protocols bgp group group-name bmp],
[edit protocols bgp group group-name neighbor address bmp],
[edit routing-options bmp],
[edit routing-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

BMP monitoring is enabled by default. You can explicitly enable BMP monitoring or disable it. You can also selectively enable or disable BMP monitoring at various hierarchy levels (for example, **[edit protocols bgp group *group-name*]** or **[edit protocols bgp group *group-name* neighbor *address*]**). If you disable BMP monitoring, withdrawal messages are sent for any previously advertised routes. These are followed by a down message. If you enable BMP monitoring, an up message is sent first and then the route advertisements follow.

Options

enable—Enable BMP monitoring.

Default: BMP monitoring is enabled by default.

disable—Disable BMP monitoring.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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mtu-discovery

Syntax

```
mtu-discovery;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure TCP path maximum transmission unit (MTU) discovery.

TCP path MTU discovery enables BGP to automatically discover the best TCP path MTU for each BGP session. In Junos OS, TCP path MTU discovery is disabled by default for all BGP neighbor sessions.

When MTU discovery is disabled, TCP sessions that are not directly connected transmit packets of 512-byte maximum segment size (MSS). These small packets minimize the chances of packet fragmentation at a device along the path to the destination. However, because most links use an MTU of at least 1500 bytes, 512-byte packets do not result in the most efficient use of link bandwidth. For directly connected EBGP sessions, MTU mismatches prevent the BGP session from being established. As a workaround, enable path MTU discovery within the EBGP group.

Path MTU discovery dynamically determines the MTU size on the network path between the source and the destination, with the goal of avoiding IP fragmentation. Path MTU discovery works by setting the Don't Fragment (DF) bit in the IP headers of outgoing packets. When a device along the path has an MTU that is smaller than the packet, the device drops the packet. The device also sends back an ICMP Fragmentation Needed (Type 3, Code 4) message that contains the device's MTU, thus allowing the source to reduce its path MTU appropriately. The process repeats until the MTU is small enough to traverse the entire path without fragmentation.

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Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Limiting TCP Segment Size for BGP on page 797
- *Configuring Junos OS for IPv6 Path MTU Discovery*
- *Configuring the Junos OS for Path MTU Discovery on Outgoing GRE Tunnel Connections*

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multihop

Syntax

```
multihop {
  no-nexthop-change;
  ttl ttl-value;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure an EBGP multihop session.

For Layer 3 VPNs, you configure the EBGP multihop session between the PE and CE routing devices. This allows you to configure one or more routing devices between the PE and CE routing devices.

An external confederation peer is a special case that allows unconnected third-party next hops. You do not need to configure multihop sessions explicitly in this particular case because multihop behavior is implied.

If you have external BGP confederation peer-to-loopback addresses, you still need the multihop configuration.

NOTE: You cannot configure the **accept-remote-nexthop** statement at the same time.

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Default If you omit this statement, all EBGP peers are assumed to be directly connected (that is, you are establishing a nonmultihop, or "regular," BGP session), and the default time-to-live (TTL) value is 1.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring EBGP Multihop Sessions on page 300
- *Configuring EBGP Multihop Sessions Between PE and CE Routers in Layer 3 VPNs*
- accept-remote-nexthop on page 1081
- no-nexthop-change on page 1283
- ttl on page 1383

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multipath (Protocols BGP)

Syntax

```
rib-sharding {
  disable
  multiple-as;
  vpn-unequal-cost equal-external-internal;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp]
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family *family-name* add-path send]
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp]
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* family *family-name* add-path send]
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Allow load sharing among multiple EBGP paths and multiple IBGP paths. A path is considered a BGP equal-cost path (and will be used for forwarding) if a tie-break is performed. The tie-break is performed after the BGP route path selection step that chooses the next-hop path that is resolved through the IGP route with the lowest metric. All paths with the same neighboring AS, learned by a multipath-enabled BGP neighbor, are considered.

NOTE: BGP multiple path options must be consistent for all routes forming a BGP multiple path. If BGP multiple path options differ, the multiple path feature chooses a preference, and the multiple path feature might not function as intended.

NOTE: Starting in Junos OS Release 18.1, BGP mulipath is supported globally at **[edit protocols bgp]** hierarchy level. You can selectively disable multipath on some BGP groups and neighbors. Include **disable** at **[edit protocols bgp**

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group *group-name* multipath] hierarchy level to disable multipath option for a group or a specific BGP neighbor.

Options

multiple-as—Disable the default check requiring that paths accepted by BGP multipath must have the same neighboring AS.

vpn-unequal-cost equal-external-internal—Enable load-balancing in a Layer 3 VPN with unequal cost paths.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding BGP Path Selection on page 14
- Example: Load Balancing BGP Traffic on page 426

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multipath (Add-Path)

Syntax

```
multipath;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family family
  add-path send],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family add-path send],
[edit protocols bgp group group-name family family add-path send],
[edit protocols bgp group group-name neighbor address family family add-path send]
```

Release Information

Statement introduced in Junos OS Release 16.1R2.

Description

You can restrict BGP **add-path** to advertise contributor multiple paths only. Advertising all available multiple paths might result in a large overhead of processing on device memory. Selective advertising of multiple paths facilitates Internet service providers and data centers that use route reflector to build in-path diversity in IBGP. You can limit and configure up to six prefixes that the BGP **multipath** algorithm selects.

For example, if a routing device has four paths to a destination in its routing table and is configured to advertise up to two paths, only contributor paths for load balancing are chosen. The best contributor path is the active path and BGP advertises this path by default. The second best contributor path is selected and this process is repeated until the specified number of paths is reached, in this case two additional paths to the same destination are selected for load balancing.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- multipath (Protocols BGP) on page 1266
- Example: Configuring Selective Advertising of BGP Multiple Paths for Load Balancing on page 498

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multipath-build-priority

Syntax

```
multipath-build-priority {
  ( low | medium );
}
```

Hierarchy Level

```
[edit fabric protocols bgp],
[edit logical-systems name protocols bgp],
[edit logical-systems name routing-instances name protocols bgp],
[edit protocols bgp],
[edit routing-instances name protocols bgp]
```

Release Information

Statement introduced in Junos OS Release 18.1R1.

Description

Configure a priority for multipath resolution during load balancing. When multipath is enabled on a route reflector, BGP calculates the multipaths each time a new route is added or whenever an existing route is changed, which uses up system resources and slows down the BGP RIB resolution. Configure BGP multipath job priority to delay the multipath calculation and to improve the RIB, also known as the routing table learning rate.

Required Privilege Level

routing

Related Documentation

- defer-initial-multipath-build on page 1134
- Understanding BGP Multipath on page 424

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multiplier (BFD Liveness Detection)

Syntax

multiplier *number*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.5.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the number of hello packets not received by a neighbor that causes the originating interface to be declared down.

Options

number—Number of hello packets.

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Range: 1 through 255

Default: 3

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116

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neighbor (Protocols BGP)

Syntax

```
neighbor address {
  accept-remote-nexthop;
  advertise-bgp-static
  advertise-external <conditional>;
  advertise-inactive;
  (advertise-peer-as | no-advertise-peer-as);
  as-override;
  authentication-algorithm algorithm;
  authentication-key key;
  authentication-key-chain key-chain;
  cluster cluster-identifier;
  damping;
  description text-description;
  enforce-first-as;
  export [ policy-names ];
  family {
    (inet | inet6 | inet-mvpn | inet6-mpvn | inet-vpn | inet6-vpn | iso-vpn | l2-vpn) {
      (any | flow | multicast | unicast | signaling) {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        damping;
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        rib-group group-name;
        topology name {
          community {
            target identifier;
          }
        }
      }
      flow {
        no-validate policy-name;
      }
      labeled-unicast {
        accepted-prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
        }
        aggregate-label {
          community community-name:
        }
        explicit-null {
          connected-only;
        }
        prefix-limit {
          maximum number;
          teardown <percentage> <idle-timeout (forever | minutes)>;
```


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```
        }
        resolve-vpn;
        rib inet.3;
        rib-group group-name;
        topology name {
          community {
            target identifier;
          }
        }
      }
    }
    forwarding-context
    route-target {
      advertise-default;
      external-paths number;
      accepted-prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
    }
    signaling {
      prefix-limit {
        maximum number;
        teardown <percentage> <idle-timeout (forever | minutes)>;
      }
    }
}
forwarding-context rti-name;
graceful-restart {
    disable;
    restart-time seconds;
    stale-routes-time seconds;
}
hold-time seconds;
import [ policy-names ];
ipsec-sa ipsec-sa;
keep (all | none);
local-address address;
local-as autonomous-system <private>;
local-interface interface-name;
local-preference preference;
log-updown;
metric-out (metric | minimum-igp <offset> | igp <offset>);
mtu-discovery;
multihop <ttl-value>;
multipath {
    multiple-as;
}
no-aggregator-id;
no-client-reflect;
out-delay seconds;
```

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```
  passive;
  peer-as autonomous-system;
  preference preference;
  rfc6514-compliant-safi129;
  tcp-aggressive-transmission;
  tcp-mss segment-size;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier> <disable>;
  }
  vpn-apply-export;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Explicitly configure a neighbor (peer). To configure multiple BGP peers, include multiple **neighbor** statements.

By default, the peer's options are identical to those of the group. You can override these options by including peer-specific option statements within the **neighbor** statement.

The **neighbor** statement is one of the statements you can include in the configuration to define a minimal BGP configuration on the routing device. (You can include an **allow all** statement in place of a **neighbor** statement.)

NOTE: On MX Series routers configured with enhanced subscriber management, you can use this statement to statically provision a subscriber's client IP address as the BGP neighbor IP address. This is supported for only LNS subscribers. With enhanced subscriber management, you must also configure the **routing-services** statement at the **[edit dynamic-profiles** *profile-name* **interfaces** *interface-name* **unit** *logical-unit-number***]** hierarchy level.

Options

address—IPv6 or IPv4 address of a single peer.

The remaining statements are explained separately. See CLI Explorer.

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *BGP Feature Guide*

nonstop-routing-options

Syntax

```
nonstop-routing-options {
  precision-timers-max-period precision-timers-max-period;
}
```

Hierarchy Level

[edit routing-options]

Release Information

Statement introduced in Junos OS Release 15.2 for the M Series, MX Series, and PTX Series.

Description

For routing platforms with two Routing Engines, a master Routing Engine is configured to switch over gracefully to a backup Routing Engine. This allows the routing protocol information to be preserved even after failover. Support of precision-timers in the kernel is a feature where the kernel takes over autogeneration of BGP keepalives right after the switchover from backup to master event occurs. The kernel in the Routing Engine continues this autogeneration until RPD is able to take over the session or until a maximum period has elapsed since the switchover event occurred.

NOTE: This maximum period configuration applies only when at least one client protocol such as BGP registers for the automatic keepalive generation service provided by the kernel, and the kernel timer generates control plane session keepalives on behalf of that protocol after a switchover event.

Options

precision-timers-max-period *precision-timers-max-period* — The maximum period for which the kernel auto generates keepalives on behalf of BGP after a switchover event from backup to master.

NOTE: You can verify the **precision-timers-max-period** using **show nonstop-routing** command.

Default: 600 seconds

Range: 60 seconds to 1800 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Maximum Period Configuration for Automatic Generation of BGP Keepalives by Kernel Timers After Switchover on page 627

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no-adaptation (BFD Liveness Detection)

Syntax

```
no-adaptation;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 9.0
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure BFD sessions not to adapt to changing network conditions. We recommend that you *do not* disable BFD adaptation unless it is preferable to have BFD adaptation disabled in your network.

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The BFD failure detection timers are adaptive and can be adjusted to be faster or slower. The lower the BFD failure detection timer value, the faster the failure detection and vice versa. For example, the timers can adapt to a higher value if the adjacency fails (that is, the timer detects failures more slowly). Or a neighbor can negotiate a higher value for a timer than the configured value. The timers adapt to a higher value when a BFD session flap occurs more than three times in a span of 15 seconds. A back-off algorithm increases the receive (Rx) interval by two if the local BFD instance is the reason for the session flap. The transmission (Tx) interval is increased by two if the remote BFD instance is the reason for the session flap. However, include the **no-adaptation** statement in the configuration if you do not want BFD sessions to adapt to changing network conditions.

You can use the **clear bfd adaptation** command to return BFD interval timers to their configured values. The **clear bfd adaptation** command does not affect traffic flow on the routing device.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116

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no advertise-peer-as

Syntax

```
no-advertise-peer-as;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Enable the default behavior of suppressing AS routes.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP Route Advertisement*
- Disabling Suppression of Route Advertisements on page 332
- advertise-peer-as on page 1090

no-aggregator-id

Syntax

```
no-aggregator-id;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Prevent different routing devices within an AS from creating aggregate routes that contain different AS paths.

Junos OS performs route aggregation, which is the process of combining the characteristics of different routes so that only a single route is advertised. Aggregation reduces the amount of information that BGP must store and exchange with other BGP systems. When aggregation occurs, the local routing device adds the local AS number and the router ID to the aggregator path attiribute. The **no-aggregator-id** statement causes Junos OS to place a 0 in the router ID field and thus eliminate the possibility of having multiple aggregate advertisements in the network, each with different path information.

Default

If you omit this statement, the router ID is included in the BGP aggregator path attribute.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Update Messages on page 12

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no-client-reflect

Syntax

```
no-client-reflect;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Disable intracluster route redistribution by the system acting as the route reflector. Include this statement when the client cluster is fully meshed to prevent the sending of redundant route advertisements. Route reflection provides a way to decrease BGP control traffic and minimizing the number of update messages sent within the AS.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring BGP Route Reflectors*
- cluster on page 1127

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no-install

Syntax

```
no-install;
```

Hierarchy Level

```
[edit protocols bgp family (inet | inet6 | inet-vpn | inet6-vpn | iso-vpn) (any | flow |
  labeled-unicast | multicast | unicast)]
```

Release Information Statement introduced in Junos OS Release 15.1.

Description Prohibit installing received routes in the forwarding table. This statement can be set per family.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding BGP Route Reflectors on page 729
- Understanding BGP Flow Routes for Traffic Filtering on page 683

no-malformed-route-limit (Protocols BGP)

Syntax

```
no-malformed-route-limit;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name
  bgp-error-tolerance],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  bgp-error-tolerance],
[edit protocols bgp bgp-error-tolerance],
[edit protocols bgp group group-name bgp-error-tolerance],
[edit protocols bgp group group-name neighbor address bgp-error-tolerance]
```

Release Information Statement introduced in Junos OS Release 13.2.

Description Disable the limit on the number of malformed hidden routes stored in memory.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Error Handling for BGP Update Messages on page 879
- Example: Configuring Error Handling for BGP Update Messages on page 881

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no-nexthop-change (BGP multihop)

Syntax

no-nexthop-change; *no-nexthop-self*

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp multihop],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* multihop],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* multihop],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp multihop],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* multihop],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* multihop],
[edit protocols bgp],
[edit protocols bgp group *group-name* multihop],
[edit protocols bgp group *group-name* neighbor *address* multihop],
[edit routing-instances *routing-instance-name* protocols bgp multihop],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* multihop],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* multihop]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify that the BGP next-hop value not be changed. For route advertisements, specify the **no-nexthop-self** option.

An external confederation peer is a special case that allows unconnected third-party next hops. You do not need to configure multihop sessions explicitly in this particular case; multihop behavior is implied.

If you have external BGP confederation peer-to-loopback addresses, you still need the multihop configuration.

NOTE: You cannot configure the **accept-remote-nexthop** statement at the same time.

Default

If you omit this statement, all EBGP peers are assumed to be directly connected (that is, you are establishing a nonmultihop, or “regular,” BGP session), and the default time-to-live (TTL) value is 1.

Options

no-nexthop-self— Specify this option for route advertisements.

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Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring EBGP Multihop Sessions on page 300
- accept-remote-nexthop on page 1081
- ttl on page 1383

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no-validate

Syntax

```
no-validate policy-name;
```

Hierarchy Level

```
[edit protocols bgp group group-name family (inet | inet flow)],
[edit protocols bgp group group-name neighbor address family (inet | inet flow)],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet flow)],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family (inet | inet flow)]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

When BGP is carrying flow-specification network layer reachability information (NLRI) messages, the **no-validate** statement omits the flow route validation procedure after packets are accepted by a policy.

The receiving BGP-enabled device accepts a flow route if it passes the following criteria:

- The originator of a flow route matches the originator of the best match unicast route for the destination address that is embedded in the route.
- There are no more specific unicast routes, when compared to the destination address of the flow route, for which the active route has been received from a different next-hop autonomous system.

The first criterion ensures that the filter is being advertised by the next-hop used by unicast forwarding for the destination address embedded in the flow route. For example, if a flow route is given as 10.1.1.1, proto=6, port=80, the receiving BGP-enabled device selects the more specific unicast route in the unicast routing table that matches the destination prefix 10.1.1.1/32. On a unicast routing table containing 10.1/16 and 10.1.1/24, the latter is chosen as the unicast route to compare against. Only the active unicast route entry is considered. This follows the concept that a flow route is valid if advertised by the originator of the best unicast route.

The second criterion addresses situations in which a given address block is allocated to different entities. Flows that resolve to a best-match unicast route that is an aggregate route are only accepted if they do not cover more specific routes that are being routed to different next-hop autonomous systems.

You can bypass the validation process and use your own specific import policy. To disable the validation procedure and use an import policy instead, include the **no-validate** statement in the configuration.

Flow routes configured for VPNs with family **inet-vpn** are not automatically validated, so the **no-validate** statement is not supported at the **[edit protocols bgp group *group-name***

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family inet-vpn] hierarchy level. No validation is needed if the flow routes are configured locally between devices in a single AS.

Options

policy-name—Import policy to match NLRI messages.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP to Carry Flow-Specification Routes on page 688
- Understanding BGP Flow Routes for Traffic Filtering on page 683

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omit-no-export (Graceful Restart for BGP Helper)

Syntax

```
omit-no-export;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp graceful-restart long-lived
  advertise-to-non-llgr-neighbor],
[edit logical-systems logical-system-name protocols bgp group group-name graceful-restart
  long-lived advertise-to-non-llgr-neighbor],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  graceful-restart long-lived advertise-to-non-llgr-neighbor],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  graceful-restart long-lived advertise-to-non-llgr-neighbor],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  group group-name graceful-restart long-lived advertise-to-non-llgr-neighbor],
[edit logical-systems logical-system-name routing-instances instance-name protocols bgp
  group group-name neighbor address graceful-restart long-lived
  advertise-to-non-llgr-neighbor],
[edit routing-instances instance-name protocols bgp graceful-restart long-lived
  advertise-to-non-llgr-neighbor],
[edit routing-instances instance-name protocols bgp group group-name graceful-restart
  long-lived advertise-to-non-llgr-neighbor],
[edit routing-instances instance-name protocols bgp group group-name neighbor address
  graceful-restart long-lived advertise-to-non-llgr-neighbor],
[edit protocols bgp graceful-restart long-lived advertise-to-non-llgr-neighbor],
[edit protocols bgp group group-name graceful-restart long-lived
  advertise-to-non-llgr-neighbor],
[edit protocols bgp group group-name neighbor address graceful-restart long-lived
  advertise-to-non-llgr-neighbor]
```

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Cause the no-export BGP community to be prevented from being automatically added to routes advertised to external BGP neighbors (presumed to be CE routers). The no-export routes containing this community name are not advertised outside a BGP confederation boundary. In VPN deployments, for example, BGP is often used as a PE-CE protocol. It might be a practical necessity in such deployments to accommodate interoperation with CEs that cannot easily be upgraded to support specifications such as this one. This requirement causes a problem while ensuring that "stale" routing information does not leak beyond the perimeter of routers that support these procedures where one or more IBGP routers are not upgraded. In the VPN PE-CE case, the protocol in use is EBGP, and the LOCAL_PREF, an IBGP-only path attribute, is used.

The principal motivation for restricting the propagation of "stale" routing information is the reason to prevent it from spreading without limit once it exits the BGP confederation boundary. VPN deployments are typically topologically constrained, removing this concern. For this reason, an implementation might advertise stale routes over a PE-CE session, when explicitly configured. In such a scenario, the implementation must attach the NO_EXPORT community to the routes in question by default, as an additional protection

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against stale routes spreading without limit. Attachment of the NO_EXPORT community can be disabled explicitly to accommodate exceptional cases. It might be necessary to advertise stale routes to a CE in some VPN deployments, even if the CE does not support this specification. In that case, if you configure the PE routers to advertise such routes, you must notify the operator of the CE receiving the routes, and the CE must be configured to depreference the routes. Typical BGP implementations perform this operation by matching on the LLGR_STALE community, and setting the LOCAL_PREF for matching routes to zero.

When the **omit-no-export** option is added or removed, the session is reset. This rest of a session enables LLGR stale routes to be readvertised with or without the no- export community (which is added outside of the export policy).

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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origin-autonomous-system (Origin Validation for BGP)

Syntax

```
origin-autonomous-system as-number {
    validation-state (invalid | valid);
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
    validation static record destination maximum-length prefix-length],
[edit logical-systems logical-system-name routing-options validation static record destination
    maximum-length prefix-length],
[edit routing-instances instance-name routing-options validation static record destination
    maximum-length prefix-length],
[edit routing-options validation static record destination maximum-length prefix-length]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure the legitimate originator autonomous system (AS). This is a required statement.

Options ***as-number***—Legitimate originator AS number.

The remaining statement is explained separately. See CLI Explorer.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Origin Validation for BGP on page 803

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outbound-route-filter

Syntax

```
outbound-route-filter {
  bgp-orf-cisco-mode;
  prefix-based {
    accept {
      (inet | inet6);
    }
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 9.2.
Statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure a BGP peer to accept outbound route filters from a remote peer.

Options

accept—Specify that outbound route filters from a BGP peer be accepted.

inet—Specify that IPv4 prefix-based outbound route filters be accepted.

inet6—Specify that IPv6 prefix-based outbound route filters be accepted.

NOTE: You can specify that both IPv4 and IPv6 outbound route filters be accepted.

prefix-based—Specify that prefix-based filters be accepted.

The **bgp-orf-cisco-mode** statement is explained separately.

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Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring BGP Prefix-Based Outbound Route Filtering on page 342

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out-delay

Syntax

```
out-delay seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Control how often BGP and the routing table exchange route information by specifying how long a route must be present in the Junos OS routing table before it is exported to BGP. Use this time delay to help bundle routing updates and to avoid sending updates too often.

Alternatively or in addition, external BGP (EBGP) sessions can also use the route-flap damping mechanism upon the reception of BGP messages coming from an external neighbor.

BGP stores the route information it receives from update messages in the routing table, and the routing table exports active routes from the routing table into BGP. BGP then advertises the exported routes to its peers. The **out-delay** statement enables a form of rate limiting. The delay is added to each update for each prefix individually. When a routing device changes its best path to a destination prefix, the device does not inform its peer about the change unless the route has been present in its routing table for the specified **out-delay**. If you use **out-delay** to perform rate-limiting, you can expect a less bursty pattern of updates. You will see a pattern in which updates arrive in a steady flow, and two updates for the same prefix are always spaced by at least the **out-delay** timer value (for example, 30 seconds). Thus, the **out-delay** setting is useful for limiting oscillation (sometimes called *churn*) in a network. Keep in mind that, regardless of the **out-delay** setting, BGP peers exchange routes immediately after neighbor establishment. The

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out-delay setting is only designed to delay the exchange of routes between BGP and the local routing table.

Caution is warranted because an **out-delay** can delay convergence. If your network is configured in a way that avoids oscillation, setting an **out-delay** is not necessary.

When configured, the **out-delay** value displays as **Outbound Timer** when using **show bgp group** or **show bgp group neighbor** commands.

Default By default, the exchange of route information between BGP and the routing table occurs immediately after the routes are received. This immediate exchange of route information might cause instabilities in the network reachability information. If you omit this statement, routes are exported to BGP immediately after they have been added to the routing table.

Options *seconds*—Output delay time.

Range: 0 through 65,535 seconds

Default: 0 seconds

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- keep on page 1219

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output-queue-priority

List of Syntax

output-queue-priority (System Configuration) on page 1294
output-queue-priority (Implementation) on page 1294

output-queue-priority (System Configuration)

```
output-queue-priority {
  expedited update-tokens number-of-tokens;
  priority priority-queue-number (1-16) update-tokens number-of-tokens;
}
```

Hierarchy Level (System Configuration)

```
[edit logical-systems logical-system-name protocols bgp],
[edit protocols bgp]
```

output-queue-priority (Implementation)

```
output-queue-priority {
  (expedited | priority priority-queue-number (1-16));
}
```

Hierarchy Level (Implementation)

```
[edit logical-systems logical-system-name protocols bgp family family-name sub-family],
[edit logical-systems logical-system-name protocols bgp group group-name family
  family-name sub-family],
[edit protocols bgp family family-name sub-family],
[edit protocols bgp group group-name family family-name sub-family],
[edit protocols bgp group group-name neighbor neighbor-id family family-name]
```

Release Information

Statement introduced in Junos OS Release 16.1 for the ACX Series, M Series, MX Series, PTX Series, QFabric systems, and QFX Series.

Description

When configuring the queues for BGP route prioritization, the **output-queue-priority** statement allows you to specify the number of tokens that are available within each of the 17 BGP output priority queues. This allows you to balance the amount of work that can be done within the route prioritization queues.

When implementing BGP route prioritization, the **output-queue-priority** statement allows you to specify the priority at which a given BGP route or route type is serviced. BGP route prioritization can also be specified per BGP neighbor during BGP configuration, as well as for the sub-family types within the following address families:

- **evpn**
- **inet**
- **inet-mdt**
- **inet-mvpn**
- **inet-vpn**
- **inet6**

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- inet6-mvpn
- inet6-vpn
- iso-vpn
- l2vpn
- route-target
- traffic-engineering

Default By default, each of the 17 BGP route priority queues (or buckets) is assigned 1 work token so that misconfigured queues do not result in starvation.

When implementing BGP route prioritization, the following types of update messages are assigned to the lowest priority queue (1) by default: route refresh, topology change, and route withdraw.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding BGP Route Prioritization on page 77
- withdraw-priority on page 1395

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passive (Protocols BGP)

Syntax

```
passive;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the routing device so that active open messages are not sent to the peer. Once you configure the routing device to be passive, the routing device will wait for the peer to issue an open request before a message is sent.

Default

If you omit this statement, all explicitly configured peers are active, and each peer periodically sends open requests until its peer responds.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Preventing BGP Session Flaps When VPN Families Are Configured on page 832

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path-count

Syntax

path-count *number*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp group *group-name* family *family* add-path send],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor address family *family* add-path send],
[edit protocols bgp group *group-name* family *family* add-path send],
[edit protocols bgp group *group-name* family *family* add-path neighbor address family *family* add-path send]

Release Information

Statement introduced in Junos OS Release 11.3.
Support for range from 2 through 20 (for BGP) introduced in Junos OS Release 14.1.
Support for 64 BGP add-paths introduced in Junos OS Release 18.4R1 for the MX Series.

Description

Specify the number of paths to a destination to advertise.

Suppose a routing device has in its routing table four paths to a destination and is configured to advertise up to three paths (**add-path send path-count 3**). The three paths are chosen based on path selection criteria. That is, the three best paths are chosen in path-selection order. The best path is the active path. This path is removed from consideration and a new best path is chosen. This process is repeated until the specified number of paths is reached.

Options

number—Number of paths to a destination to advertise.

Range: 2 through 6

Default: 1

Range: 2 through 64 (for BGP)

NOTE: This range is applicable only under prefix-policy **add-path .**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Advertising Multiple BGP Paths to a Destination*
- prefix-policy on page 1312

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path-selection

Syntax

```
path-selection {
  (always-compare-med | cisco-non-deterministic | external-router-id);
  as-path-ignore;
  l2vpn-use-bgp-rules;
  med-plus-igp {
    igp-multiplier number;
    med-multiplier number;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit protocols bgp],
[edit routing-instances routing-instance-name protocols bgp]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
med-plus-igp option introduced in Junos OS Release 8.1.
as-path-ignore and **l2vpn-use-bgp-rules** options introduced in Junos OS Release 10.2.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure BGP path selection.

Default

If the **path-selection** statement is not included in the configuration, only the multiple exit discriminators (MEDs) of routes that have the same peer ASs are compared.

Options

always-compare-med—Always compare MEDs whether or not the peer ASs of the compared routes are the same.

NOTE: We recommend that you configure the **always-compare-med** option.

as-path-ignore—In the best-path algorithm, skip the step that compares the autonomous system (AS) path lengths. By default, the best-path algorithm evaluates the length of the AS paths and prefers the route with the shortest AS path length.

NOTE: Starting with Junos OS Release 14.1R8, 14.2R7, 15.1R4, 15.1F6, and 16.1R1, the **as-path-ignore** option is supported for routing instances.

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cisco-non-deterministic—Emulate the Cisco IOS default behavior. This mode evaluates routes in the order that they are received and does not group them according to their neighboring AS. With **cisco-non-deterministic** mode, the active path is always first. All inactive, but eligible, paths follow the active path and are maintained in the order in which they were received, with the most recent path first. Ineligible paths remain at the end of the list.

As an example, suppose you have three path advertisements for the 192.168.1.0 /24 route:

- Path 1—learned through EBGP; AS Path of 65010; MED of 200
- Path 2—learned through IBGP; AS Path of 65020; MED of 150; IGP cost of 5
- Path 3—learned through IBGP; AS Path of 65010; MED of 100; IGP cost of 10

These advertisements are received in quick succession, within a second, in the order listed. Path 3 is received most recently, so the routing device compares it against path 2, the next most recent advertisement. The cost to the IBGP peer is better for path 2, so the routing device eliminates path 3 from contention. When comparing paths 1 and 2, the routing device prefers path 1 because it is received from an EBGP peer. This allows the routing device to install path 1 as the active path for the route.

NOTE: We do not recommend using this configuration option in your network. It is provided solely for interoperability to allow all routing devices in the network to make consistent route selections.

external-router-id—Compare the router ID between external BGP paths to determine the active path.

igp-multiplier *number*—The multiplier value for the IGP cost to a next-hop address. This option is useful for making the MED and IGP cost comparable.

Range: 1 through 1000

Default: 1

med-multiplier *number*—The multiplier value for the MED calculation. This option is useful for making the MED and IGP cost comparable.

Range: 1 through 1000

Default: 1

med-plus-igp—Add the IGP cost to the indirect next-hop destination to the MED before comparing MED values for path selection. This statement only affects best-path selection. It does not affect the advertised MED.

The other option is explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Understanding BGP Path Selection on page 14
- Example: Ignoring the AS Path Attribute When Selecting the Best Path on page 180

path-selection-mode

Syntax

```
path-selection-mode {
  all-paths;
  equal-cost-paths;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family
  family-name add-path send]
[edit protocols bgp group group-name family family-name add-path send]
```

Release Information

Statement introduced in 18.4R1 for the MX Series and PTX Series.

Description

Specify whether BGP can advertise all the available paths or only the equal-cost paths. BGP can advertise upto 64 add-path routes and a second best ECMP path as a backup in addition to the multiple ECMP paths. You cannot enable both **multipath** and **path-selection-mode** at the same time.

Options

all-paths— Specify the total number of add-path routes to advertise. BGP advertises all the paths that are allowed by the configured prefix policy and the maximum paths configured using the **path-count** option.

equal-cost-paths— Specify the multipaths to advertise. You cannot enable this option with the **multipath** option.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- add-path on page 1082
- include-backup-path on page 1206
- Understanding the Advertisement of Multiple Paths to a Single Destination in BGP on page 468

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peer-as (Protocols BGP)

Syntax

peer-as *autonomous-system*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the neighbor (peer) autonomous system (AS) number.

For EBGP, the peer is in another AS, so the AS number you specify in the **peer-as** statement must be different from the local router's AS number, which you specify in the **autonomous-system** statement. For IBGP, the peer is in the same AS, so the two AS numbers that you specify in the **autonomous-system** and **peer-as** statements must be the same.

The AS numeric range in plain-number format has been extended in Junos OS Release 9.1 to provide BGP support for 4-byte AS numbers, as defined in RFC 4893, *BGP Support for Four-octet AS Number Space*. RFC 4893 introduces two new optional transitive BGP attributes, AS4_PATH and AS4_AGGREGATOR. These new attributes are used to propagate 4-byte AS path information across BGP speakers that do not support 4-byte AS numbers. RFC 4893 also introduces a reserved, well-known, 2-byte AS number, AS 23456. This reserved AS number is called AS_TRANS in RFC 4893. All releases of the Junos OS support 2-byte AS numbers.

In Junos OS Release 9.2 and later, you can also configure a 4-byte AS number using the AS-dot notation format of two integer values joined by a period: *<16-bit high-order value in decimal>.<16-bit low-order value in decimal>*. For example, the 4-byte AS number of 65,546 in plain-number format is represented as 1.10 in the AS-dot notation format.

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With the introduction of 4-byte AS numbers, you might have a combination of routers that support 4-byte AS numbers and 2-byte AS numbers. For more information about what happens when establishing BGP peer relationships between 4-byte and 2-byte capable routers, see the following topics:

- *Using 4-Byte Autonomous System Numbers in BGP Networks Technology Overview*.

Options

autonomous-system—AS number.

Range: 1 through 4,294,967,295 ($2^{32} - 1$) in plain-number format for 4-byte AS numbers

Range: 1 through 65,535 in plain-number format for 2-byte AS numbers (this is a subset of the 4-byte range)

Range: 0.0 through 65535.65535 in AS-dot notation format for 4-byte AS numbers

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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port (Origin Validation for BGP)

Syntax

```
port port-number;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address],
[edit routing-options validation group group-name session server-ip-address]
```

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure an alternative TCP port number to be used for the outgoing connection with the cache server. The well-known resource public key infrastructure (RPKI) port is TCP port 2222. For a given deployment, an RPKI cache server might listen on some other TCP port number. If so, configure the alternative port number with this statement.

Options

port-number—TCP port number to be used for the outgoing connection to the cache server.

Default: 2222

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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post-policy

Syntax

```
post-policy {
  exclude-non-eligible;
}
```

Hierarchy Level

[edit protocols bgp bmp route-monitoring],
[edit protocols bgp group *group-name* bmp route-monitoring],
[edit protocols bgp group neighbor*group-name* neighbor *address* bmp route-monitoring],
[edit routing-options bmp route-monitoring],
[edit rouiting-options bmp station *station-name* route-monitoring]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

For BMP route monitoring, allows you to excludes routes that are non-eligible for the decision process (for example, protocol nexthop not resolved). This represents the view of the BGP routes after running the import policy. If the import policy has rejected the BGP route, the route does not exist in the post policy view.

NOTE: If post-policy is configured the router applies the import policies on the routes received so that BMP can display the routes as follows:

- If an import policy modifies any parameters in the route, the route is displayed by BMP with the new values.
- If an import policy modifies the NH and the NH is unresolved by the local router, the route is displayed by BMP as reachable.
- If an import policy rejects a route, it is displayed as unreachable in BMP update.
- If a route is received with unreachable NH, but the import policy doesn't reject the route, then BMP displays the route as reachable.

Using post-policy with **exclude-non-eligible** causes an unreachable BMP update in the following:

- If an import policy modifies the NH and the NH is unresolved by the local router, the route is displayed by BMP as unreachable.
- if a route is received with a NH that is unreachable, and the import policy does not reject this route, it is displayed by BMP as unreachable.

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NOTE: If you have initially configured post-policy route monitoring, but later delete the initial configuration and configure pre-policy route monitoring, then the previously advertised post-policy routes are withdrawn. Conversely, if you have initially configured pre-policy route monitoring and later modify it to post-policy route monitoring, then the previously advertised pre-policy routes are withdrawn.

Options **exclude-non-eligible**—Exclude routes that are non-eligible for the decision process.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Configuring BGP Monitoring Protocol Version 3 on page 946

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precision-timers

Syntax precision-timers;

Hierarchy Level [edit logical-systems *logical-system-name* protocols bgp],
[edit protocols bgp]

Release Information Statement introduced in Junos OS Release 11.4.

Description Enable BGP sessions to send frequent keepalive messages with a hold time as short as 10 seconds.

NOTE: The hold time is three times the interval at which keepalive messages are sent, and the hold time is the maximum number of seconds allowed to elapse between successive keepalive messages that BGP receives from a peer. When establishing a BGP connection with the local routing device, a peer sends an open message, which contains a hold-time value. BGP on the local routing device uses the smaller of either the local hold-time value or the peer's hold-time value as the hold time for the BGP connection between the two peers.

The default hold-time is 90 seconds, meaning that the default frequency for keepalive messages is 30 seconds. More frequent keepalive messages and shorter hold times might be desirable in large-scale deployments with many active sessions (such as edge or large VPN deployments). To configure the hold time and the frequency of keepalive messages, include the **hold-time** statement at the **[edit protocols bgp]** hierarchy level. You can configure the hold time at a logical system, routing instance, global, group, or neighbor level. When you set a hold time value to less than 20 seconds, we recommend that you also configure the BGP **precision-timers** statement. The **precision-timers** statement ensures that if scheduler slip messages occur, the routing device continues to send keepalive messages. When the **precision-timers** statement is included, keepalive message generation is performed in a dedicated kernel thread, which helps to prevent BGP session flaps.

NOTE: Starting with Junos OS Release 15.2, you can register or unregister keepalives of BGP with the automated keepalive precision timer service of the kernel. This service ensures a reliable generation of keepalives for some configurable maximum period after a switchover of the routing engine from backup to master until BGP is able to take over the keepalive generation.

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Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- hold-time on page 1201

preference (Origin Validation for BGP)

Syntax
```
preference number;
```

Hierarchy Level
```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address],
[edit routing-options validation group group-name session server-ip-address]
```

Release Information
Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description
Each resource public key infrastructure (RPKI) cache server has a static preference. Higher preferences are preferred. During a session start or restart, the routing device attempts to start a session with the cache server that has the numerically highest preference. The routing device connects to multiple cache servers in preference order.

Options
number—Preference number for the cache server.
Range: 1 through 255
Default: 100

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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preference (Protocols BGP)

Syntax

preference *preference*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the preference for routes learned from BGP.

At the BGP global level, the preference statement sets the preference for routes learned from BGP. You can override this preference in a BGP group or peer preference statement.

At the group or peer level, the preference statement sets the preference for routes learned from the group or peer. Use this statement to override the preference set in the BGP global preference statement when you want to favor routes from one group or peer over those of another.

NOTE: **Do not set preference2 for BGP route-policy.**

Options

preference—Preference to assign to routes learned from BGP or from the group or peer.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

Default: 170 for the primary preference

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- local-preference on page 1237
- Example: Configuring the Preference Value for BGP Routes on page 235

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prefix-limit

Syntax

```
prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | minutes)>;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family (inet | inet6) (any | flow |
    labeled-unicast | multicast | unicast)],
[edit logical-systems logical-system-name protocols bgp group group-name family (inet |
    inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
    family  (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
    bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
    bgp group group-name family (inet | inet6) (any | flow | labeled-unicast | multicast |
    unicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name
    protocols bgp group group-name neighbor address family (inet | inet6) (any | flow
    | labeled-unicast | multicast | unicast)],
[edit protocols bgp family (inet | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit protocols bgp group group-name family (inet | inet6) (any | labeled-unicast | multicast
    | unicast)],
[edit protocols bgp group group-name neighbor address family (inet | inet6) (any | flow
    | labeled-unicast | multicast | unicast)],
[edit routing-instances routing-instance-name protocols bgp family (inet | inet6) (any | flow
    |  labeled-unicast | multicast | unicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
    | inet6) (any | flow | labeled-unicast | multicast | unicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name
    neighbor address family (inet | inet6) (any | flow |  labeled-unicast | multicast | unicast)]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Limit the number of prefixes received on a BGP peer session and a rate-limit logging when injected prefixes exceed a set limit.

This functionality is identical to the **accepted-prefix-limit** functionality except that it operates against received prefixes rather than accepted prefixes.

Options

maximum *number*—When you set the maximum number of prefixes, a message with peer address, address family and instance name is logged when that number is exceeded.

Range: 1 through 4,294,967,295 ($2^{32} - 1$)

teardown <*percentage*>—If you include the **teardown** statement, the session is torn down when the maximum number of prefixes is exceeded. If you specify a percentage,

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messages are logged when the number of prefixes exceeds that percentage. After the session is torn down, it is reestablished in a short time unless you include the **idle-timeout** statement. Then the session can be kept down for a specified amount of time, or forever. If you specify **forever**, the session is reestablished only after you issue a **clear bgp neighbor** command.

Range: 1 through 100

idle-timeout (forever | *timeout-in-minutes*)—(Optional) If you include the **idle-timeout** statement, the session is torn down for a specified amount of time, or forever. If you specify a period of time, the session is allowed to reestablish after this timeout period. If you specify **forever**, the session is reestablished only after you intervene with a **clear bgp neighbor** command.

Range: 1 through 2400

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- accepted-prefix-limit on page 1079
- Limiting the Number of Prefixes Received on a BGP Peer Session on page 659

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prefix-policy

Syntax

```
prefix-policy [ policy-names ];
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family family
  add-path send],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family add-path send],
[edit protocols bgp group group-name family family add-path send],
[edit protocols bgp group group-name family family add-path neighbor address family family
  add-path send]
```

Release Information

Statement introduced in Junos OS Release 11.3.

Description

Filter the paths to a destination to advertise.

Prefix policies enable you to filter routes on a router that is configured to advertise multiple paths to a destination. Prefix policies can only match prefixes. They cannot match route attributes, and they cannot change the attributes of routes.

The **add-path prefix-policy** allows up to 64 BGP add-paths be advertised for a subset of prefixes that match the add-path prefix-policy. To enable this feature for a prefix, the **add-path prefix-policy** term matching the prefix should have a new *then* action to set **add-path send-count** *<2...64>*. This new action is not applicable if the policy-statement containing it is used in any place other than **add-path prefix-policy**.

Options

policy-names—Name of a policy (or a set of policies) configured at the **[edit policy-options]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Advertising Multiple BGP Paths to a Destination*
- *Actions in Routing Policy Terms*

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pre-policy

Syntax

```
pre-policy {
  exclude-non-feasible;
}
```

Hierarchy Level

[edit protocols bgp bmp route-monitoring],
[edit protocols bgp group *group-name* bmp route-monitoring],
[edit protocols bgp group neighbor*group-name* neighbor *address* bmp route-monitoring],
[edit routing-options bmp route-monitoring],
[edit rouiting-options bmp station *station-name* route-monitoring]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Excludes routes that are non-feasible from the BMP route monitoring decision process (for example, a route loop). This represents the view of the BGP routes before running the import policy.

NOTE: If you have initially configured pre-policy route monitoring, but later delete the initial configuration and configure post-policy route monitoring, then the previously advertised pre-policy routes are withdrawn. Conversely, if you have initially configured post-policy route monitoring and later modify it to pre-policy route monitoring, then the previously advertised post-policy routes are withdrawn.

Options

exclude-non-feasible—Exclude routes that are non-feasible for the decision process.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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priority (Protocols BMP)

Syntax

```
priority (high | medium | low);
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit routing-options bmp],
[edit rouiting-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specifies the dispatch priority for BMP. The dispatch priority controls the frequency with which the device is able to forward BMP messages to BMP stations.

Options

high—Specifies that the routing protocol process handle BMP requests with high urgency.

medium—Specifies that the routing protocol process handle BMP requests with medium urgency.

low—Specifies that the routing protocol process handle BMP requests with low urgency.

Default: The default dispatch priority is **low** to minimize interference with other routing protocol process priorities and to match the behavior of previous versions of BMP.

NOTE: **Setting high or medium priority may reduce the performance of the routing protocol process in its handling route convergence or other work.**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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protection (Protocols BGP)

Syntax

```
protection;
```

Hierarchy Level

```
[edit routing-instances instance-name protocols bgp family inet unicast],
[edit routing-instances instance-name protocols bgp family inet6 unicast],
[edit routing-instances instance-name protocols bgp family inet labeled-unicast],
[edit routing-instances instance-name protocols bgp family inet6 labeled-unicast]
```

Description Configure the backup path to protect the active provider edge path in a Layer 3 VPN or a BGP labeled unicast path.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Provider Edge Link Protection in Layer 3 VPNs*
- *Example: Configuring Provider Edge Link Protection for BGP Labeled Unicast Paths*

protection (Protocols MPLS)

Syntax

```
protection;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family inet
  labeled-unicast],
[edit protocols bgp group group-name family inet labeled-unicast]
```

Release Information Statement introduced in Junos OS Release 13.2.
Statement introduced in Junos OS Release 16.1R2 and 17.2R1 for PTX Series routers.

Description Configure protection on a link between two routers in different autonomous systems.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Understanding MPLS Inter-AS Link Protection*

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protocols

Syntax

```
protocols {
  bgp {
    ... bgp-configuration ...
  }
  isis {
    ... isis-configuration ...
  }
  ldp {
    ... ldp-configuration ...
  }
  mpls {
    ... mpls -configuration ...
  }
  msdp {
    ... msdp-configuration ...
  }
  mstp {
    ... mstp-configuration ...
  }
  ospf {
    domain-id domain-id;
    domain-vpn-tag number;
    route-type-community (iana | vendor);
    traffic-engineering {
      <advertise-unnumbered-interfaces>;
      <credibility-protocol-preference>;
      ignore-lsp-metrics;
      multicast-rpf-routes;
      no-topology;
      shortcuts {
        lsp-metric-into-summary;
      }
    }
    ... ospf-configuration ...
  }
  ospf3 {
    domain-id domain-id;
    domain-vpn-tag number;
    route-type-community (iana | vendor);
    traffic-engineering {
      <advertise-unnumbered-interfaces>;
      <credibility-protocol-preference>;
      ignore-lsp-metrics;
      multicast-rpf-routes;
      no-topology;
      shortcuts {
        lsp-metric-into-summary;
      }
    }
    ... ospf3-configuration ...
  }
```


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```
  pim {
    ... pim-configuration ...
  }
  rip {
    ... rip-configuration ...
  }
  ripng {
    ... ripng-configuration ...
  }
  rstp {
    rstp-configuration;
  }
  rsvp{
    ... rsvp-configuration ...
  }
  vstp {
    vstp configuration;
  }
  vpls {
    vpls configuration;
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* routing-instances *routing-instance-name*], [edit routing-instances *routing-instance-name*]

Release Information Statement introduced before Junos OS Release 7.4.
Support for RIPng introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 11.1 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
mpls and **rsvp** options added in Junos OS Release 15.1.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Specify the protocol for a routing instance. You can configure multiple instances of many protocol types. Not all protocols are supported on the switches. See the switch CLI.

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Options

bgp—Specify BGP as the protocol for a routing instance.

isis—Specify IS-IS as the protocol for a routing instance.

ldp—Specify LDP as the protocol for a routing instance or for a virtual router instance.

l2vpn—Specify Layer 2 VPN as the protocol for a routing instance.

mpls—Specify MPLS as the protocol for a routing instance.

msdp—Specify the Multicast Source Discovery Protocol (MSDP) for a routing instance.

mstp—Specify the Multiple Spanning Tree Protocol (MSTP) for a virtual switch routing instance.

ospf—Specify OSPF as the protocol for a routing instance.

ospf3—Specify OSPF version 3 (OSPFv3) as the protocol for a routing instance.

NOTE: **OSPFv3 supports the no-forwarding, virtual-router, and vrf routing instance types only.**

pim—Specify the Protocol Independent Multicast (PIM) protocol for a routing instance.

rip—Specify RIP as the protocol for a routing instance.

ripng—Specify RIP next generation (RIPng) as the protocol for a routing instance.

rstp—Specify the Rapid Spanning Tree Protocol (RSTP) for a virtual switch routing instance.

rsvp—Specify the RSVP for a routing instance.

vstp—Specify the VLAN Spanning Tree Protocol (VSTP) for a virtual switch routing instance.

vpls—Specify VPLS as the protocol for a routing instance.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Multiple Routing Instances of OSPF*

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receive (Protocols BGP)

Syntax

```
receive;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name family family
  add-path],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family family add-path],
[edit protocols bgp group group-name family family add-path],
[edit protocols bgp group group-name family family add-path neighbor address family family
  add-path]
```

Release Information Statement introduced in Junos OS Release 11.3.

Description Enable the router to receive multiple paths to a destination. You can enable the router to receive multiple paths from specified neighbors or from all neighbors.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Advertising Multiple BGP Paths to a Destination*

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receiver (Graceful Restart for BGP Helper)

Syntax

```
receiver {
  enable:
  disable;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit routing-instances *instance-name* protocols bgp graceful-restart long-lived],
[edit routing-instances *instance-name* protocols bgp group *group-name* graceful-restart long-lived],
[edit routing-instances *instance-name* protocols bgp group *group-name* neighbor *address* graceful-restart],
[edit protocols bgp graceful-restart long-lived],
[edit protocols bgp group *group-name* graceful-restart long-lived],
[edit protocols bgp group *group-name* neighbor *address* graceful-restart long-lived]

Release Information

Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description

Enable the long-lived graceful restart mechanism for a BGP receiver or helper router to preserve BGP routing details for a longer period from a failed BGP peer. Long-lived graceful restart receiver or helper mode is enabled by default, unless ordinary graceful restart receiver or helper mode is disabled.

The **long-lived receiver enable** overrides a disable option inherited from a higher level in the configuration. When the LLGR receiver or helper mode is enabled or disabled, the session is reset. This behavior enables the new capability value to be sent to the neighbor.

Options

enable—Enable long-lived BGP graceful restart for a receiver or helper router

disable—Disable long-lived BGP graceful restart for a receiver or helper router

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*

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- *High Availability Feature Guide*

record (Origin Validation for BGP)

Syntax

```
record destination {
  maximum-length prefix-length {
    origin-autonomous-system as-number {
      validation-state (invalid | valid);
    }
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation static],
[edit logical-systems logical-system-name routing-options validation static],
[edit routing-instances instance-name routing-options validation static],
[edit routing-options validation static]
```

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure the network prefix for the route validation (RV) record.

An RV record matches any route whose prefix matches the RV prefix, whose prefix length does not exceed the maximum-length given in the RV record, and whose origin AS equals the origin-autonomous-system given in the RV record. RV records are received from the cache server using the protocol defined in Internet draft draft-ietf-sidr-rpki-rtr-19, *The RPKI/Router Protocol*, and can also be configured statically, as shown here.

Options

destination—Network prefix for the RV record.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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record-lifetime (Origin Validation for BGP)

Syntax

```
record-lifetime seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address],
[edit routing-options validation group group-name session server-ip-address]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure the amount of time that route validation (RV) records learned from a cache server are valid. RV records expire if the session to the cache server goes down and remains down for the **record-lifetime** (seconds).

Options

seconds—Amount of time that an RV remains valid after the session to the cache server goes down.

Range: 60 (one minute) through 604800 (one week)

Default: 3600 seconds (one hour)

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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refresh-time (Origin Validation for BGP)

Syntax

```
refresh-time seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name session server-ip-address],
[edit logical-systems logical-system-name routing-options validation group group-name
  session server-ip-address],
[edit routing-instances instance-name routing-options validation group group-name session
  server-ip-address],
[edit routing-options validation group group-name session server-ip-address]
```

Release Information Statement introduced in Junos OS Release 12.2.

Description Configure a liveliness check interval for a configured resource public key infrastructure (RPKI) cache server. Every **refresh-time** (seconds), a serial query protocol data unit (PDU) with the last known serial number is transmitted. The **refresh-time** cannot be longer than half of the hold-time.

Options ***seconds***—Interval at which serial query PDUs are sent.

Range: 1 through 1800

Default: 300

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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remove-private

Syntax

```
remove-private;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor address],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
no-peer-loop-check option added in Junos OS Release 15.1.

Description

When advertising AS paths to remote systems, have the local system strip private AS numbers from the AS path. The numbers are stripped from the AS path starting at the left end of the AS path (the end where AS paths have been most recently added). The routing device stops searching for private ASs when it finds the first nonprivate AS or a peer's private AS. If the AS path contains the AS number of the external BGP (EBGP) neighbor, BGP does not remove the private AS number.

NOTE: As of Junos OS 10.0R2 and higher, if there is a need to send prefixes to an EBGP peer that has an AS number that matches an AS number in the AS path, consider using the **as-override** statement instead of the **remove-private** statement.

The operation takes place after any confederation member ASs have already been removed from the AS path, if applicable.

Junos OS recognizes the set of AS numbers that is considered private, a range that is defined in the Internet Assigned Numbers Authority (IANA) assigned numbers document.

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The set of reserved AS numbers is in the range from 64,512 through 65,535. The 32-bit private ASN scope is in the range from 4,200,000,000 through 4,294,967,294.

Options

all—Remove all private AS numbers from the original path. Do not stop the process of removing private AS numbers, even if a public AS number is encountered.

nearest—When you use the **all** and **replace** options, choose the last (right-most) public AS number encountered in the original AS path for the replacement value, as the AS path is processed from left to right. If no public AS number is encountered, the default replacement value is used. (See the **replace** option for information about the default replacement value.)

replace—When you use the **all** option, instead of a removing private AS numbers, perform a replace operation. The default replacement value for the private AS number is the local AS number at the BGP group level for the BGP peer. If you are unsure about the replacement value, check the local AS value displayed in the output of the **show bgp group *group-name*** command.

no-peer-loop-check—Peer loop check is removed. By default, the **remove-private** statement has a peer loop check restriction. If a private AS in the AS path has the same value as the configured **peer-as** for the neighbor, **remove-private** does not remove or replace this private AS number. This restriction provides peer-as loop protection. However, you can remove this restriction using the **no-peer-loop-check** option.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Removing Private AS Numbers from AS Paths on page 189

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resolve-vpn

Syntax

```
resolve-vpn;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit protocols bgp family inet labeled-unicast],
[edit protocols bgp group *group-name* family inet labeled-unicast],
[edit protocols bgp group *group-name* neighbor *address* family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family inet labeled-unicast],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family inet labeled-unicast]

Release Information

Statement introduced before Junos OS Release 7.4.

Description

Allow labeled routes to be placed in the inet.3 routing table for route resolution. These routes are then resolved for PE router connections where the remote PE is located across another AS. For a PE router to install a route in the VRF, the next hop must resolve to a route stored within the inet.3 table.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Understanding Multiprotocol BGP on page 655

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restart-time (BGP Graceful Restart)

Syntax

```
restart-time seconds;
```

Hierarchy Level

```
[edit protocols (bgp | rip | ripng) graceful-restart],
[edit logical-systems logical-system-name protocols (bgp | rip | ripng) graceful-restart
   (Enabling Globally)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
   bgp graceful-restart],
[edit routing-instances routing-instance-name protocols bgp graceful-restart]
```

Release Information

Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the duration of the BGP, RIP, or next-generation RIP (RIPng) graceful restart period.

Options

seconds—Length of time for the graceful restart period.

Range: 1 through 600 seconds

Default: Varies by protocol:

- BGP—120 seconds
- RIP and RIPng—60 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *Configuring Graceful Restart Options for RIP and RIPng*
- *Configuring Graceful Restart for QFabric Systems*
- stale-routes-time on page 1355

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restarter (Graceful Restart for BGP Restarter)

Syntax

```
restarter {
  disable;
  stale-time interval;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived],
[edit protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived]

NOTE: Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

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Release Information Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description Configure the long-lived graceful restart mechanism for a BGP restarter router to preserve BGP routing details for a longer period from a failed BGP peer. You can also configure the BGP long-lived graceful restarter mode negotiation mechanism for a particular address family instead of configuring this capability for all address families in a system, logical system, or routing instance.

The stanzas in the per-family graceful-restart long-lived restarter configuration section enables LLGR restarter mode negotiation for BGP globally, or for a group or neighbor. The values are inherited by groups from the global configuration, and by neighbors from the group configuration. The disable attribute is used to override configuration inherited from a higher level. It does not disable LLGR receiver mode; you must disable LLGR receiver mode explicitly for all families as necessary. A hidden **enable** attribute can be used to override an inherited disable attribute. Configuring graceful-restart long-lived restarter at the neighbor level (when it is not configured at the containing group level or globally) causes an internal group to be split. When LLGR restarter is enabled or disabled for a family or the stale- time is changed, the session is reset so that the new capability can be sent to the neighbor.

Options The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

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rfc6514-compliant-safi129 (Protocols BGP)

Syntax

```
rfc6514-compliant-safi129
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor
  neighbor-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor neighbor-name],
[edit protocols bgp],
[edit protocol bgp group group-name],
[edit protocols bgp group group-name neighbor neighbor-name],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  neighbor-name]
```

Release Information

Statement introduced in Junos OS Release 16.1 for MX Series routers.

Description

Parse and send BGP VPN multicast traffic according to Subsequent Address Family Identifier (SAFI) 129, as defined in RFC 6514 (that is, *length, prefix*). The Network Layer Reachability Information (NLRI) format used for BGP VPN multicast in previous releases of Junos OS was SAFI 128, which was *length, label, prefix*.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BGP Neighbor Discovery Through RPM*

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rib (Protocols BGP)

Syntax

```
rib (inet.3 | inet6.3) ;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family (inet | inet6) labeled-unicast],
[edit logical-systems logical-system-name protocols bgp group group-name family (inet |
  inet6) labeled-unicast],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family (inet | inet6) labeled-unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family (inet | inet6) labeled-unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family (inet | inet6) labeled-unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name
  protocols bgp group group-name neighbor address family (inet | inet6) labeled-unicast],
[edit protocols bgp family (inet | inet6) labeled-unicast],
[edit protocols bgp group group-name family (inet | inet6) labeled-unicast],
[edit protocols bgp group group-name neighbor address family (inet | inet6) labeled-unicast],
[edit routing-instances routing-instance-name protocols bgp family (inet | inet6)
  labeled-unicast],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet6) labeled-unicast],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address (inet | inet6) labeled-unicast]
```

Release Information

Statement introduced before Junos OS Release 7.4.

Description

You can allow both labeled and unlabeled routes to be exchanged in a single session. The labeled routes are placed in the inet.3 or inet6.3 routing table, and both labeled and unlabeled unicast routes can be sent or received by the router.

Options

inet.3—Name of the routing table for IPv4.

inet6.3—Name of the routing table for IPv6.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring IPv6 BGP Routes over IPv4 Transport on page 661
- Enabling Layer 2 VPN and VPLS Signaling on page 682
- Understanding Multiprotocol BGP on page 655

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rib-group (Protocols BGP)

Syntax

```
rib-group group-name;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family inet (labeled-unicast |
  unicast | multicast)],
[edit logical-systems logical-system-name protocols bgp group group-name family inet
  (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family inet (labeled-unicast | unicast | multicast)],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address family inet (labeled-unicast | unicast | multicast)],
[edit protocols bgp family inet (labeled-unicast | unicast | multicast)],
[edit protocols bgp group group-name family inet (labeled-unicast | unicast | multicast)],
[edit protocols bgp group group-name neighbor address family inet (labeled-unicast | unicast
  | multicast)],
[edit routing-instances routing-instance-name protocols bgp family inet (labeled-unicast |
  unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name family inet
  (labeled-unicast | unicast | multicast)],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family inet (labeled-unicast | unicast | multicast)]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Add unicast prefixes to unicast and multicast tables.

Options

group-name—Name of the routing table group. The name must start with a letter and can include letters, numbers, and hyphens. You generally specify only one routing table group.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Exporting Specific Routes from One Routing Table Into Another Routing Table*
- *Example: Importing Direct and Static Routes Into a Routing Instance*
- Configuring BGP Routing Table Groups on page 660

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route-monitoring

Syntax

```
route-monitoring {
  none;
  post-policy {
    exclude-non-eligble;
  }
  pre-policy {
    exclude-non-feasible;
  }
  loc-rib;
  rib-out {
    post-policy;
    pre-policy;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bmp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bmp],
[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit protocols bgp bmp],
[edit protocols bgp group *group-name* bmp],
[edit protocols bgp group *group-name* neighbor *address* bmp],
[edit routing-options bmp],
[edit routing-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify whether BMP should send pre-policy route monitoring messages, post-policy route monitoring messages, both types of messages, or none at all. The pre-policy can be configured to exclude routes that are non-feasible for the decision process (for example, a route loop). The post-policy can be configured to exclude routes that are not eligible for the decision process (for example, protocol nexthop not resolved).

You can also selectively enable or disable BMP route monitoring at various hierarchy levels (for example, **[edit protocols bgp group *group-name*]** or **[edit protocols bgp group *group-name* neighbor *address*]**).

NOTE: If you have initially configured pre-policy route monitoring, but later delete the initial configuration and configure post-policy route monitoring, then the previously advertised pre-policy routes are withdrawn. Conversely, if you have initially configured post-policy route monitoring and later modify

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it to pre-policy route monitoring, then the previously advertised post-policy routes are withdrawn.

Options

none— Explicitly disables BMP route montioring.

Default: If you configure the **route-monitoring** statement at the **[edit routing-options bmp]** hierarchy level, the default option is **pre-policy**.

NOTE: If **post-policy** or **pre-policy** is not configured explicitly, then the default mode **pre-policy** would be applicable.

The **route-monitoring** options **pre-policy**, **post-policy**, **rib-out pre-policy**, and **rib-out post-policy** are not mutually exclusive. You can configure any combination, or none, or all. If none of the options are configured, **pre-policy** remains as the default.

If you configure the **route-monitoring** statement at any of the **[edit protocols bgp]** hierarchy levels, the default option is to inherit the configuration from the **route-monitoring** statement configured at the **[edit routing-options bmp]** hierarchy level.

The other statements are explained separately.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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route-refresh-priority

Syntax

```
route-refresh-priority (expedited | priority priority-queue-number (1-16));
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family family-name sub-family],
[edit logical-systems logical-system-name protocols bgp group group-name family
  family-name sub-family],
[edit protocols bgp family family-name sub-family],
[edit protocols bgp group group-name family family-name sub-family],
[edit protocols bgp group group-name neighbor neighbor-id family family-name]
```

Release Information

Statement introduced in Junos OS Release 16.1 for the ACX Series, M Series, MX Series, PTX Series, QFabric systems, and QFX Series.

Description

Within BGP route prioritization, the **route-refresh-priority** statement allows you to set specific priority levels for BGP routes that are to be refreshed. The **route-refresh-priority** statement can be configured for BGP neighbors during BGP configuration, or for sub-families within the following address families:

- **evpn**
- **inet**
- **inet-mdt**
- **inet-mvpn**
- **inet-vpn**
- **inet6**
- **inet6-mvpn**
- **inet6-vpn**
- **iso-vpn**
- **l2vpn**
- **route-target**
- **traffic-engineering**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- output-queue-priority on page 1294
- withdraw-priority on page 1395
- Understanding BGP Route Prioritization on page 77

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route-target (Protocols BGP)

Syntax

```
route-target {
  accepted-prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | time-in-minutes)>;
  }
  advertise-default;
  external-paths number;
  prefix-limit {
    maximum number;
    teardown <percentage> <idle-timeout (forever | time-in-minutes)>;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family],
[edit logical-systems logical-system-name protocols bgp group group-name family],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address family],
[edit protocols bgp family],
[edit protocols bgp group group-name family],
[edit protocols bgp group group-name neighbor address family],
[edit routing-instances routing-instance-name protocols bgp group group-name family],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family]
```

Release Information Statement introduced before Junos OS Release 7.4.

Description Limit the number of prefixes advertised on BGP peers specifically to the peers that need the updates.

Options

advertise-default—Advertise default routes and suppress more specific routes.

external-paths *number*—Number of external paths accepted for route filtering.

Range: 1 through 256 paths

Default: 1 path

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring an Export Policy for BGP Route Target Filtering for VPNs*

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- *Example: Configuring Proxy BGP Route Target Filtering for VPNs*

routing-instance (BMP)

Syntax

```
routing-instance routing-instance;
```

Hierarchy Level

```
[edit routing-options bmp],
[edit routing-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 18.3R1.

Description

Configure the routing instance name for the routing instance you want the BGP Monitoring Protocol (BMP) to use. This can be any routing instance name. If you want to use the reserved non-default management routing instance mgmt_junos, make sure you configure the **management-instance** statement.

When **routing-instance** is configured at both hierarchy levels—**[edit routing-options bmp station *station-name*]** and **[edit routing-options bmp]**—the configuration at the **[edit routing-options bmp station *station-name*]** hierarchy level takes precedence.

NOTE: You must also define the routing instance you want to use under the **[edit routing-instances]** hierarchy level.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *management-instance*
- *Management Interface in a Nondefault Instance*
- Configuring BGP Monitoring Protocol to Run Over a Different Routing Instance on page 940

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routing-instances (Multiple Routing Entities)

Syntax routing-instances *routing-instance-name* { ... }

Hierarchy Level [edit],
[edit logical-systems *logical-system-name*]

Release Information Statement introduced before Junos OS Release 7.4.
remote-vtep-v6-list statement introduced in Junos OS Release 17.3 for MX Series routers with MPC and MIC interfaces.

Description Configure an additional routing entity for a router. You can create multiple instances of BGP, IS-IS, OSPF, OSPFv3, and RIP for a router. You can also create multiple routing instances for separating routing tables, routing policies, and interfaces for individual wholesale subscribers (retailers) in a Layer 3 wholesale network.

Each routing instance consist of the following:

- A set of routing tables
- A set of interfaces that belong to these routing tables
- A set of routing option configurations

Each routing instance has a unique name and a corresponding IP unicast table. For example, if you configure a routing instance with the name **my-instance**, its corresponding IP unicast table is my-instance.inet.0. All routes for **my-instance** are installed into my-instance.inet.0.

Routes are installed into the default routing instance inet.0 by default, unless a routing instance is specified.

In Junos OS Release 9.0 and later, you can no longer specify a routing-instance name of *master*, *default*, or *bgp* or include special characters within the name of a routing instance.

In Junos OS Release 9.6 and later, you can include a slash (/) in a routing-instance name only if a logical system is not configured. That is, you cannot include the slash character in a routing-instance name if a logical system other than the default is explicitly configured. Routing-instance names, further, are restricted from having the form __.*__ (beginning and ending with underscores). The colon **:** character cannot be used when multitopology routing (MTR) is enabled.

Default Routing instances are disabled for the router.

Options *routing-instance-name*——Name of the routing instance. This must be a non-reserved string of not more than 128 characters.

remote-vtep-list—Configure static remote VXLAN tunnel endpoints.

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remote-vtep-v6-list—Configure static IPv6 remote VXLAN tunnel endpoints.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Configuring Interprovider Layer 3 VPN Option A*
- *Example: Configuring Interprovider Layer 3 VPN Option B*
- *Example: Configuring Interprovider Layer 3 VPN Option C*

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segment-list

Syntax

```
segment-list name {
  hop-name {
    ip_address IP address;
    label number ;
    label-type node;
  }
  auto-translate {
    protected mandatory;
    unprotected mandatory;
  }
  dynamic;
  inherit-label-nexthops;
}
```

Hierarchy Level

```
[edit logical-systems name protocols source-packet-routing],
[edit protocols source-packet-routing]
```

Release Information

Statement introduced in Junos OS Release 17.4R1 for MX Series and PTX Series with FPC-PTX-P1-A.
ip-address statement introduced in Junos OS Release 18.1R1 on MX Series routers.
inherit-label-nexthops, **node-type**, and **auto-translate** statements introduced in Junos OS Release 19.1R1 on MX Series routers.
dynamic statement introduced in Junos OS Release 19.2R1 on all platforms.

Description

Specify an name to identify the segment routing list (used in traffic engineering policy) and the explicit path for source routing label switched path (LSPs) to traverse through traffic engineering segments. The segment list is essentially a stack of segment identifiers.

Starting in Junos OS release 19.1R1 for MX and PTX Series routers, you can enable a translation service to translate next-hop IP addresses into the corresponding segment identifier (SID) labels. The translation service keeps track of the node reached at each hop.

When configured, the **segment-list** of a segment routing traffic engineering (SR-TE) LSP accepts IP addresses for all the hops along the path. These IP addresses can be either the loopback address of a node, or the IP address of a link, as identified by the **node-type**. When **auto-translation** is enabled, next hop IP addresses are automatically translated to corresponding SIDs using the translation service. A retry rate can be set for the retry timer at the source-packet-routing hierarchy level.

NOTE: The segment list enables BGP and static segment routing LSP to steer traffic based on segment routing policies. When a segment list is used by the protocol BGP, the BGP protocol validates these segment identifiers and selects valid segments for traffic engineering.

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Options **<hop-name>**—Indicates the next hop in the segment routing traffic engineering policy (SR-TE).

- **ip-address**—Specify the IP address of the hop. For a segment-list to be used by a non-colored segment routing LSP, the first hop must specify an IP address.
- **label**—Specify the SID label of the hop in a segment routing traffic engineering segment list. In static segment routing LSPs, the source routing path uses the segment list only if the second to Nth hop specifies segment identifiers (SID) labels.

NOTE: The range is from 0 to 1,048,576 and is applies to BGP and static segment routing LSPs.

- **label-type**—Use with the option below to indicate that the specified address is the IP address of the node, for example, its loopback address, as opposed to that of a link.
  - **node**—Hops that have been specified as **node** are translated to a prefix SID, which can be either a node SID or an anycast SID depending on the type of hop IP address. IP addresses not identified as **node** are consider to be a link.

NOTE: If the first hop is a **node**, for LSP resolution to work correctly, **inherit-label-nexthops** must be enabled at either **source-packet-routing** hierarchy level, or at the relevant **segment-list** hierarchy level.

auto-translate— This option must be enabled before a given segment list can use IP addresses instead of SIDs for any hop other than the first hop. In addition, all hops in the segment list must have IP addresses. If any hops on the list have both an IP address and a label configured, the label will be retained. Link addresses are only translated into labels if the preceding node advertises an adjacency SID for the address (otherwise translation fails).

NOTE: In Junos OS Release 19.1R1, for auto-translate to work for OSPF, RSVP for segment routing must be enabled on all participating interfaces.

- **protected**—(Optional) Enable this option to ensure the adjacency SID is eligible to have a backup path, and that a B-flag is set in adjacency SID advertisements. Note that unless **mandatory** is also selected, the choice succeeds regardless.
  - **mandatory**—(Optional) Enable this option to have translation fail if any *unprotected* links are found in the hop-list.

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- **unprotected**—(Optional) Enable this option to ensure that no backup path is calculated for a specific adjacency SID, and that a B-flag is not set in adjacency SID advertisements. Note that unless **mandatory** is also selected, the choice succeeds regardless.
- **mandatory**—(Optional) Enable this option to have translation fail if any *protected* links are found the hop-list.

inherit-label-nexthops—Inherit label next hops for first hop in this segment list that have both IP address and label configured in the first hop.

You can configure the **inherit-label-nexthops** statement globally or individually for each segment list.

The **inherit-label-nexthops** statement takes effect only when the segment list first hop has both IP address and SID label present.

If the **inherit-label-nexthops** is not configured at the **[edit protocols source-packet-routing segment-list]** hierarchy, and the first hop in the segment list has both IP address and label specified, the default behavior is to use the IP address.

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Static Adjacency Segment Identifier for ISIS*
- *Static Segment Routing Label Switched Path*
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916
- *Understanding Static Segment Routing LSP in MPLS Networks*
- *show spring-traffic-engineering*
- *extended-nexthop-color*
- source-routing-path on page 1351
- *sr-preference-override*

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send (Logical Systems Add-Path)

Syntax

```
send {
  path-count number;
  prefix-policy [ policy-names ];
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp group *group-name* family inet unicast add-path],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor address family inet unicast add-path],
[edit protocols bgp group *group-name* family inet unicast add-path],
[edit protocols bgp group *group-name* family inet unicast add-path neighbor address family inet unicast add-path]

Release Information

Statement introduced in Junos OS Release 11.3.

Description

Enable advertisement of multiple paths to a destination, instead of advertising only the active path.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Example: Advertising Multiple BGP Paths to a Destination*

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session (Origin Validation for BGP)

Syntax

```
session address {
  hold-time seconds;
  local-address local-ip-address;
  port port-number;
  preference number;
  record-lifetime seconds;
  refresh-time seconds;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation group group-name],
[edit logical-systems logical-system-name routing-options validation group group-name],
[edit routing-instances instance-name routing-options validation group group-name],
[edit routing-options validation group group-name]
```

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure a TCP session with a resource public key infrastructure (RPKI) cache server. The router-to-cache transport protocol is carried using a TCP session to a configurable port. Caches are organized in groups. The Junos OS implementation supports up to 63 sessions per group and both IPv4 and IPv6 address families.

The maximum number of sessions in a group is two, by default, and is configurable. If the number of sessions in a group exceeds the max-sessions value, the connections are established in order by preference value. A numerically higher preference results in a higher probability for session establishment. The order of session establishment is random among sessions with equal preferences.

Options

address—IP address of the cache server.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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session-mode

Syntax

```
session-mode (automatic | multihop | single-hop);
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 11.1.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure BFD session mode to be single-hop or multihop. By default, BGP uses single-hop BFD sessions if the peer is directly connected to the router's interface. BGP uses multihop BFD sessions if the peer is not directly connected to the router's interface. If the peer session's **local-address** option is configured, the directly connected check is based partly on the source address that would be used for BGP and BFD.

For backward compatibility, you can override the default behavior by configuring the **single-hop** or **multihop** option. Before Junos OS Release 11.1, the behavior was to assume that IBGP peer sessions were multihop.

Options

automatic—Configure BGP to use single-hop BFD sessions if the peer is directly connected to the router's interface, and multihop BFD sessions if the peer is not directly connected to the router's interface

multihop—Configure BGP to use multihop BFD sessions.

single-hop—Configure BGP to use single-hop BFD sessions.

Default: automatic

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- Example: Configuring BFD Authentication for BGP on page 416
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- Example: Configuring BFD Authentication for BGP on page 416
- Understanding BFD Authentication for BGP on page 414

shutdown (Protocols BGP)

Syntax

```
shutdown {
  notify-message notify-message;
}
```

Hierarchy Level

[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced in Junos OS Release 19.1.

Description

Extended BGP administrative shutdown communication. This shutdown communication feature allows configuration, encode, and sending of additional text message along with BGP cease notification to the peer. This feature is useful during maintenance or unstable window.

Options

notify-message—Notification message

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- graceful-shutdown (Protocols BGP) on page 1191

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snmp-options

Syntax snmp-options backward-traps-only-from-established;

Hierarchy Level [edit protocols bgp]

Release Information Statement introduced in Junos OS Release 16.1 for the M Series, MX Series, and T Series.

Description Configure the SNMP options and customize the behavior of BGP-related MIBs. By default, SNMP generates traps when a session moves from a higher state to a lower state. For example, from **Active** to **Idle** or from **Established** to **Idle**. This can result in many uninteresting traps, especially when there are a large number of unconfigured BGP sessions that toggle continuously between**Active** and **Idle** state. Set the **backward-traps-only-from-established** option to eliminate the uninteresting traps, and receive backward trap notifications only when transitioning away from the **Established** state. This can substantially reduce the number of traps sent.

Options **backward-traps-only-from-established**—Limit the generation of traps for backward transitions to session states that are moving from **Established** state only.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Viewing BGP Trace Files on Logical Systems on page 948

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source-packet-routing

Syntax

```
source-packet-routing {
  inherit-label-nexthops;
  lsp-external-controller name;
  maximum-segment-list-depth maximum-segment-list-depth;
  preference preference;
  retry-timer seconds;
  segment-list;
  source-routing-path name;
  sr-preference sr-preference;
  sr-preference-override sr-preference-override;
  telemetry;
  traceoptions;
}
```

Hierarchy Level

```
[edit logical-systems name protocols],
[edit protocols]
```

Release Information

Statement introduced in Junos OS Release 17.4R1 for the MX Series and PTX Series with FPC-PTX-P1-A.
telemetry option introduced in Junos OS Release 18.3R1 for the MX Series and PTX Series with FPC-PTX-P1-A.
inherit-label-nexthops and **retry-timer** statements introduced in Junos OS Release 19.1R1 on MX Series routers.

Description

Enable Source Packet Routing in Networking (SPRING) or segment routing for traffic engineering packets for protocols that support segment routing. For example, you can configure segment routing capability for a BGP address family to steer traffic according to network requirements.

To enable segment routing traffic engineering for a BGP family, configure **segment-routing-te** at the **[edit protocols bgp family inet|inet6] and [edit protocols bgp group *group-name* neighbor *neighbor*family inet|inet6]** hierarchy levels. Also, configure **sr-preference-override** at the **[edit protocols bgp family inet|inet6 source-packet-routing]** hierarchy level. This allows BGP to support segment routing policies and to steer traffic based on the segment list.

A policy action **color: *color-mode*:*color-value*** is configured at the **[edit policy-options community *name*members]** hierarchy level to categorize segment routing traffic. The color value is attached to BGP communities when exporting prefixes from inet-unicast and inet6-unicast address families, which associates a BGP community with a segment routing policy path definition.

Options

inherit-label-nexthops—Inherit label next hops for first hop in all the segment lists.

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When the **inherit-label-nexthops** is configured at the **[edit protocols source-packet-routing]** hierarchy, it is applied globally, and takes precedence over individual **segment-list** level configuration.

For dynamic non-colored static LSPs, that is the PCEP-driven segment routing LSPs, the **inherit-label-nexthops** statement must be enabled globally, as the segment-level configuration is not applied.

lsp-external-controller ***name***—Specify an external path computing entity, typically the network controller.

maximum-segment-list-depth—Specify a maximum segment list depth for segment routing traffic engineering policies.

Default: The default value is 5.

Range: 1 through 16.

preference—Route preference for segment routing traffic engineering routes.

retry-timer—Number of seconds to wait before trying to reconnect to the auto-translate service if the previous attempt failed. Connections may fail if there is no link, or node, for a given IP address, or if the link or node does not have a SID.

Default: 30 seconds

Range: 1 through 600

sr-preference—Specify a preference for static segment routing policies. BGP chooses a segment routing policy with a higher value over policies with lower values.

Range: **0** through **4,294,967,295**

sr-preference-override—Specify a preference override for static segment routing policies that BGP uses to select a segment routing policy. BGP chooses a policy with a higher value over policies with lower values.

Default: The default value is **100**

Range: **0** through**4,294,967,295**

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *show spring-traffic-engineering*
- *extended-nexthop-color*
- segment-list on page 1340
- source-routing-path on page 1351
- *sr-preference-override*
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916
- *Understanding Static Segment Routing LSP in MPLS Networks*

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source-routing-path

Syntax

```
source-routing-path name {
  binding-sid binding-sid;
  color color;
  metric value;
  no-ingress;
  preference preference;
  primary name {
    weight weight;
  }
  secondary name {
    weight weight;
  }
  sr-preference sr-preference;
  to to;
}
```

Hierarchy Level

```
[edit logical-systems name protocols source-packet-routing],
[edit protocols source-packet-routing]
```

Release Information

Statement introduced in Junos OS Release 17.4R1 for MX Series and PTX Series with FPC-PTX-P1-A.

The **metric**, **no-ingress**, and **secondary** statements are introduced in Junos OS Release 18.1R1 for MX Series.

Description

Configure a source routing label switched path (LSP) for steering traffic at an ingress router. Specify a binding segment identifier from the static label range. Configure other parameters such as color, weight, preference, and segment routing SR) preference for traffic engineering.

Starting with Junos OS Release 18.1R1, static non-colored SR label switched paths (LSPs) for protocol SPRING-TE in an MPLS network. Configure parameters such as destination address, binding SIDs, primary segment, secondary segment, metric, and preference. These SR LSPs do not have a color associated with them. If an ingress route is not required for a non-colored SR LSP then the ingress route installation in inet.3 table can be disabled.

Options

name—Specify a name to identify a source routing path.

binding-sid—Specify the binding label to enable transit functionality for this tunnel. For a non-colored static SR LSP, the binding SID label of protocol SPRING-TE have , by default, a preference of 8 and a metric of 1.

NOTE: This is optional for MPLS networks.

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Range: 16 through 1,048,576

color—Specify a color identifier for the tunnel end point.

NOTE: This is only for colored SR LSPs. For non-colored SR LSPs, you do not have to configure the color parameter.

metric—Specify metric for routes downloaded for the non-colored static SR tunnel.

Default:

NOTE: This is the default label range for static LSPs in MPLS networks. You can configure the label range at **[edit protocols mpls label-range static label-range]** hierarchy level.

1000000 through 1048575

Range:

NOTE: This range is for protocol BGP.

1 through 16777215

no-ingress—Disable ingress route that is not required for the non-colored static SR tunnel

preference—Specify the preference for routes downloaded for this tunnel.

primary—Specify a primary segment list for the configured source routing path.

The non-colored static SR LSP can have a maximum of 8 primary paths. incase of multiple operational primary paths, the PFE distributes the traffic over the paths based on the weight configured on the paths. If none of the paths have weights configured then the weights default to 1 making it an ECMP path. the paths become weighted ECMP if the at least one of the paths have a non-zero weight. In both cases , when one or some of the paths fail, the PFE automatically re-balances the traffic over the remaining paths resulting in path protection.

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weight *weight_value*—Specify a percentage of the bandwidth with respect to the sum of weights of all paths for the primary segment list. If forwarding interfaces are also configured with weighted ECMP, then Junos OS applies hierarchical weighted ECMP. If the weight percentage is not configured, then only IGP weights are applied on the forwarding interfaces.

secondary—Specify a secondary segment list for the configured non-colored static SR LSP.

sr-preference—Configure a preference for segment routing routes for traffic engineering. BGP chooses a higher preference over a lower preference value.

Range: **0** through **4,294,967,295**

to—Specify the IP address of the tunnel end-point

The remaining statements are explained separately. Search for a statement in CLI Explorer or click a linked statement in the Syntax section for details..

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *extended-nexthop-color*
- segment-list on page 1340
- source-packet-routing on page 1348
- *sr-preference-override*
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916

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stale-labels-holddown-period

Syntax stale-labels-holddown-period *stale-labels-holddown-period*;

Hierarchy Level [edit fabric protocols bgp],
[edit protocols bgp],
[edit routing-instances *name* protocols bgp]

Release Information Statement introduced in Junos OS Release 16.1R1.

Description Configure a time duration for which the BGP allocated MPLS labels are retained after they go stale. Holding the stale labels without deleting them immediately allows the upstream peers to receive and install the new labeled advertisements. Note that these MPLS stale labels are retained even when MPLS fast reroute (FRR) is not configured.

NOTE: During this hold down period you cannot use the label space for new label allocation, which momentarily reduces the supported label scale. Therefore, we recommend setting an appropriate minimum value as the hold down time period for stale labels.

Options **stale-labels-holddown-period**—Specify a time duration in seconds for which the MPLS labels allocated by BGP are kept after they go stale.

Range: 1 through 600

Required Privilege Level
- routing—To view this statement in the configuration.
- routing-control—To add this statement to the configuration.

Related Documentation
- stale-routes-time on page 1355

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stale-routes-time

Syntax

```
stale-routes-time seconds;
```

Hierarchy Level

```
[edit logical-systems logical-routing-name protocols bgp graceful-restart],
[edit logical-systems logical-routing-name routing-instances routing-instance-name protocols
  bgp graceful-restart],
[edit protocols bgp graceful-restart],
[edit routing-instances routing-instance-name protocols bgp graceful-restart]
```

Release Information

Statement introduced in Junos OS Release 8.3.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 14.1x53-D20 for the OCX Series.

Description

Specify the maximum time that stale routes are kept during a restart. The **stale-routes-time** statement allows you to set the length of time the routing device waits to receive messages from restarting neighbors before declaring them down.

Options

seconds—Time the router device waits to receive messages from restarting neighbors before declaring them down.

Range: 1 through 600 seconds

Default: 300 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *Configuring Graceful Restart for QFabric Systems*
- restart-time (BGP Graceful Restart) on page 1327

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stale-time (Long-Lived Graceful Restart for BGP Restarter)

Syntax stale-time *interval*;

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit protocols bgp family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit protocols bgp group *group-name* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter],
[edit protocols bgp group *group-name* neighbor *address* family (l2vpn | route-target | inet) (labeled-unicast | flow) graceful-restart long-lived restarter]

NOTE: Each routing table is identified by the protocol family or address family indicator (AFI) and a subsequent address family identifier (SAFI). The AFI parameter can be one of the **(l2vpn | inet | route-target)** protocols and the SAFI parameter can be either of the **(flow | labeled-unicast)** protocols for inet family and one of the **(auto-discovery-mspw | auto-discovery-only | signaling)** protcols for L2VPN family..

Configuring LLGR does not require that BGP graceful restart also be configured. The long-lived-graceful-restart section is visible only for families l2vpn, inet labeled-unicast, inet flow and route-target. It is prohibited for inet-mvpn, inet6-mvpn and inet-mdt. It is hidden for other families.

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Release Information Statement introduced in Junos OS Release 15.1 for M Series, MX Series, and T series routers.

Description Specify the period of time for which stale routes must be preserved by using le the long-lived graceful restart capability for BGP sessions on the restarting router. When LLGR restarter is enabled or disabled for a family or the stale- time is changed, the session is reset so that the new capability can be sent to the neighbor. You can configure the stale period for each address family at the logical system or routing instance level.

The stanzas in the per-family graceful-restart long-lived restarter configuration section enables LLGR restarter mode negotiation for BGP globally, or for a group or neighbor. The values are inherited by groups from the global configuration, and by neighbors from the group configuration. The disable attribute is used to override configuration inherited from a higher level. It does not disable LLGR receiver mode; you must disable LLGR receiver mode explicitly for all families as necessary.

In addition, times can also be configured using the following notation: <hours>:<minutes>:<seconds> For example, 12:00:00 specifies twelve hours. The hours and minutes are optional.

The two notations can be combined, for example, 2w1d 12:00:02 specifies two weeks, one day, twelve hours and two seconds (1339202 seconds). (Note that the CLI requires double-quotes around a value like this with spaces in it.) Expressed in this notation, the maximum stale time is 27w5d 04:20:15 (27 weeks, 5 days, 4 hours, 20 minutes and 15 seconds). While the show configuration command displays the actually configured values, when the associated timers are displayed in run-time show commands such as **show bgp neighbor**, the values are normalized, such as 1d36h becoming 2d 12:00:00. The full rules for displaying normalized LLGR times depend on the **clear bgp neighbor neighbor-address gracefully** command configuration.

Options *interval*—Period as a measure of the number of weeks, days, hours, minutes, and seconds for which stale routes must be maintained when long-lived graceful restart mechanism is enabled on the restarter router.

The range of values for stale-time is from 1 to 16777215 (2^24 – 1) seconds. The value is a simple integer giving the number of seconds by default, but it can also be specified using the following notation:

[<weeks>w][<days>d][<hours>h][<minutes>m][<seconds>s]

For example, you can specify 27 days as 27d, 648h, 38880m or 2332800s. 90 minutes can be configured as 1h30m, 90m or 5400s. The specified number of days is multiplied by 86400, the number of hours by 3600 and the number of minutes by 60; these are added to the seconds to get the total. A combined format of days and hours, in different time period units, such as 1d36h are permitted, as long as the specified total does not exceed the maximum stale time.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

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Related Documentation

- *Configuring Graceful Restart Options for BGP*
- *High Availability Feature Guide*

static (Origin Validation for BGP)

Syntax

```
static {
  record destination {
    maximum-length prefix-length {
      origin-autonomous-system as-number {
        validation-state (invalid | valid);
      }
    }
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation],
[edit logical-systems logical-system-name routing-options validation],
[edit routing-instances instance-name routing-options validation],
[edit routing-options validation]
```

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure a static route validation (RV) record.

RV records are received from the cache server using the protocol defined in Internet draft draft-ietf-sidr-rpki-rtr-19, *The RPKI/Router Protocol*, and can also be configured statically, as shown here.

Static records are useful for overwriting the information received from an RPKI cache server.

An RV record matches any route whose prefix matches the RV prefix **record**, whose prefix length does not exceed the **maximum-length** given in the RV record, and whose origin AS equals the **origin-autonomous-system** number given in the RV record.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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station

Syntax

```
station station-name {
  authentication-algorithm (aes-128-cmac-96 | hmac-sha-1-96 | md5);
  authentication-key key;
  authentication-key-chain authentication-key-chain;
  connection-mode (active | passive);
  hold-down {
    seconds;
    flaps flaps;
    period seconds;
  }
  initiation-message text;
  local-address address;
  local-port port;
  monitor (disable | enable);
  priority (high | low | medium);
  routing-instance routing-instance-name;
  route-monitoring {
    none;
    post-policy {
      exclude-non-eligble;
    }
    pre-policy {
      exclude-non-feasible;
    }
  }
  station-address (ip-address | name);
  station-port port-number;
  statistics-timeout seconds;
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag <flag-modifier>;
  }
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit routing-options bmp]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Statement introduced in Junos OS Release 15.1X53-60 and Junos OS Release 17.1R1 for QFX10000 switches.
Statement introduced in Junos OS Release 17.2R1 for QFX5110 and QFX5200 switches.

Description

Specify and configure a BMP monitoring station. Be aware that each BMP monitoring station can use a significant amount of a device's resources. You can configure up to three BMP monitoring stations.

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Options ***station-name***—Specify a name for the BMP station.

The other statements are explained separately.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

station-address

Syntax

```
station-address (address | station-name);
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit routing-options bmp],
[edit rouiting-options bmp station station-name]
```

Release Information Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Statement introduced in Junos OS Release 15.1X53-60 and Junos OS Release 17.1R1 for QFX10000 switches.
Statement introduced in Junos OS Release 17.2R1 for QFX5110 and QFX5200 switches.

Description Specify the name or address for the BMP monitoring station. You can specify one or the other but not both.

Options ***station-address***—Specify the address for the BMP station. The address should be a valid IPv4 or IPv6 address.

station-name—Specify the name for the BMP station.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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station-port

Syntax

```
station-port port;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit routing-options bmp],
[edit rouiting-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Statement introduced in Junos OS Release 15.1X53-60 and Junos OS Release 17.1R1 for QFX10000 switches.
Statement introduced in Junos OS Release 17.2R1 for QFX5110 and QFX5200 switches.

Description

Specify the port number for the BMP monitoring station.

Options

port—Specify the port number for the BMP monitoring station. If the connection-mode statement is configured as **active** a station port number is required. If the **connection-mode** statement is configured as **passive**, you must not configure a station port number.

Range: 1 though 65535

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946
- connection-mode on page 1131

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statistics

Syntax

```
statistics {
  no-ingress;
  no-transit;
}
```

Hierarchy Level

[edit logical-systems *name* protocols source-packet-routing telemetry],
[edit protocols source-packet-routing telemetry]

Release Information

Statement introduced in Junos OS Release 18.3R1 on the MX Series and PTX Series with FPC-PTX-P1-A.

Description

Enable traffic-statistics collection on SR-TE policies through sensors for both SRTE policy next hop and binding segment identifier (SID) installed in the forwarding table, by using JVISION traffic sensors in Junos data plane to stream out traffic statistics on static segment routing policies and their corresponding binding SID routes.

Options

Default: By default statistics collection is disabled for static SRTE routes.

no-ingress—(Optional) Create sensors for binding SID transit routes only.

no-transit—(Optional) Create sensors for SRTE policy next hops and collect statistics on all steering routes that use the SRTE policy as nexthop.

NOTE: **no-ingress and no-transit are mutually exclusive. You cannot disable traffic collection at both destination route and binding SID route.If you enable statistics collection and do not configure one of the two options then the sensors collect traffic statistics steered by all routes that use the SRTE policy as a nexthop and the labeled traffic steered by the binding SID that are installed in the forwarding table.**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- telemetry on page 1367
- source-packet-routing on page 1348
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916

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statistics-timeout

Syntax

```
statistics-timeout seconds;
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-options bmp],
[edit logical-systems logical-system-name routing-options bmp station station-name],
[edit routing-options bmp],
[edit rouiting-options bmp station station-name]
```

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Statement introduced in Junos OS Release 15.1X53-60 and Junos OS Release 17.1R1 for QFX10000 switches.
Statement introduced in Junos OS Release 17.2R1 for QFX5110 and QFX5200 switches.

Description

Specify how often statistics messages are sent to the BMP monitoring station. If you configure a value of 0, no statistics messages are sent.

Options

seconds—Specify the number for the BMP monitoring station.

Default: 3600 seconds

Range: 15 though 65535 seconds

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring BGP Monitoring Protocol Version 3 on page 946

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strip-nexthop

Syntax

```
strip-nexthop;
```

Hierarchy Level

```
[edit protocols bgp family (inet | inet-vpn | inet6 | inet6-vpn) flow],
[edit protocols bgp group group-name family (inet | inet-vpn | inet6 | inet6-vpn) flow],
[edit protocols bgp group group-name neighbor address family (inet | inet-vpn | inet6 |
  inet6-vpn flow)],
[edit routing-instances routing-instance-name protocols bgp family (inet | inet-vpn | inet6 |
  inet6-vpn) flow],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet-vpn | inet6 | inet6-vpn) flow],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address family (inet | inet-vpn | inet6 | inet6-vpn) flow]
```

Release Information

Statement introduced in Junos OS Release 17.2 for MX Series.

Description

Prevents BGP from advertising flow route updates with real nexthop address even when the route is present in the local routing table. When **strip-nexthop** is not configured, Junos advertises the real next hop to its neighbors in order to interoperate with devices that have the capability to accept and advertise real BGP nexthops. You can either propagate the received next hop to an EBGP peer in the case of a route reflector or define a policy to advertise self next hop.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Enabling BGP to Carry Flow-Specification Routes on page 688

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tcp-aggressive-transmission

Syntax

```
tcp-aggressive-transmission;
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *neighbor-address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *neighbor_address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *neighbor-address*]

Release Information

Statement introduced in Junos OS Release 13.3 for the T Series.

Description

Enables a TCP socket option for the affected BGP sessions, which prioritizes pure ACKs and does not exponentially back-off retransmission for couple of retransmissions.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

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tcp-mss (Protocols BGP)

Syntax

```
tcp-mss segment-size;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor
  neighbor-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor neighbor-name],
[edit protocols bgp],
[edit protocol bgp group group-name],
[edit protocols bgp group group-name neighbor neighbor-name],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  neighbor-name]
```

Release Information

Statement introduced in Junos OS Release 8.1.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure the maximum segment size (MSS) for the TCP connection for BGP neighbors.

The MSS is only valid in increments of 2 KB. The value used is based on the value set, but is rounded down to the nearest multiple of 2048.

Options

segment-size—MSS for the TCP connection.

Range: 1 through 4096

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Limiting TCP Segment Size for BGP on page 797

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telemetry

Syntax

```
telemetry {
  statistics{
    no-ingress;
    no-transit;
  }
}
```

Hierarchy Level

[edit logical-systems *name* protocols source-packet-routing],
[edit protocols source-packet-routing]

Release Information

Statement introduced in Junos OS Release 18.3R1 on the MX Series and PTX Series with FPC-PTX-P1-A.

Description

Enable telemetry on segment routing traffic engineering policies at ingress nodes. Junos OS creates the following sensors to collect traffic statistics for segment routing:

- BGP-SRTE policies for ingress routes, sensors are attached to nexthops in inet{6}color.0 table.
- Static SRTE policies for ingress routes, sensors are attached to nexthops in inet{6}color.0 table.
- Transit routes for BGP-SRTE policies in mpls.0 table.
- Transit routes for static SRTE policies in mpls.0 table.

NOTE: If both static SRTE policy and BGP SRTE policy are to present for the same destination and color then only one of them is made active and BSID of the corresponding active policy is programmed to the mpls.0 table. In this case the sensor is attached to BSID of the active policy only.

Options

statistics— Enable collection of traffic statistics on segment routing traffic engineering policies.

Required Privilege Level

routing

Related Documentation

- statistics on page 1362
- source-packet-routing on page 1348
- Segment Routing Traffic Engineering at BGP Ingress Peer Overview on page 916

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threshold (detection-time)

Syntax threshold *milliseconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection detection-time],
[edit protocols bgp bfd-liveness-detection detection-time],
[edit protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection detection-time]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection detection-time],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection detection-time]

Release Information
Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPNs and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

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Description Specify the threshold for the adaptation of the BFD session detection time. When the detection time adapts to a value equal to or greater than the threshold, a single trap and a single system log message are sent.

NOTE: The threshold value must be equal to or greater than the transmit interval.

The threshold time must be equal to or greater than the value specified in the minimum-interval or the minimum-receive-interval statement.

Options ***milliseconds***—Value for the detection time adaptation threshold.

Range: 1 through 255,000

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*

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threshold (transmit-interval)

Syntax threshold *milliseconds*;

Hierarchy Level
[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval],
[edit protocols bgp bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection transmit-interval]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection transmit-interval],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection transmit-interval]

Release Information
Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 12.1 for QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

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Description Specify the threshold for the adaptation of the BFD session transmit interval. When the transmit interval adapts to a value greater than the threshold, a single trap and a single system message are sent.

Options ***milliseconds***—Value for the transmit interval adaptation threshold.

Range: 0 through 4,294,967,295 ($2^{32} - 1$)

NOTE: The threshold value specified in the **threshold** statement must be greater than the value specified in the **minimum-interval** statement for the **transmit-interval** statement.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116

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topology (Protocols BGP)

Syntax

```
topology name {
  community {
    target identifier;
  }
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family (inet | inet6) unicast],
[edit logical-systems logical-system-name protocols bgp group group-name family (inet |
  inet6) unicast],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  family (inet | inet6) unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp family (inet | inet6) unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name family (inet | inet6) unicast],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address family (inet | inet6) unicast],
[edit protocols bgp family (inet | inet6) unicast],
[edit protocols bgp group group-name family (inet | inet6) unicast],
[edit protocols bgp group group-name neighbor address family (inet | inet6) unicast],
[edit routing-instances routing-instance-name protocols bgp family (inet | inet6) unicast],
[edit routing-instances routing-instance-name protocols bgp group group-name family (inet
  | inet6) unicast],
[edit routing-instances routing-instance-name protocols bgp group group-name neighbor
  address family (inet | inet6)]
```

Release Information

Statement introduced in Junos OS Release 9.0.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Enable a topology for BGP multitopology routing. You must first configure one or more topologies under the **[edit routing-options]** hierarchy level.

Apply the community tags to identify the application topologies by configuring a routing topology name and BGP community value.

In Junos OS, multitopology support for BGP is based on the community value in a BGP route. This configuration determines the association between a topology and one or more community values and populates the topology routing tables. Arriving BGP updates that have a matching community value are replicated in the associated topology routing table. You decide which BGP community values are associated with a given topology.

For example, you can create a configuration that causes BGP updates that are received with community value **target:40:40** to be added into topology routing table **:voice.inet.0** (in addition to the default routing table **inet.0**). Likewise, you configuration can specify that updates that are received with community value **target:50:50** are added into topology routing table **:video.inet.0** (in addition to the default routing table **inet.0**).

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Options *name*—Name of a topology you configured at the **[edit routing-options]** hierarchy level to create a topology for a specific type of traffic, such as voice or video.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Example: Configuring Multitopology Routing to Provide Redundancy for Multicast Traffic over Separate Network Paths*
- *Example: Configuring Multitopology Routing for Class-Based Forwarding of Voice, Video, and Data Traffic*
- *Understanding Multitopology Routing for Class-Based Forwarding of Voice, Video, and Data Traffic*
- *Understanding Multitopology Routing in Conjunction with PIM*

traceoptions (Origin Validation for BGP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation],
[edit logical-systems logical-system-name routing-options validation],
[edit routing-instances instance-name routing-options validation],
[edit routing-options validation]
```

Release Information
Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description Configure tracing operations for resource public key infrastructure (RPKI) BGP route validation.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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traceoptions (Protocols BGP)

Syntax

```
traceoptions {
  file filename <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp],
[edit logical-systems *logical-system-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*],
[edit protocols bgp],
[edit protocols bgp group *group-name*],
[edit protocols bgp group *group-name* neighbor *address*],
[edit routing-instances *routing-instance-name* protocols bgp],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name*],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address*]

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
4byte-as statement introduced in Junos OS Release 9.2.
4byte-as statement introduced in Junos OS Release 9.2 for EX Series switches.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure BGP protocol-level tracing options. To specify more than one tracing operation, include multiple flag statements.

NOTE: The **traceoptions** statement is not supported on QFabric systems.

Default

The default BGP protocol-level tracing options are inherited from the routing protocols **traceoptions** statement included at the **[edit routing-options]** hierarchy level. The default group-level trace options are inherited from the BGP protocol-level **traceoptions** statement. The default peer-level trace options are inherited from the group-level **traceoptions** statement.

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Options **disable**—(Optional) Disable the tracing operation. You can use this option to disable a single operation when you have defined a broad group of tracing operations, such as **all**.

file ***name***—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BGP tracing output in the file **bgp-log**.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*.0** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

BGP Tracing Flags

- **4byte-as**—4-byte AS events.
- **bfd**—BFD protocol events.
- **damping**—Damping operations.
- **graceful-restart**—Graceful restart events.
- **keepalive**—BGP keepalive messages. If you enable the the BGP **update** flag only, received keepalive messages do not generate a trace message.
- **nsr-synchronization**—Nonstop routing synchronization events.
- **open**—Open packets. These packets are sent between peers when they are establishing a connection.
- **packets**—All BGP protocol packets.
- **refresh**—BGP refresh packets.
- **update**—Update packets. These packets provide routing updates to BGP systems. If you enable only this flag, received keepalive messages do not generate a trace message. Use the **keepalive** flag to generate a trace message for keepalive messages.

Global Tracing Flags

- **all**—All tracing operations
- **general**—A combination of the **normal** and **route** trace operations
- **normal**—All normal operations

Default: If you do not specify this option, only unusual or abnormal operations are traced.

- **policy**—Policy operations and actions

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- **route**—Routing table changes
- **state**—State transitions
- **task**—Routing protocol task processing
- **timer**—Routing protocol timer processing

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **filter**—Provide filter trace information. Applies only to **route**, **damping**, and **update** tracing flags.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- log-updown on page 1240 statement
- *Tracing Nonstop Active Routing Synchronization Events*
- Understanding Trace Operations for BGP Protocol Traffic on page 946
- *Configuring OSPF Refresh and Flooding Reduction in Stable Topologies*

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traceoptions (Protocols BMP)

Syntax

```
traceoptions {
  file file-name <files number> <size size> <world-readable | no-world-readable>;
  flag flag <flag-modifier> <disable>;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-options bmp],
[edit logical-systems *logical-system-name* routing-options bmp station *station-name*],
[edit routing-options bmp],
[edit rouiting-options bmp station *station-name*]

Release Information

Statement introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Statement introduced in Junos OS Release 13.3.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Configure tracing options for BMP monitoring. To specify more than one tracing operation, include multiple flag statements.

Options

file ***file-name***—Name of the file to receive the output of the tracing operation. Enclose the name within quotation marks. All files are placed in the directory **/var/log**. We recommend that you place BMP tracing output in the file **bmp-log**.

files ***number***—(Optional) Maximum number of trace files. When a trace file named ***trace-file*.0** reaches its maximum size, it is renamed ***trace-file*.0**, then ***trace-file*.1**, and so on, until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum number of files, you must also specify a maximum file size with the **size** option.

Range: 2 through 1000 files

Default: 10 files

flag—Tracing operation to perform. To specify more than one tracing operation, include multiple **flag** statements.

- **all**—Trace all BMP monitoring operations.
- **down**—Down messages.
- **error**—Error conditions.
- **event**—Major events, station establishment, errors, and events.
- **general**—General events.
- **normal**—Normal events.
- **packets**—All messages.
- **policy**—Policy processing.
- **route**—Routing information.

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- **route-monitoring**—Route monitoring messages.
- **state**—State transitions.
- **statistics**—Statistics messages.
- **task**—Routing protocol task processing.
- **timer**—Routing protocol timer processing.
- **up**—Up messages.
- **write**—Writing of messages.

flag-modifier—(Optional) Modifier for the tracing flag. You can specify one or more of these modifiers:

- **detail**—Provide detailed trace information.
- **disable**—Disable the tracing flag.
- **receive**—Trace the packets being received.
- **send**—Trace the packets being transmitted.

no-world-readable—(Optional) Prevent any user from reading the log file.

size *size*—(Optional) Maximum size of each trace file, in kilobytes (KB), megabytes (MB), or gigabytes (GB). When a trace file named ***trace-file*** reaches this size, it is renamed ***trace-file*.0**. When the ***trace-file*** again reaches its maximum size, ***trace-file*.0** is renamed ***trace-file*.1** and ***trace-file*** is renamed ***trace-file*.0**. This renaming scheme continues until the maximum number of trace files is reached. Then, the oldest trace file is overwritten. If you specify a maximum file size, you also must specify a maximum number of trace files with the **files** option.

Syntax: ***x*k** to specify KB, ***x*m** to specify MB, or ***x*g** to specify GB

Range: 10 KB through the maximum file size supported on your system

Default: 128 KB

world-readable—(Optional) Allow any user to read the log file.

Required Privilege Level

routing and trace—To view this statement in the configuration.
routing-control and trace-control—To add this statement to the configuration.

Related Documentation

- Tracing BMP Operations on page 954
- Understanding Trace Operations for BGP Protocol Traffic on page 946
- *Configuring OSPF Refresh and Flooding Reduction in Stable Topologies*

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traffic-statistics (Protocols BGP)

Syntax

```
traffic-statistics {
  labeled-path
  file filename <world-readable | no-world-readable>;
  interval seconds;
}
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family (inet | inet6) labeled-unicast],
[edit logical-systems logical-system-name protocols bgp group group-name family (inet |
  inet6) labeled-unicast],
[edit protocols bgp family (inet | inet6) labeled-unicast],
[edit protocols bgp group group-name family (inet | inet6) labeled-unicast]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 14.1X53-D10 for the QFX Series and for EX4600 switches.
labeled-path introduced in Junos OS Release 18.1R1 for the MX Series.

Description

Enable the collection of traffic statistics for interprovider or carrier-of-carriers VPNs.

Options

file *filename*—Specify a filename for the BGP labeled–unicast traffic statistics file. If you do not specify a filename, statistics are still collected but can only be viewed by using the **show bgp group traffic statistics *group-name*** command.

interval *seconds*—Specify how often BGP labeled-unicast traffic statistics are collected.

labeled-path—Specify this option to collect labeled path traffic statistics of ingress BGP nodes.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BGP to Gather Interprovider and Carrier-of-Carriers VPNs Statistics*
- *MPLS Feature Support on QFX Series and EX4600 Switches*
- Understanding Interprovider and Carrier-of-Carriers VPNs on page 928

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traffic-statistics-labeled-path

Syntax

```
traffic-statistics-labeled-path {
  file filename <files files> <size size> <(world-readable | no-world-readable)>;
  interval seconds;
}
```

Hierarchy Level

[edit fabric protocols bgp],
[edit logical-systems *name* protocols bgp],
[edit logical-systems *name* routing-instances *name* protocols bgp],
[edit protocols bgp],
[edit routing-instances *name* protocols bgp]

Release Information

Statement introduced in Junos OS Release 18.1R1 for the MX Series.

Description

Enable collection of periodic ingress labeled statistics for BGP label-switched paths in a network configured with segment routing. The traffic statistics are collected at a specified time interval and saved in a specified file. To collect traffic statistics of labeled unicast IPv4 and IPv6 families for specific BGP groups, configure the **labeled-path** option under the family or BGP group level at **[edit logical-systems *logical-system-name* protocols bgp group *group-name* family (inet | inet6) labeled-unicast]** hierarchy level.

Options

file *filename*—Specify a filename to collect traffic statistics.

interval—Specify a time interval in seconds to collect traffic statistics.

Range: 60 through **65535** seconds.

size— (Optional) Specify the size of the file that records traffic statistics.

Range: 10240 through **4294967295**

world readable | world unreadable— (Optional) Specify whether the traffic statistics log file is accessible to everyone or not.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Enabling Traffic Statistics Collection for BGP Labeled Unicast on page 923
- show bgp group traffic-statistics on page 1460

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transmit-interval (BFD Liveness Detection)

Syntax

```
transmit-interval {
  minimum-interval milliseconds;
  threshold milliseconds;
}
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.2.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Support for BFD authentication introduced in Junos OS Release 9.6.
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the transmit interval for the **bfd-liveness-detection** statement. The negotiated transmit interval for a peer is the interval between the sending of BFD packets to peers.

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The receive interval for a peer is the minimum time that it requires between packets sent from its peer; the receive interval is not negotiated between peers. To determine the transmit interval, each peer compares its configured minimum transmit interval with its peer's minimum receive interval. The larger of the two numbers is accepted as the transmit interval for that peer.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *Configuring BFD for Layer 2 VPN and VPLS*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- bfd-liveness-detection on page 1116
- threshold on page 1370
- minimum-interval on page 1257
- minimum-receive-interval on page 1259

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ttl (Protocols BGP)

Syntax

```
ttl ttl-value;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp multihop],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name multihop],
[edit logical-systems logical-system-name protocols bgp group group-name
  neighbor address],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor address
  multihop],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp multihop],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name multihop],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name neighbor address multihop],
[edit protocols bgp],
[edit protocols bgp multihop],
[edit protocols bgp group group-name multihop],
[edit protocols bgp group group-name neighbor address],
[edit protocols bgp group group-name neighbor address multihop],
[edit routing-instances routing-instance-name protocols bgp],
[edit routing-instances routing-instance-name protocols bgp multihop],
[edit routing-instances routing-instance-name protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name multihop],
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address]
[edit routing-instances routing-instance-name protocols bgp group group-name
  neighbor address multihop]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.
Support for setting the TTL on single-hop external BGP (EBGP) peers introduced in Junos OS Release 13.3.

Description

Configure the maximum time-to-live (TTL) value for the TTL in the IP header of BGP packets.

For BGP multihop scenarios, in which EBGP peers are not directly connected to each other, setting a TTL is optional. The default setting is 64.

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For BGP single-hop scenarios, in which external EBGP peers are directly connected to each other, you can, optionally, set the TTL to 255 and configure an inbound firewall filter to allow only BGP control packets with the TTL set to 255. This is in accordance with RFC 3682, *The Generalized TTL Security Mechanism (GTSM)*. For example:

Send all BGP control packets with the TTL set to 255:

```
user@host# show protocols
bgp {
   group toAS2 {
      type external;
      peer-as 2;
      ttl 255;
      neighbor 10.1.2.3;
      neighbor 10.3.4.5;
      neighbor 10.5.6.7;
   }
}
```

Accept only BGP control packets that have the TTL set to 255:

```
user@host# show firewall
filter ttl-security {
   term gtsm {
      from {
         source-address {
            10.1.2.3/32;
            10.3.4.5/32;
            10.5.6.7/32;
         }
         protocol tcp;
         ttl-except 255;
         port 179;
      }
      then {
         discard;
      }
   }
   term else {
      then {
         accept;
      }
   }
}
```


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Apply the firewall filter to the inbound interface for the EBGP single-hop peer:

```
user@host# show interfaces
ge-1/0/0 {
   unit 0 {
      family inet {
         filter {
            input gtsm;
         }
      }
   }
}
```

Options

ttl-value—TTL value for BGP packets.

Range: 1 through 255, for multihop peers

Default: 64 (for multihop EBGP sessions, confederations, and IBGP sessions)

Range: 1 or 255, for single-hop peers

Default: 1 (for single-hop EBGP sessions)

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring EBGP Multihop Sessions on page 300
- multihop on page 1264
- no-nexthop-change on page 1283
- https://www.juniper.net/us/en/community/junos/script-automation/library/configuration/ttl-security/

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tunnel-attributes

Syntax

```
tunnel-attributes name{
  dynamic-tunnel-source-prefix dynamic-tunnel-source-prefix;
  dynamic-tunnel-type V4oV6;
  dynamic-tunnel-mtu dynamic-tunnel-mtu;
  dynamic-tunnel-reassembly;
  dynamic-tunnel-anchor-pfe dynamic-tunnel-anchor-pfe
  dynamic-tunnel-anti-spoof (off | on);
}
```

Hierarchy Level

```
[edit logical-systems name routing-instances name routing-options dynamic-tunnels],
[edit logical-systems name routing-options dynamic-tunnels],
[edit routing-instances name routing-options dynamic-tunnels],
[edit routing-options dynamic-tunnels]
```

Release Information Statement introduced in Junos OS Release 17.3R1 on the MX Series.

Description Define dynamic tunnel attributes for transporting IPv4 traffic over an IPv6 network. You can configure multiple tunnels and specify different attributes for each tunnel. Service providers with IPv6 infrastructure can configure individual tunnels for each customer to route IPv4 traffic.

Options

name— Specify a dynamic tunnel name. You can have multiple tunnels configured with different attributes.

dynamic-tunnel-anchor-pfe— Specify a dynamic tunnel anchor PFE name of format pfe-x/y/z.

dynamic-tunnel-anti-spoof— Enable or disable anti-spoofing check.

Values:

Default Dynamic tunnel anti-spoof is enabled by default.

- **off**—Disable anti-spoofing check
- **on**—Enable anti-spoofing check.

dynamic-tunnel-mtu— Specify the dynamic tunnel maximum transmission unit (MTU) value

Range: **296** through **9232**

dynamic-tunnel-source-prefix— Specify the tunnel source address

dynamic-tunnel-type— Specify the tunnel type

Values:

- **V4oV6**— Tunnel type is IPv4 over IPv6

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dynamic-tunnel-reassembly— Enable IPV6 fragment reassembly for forwarding Ipv4 traffic

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- *dynamic-tunnels*
- extended-nexthop on page 1164
- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676

type (Protocols BGP)

Syntax

```
type type;
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name routing-instances routing-instance-name protocols
  bgp group group-name],
[edit protocols bgp group group-name],
[edit routing-instances routing-instance-name protocols bgp group group-name]
```

Release Information

Statement introduced before Junos OS Release 7.4.
Statement introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 11.3 for the QFX Series.

Description

Specify the type of BGP peer group.

When configuring a BGP group, you can indicate whether the group is an IBGP group or an EBGP group. All peers in an IBGP group are in the same AS, while peers in an EBGP group are in different ASs and normally share a subnet.

Options

type—Type of group:

- **external**—External group, which allows inter-AS BGP routing
- **internal**—Internal group, which allows intra-AS BGP routing

Default: If you do not specify the BGP group type or assign a **peer-as**, then Junos OS assigns peer group type **external** by default.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Example: Configuring External BGP Point-to-Point Peer Sessions on page 24
- Example: Configuring Internal BGP Peer Sessions on page 51
- *BGP Feature Guide*

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unconfigured-peer-graceful-restart

Syntax
```
unconfigured-peer-graceful-restart;
```

Hierarchy Level
```
[edit protocols bgp]
```

Release Information Statement introduced in Junos OS Release 14.1.

Description When **set protocols bgp group *group-name* allow network** is configured to accept dynamic BGP sessions, **unconfigured-peer-graceful-restart** statement should be configured to avoid traffic drop during graceful restart or graceful Routing Engine switchover.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

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validation (Origin Validation for BGP)

Syntax

```
validation {
  group group-name {
    max-sessions number;
    session address {
      hold-time seconds;
      local-address local-ip-address;
      port port-number;
      preference number;
      record-lifetime seconds;
      refresh-time seconds;
    }
  }
  static {
    record destination {
      maximum-length prefix-length {
        origin-autonomous-system as-number {
          validation-state (invalid | valid);
        }
      }
    }
  }
  traceoptions {
    file filename <files number> <size size> <world-readable | no-world-readable>;
    flag flag;
  }
```

Hierarchy Level

[edit logical-systems *logical-system-name* routing-instances *instance-name* routing-options],
[edit logical-systems *logical-system-name* routing-options],
[edit routing-instances *instance-name* routing-options],
[edit routing-options]

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure resource public key infrastructure (RPKI) BGP route validation.

The remaining statements are explained separately. See CLI Explorer.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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validation-state (Origin Validation for BGP)

Syntax

```
validation-state (invalid | valid);
```

Hierarchy Level

```
[edit logical-systems logical-system-name routing-instances instance-name routing-options
  validation static record destination maximum-length prefix-length
  origin-autonomous-system as-number],
[edit logical-systems logical-system-name routing-options validation static record destination
  maximum-length prefix-length origin-autonomous-system as-number],
[edit routing-instances instance-name routing-options validation static record destination
  maximum-length prefix-length origin-autonomous-system as-number],
[edit routing-options validation static record destination maximum-length prefix-length
  origin-autonomous-system as-number]
```

Release Information

Statement introduced in Junos OS Release 12.2.
Statement introduced in Junos OS Release 12.3 for ACX Series routers.

Description

Configure the validation state for a route validation record.

Options

invalid—A negative (invalid) validation state. Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database.

valid—A positive (valid) validation state. Indicates that the prefix and AS pair are found in the database.

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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version (BFD Liveness Detection)

Syntax

```
version (0 | 1 | automatic);
```

Hierarchy Level

[edit logical-systems *logical-system-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit logical-systems *logical-system-name* routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit logical-system *logical-system-name* routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection],
[edit protocols bgp bfd-liveness-detection],
[edit protocols bgp group *group-name* bfd-liveness-detection],
[edit protocols bgp group *group-name* neighbor *address* bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols bgp group *group-name* neighbor *address* bfd-liveness-detection]
[edit routing-instances *routing-instance-name* protocols l2vpn oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls mesh-group *mesh-group-name* neighbor *neighbor-id* oam bfd-liveness-detection],
[edit routing-instances *routing-instance-name* protocols vpls oam bfd-liveness-detection]

Release Information

Statement introduced in Junos OS Release 8.1
Statement introduced in Junos OS Release 12.1 for the QFX Series.
Statement introduced in Junos OS Release 13.2 for Layer 2 VPN and VPLS.
Statement introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Specify the BFD version for detection. You can explicitly configure BFD version 0, version 1, or the routing device can automatically detect the BFD version. By default, the routing device automatically detects the BFD version, which is either 0 or 1.

Options

Configure the BFD version to detect: **0** (BFD version 0), **1** (BFD version 1), or **automatic** (autodetect the BFD version)

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Default: automatic

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring BFD for Layer 2 VPN and VPLS*
- Example: Configuring BFD Authentication for BGP on page 416
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- Example: Configuring BFD Authentication for BGP on page 416
- Understanding BFD Authentication for BGP on page 414

vpn-apply-export

Syntax
```
vpn-apply-export;
```

Hierarchy Level
```
[edit logical-systems logical-system-name protocols bgp],
[edit logical-systems logical-system-name protocols bgp group group-name],
[edit logical-systems logical-system-name protocols bgp group group-name neighbor
  neighbor],
[edit protocols bgp],
[edit protocols bgp group group-name],
[edit protocols bgp group group-name neighbor neighbor]
```

Release Information
Statement introduced before Junos OS Release 7.4.

Description
Apply both the VRF export and BGP group or neighbor export policies (VRF first, then BGP) before routes from the **vrf** or **l2vpn** routing tables are advertised to other PE routers.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation
- *Configuring Policies for the VRF Table on PE Routers in VPNs*

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v4ov6

Syntax v4ov6 ipv6-anycast-source-duplication;

Hierarchy Level
[edit logical-systems *name* routing-instances *name* routing-options dynamic-tunnels],
[edit logical-systems *name* routing-options dynamic-tunnels],
[edit logical-systems *name* tenants *name* routing-instances *name* routing-options dynamic-tunnels],
[edit routing-instances *name* routing-options dynamic-tunnels],
[edit routing-options dynamic-tunnels],
[edit tenants *name* routing-instances *name* routing-options dynamic-tunnels]

Description Enable dynamic tunnel V4oV6 mode

Options **ipv6-anycast-source-duplication**—Enable full resolved nh base source-tunnel

Required Privilege Level routing

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withdraw-priority

Syntax

```
withdraw-priority (expedited | priority priority-queue-number (1-16));
```

Hierarchy Level

```
[edit logical-systems logical-system-name protocols bgp family family-name sub-family],
[edit logical-systems logical-system-name protocols bgp group group-name family
  family-name sub-family],
[edit protocols bgp family family-name sub-family],
[edit protocols bgp group group-name family family-name sub-family],
[edit protocols bgp group group-name neighbor neighbor-id family family-name]
```

Release Information

Statement introduced in Junos OS Release 16.1 for the ACX Series, M Series, MX Series, PTX Series, QFabric systems, and QFX Series.

Description

Within BGP route prioritization, the **withdraw-priority** statement allows you to set specific priority levels for BGP routes that are to be withdrawn. The **withdraw-priority** statement can be configured for BGP neighbors during BGP configuration, or for sub-families within the following address families:

- **evpn**
- **inet**
- **inet-mdt**
- **inet-mvpn**
- **inet-vpn**
- **inet6**
- **inet6-mvpn**
- **inet6-vpn**
- **iso-vpn**
- **l2vpn**
- **route-target**
- **traffic-engineering**

Required Privilege Level

routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- output-queue-priority on page 1294
- Understanding BGP Route Prioritization on page 77

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CHAPTER 31

Operational Commands

- clear bfd adaptation
- clear bfd session
- clear bgp damping
- clear bgp neighbor
- clear bgp table
- clear validation database
- clear validation session
- clear validation statistics
- monitor traffic
- request validation policy
- restart
- show bfd session
- show bgp bmp
- show bgp group
- show bgp group output-queues
- show bgp group traffic-statistics
- show bgp neighbor
- show bgp output-scheduler
- show bgp replication
- show bgp replication logical-system
- show bgp summary
- show dynamic-tunnels pfe-tunnel-localization
- show nonstop-routing
- show (ospf | ospf3) bgp-orr
- show policy
- show policy conditions
- show policy damping
- show route

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- show route active-path
- show route advertising-protocol
- show route all
- show route aspath-regex
- show route best
- show route brief
- show route community
- show route community-name
- show route damping
- show route detail
- show route exact
- show route export
- show route extensive
- show route flow validation
- show route forwarding-table
- show route hidden
- show route inactive-path
- show route inactive-prefix
- show route instance
- show route next-hop
- show route no-community
- show route output
- show route protocol
- show route receive-protocol
- show route table
- show route terse
- show security keychain
- show validation database
- show validation group
- show validation replication database
- show validation session
- show validation statistics
- show v4ov6-tunnels
- test policy

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clear bfd adaptation

Syntax

```
clear bfd adaptation
<all>
<address session-address>
<discriminator discr-number>
```

Release Information Command introduced before Junos OS Release 7.4.

Description Clear adaptation for Bidirectional Forwarding Detection (BFD) sessions. BFD is a simple hello mechanism that detects failures in a network. Configured BFD interval timers can change, adapting to network situations. Use this command to return BFD interval timers to their configured values.

The **clear bfd adaptation** command is hitless, meaning that the command does not affect traffic flow on the routing device.

Options

all—Clear adaptation for all BFD sessions.

address *session-address*—(Optional) Clear adaptation for all BFD sessions matching the specified address.

discriminator *discr-number*—(Optional) Clear adaptation for the local BFD session matching the specified discriminator.

Additional Information For more information, see the description of the **bfd-liveness-detection** configuration statement in the *Junos Routing Protocols Configuration Guide*.

Required Privilege Level clear

Related Documentation

- show bfd session on page 1436

List of Sample Output clear bfd adaptation on page 1399

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear bfd adaptation

```
user@host> clear bfd adaptation
```

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clear bfd session

List of Syntax
Syntax on page 1400
Syntax (EX Series Switch and QFX Series) on page 1400

Syntax

```
clear bfd session
<all>
<address session-address>
<discriminator discr-number>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switch and QFX Series)

```
clear bfd session
<all>
<address session-address>
<discriminator discr-number>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 12.1 for the QFX Series.

Description
Drop one or more Bidirectional Forwarding Detection (BFD) sessions.

Options
all—Drop all BFD sessions.

address *session-address*—(Optional) Drop all BFD sessions matching the specified address.

discriminator *discr-number*—(Optional) Drop the local BFD session matching the specified discriminator.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
clear

Related Documentation
- show bfd session on page 1436

List of Sample Output
clear bfd session all on page 1400

Output Fields
When you enter this command, you are provided feedback on the status of your request.

Sample Output

clear bfd session all

```
user@host> clear bfd session all
```


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clear bgp damping

List of Syntax
Syntax on page 1402
Syntax (EX Series Switch and QFX Series) on page 1402

Syntax

```
clear bgp damping
<logical-system (all | logical-system-name)>
<prefix>
```

Syntax (EX Series Switch and QFX Series)

```
clear bgp damping
<prefix>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description
Clear BGP route flap damping information.

Options
none—Clear all BGP route flap damping information.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

prefix—(Optional) Clear route flap damping information for only the specified destination prefix.

Required Privilege Level
clear

Related Documentation
- show policy damping on page 1512
- show route damping on page 1560

List of Sample Output
clear bgp damping on page 1402

Output Fields
This command produces no output.

Sample Output

clear bgp damping

```
user@host> clear bgp damping
```


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clear bgp neighbor

List of Syntax

Syntax on page 1403
Syntax (EX Series Switch and QFX Series) on page 1403

Syntax

```
clear bgp neighbor
<all>
<as as-number>
<gracefully>
<instance instance-name>
<logical-system (all | logical-system-name)>
<malformed-route>
<neighbor>
<soft | soft-inbound>
<soft-minimum-igp>
<stale-routes>
```

Syntax (EX Series Switch and QFX Series)

```
clear bgp neighbor
<all>
<as as-number>
<instance instance-name>
<malformed-route>
<neighbor>
<soft | soft-inbound>
<soft-minimum-igp>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
malformed-route option introduced in Junos OS Release 13.2.
all option introduced in Junos OS Release 14.2.
gracefully and **stale-routes** options introduced in Junos OS Release 15.1.

Description

Perform one of the following tasks:

- Change the state of one or more BGP neighbors to **IDLE**. For neighbors in the **ESTABLISHED** state, this command drops the TCP connection to the neighbors and then reestablishes the connection.
- (**soft** keyword only) Reapply export policies and send refresh updates to one or more BGP neighbors without changing their state.
- (**soft-inbound** keyword only) Send a route-refresh message to one or more BGP neighbors without changing their state, and reapply import policies on the received updates.

Options

all—Change the state of all BGP neighbors to **IDLE**.

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as *as-number*—(Optional) Apply this command only to neighbors in the specified autonomous system (AS).

gracefully—(Optional) Enable the BGP peer to start graceful-restart receiving-speaker mode. The receiving speaker also sends its own routes to the restarted speaker, and sends an End-of-RIB marker when it completes the update. The **clear bgp neighbor *neighbor-address* gracefully** command is the same as **clear bgp neighbor hard** (the default for **clear bgp neighbor**), but it does not use the new Hard Reset subcode on the Notify and Cease messages that are sent. This allows the neighbor to enter GR or LLGR helper mode, if negotiated. The session is still cleared on this router, and this router does not enter GR or LLGR helper mode.

instance *instance-name*—(Optional) Apply this command only to neighbors for the specified routing instance.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

malformed-route—(Optional) Remove malformed routes. If a specific neighbor is provided, Junos OS removes malformed routes for that particular neighbor. Otherwise, Junos OS removes malformed routes for all BGP neighbors. To find routes that have malformed attributes, run the **show route hidden** command, and look for routes marked with **MalformedAttr** in the AS path field.

neighbor—(Optional) IP address of a BGP peer. Apply this command only to the specified neighbor.

soft—(Optional) Reapply any export policies and send refresh updates to neighbors without clearing the state.

soft-inbound—(Optional) Send a route-refresh message to BGP neighbors and reapply import policies on the route updates received from the BGP neighbors without clearing the BGP state.

soft-minimum-igp—(Optional) Provide soft refresh of the outbound state when the interior gateway protocol (IGP) metric is reset.

stale-routes—(Optional) Any stale route currently being held for the specified neighbor because of BGP graceful restart (GR) or long-lived graceful restart (LLGR) receiver mode operations.

Required Privilege Level clear

Related Documentation
- show bgp neighbor on page 1463

List of Sample Output clear bgp neighbor on page 1405

Output Fields When you enter this command, you are provided feedback on the status of your request.

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Sample Output

clear bgp neighbor

```
user@host> clear bgp neighbor
```

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clear bgp table

Syntax

```
clear bgp table table-name
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switch and QFX Series)

```
clear bgp table table-name
```

Release Information

Command introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Request that BGP refresh routes in a specified routing table.

Options

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

table-name—Request that BGP refresh routes in the specified table.

Additional Information

In some cases, a prefix limit is associated with a routing table for a VPN instance. When this limit is exceeded (for example, because of a network misconfiguration), some routes might not be inserted in the table. Such routes need to be added to the table after the network issue is resolved. Use the **clear bgp table** command to request that BGP refresh routes in a VPN instance table.

Required Privilege Level

clear

List of Sample Output

clear bgp table private.inet.0 on page 1406
clear bgp table inet.6 logical-system all on page 1406
clear bgp table private.inet.6 logical-system ls1 on page 1407
clear bgp table logical-system all inet.0 on page 1407
clear bgp table logical-system ls2 private.inet.0 on page 1407

Output Fields

This command produces no output.

Sample Output

clear bgp table private.inet.0

```
user@host> clear bgp table private.inet.0
```

clear bgp table inet.6 logical-system all

```
user@host> clear bgp table inet.6 logical-system all
```


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clear bgp table private.inet.6 logical-system ls1

```
user@host> clear bgp table private.inet.6 logical-system ls1
```

clear bgp table logical-system all inet.0

```
user@host> clear bgp table logical-system all inet.0
```

clear bgp table logical-system ls2 private.inet.0

```
user@host> clear bgp table logical-system ls2 private.inet.0
```

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clear validation database

Syntax

```
clear validation database
<instance instance-name>
<logical-system logical-system-name>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Clear the route validation database.

Options

none—Clear the route validation database for all routing instances.

instance *instance-name*—(Optional) Clear the route validation database for the specified instance.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

Required Privilege Level clear

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output clear validation database on page 1408

Sample Output

clear validation database

```
user@host> clear validation database
Clearing database
```


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clear validation session

Syntax

```
clear validation session
<destination session-ip-address>
<instance instance-name>
<logical-system logical-system-name>
<soft-inbound>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Clear the route validation session to the cache server.

Options

none—Clear all route validation sessions for all routing instances.

destination *session-ip-address*—(Optional) Clear the specified route validation session.

instance *instance-name*—(Optional) Clear the route validation session for the specified instance.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

soft-inbound—(Optional) Rather than flapping the session to the cache server and removing its contents from the database, refresh the session information without removing the database entries.

Required Privilege Level clear

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output clear validation session on page 1409

Sample Output

clear validation session

```
user@host> clear validation session
Cleared 3 sessions
```

clear validation statistics

Syntax

```
clear validation statistics
<instance instance-name>
<logical-system logical-system-name>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Clear the route validation statistics.

Options

none—Clear the route validation statistics for all routing instances.

instance *instance-name*—(Optional) Clear the route validation statistics for the specified instance.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

Required Privilege Level clear

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output clear validation statistics on page 1410

Sample Output

clear validation statistics

```
user@host> clear validation statistics
Statistics cleared
```


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monitor traffic

Syntax

```
monitor traffic
<brief | detail | extensive>
<absolute-sequence>
<count count>
<interface interface-name>
<layer2-headers>
<matching matching>
<no-domain-names>
<no-promiscuous>
<no-resolve>
<no-timestamp>
<print-ascii>
<print-hex>
<read-file filename>
<resolve-timeout>
<size size>
<write-file filename>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Options **read-file** and **write-file** introduced in Junos OS Release 19.1R1.

Description

Display packet headers or packets received and sent from the Routing Engine.

NOTE:

- Using the **monitor-traffic** command can degrade router or switch performance.
- Delays from DNS resolution can be eliminated by using the **no-resolve** option.

NOTE: This command is not supported on the QFabric system.

NOTE: In Junos OS Evolved, if you modify an interface that you are monitoring with the **monitor traffic interface** command, the monitoring session ends with the message: pcap_loop: read: Device not configured. To continue monitoring the interface, rerun the **monitor traffic interface** command. However, if the monitored interface is removed, the command session continues, but there will be no packets or errors reported.

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Options

none—(Optional) Display packet headers transmitted through fxp0. On a TX Matrix Plus router, display packet headers transmitted through em0.

brief | detail | extensive—(Optional) Display the specified level of output.

absolute-sequence—(Optional) Display absolute TCP sequence numbers.

count *count*—(Optional) Specify the number of packet headers to display (0 through 1,000,000). The monitor traffic command quits automatically after displaying the number of packets specified.

interface *interface-name*—(Optional) Specify the interface on which the **monitor traffic** command displays packet data. If no interface is specified, the **monitor traffic** command displays packet data arriving on the lowest-numbered interface.

layer2-headers—(Optional) Display the link-level header on each line.

matching *matching*—(Optional) Display packet headers that match a regular expression. Use matching expressions to define the level of detail with which the **monitor traffic** command filters and displays packet data.

no-domain-names—(Optional) Suppress the display of the domain portion of hostnames. With the **no-domain-names** option enabled, the **monitor traffic** command displays only **team** for the hostname **team.company.net**.

no-promiscuous—(Optional) Do not put the interface into promiscuous mode.

no-resolve—(Optional) Suppress reverse lookup of the IP addresses.

no-timestamp—(Optional) Suppress timestamps on displayed packets.

print-ascii—(Optional) Display each packet in ASCII format.

print-hex—(Optional) Display each packet, except the link-level header, in hexadecimal format.

read-file *filename*—Read packets from the file specified.

resolve-timeout *timeout*—(Optional) Amount of time the router or switch waits for each reverse lookup before timing out. You can set the timeout for 1 through 4,294,967,295 seconds. The default is 4 seconds. To display each packet, use the **print-ascii**, **print-hex**, or **extensive** option.

size *size*—(Optional) Read but do not display up to the specified number of bytes for each packet. When set to **brief** output, the default packet size is 96 bytes and is adequate for capturing IP, ICMP, UDP, and TCP packet data. When set to **detail** and **extensive** output, the default packet size is 1514. The **monitor traffic** command truncates displayed packets if the matched data exceeds the configured size.

write-file *filename*—Write packets to the file specified.

Additional Information

In the **monitor traffic** command, you can specify an expression to match by using the **matching** option and including the expression in quotation marks:

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```
monitor traffic matching "expression"
```

Replace ***expression*** with one or more of the match conditions listed in Table 27 on page 1413.

Table 27: Match Conditions for the monitor traffic Command

Match Type	Condition	Description
Entity	**host** [*address* | *hostname*]	Matches packets that contain the specified address or hostname. The protocol match conditions **arp**, **ip**, or **rarp**, or any of the directional match conditions can be prepended to the **host** match condition.
	net *address*	Matches packets with source or destination addresses containing the specified network address.
	net *address* **mask** *mask*	Matches packets containing the specified network address and subnet mask.
	port (*port-number* | *port-name*)	Matches packets containing the specified source or destination TCP or UDP port number or port name. In place of the numeric port address, you can specify a text synonym, such as **bgp** (179), **dhcp** (67), or **domain** (53) (the port numbers are also listed).
Directional	**dst**	Matches packets going to the specified destination. This match condition can be prepended to any of the entity type match conditions.
	src	Matches packets from a specified source. This match condition can be prepended to any of the entity type match conditions.
	src and **dst**	Matches packets that contain the specified source and destination addresses. This match condition can be prepended to any of the entity type match conditions.
	src or **dst**	Matches packets containing either of the specified addresses. This match condition can be prepended to any of the entity type match conditions.
Packet Length	**less** *value*	Matches packets shorter than or equal to the specified value, in bytes.
	greater *value*	Matches packets longer than or equal to the specified value, in bytes.

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Table 27: Match Conditions for the monitor traffic Command (continued)

Match Type	Condition	Description
Protocol	**amt**	Matches all AMT packets. Use the extensive level of output to decode the inner IGMP packets in addition to the AMT outer packet.
	arp	Matches all ARP packets.
	ether	Matches all Ethernet packets.
	ether (broadcast | multicast)	Matches broadcast or multicast Ethernet frames. This match condition can be prepended with**src** and **dst**.
	ether *protocol* **(***address* **| (arp | ip | rarp))**	Matches packets with the specified Ethernet address or Ethernet packets of the specified protocol type. The **ether protocol** arguments **arp**, **ip**, and **rarp** are also independent match conditions, so they must be preceded by a backslash (\) when used in the **ether protocol** match condition.
	icmp	Matches all ICMP packets.
	ip	Matches all IP packets.
	ip (broadcast | multicast)	Matches broadcast or multicast IP packets.
	ip protocol (*address* **| (icmp | igrp | tcp | udp))**	Matches packets with the specified address or protocol type. The **ip protocol** arguments **icmp**, **tcp**, and **udp** are also independent match conditions, so they must be preceded by a backslash (\) when used in the **ip protocol** match condition.
	isis	Matches all IS-IS routing messages.
	proto *ip-protocol-number*	Matches packets whose headers contain the specified IP protocol number.
	rarp	Matches all RARP packets.
	tcp	Matches all TCP datagrams.
	udp	Matches all UDP datagrams.

To combine expressions, use the logical operators listed in Table 28 on page 1415.

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Table 28: Logical Operators for the monitor traffic Command

Logical Operator (Highest to Lowest Precedence)	Description
!	Logical NOT. If the first condition does not match, the next condition is evaluated.
&&	Logical AND. If the first condition matches, the next condition is evaluated. If the first condition does not match, the next condition is skipped.
||	Logical OR. If the first condition matches, the next condition is skipped. If the first condition does not match, the next condition is evaluated.
( )	Group operators to override default precedence order. Parentheses are special characters, each of which must be preceded by a backslash (\).

You can use relational operators to compare arithmetic expressions composed of integer constants, binary operators, a length operator, and special packet data accessors. The arithmetic expression matching condition uses the following syntax:

```
monitor traffic matching "ether[0] & 1 != 0""arithmetic_expression relational_operator
  arithmetic_expression"
```

The packet data accessor uses the following syntax:

```
protocol [byte-offset <size>]
```

The optional *size* field represents the number of bytes examined in the packet header. The available values are**1**, **2**, or **4** bytes. The following sample command captures all multicast traffic:

```
user@host> monitor traffic matching "ether[0] & 1 != 0"
```

To specify match conditions that have a numeric value, use the arithmetic and relational operators listed in Table 29 on page 1416.

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NOTE: Because the Packet Forwarding Engine removes Layer 2 header information before sending packets to the Routing Engine:

- The **monitor traffic** command cannot apply match conditions to inbound traffic.
- The **monitor traffic interface** command also cannot apply match conditions for Layer 3 and Layer 4 packet data, resulting in the **match** pipe option (**| match**) for this command for Layer 3 and Layer 4 packets not working either. Therefore, ensure that you specify match conditions as described in this command summary. For more information about match conditions, see Table 27 on page 1413.
- The 802.1Q VLAN tag information included in the Layer 2 header is removed from all inbound traffic packets. Because the **monitor traffic interface ae[*x*]** command for aggregated Ethernet interfaces (such as) only shows inbound traffic data, the command does not show VLAN tag information in the output.

Table 29: Arithmetic and Relational Operators for the monitor traffic Command

Arithmetic or Relational Operator	Description
Arithmetic Operator	
+	Addition operator.
-	Subtraction operator.
/	Division operator.
&	Bitwise AND.
*	Bitwise exclusive OR.
|	Bitwise inclusive OR.
Relational Operator (Highest to Lowest Precedence)	
<=	If the first expression is less than or equal to the second, the packet matches.
>=	If the first expression is greater than or equal to the second, the packet matches.
<	If the first expression is less than the second, the packet matches.
>	If the first expression is greater than the second, the packet matches.
=	If the compared expressions are equal, the packet matches.

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Table 29: Arithmetic and Relational Operators for the monitor traffic Command (continued)

Arithmetic or Relational Operator	Description
!=	If the compared expressions are unequal, the packet matches.

Required Privilege Level trace
maintenance

List of Sample Output

monitor traffic count on page 1417
monitor traffic detail count on page 1417
monitor traffic extensive (Absolute Sequence) on page 1418
monitor traffic extensive (Relative Sequence) on page 1418
monitor traffic extensive count on page 1418
monitor traffic interface on page 1419
monitor traffic matching on page 1419
monitor traffic (TX Matrix Plus Router) on page 1419
monitor traffic (QFX3500 Switch) on page 1420
monitor traffic matching icmp on page 1421
monitor traffic matching IP protocol number on page 1421
monitor traffic matching arp on page 1422
monitor traffic matching port on page 1422
monitor traffic read-files on page 1422
monitor traffic write-file on page 1423

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

monitor traffic count

```
user@host> monitor traffic count 2
listening on fxp0
04:35:49.814125  In my-server.home.net.1295 > my-server.work.net.telnet: . ack
4122529478 win 16798 (DF)
04:35:49.814185
Out my-server.work.net.telnet > my-server.home.net.1295: P
1:38(37) ack 0 win 17680 (DF) [tos 0x10]
```

monitor traffic detail count

```
user@host> monitor traffic detail count 2
listening on fxp0
04:38:16.265864  In my-server.home.net.1295 > my-server.work.net.telnet: . ack
4122529971 win 17678 (DF) (ttl 121, id 6812)
04:38:16.265926
```

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```
Out my-server.work.net.telnet.telnet > my-server.home.net.1295: P 1:38(37) ack 0
 win 17680 (DF) [tos 0x10]  (ttl 6)
```

monitor traffic extensive (Absolute Sequence)

user@host> **monitor traffic extensive no-domain-names no-resolve no-timestamp count 20 matching "tcp" absolute-sequence**

```
listening on fxp0
 In 203.0.113.193.179 > 192.168.4.227.1024: . 4042780859:4042780859(0)
ack 1845421797 win 16384 <nop,nop,timestamp 4935628 965951> [tos 0xc0]  (ttl )
 In 203.0.113.193.179 > 192.168.4.227.1024: P 4042780859:4042780912(53)
ack 1845421797 win 16384
<nop,nop,timestamp 4935628 965951>:
BGP [|BGP UPDAT)
In 192.168.4.227.1024 > 203.0.113.193.179:
P 1845421797:1845421852(55) ack 4042780912 win 16384 <nop,nop,timestamp 965951
4935628>: BGP [|BGP UPDAT)
...
```

monitor traffic extensive (Relative Sequence)

user@host> **monitor traffic extensive no-domain-names no-resolve no-timestamp count 20 matching "tcp"**

```
listening on fxp0
 In 172.24.248.221.1680 > 192.168.4.210.23: . 396159737:396159737(0)
ack 1664980689 win 17574 (DF) (ttl 121, id 50003)
Out 192.168.4.210.23 > 172.24.248.221.1680: P 1:40(39)
ack 0 win 17680 (DF) [tos 0x10]  (ttl 64, id 5394)
 In 203.0.113.193.179 > 192.168.4.227.1024: P 4042775817:4042775874(57)
ack 1845416593 win 16384 <nop,nop,timestamp 4935379 965690>: BGP [|BGP UPDAT)
...
```

monitor traffic extensive count

monitor traffic extensive count 5 no-domain-names no-resolve

```
listening on fxp013:18:17.406933
In 192.168.4.206.2723610880 > 172.17.28.8.2049:
40 null (ttl 64, id 38367)13:18:17.407577
In 172.17.28.8.2049 > 192.168.4.206.2723610880:
reply ok 28 null (ttl 61, id 35495)13:18:17.541140
In 0:e0:1e:42:9c:e0 0:e0:1e:42:9c:e0 9000 60:
0000 0100 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 0000 0000
0000 0000 000013:18:17.591513
In 172.24.248.156.4139 > 192.168.4.210.23:
3556964918:3556964918(0)
ack 295526518 win 17601 (DF)
(ttl 121, id 14)13:18:17.591568
Out 192.168.4.210.23 >
172.24.248.156.4139: P 1:40(39)
ack 0 win 17680 (DF) [tos 0x10]
```


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```
(ttl 64, id 52376)
```

monitor traffic interface

```
user@host> monitor traffic interface fxp0
listening on fxp0.0
18:17:28.800650  In server.home.net.723 > host1-0.lab.home.net.log
18:17:28.800733 Out host2-0.lab.home.net.login > server.home.net.7
18:17:28.817813  In host30.lab.home.net.syslog > host40.home0
18:17:28.817846  In host30.lab.home.net.syslog > host40.home0
...
```

monitor traffic matching

```
user@host> monitor traffic matching "net 192.168.1.0/24"
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on fxp0, capture size 96 bytes

Reverse lookup for 192.168.1.255 failed (check DNS reachability).
Other reverse lookup failures will not be reported.
Use no-resolve to avoid reverse lookups on IP addresses.

21:55:54.003511  In IP truncated-ip - 18 bytes missing!
192.168.1.17.netbios-ns > 192.168.1.255.netbios-ns: UDP, length 50
21:55:54.003585 Out IP truncated-ip - 18 bytes missing!
192.168.1.17.netbios-ns > 192.168.1.255.netbios-ns: UDP, length 50
21:55:54.003864  In arp who-has 192.168.1.17 tell 192.168.1.9
...
```

monitor traffic (TX Matrix Plus Router)

```
user@host> monitor traffic
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on em0, capture size 96 bytes
04:11:59.862121 Out IP truncated-ip - 25 bytes missing!
summit-em0.example.net.syslog > sv-log-01.example.net.syslog:
SYSLOG kernel.info, length: 57
04:11:59.862303
Out IP truncated-ip - 25 bytes missing!
summit-em0.example.net.syslog >
sv-log-02.example.net.syslog: SYSLOG kernel.info, length: 57
04:11:59.923948
In IP aj-em0.example.net.65235 >
summit-em0.example.net.telnet: .
ack 1087492766 win 33304 <nop,nop,timestamp 42366734 993490>
04:11:59.923983 Out IP truncated-ip - 232 bytes missing!
summit-em0.example.net.telnet > aj-em0.example.net.65235: P 1:241(240) ack 0 win
 33304
<nop,nop,timestamp 993590 42366734>
04:12:00.022900
In IP aj-em0.exmaple.net.65235 >
```

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```
summit-em0.example.net.telnet: . ack 241 win 33304 <nop,nop,timestamp 42366834
993590>
04:12:00.141204
In IP truncated-ip - 40 bytes missing!
ipg-lnx-shell1.example.net.46182 > summit-em0.example.net.telnet: P
2950530356:2950530404(48) ack 485494987 win 63712
<nop,nop,timestamp 1308555294 987086>
04:12:00.141345
Out IP summit-em0.example.net.telnet >
ipg-lnx-shell1.example.net.46182: P 1:6(5)
ack 48 win 33304
<nop,nop,timestamp 993809 1308555294>
04:12:00.141572
In IP ipg-lnx-shell1.example.net.46182 >
summit-em0.example.net.telnet: .
ack 6 win 63712
<nop,nop,timestamp 1308555294 993809>
04:12:00.141597
Out IP summit-em0.example.net.telnet >
ipg-lnx-shell1.example.net.46182: P 6:10(4) ack 48 win 33304
<nop,nop,timestamp 993810 1308555294>
04:12:00.141821
In IP ipg-lnx-shell1.example.net.46182 >
summit-em0.exmaple.net.telnet: .
ack 10 win 63712 <nop,nop,timestamp 1308555294 993810>
04:12:00.141837 Out IP truncated-ip - 2 bytes missing!
summit-em0.example.net.telnet >
ipg-lnx-shell1.example.net.46182: P 10:20(10) ack 48 win 33304
<nop,nop,timestamp 993810 1308555294>
04:12:00.142072
In IP ipg-lnx-shell1.example.net.46182 >
summit-em0.example.net.telnet: . ack 20 win 63712
<nop,nop,timestamp 1308555294 993810>
04:12:00.142089 Out IP summit-em0.example.net.telnet >
ipg-lnx-shell1.example.net.46182: P 20:28(8) ack 48 win 33304 <nop,nop,timestamp
 993810 1308555294>
04:12:00.142321
In IP ipg-lnx-shell1.exmample.net.46182 >
summit-em0.englab.example.net.telnet: .
ack 28 win 63712 <nop,nop,timestamp 1308555294 993810>
04:12:00.142337
Out IP truncated-ip - 1 bytes missing!
summit-em0.example.net.telnet >
ipg-lnx-shell.example.net.46182: P 28:37(9) ack 48 win 33304 <nop,nop,timestamp
993810 1308555294>
...
```

monitor traffic (QFX3500 Switch)

```
user@switch> monitor traffic
```

```
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on me4, capture size 96 bytes
Reverse lookup for 172.22.16.246 failed (check DNS reachability).
Other reverse lookup failures will not be reported.
Use <no-resolve> to avoid reverse lookups on IP addresses.
16:35:32.240873 Out IP truncated-ip - 112 bytes missing! labqfx-me0.example.net.ssh
 >
```


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```
172.22.16.246.telefinder: P 4200727624:4200727756(132) ack 2889954831 win 65535
16:35:32.240900 Out IP truncated-ip - 176 bytes missing! labqfx-me0.example.net.ssh
 >
172.22.16.246.telefinder: P 132:328(196) ack 1 win 65535
...
```

monitor traffic matching icmp

```
user@host> monitor traffic matching "icmp" no-resolve
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is OFF.
Listening on me0, capture size 96 bytes

09:23:17.728737  In IP 172.19.10.9 > 10.10.211.93: ICMP echo request, id 1, seq
322, length 40
09:23:17.728780 Out IP 10.10.211.93 > 172.19.10.9: ICMP echo reply, id 1, seq
322, length 40
09:23:18.735848  In IP 172.19.10.9 > 10.10.211.93: ICMP echo request, id 1, seq
323, length 40
09:23:18.735891 Out IP 10.10.211.93 > 172.19.10.9: ICMP echo reply, id 1, seq
323, length 40
09:23:19.749732  In IP 172.19.10.9 > 10.10.211.93: ICMP echo request, id 1, seq
324, length 40
09:23:19.749775 Out IP 10.10.211.93 > 172.19.10.9: ICMP echo reply, id 1, seq
324, length 40
09:23:20.749747  In IP 172.19.10.9 > 10.10.211.93: ICMP echo request, id 1, seq
325, length 40
09:23:20.749791 Out IP 10.10.211.93 > 172.19.10.9: ICMP echo reply, id 1, seq
325, length 40
...
```

monitor traffic matching IP protocol number

```
user@host> monitor traffic matching "proto 89" no-resolve
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is OFF.
Listening on me0, capture size 96 bytes

13:06:14.700311  In IP truncated-ip - 16 bytes missing! 10.94.211.254 > 224.0.0.
5: OSPFv2, Hello, length 56
13:06:16.067010  In IP truncated-ip - 20 bytes missing! 10.94.211.102 > 224.0.0.
5: OSPFv2, Hello, length 60
13:06:16.287566  In IP truncated-ip - 20 bytes missing! 10.94.211.142 > 224.0.0.
5: OSPFv2, Hello, length 60
13:06:20.758500  In IP truncated-ip - 16 bytes missing! 10.200.211.254 > 224.0.0
.5: OSPFv2, Hello, length 56
13:06:24.309882  In IP truncated-ip - 20 bytes missing! 10.94.211.102 > 224.0.0.
5: OSPFv2, Hello, length 60
13:06:24.396699  In IP truncated-ip - 16 bytes missing! 10.94.211.254 > 224.0.0.
5: OSPFv2, Hello, length 56
13:06:25.067386  In IP truncated-ip - 20 bytes missing! 10.94.211.142 > 224.0.0.
5: OSPFv2, Hello, length 60
13:06:29.499988  In IP truncated-ip - 16 bytes missing! 10.200.211.254 > 224.0.0
.5: OSPFv2, Hello, length 56
13:06:32.858753  In IP truncated-ip - 20 bytes missing! 10.94.211.102 > 224.0.0.
5: OSPFv2, Hello, length 60
...
```

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monitor traffic matching arp

user@host> monitor traffic matching “arp” no-resolve

```
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is OFF.
Listening on me0, capture size 96 bytes

11:57:54.664501  In arp who-has 10.10.213.109 (00:1f:d5:f3:28:30) tell 10.10.213.31
11:57:56.828387  In arp who-has 10.10.213.233 (00:24:9d:06:77:4f) tell 10.10.213.31
11:58:01.735803  In arp who-has 10.10.213.251 (88:e0:f4:1d:41:40) tell 10.10.213.31
11:58:04.663241  In arp who-has 10.10.213.254 tell 10.94.211.170
11:58:28.488191  In arp who-has 10.10.213.149 (00:e0:91:c2:ff:8d) tell 10.10.213.31
11:58:41.858612  In arp who-has 10.10.213.148 tell 10.94.211.254
11:58:42.621533  In arp who-has 10.10.213.254 (5f:5e:ac:79:49:81) tell 10.10.213.31
11:58:44.533391  In arp who-has 10.10.213.186 tell 10.94.211.254
11:58:45.170405  In arp who-has 10.10.213.186 tell 10.94.211.254
11:58:45.770512  In arp who-has 10.10.213.186 tell 10.94.211.254
```

monitor traffic matching port

user@host> monitor traffic matching “port 22” no-resolve

```
verbose output suppressed, use <detail> or <extensive> for full protocol decode
Address resolution is OFF.
Listening on me0, capture size 96 bytes

13:14:19.108089  In IP 192.0.2.22.56714 > 10.19.300.05.22: S
2210742342:2210742342(0) win 65535 <mss 1360,nop,wscale 7,nop,nop,sackOK>
13:14:19.108165 Out IP 10.19.300.05.22 > 192.0.2.22.56714: S 23075150:23075150(0)
 ack 2210742343 win 65535 <mss 1460,nop,wscale 1,sackOK,eol>
13:14:19.136883  In IP 192.0.2.22.56714 > 10.19.300.05.22: . ack 1 win 32768
13:14:19.231364 Out IP truncated-ip - 1 bytes missing! 10.19.300.05.22 >
172.29.102.9.56714: P 1:22(21) ack 1 win 33320
13:14:19.260174  In IP truncated-ip - 10 bytes missing! 192.0.2.22.56714 >
10.94.211.93.22: P 1:31(30) ack 22 win 32767
13:14:19.284865 Out IP truncated-ip - 964 bytes missing! 10.19.300.05.22 >
172.29.102.9.56714: P 22:1006(984) ack 31 win 33320
13:14:19.314549  In IP truncated-ip - 652 bytes missing! 192.0.2.22.56714 >
10.94.211.93.22: P 31:703(672) ack 1006 win 32760
13:14:19.414135 Out IP 10.19.300.05.22 > 192.0.2.22.56714: . ack 703 win 33320
13:14:19.443858  In IP 192.0.2.22.56714 > 10.19.300.05.22: P 703:719(16) ack 1006
 win 32760
13:14:19.467379 Out IP truncated-ip - 516 bytes missing! 10.19.300.05.22 >
172.29.102.9.56714: P 1006:1542(536) ack 719 win 33320
13:14:19.734097  In IP 192.0.2.22.56714 > 10.19.300.05.22: . ack 1542 win 32768
13:14:19.843574  In IP truncated-ip - 508 bytes missing! 192.0.2.22.56714 >
10.94.211.93.22: P 719:1247(528) ack 1542 win 32768
...
```

monitor traffic read-files

user@host> monitor traffic read-file tcpdump_20_7_18.pcap

```
15:20:42.597413 Out IP 128.0.0.1.6234 > 128.0.0.17.37217: . ack 1416364513 win
65535 <nop,nop,timestamp 2494269906 347794433>
15:20:42.597424 Out IP 128.0.0.1.6234 > 128.0.0.16.49400: . ack 3549610340 win
65535 <nop,nop,timestamp 2494269906 347799892>
15:20:42.598214 Out IP truncated-ip - 32 bytes missing! 128.0.0.1.6234 >
128.0.0.16.49400: P 0:40(40) ack 1 win 65535 <nop,nop,timestamp 2494269907
```


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```
347799892>
                            0001 0000 0020 0000
```

monitor traffic write-file

user@host> **monitor traffic write-file *filename***

```
Address resolution is ON. Use <no-resolve> to avoid any reverse lookup delay.
Address resolution timeout is 4s.
Listening on em1, capture size 96 bytes

^C
955 packets received by filter
0 packets dropped by kernel
```

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request validation policy

Syntax

```
request validation policy
<instance instance-name>
<logical-system logical-system-name>
<record ip-prefix>
```

Release Information Command introduced in Junos OS Release 12.2.

Description When BGP origin validation is configured, manually request a route validation record policy to be reevaluated. This command causes dependent route validation records to be reevaluated. Dependent route validation records are exactly matching and more specific records.

Options

none—Request a policy reevaluation of all dependent route validation records.

instance *instance-name*—(Optional) Request a policy reevaluation of all dependent route validation records for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

record *ip-prefix*—(Optional) Request a policy reevaluation of all route validation records that match a given prefix.

Required Privilege Level maintenance

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output request validation policy on page 1424

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

request validation policy

```
user@host> request validation policy
Enqueued 1 IPv4 records
Enqueued 0 IPv6 records
```


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restart

List of Syntax

Syntax on page 1425
Syntax (ACX Series Routers) on page 1425
Syntax (EX Series Switches) on page 1425
Syntax (MX Series Routers) on page 1426
Syntax (QFX Series) on page 1426
Syntax (Routing Matrix) on page 1426
Syntax (TX Matrix Routers) on page 1427
Syntax (TX Matrix Plus Routers) on page 1427
Syntax (QFX Series) on page 1427

Syntax

```
restart
<adaptive-services |ancpd-service | application-identification |audit-process |
  auto-configuration |captive-portal-content-delivery |ce-l2tp-service |chassis-control |
  class-of-service |clksyncd-service |database-replication|datapath-trace-service
  |dhcp-service | diameter-service | disk-monitoring | dynamic-flow-capture |
  ecc-error-logging | ethernet-connectivity-fault-management
  |ethernet-link-fault-management |event-processing | firewall |
  general-authentication-service | gracefully | iccp-service |idp-policy | immediately
  |interface-control | ipsec-key-management | kernel-health-monitoring | kernel-replication
  | l2-learning | l2cpd-service | l2tp-service | l2tp-universal-edge | lacp | license-service
  |link-management |local-policy-decision-function |mac-validation |mib-process |
  mountd-service |mpls-traceroute |mspd | multicast-snooping |named-service | nfsd-service
  | packet-triggered-subscribers |peer-selection-service |pgm | pic-services-logging |
  pki-service |ppp | ppp-service | pppoe | protected-system-domain-service |
  redundancy-interface-process | remote-operations | root-system-domain-service | routing
  <logical-system logical-system-name> | sampling | sbc-configuration-process | sdk-service
  |service-deployment | services | snmp |soft |static-subscribers |statistics-service|
  subscriber-management | subscriber-management-helper | tunnel-oamd |usb-control|
  vrrp |web-management>
<gracefully | immediately | soft>
```

Syntax (ACX Series Routers)

```
restart
<adaptive-services |audit-process | auto-configuration | autoinstallation |chassis-control |
  class-of-service |clksyncd-service |database-replication| dhcp-service | diameter-service
  | disk-monitoring | dynamic-flow-capture | ethernet-connectivity-fault-management |
  ethernet-link-fault-management |event-processing | firewall |
  general-authentication-service | gracefully | immediately |interface-control |
  ipsec-key-management | l2-learning | lacp |link-management |mib-process | mountd-service
  |mpls-traceroute |mspd | named-service | nfsd-service | pgm | pki-service | ppp | pppoe |
  redundancy-interface-process | remote-operations | routing | sampling | sdk-service
  |secure-neighbor-discovery | service-deployment | services | snmp |soft | statistics-service|
  subscriber-management | subscriber-management-helper | tunnel-oamd | vrrp>
```

Syntax (EX Series Switches)

```
restart
<autoinstallation | chassis-control | class-of-service | database-replication | dhcp |
  dhcp-service | diameter-service | dot1x-protocol | ethernet-link-fault-management |
  ethernet-switching | event-processing | firewall | general-authentication-service |
```

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```
  interface-control | kernel-health-monitoring | kernel-replication | l2-learning | lacp |
  license-service | link-management | lldpd-service | mib-process | mountd-service |
  multicast-snooping | pgm | redundancy-interface-process | remote-operations | routing |
  secure-neighbor-discovery | service-deployment | sflow-service | snmp | vrrp |
  web-management>
```

Syntax (MX Series Routers)

```
restart
<adaptive-services | ancpd-service | application-identification | audit-process |
  auto-configuration | bbe-stats-service | captive-portal-content-delivery | ce-l2tp-service
  | chassis-control | class-of-service | clksyncd-service | database-replication |
  datapath-trace-service | dhcp-service | diameter-service | disk-monitoring |
  dynamic-flow-capture | ecc-error-logging | ethernet-connectivity-fault-management |
  ethernet-link-fault-management | event-processing | firewall |
  general-authentication-service | gracefully | iccp-service | idp-policy | immediately
  |interface-control | ipsec-key-management |kernel-health-monitoring | kernel-replication
  | l2-learning | l2cpd-service | l2tp-service | l2tp-universal-edge | lacp | license-service |
  link-management | local-policy-decision-function | mac-validation | mib-process |
  mountd-service | mpls-traceroute | mspd | multicast-snooping |named-service | nfsd-service
  | packet-triggered-subscribers |peer-selection-service | pgm | pic-services-logging |
  pki-service | ppp | ppp-service | pppoe | protected-system-domain-service |
  redundancy-interface-process | remote-operations | root-system-domain-service | routing
  | routing <logical-system logical-system-name> | sampling | sbc-configuration-process |
  sdk-service | service-deployment | services | snmp |soft |static-subscribers
  |statistics-service| subscriber-management | subscriber-management-helper | tunnel-oamd
  | usb-control | vrrp | web-management>
<all-members>
<gracefully | immediately | soft>
<local>
<member member-id>
```

Syntax (QFX Series)

```
restart
<adaptive-services | audit-process | chassis-control | class-of-service | dialer-services |
  diameter-service | dlsw | ethernet-connectivity | event-processing | fibre-channel | firewall
  | general-authentication-service | igmp-host-services | interface-control |
  ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process |
  named-service | network-access-service | nstrace-process | pgm | ppp | pppoe |
  redundancy-interface-process | remote-operations |logical-system-name> | routing |
  sampling |secure-neighbor-discovery | service-deployment | snmp | usb-control |
  web-management>
<gracefully | immediately | soft>
```

Syntax (Routing Matrix)

```
restart
<adaptive-services | audit-process | chassis-control | class-of-service | disk-monitoring |
  dynamic-flow-capture | ecc-error-logging | event-processing | firewall | interface-control
  | ipsec-key-management | kernel-replication | l2-learning | l2tp-service | lacp |
  link-management | mib-process | pgm | pic-services-logging | ppp | pppoe |
  redundancy-interface-process | remote-operations | routing <logical-system
  logical-system-name> | sampling | service-deployment | snmp>
<all | all-lcc | lcc number>
<gracefully | immediately | soft>
```


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Syntax (TX Matrix Routers)

```
restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service |
  diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging |
  event-processing | firewall | interface-control | ipsec-key-management | kernel-replication
  | l2-learning | l2tp-service | lacp | link-management | mib-process |pgm | pic-services-logging
  | ppp | pppoe | redundancy-interface-process | remote-operations | routing <logical-system
  logical-system-name>  | sampling | service-deployment | snmp| statistics-service>
<all-chassis | all-lcc | lcc number | scc>
<gracefully | immediately | soft>
```

Syntax (TX Matrix Plus Routers)

```
restart
<adaptive-services | audit-process | chassis-control | class-of-service | dhcp-service |
  diameter-service | disk-monitoring | dynamic-flow-capture | ecc-error-logging |
  event-processing | firewall | interface-control | ipsec-key-management | kernel-replication
  | l2-learning | l2tp-service | lacp | link-management | mib-process | pgm |
  pic-services-logging | ppp | pppoe | redundancy-interface-process | remote-operations |
  routing <logical-system logical-system-name>  | sampling | service-deployment | snmp|
  statistics-service>
<all-chassis | all-lcc | all-sfc | lcc number | sfc number>
<gracefully | immediately | soft>
```

Syntax (QFX Series)

```
restart
<adaptive-services | audit-process | chassis-control | class-of-service | dialer-services |
  diameter-service | dlsw | ethernet-connectivity | event-processing | fibre-channel | firewall
  | general-authentication-service | igmp-host-services | interface-control |
  ipsec-key-management | isdn-signaling | l2ald | l2-learning | l2tp-service | mib-process |
  named-service | network-access-service | nstrace-process | pgm | ppp | pppoe |
  redundancy-interface-process | remote-operations |logical-system-name>  | routing |
  sampling |secure-neighbor-discovery | service-deployment | snmp | usb-control |
  web-management>
<gracefully | immediately | soft>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.1 for the QFX Series.
Command introduced in Junos OS Release 12.2 for ACX Series routers.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
Options added:

- **dynamic-flow-capture** in Junos OS Release 7.4.
- **dlsw** in Junos OS Release 7.5.
- **event-processing** in Junos OS Release 7.5.
- **ppp** in Junos OS Release 7.5.
- **l2ald** in Junos OS Release 8.0.
- **link-management** in Junos Release 8.0.
- **pgcp-service** in Junos OS Release 8.4.

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- **sbc-configuration-process** in Junos OS Release 9.5.
- **services pgcp gateway** in Junos OS Release 9.6.
- **sfc** and **all-sfc** for the TX Matrix Router in Junos OS Release 9.6.
- **bbe-stats-service** in Junos OS Release 18.4R1 on MX Series routers.
- **kernel-health-monitoring** in Junos OS Release 19.1R1.

Description Restart a Junos OS process.

CAUTION: Never restart a software process unless instructed to do so by a customer support engineer. A restart might cause the router or switch to drop calls and interrupt transmission, resulting in possible loss of data.

Options **none**—Same as **gracefully**.

adaptive-services—(Optional) Restart the configuration management process that manages the configuration for stateful firewall, Network Address Translation (NAT), intrusion detection services (IDS), and IP Security (IPsec) services on the Adaptive Services PIC.

all-chassis—(TX Matrix and TX Matrix Plus routers only) (Optional) Restart the software process on all chassis.

all-lcc—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process on all T640 routers connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process on all T1600 routers connected to the TX Matrix Plus router.

all-members—(MX Series routers only) (Optional) Restart the software process for all members of the Virtual Chassis configuration.

all-sfc—(TX Matrix Plus routers only) (Optional) For a TX Matrix Plus router, restart the software processes for the TX Matrix Plus router (or switch-fabric chassis).

ancpd-service—(Optional) Restart the Access Node Control Protocol (ANCP) process, which works with a special Internet Group Management Protocol (IGMP) session to collect outgoing interface mapping events in a scalable manner.

application-identification—(Optional) Restart the process that identifies an application using intrusion detection and prevention (IDP) to allow or deny traffic based on applications running on standard or nonstandard ports.

audit-process—(Optional) Restart the RADIUS accounting process that gathers statistical data that can be used for general network monitoring, analyzing, and tracking usage patterns, for billing a user based on the amount of time or type of services accessed.

auto-configuration—(Optional) Restart the Interface Auto-Configuration process.

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autoinstallation—(EX Series switches only) (Optional) Restart the autoinstallation process.

bbe-stats-service—(MX Series routers only) (Optional) Restart bbe-statsd, the BBE statistics collection and management process.

captive-portal-content-delivery—(Optional) Restart the HTTP redirect service by specifying the location to which a subscriber's initial Web browser session is redirected, enabling initial provisioning and service selection for the subscriber.

ce-l2tp-service—(M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Universal Edge Layer 2 Tunneling Protocol (L2TP) process, which establishes L2TP tunnels and Point-to-Point Protocol (PPP) sessions through L2TP tunnels.

chassis-control—(Optional) Restart the chassis management process.

class-of-service—(Optional) Restart the class-of-service (CoS) process, which controls the router's or switch's CoS configuration.

clksyncd-service—(Optional) Restart the external clock synchronization process, which uses synchronous Ethernet (SyncE).

database-replication—(EX Series switches and MX Series routers only) (Optional) Restart the database replication process.

datapath-trace-service—(Optional) Restart the packet path tracing process.

dhcp—(EX Series switches only) (Optional) Restart the software process for a Dynamic Host Configuration Protocol (DHCP) server. A DHCP server allocates network IP addresses and delivers configuration settings to client hosts without user intervention.

dhcp-service—(Optional) Restart the Dynamic Host Configuration Protocol process.

dialer-services—(EX Series switches only) (Optional) Restart the ISDN dial-out process.

diameter-service—(Optional) Restart the diameter process.

disk-monitoring—(Optional) Restart disk monitoring, which checks the health of the hard disk drive on the Routing Engine.

dlsw—(QFX Series only) (Optional) Restart the data link switching (DLSw) service.

dot1x-protocol—(EX Series switches only) (Optional) Restart the port-based network access control process.

dynamic-flow-capture—(Optional) Restart the dynamic flow capture (DFC) process, which controls DFC configurations on Monitoring Services III PICs.

ecc-error-logging—(Optional) Restart the error checking and correction (ECC) process, which logs ECC parity errors in memory on the Routing Engine.

ethernet-connectivity-fault-management—(Optional) Restart the process that provides IEEE 802.1ag Operation, Administration, and Management (OAM) connectivity fault

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management (CFM) database information for CFM maintenance association end points (MEPs) in a CFM session.

ethernet-link-fault-management—(EX Series switches and MX Series routers only) (Optional) Restart the process that provides the OAM link fault management (LFM) information for Ethernet interfaces.

ethernet-switching—(EX Series switches only) (Optional) Restart the Ethernet switching process.

event-processing—(Optional) Restart the event process (eventd).

fibre-channel—(QFX Series only) (Optional) Restart the Fibre Channel process.

firewall—(Optional) Restart the firewall management process, which manages the firewall configuration and enables accepting or rejecting packets that are transiting an interface on a router or switch.

general-authentication-service—(EX Series switches and MX Series routers only) (Optional) Restart the general authentication process.

gracefully—(Optional) Restart the software process.

iccp-service—(Optional) Restart the Inter-Chassis Communication Protocol (ICCP) process.

idp-policy—(Optional) Restart the intrusion detection and prevention (IDP) protocol process.

immediately—(Optional) Immediately restart the software process.

interface-control—(Optional) Restart the interface process, which controls the router's or switch's physical interface devices and logical interfaces.

ipsec-key-management—(Optional) Restart the IPsec key management process.

isdn-signaling—(QFX Series only) (Optional) Restart the ISDN signaling process, which initiates ISDN connections.

kernel-health-monitoring—(Optional) Restart the Routing Engine kernel health monitoring process, which enables health parameter data to be sent from kernel components to data collection applications. When you change the polling interval through **sysctl kern.jkhmd_polling_time_secs**, you must restart the kernel health monitoring process for the new polling interval to take effect.

kernel-replication—(Optional) Restart the kernel replication process, which replicates the state of the backup Routing Engine when graceful Routing Engine switchover (GRES) is configured.

l2-learning—(Optional) Restart the Layer 2 address flooding and learning process.

l2cpd-service—(Optional) Restart the Layer 2 Control Protocol process, which enables features such as Layer 2 protocol tunneling and nonstop bridging.

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l2tp-service— (M10, M10i, M7i, and MX Series routers only) (Optional) Restart the Layer 2 Tunneling Protocol (L2TP) process, which sets up client services for establishing Point-to-Point Protocol (PPP) tunnels across a network and negotiating Multilink PPP if it is implemented.

l2tp-universal-edge—(MX Series routers only) (Optional) Restart the L2TP process, which establishes L2TP tunnels and PPP sessions through L2TP tunnels.

lacp—(Optional) Restart the Link Aggregation Control Protocol (LACP) process. LACP provides a standardized means for exchanging information between partner systems on a link to allow their link aggregation control instances to reach agreement on the identity of the LAG to which the link belongs, and then to move the link to that LAG, and to enable the transmission and reception processes for the link to function in an orderly manner.

lcc *number*—(TX Matrix and TX Matrix Plus routers only) (Optional) For a TX Matrix router, restart the software process for a specific T640 router that is connected to the TX Matrix router. For a TX Matrix Plus router, restart the software process for a specific router that is connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

license-service—(EX Series switches only) (Optional) Restart the feature license management process.

link-management— (TX Matrix and TX Matrix Plus routers and EX Series switches only) (Optional) Restart the Link Management Protocol (LMP) process, which establishes and maintains LMP control channels.

lldpd-service—(EX Series switches only) (Optional) Restart the Link Layer Discovery Protocol (LLDP) process.

local—(MX Series routers only) (Optional) Restart the software process for the local Virtual Chassis member.

local-policy-decision-function— (Optional) Restart the process for the Local Policy Decision Function, which regulates collection of statistics related to applications and application groups and tracking of information about dynamic subscribers and static interfaces.

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mac-validation— (Optional) Restart the Media Access Control (MAC) validation process, which configures MAC address validation for subscriber interfaces created on demux interfaces in dynamic profiles on MX Series routers.

member *member-id*—(MX Series routers only) (Optional) Restart the software process for a specific member of the Virtual Chassis configuration. Replace ***member-id*** with a value of **0** or **1**.

mib-process—(Optional) Restart the Management Information Base (MIB) version II process, which provides the router's MIB II agent.

mobile-ip—(Optional) Restart the Mobile IP process, which configures Junos OS Mobile IP features.

mountd-service—(EX Series switches and MX Series routers only) (Optional) Restart the service for NFS mount requests.

mpls-traceroute—(Optional) Restart the MPLS Periodic Traceroute process.

mspd—(Optional) Restart the Multiservice process.

multicast-snooping—(EX Series switches and MX Series routers only) (Optional) Restart the multicast snooping process, which makes Layer 2 devices, such as VLAN switches, aware of Layer 3 information, such as the media access control (MAC) addresses of members of a multicast group.

named-service—(Optional) Restart the DNS Server process, which is used by a router or a switch to resolve hostnames into addresses.

network-access-service—(QFX Series only) (Optional) Restart the network access process, which provides the router's Challenge Handshake Authentication Protocol (CHAP) authentication service.

nfsd-service—(Optional) Restart the Remote NFS Server process, which provides remote file access for applications that need NFS-based transport.

packet-triggered-subscribers—(Optional) Restart the packet-triggered subscribers and policy control (PTSP) process, which allows the application of policies to dynamic subscribers that are controlled by a subscriber termination device.

peer-selection-service—(Optional) Restart the Peer Selection Service process.

pgcp-service—(Optional) Restart the pgcpd service process running on the Routing Engine. This option does not restart pgcpd processes running on mobile station PICs. To restart pgcpd processes running on mobile station PICs, use the **services pgcp gateway** option.

pgm—(Optional) Restart the process that implements the Pragmatic General Multicast (PGM) protocol for assisting in the reliable delivery of multicast packets.

pic-services-logging—(Optional) Restart the logging process for some PICs. With this process, also known as fsad (the file system access daemon), PICs send special logging information to the Routing Engine for archiving on the hard disk.

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pki-service—(Optional) Restart the PKI Service process.

ppp—(Optional) Restart the Point-to-Point Protocol (PPP) process, which is the encapsulation protocol process for transporting IP traffic across point-to-point links.

ppp-service—(Optional) Restart the Universal edge PPP process, which is the encapsulation protocol process for transporting IP traffic across universal edge routers.

pppoe—(Optional) Restart the Point-to-Point Protocol over Ethernet (PPPoE) process, which combines PPP that typically runs over broadband connections with the Ethernet link-layer protocol that allows users to connect to a network of hosts over a bridge or access concentrator.

protected-system-domain-service—(Optional) Restart the Protected System Domain (PSD) process.

redundancy-interface-process—(Optional) Restart the ASP redundancy process.

remote-operations—(Optional) Restart the remote operations process, which provides the ping and traceroute MIBs.

root-system-domain-service—(Optional) Restart the Root System Domain (RSD) service.

routing—(ACX Series routers, QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the routing protocol process.

routing <logical-system *logical-system-name*>—(Optional) Restart the routing protocol process, which controls the routing protocols that run on the router or switch and maintains the routing tables. Optionally, restart the routing protocol process for the specified logical system only.

sampling—(Optional) Restart the sampling process, which performs packet sampling based on particular input interfaces and various fields in the packet header.

sbc-configuration-process—(Optional) Restart the session border controller (SBC) process of the border signaling gateway (BSG).

scc—(TX Matrix routers only) (Optional) Restart the software process on the TX Matrix router (or switch-card chassis).

sdk-service—(Optional) Restart the SDK Service process, which runs on the Routing Engine and is responsible for communications between the SDK application and Junos OS. Although the SDK Service process is present on the router, it is turned off by default.

secure-neighbor-discovery—(QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the secure Neighbor Discovery Protocol (NDP) process, which provides support for protecting NDP messages.

sfc *number*—(TX Matrix Plus routers only) (Optional) Restart the software process on the TX Matrix Plus router (or switch-fabric chassis). Replace ***number*** with **0**.

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service-deployment—(Optional) Restart the service deployment process, which enables Junos OS to work with the Session and Resource Control (SRC) software.

services—(Optional) Restart a service.

services pgcp gateway *gateway-name*—(Optional) Restart the pgcpd process for a specific border gateway function (BGF) running on an MS-PIC. This option does not restart the pgcpd process running on the Routing Engine. To restart the pgcpd process on the Routing Engine, use the **pgcp-service** option.

sflow-service—(EX Series switches only) (Optional) Restart the flow sampling (sFlow technology) process.

snmp—(Optional) Restart the SNMP process, which enables the monitoring of network devices from a central location and provides the router's or switch's SNMP master agent.

soft—(Optional) Reread and reactivate the configuration without completely restarting the software processes. For example, BGP peers stay up and the routing table stays constant. Omitting this option results in a graceful restart of the software process.

static-subscribers—(Optional) Restart the static subscribers process, which associates subscribers with statically configured interfaces and provides dynamic service activation and activation for these subscribers.

statistics-service—(Optional) Restart the process that manages the Packet Forwarding Engine statistics.

subscriber-management—(Optional) Restart the Subscriber Management process.

subscriber-management-helper—(Optional) Restart the Subscriber Management Helper process.

tunnel-oamd—(Optional) Restart the Tunnel OAM process, which enables the Operations, Administration, and Maintenance of Layer 2 tunneled networks. Layer 2 protocol tunneling (L2PT) allows service providers to send Layer 2 protocol data units (PDUs) across the provider's cloud and deliver them to Juniper Networks EX Series Ethernet Switches that are not part of the local broadcast domain.

usb-control—(MX Series routers) (Optional) Restart the USB control process.

vrrp—(ACX Series routers, EX Series switches, and MX Series routers only) (Optional) Restart the Virtual Router Redundancy Protocol (VRRP) process, which enables hosts on a LAN to make use of redundant routing platforms on that LAN without requiring more than the static configuration of a single default route on the hosts.

web-management—(QFX Series, EX Series switches, and MX Series routers only) (Optional) Restart the Web management process.

Required Privilege Level reset

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Related Documentation
- *Overview of Junos OS CLI Operational Mode Commands*

List of Sample Output restart interface-control gracefully on page 1435

Output Fields When you enter this command, you are provided feedback on the status of your request.

Sample Output

restart interface-control gracefully

```
user@host> restart interface-control gracefully
Interface control process started, pid 41129
```

show bfd session

List of Syntax

Syntax on page 1436
Syntax (EX Series Switch and QFX Series) on page 1436

Syntax

```
show bfd session
<brief | detail | extensive | summary>
<address address>
<client rsvp-oam (brief | detail | extensive | summary) | vpls-oam (brief | detail | extensive |
  instance instance-name | summary)>
<discriminator discriminator>
<logical-system (all | logical-system-name)>
<prefix address>
<subscriber (address destination-address | discriminator discriminator | extensive)>
```

Syntax (EX Series Switch and QFX Series)

```
show bfd session
<brief | detail | extensive | summary>
<address address>
<client rsvp-oam (brief | detail | extensive | summary) | vpls-oam (brief | detail | extensive |
  instance instance-name | summary)>
<discriminator discriminator>
<prefix address>
```

Release Information

Command introduced before Junos OS Release 7.4.
Options **discriminator** and **address** introduced in Junos OS Release 8.2.
Option **prefix** introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 12.1 for the QFX Series.
Option **client** introduced in Junos OS Release 12.3R3.
Option **subscriber** introduced in Junos OS Release 15.1 for the MX Series.

Description

Display information about active Bidirectional Forwarding Detection (BFD) sessions.

Options

none—(Same as **brief**) Display information about active BFD sessions.

brief | detail | extensive | summary—(Optional) Display the specified level of output.

address *address*—(Optional) Display information about the BFD session for the specified neighbor address.

client rsvp-oam
(brief | detail | extensive | summary)
| vpls-oam
(brief | detail | extensive | instance *instance-name* | summary)—(Optional) Display information about RSVP-OAM or VPLS-OAM BFD sessions in the specified level of output. For VPLS-OAM, display the specified level of output or display information about all of the BFD sessions for the specified VPLS routing instance.

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discriminator ***discriminator***—(Optional) Display information about the BFD session using the specified local discriminator.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

<subscriber (address *destination-address* | discriminator *discriminator* | extensive)>—(Optional) Display information about all BFD sessions for subscribers, or for a single BFD subscriber session with a particular destination address, or with a particular denominator.

Required Privilege Level

view

Related Documentation

- clear bfd session on page 1400
- *Understanding BFD for Static Routes for Faster Network Failure Detection*
- *Example: Configuring BFD for Static Routes for Faster Network Failure Detection*
- *Understanding BFD for OSPF*
- *Example: Configuring BFD for OSPF*
- Understanding BFD for BGP on page 403
- Example: Configuring BFD on Internal BGP Peer Sessions on page 404
- *Understanding Bidirectional Forwarding Detection Authentication for PIM*
- *Configuring BFD for PIM*
- *Understanding BFD for IS-IS*

List of Sample Output

show bfd session on page 1441
show bfd session brief on page 1442
show bfd session detail on page 1442
show bfd session detail (with Authentication) on page 1442
show bfd session address extensive on page 1442
show bfd session client rsvp-oam on page 1443
show bfd session client vpls-oam summary on page 1443
show bfd session client vpls-oam instance instance-name on page 1443
show bfd session extensive on page 1443
show bfd session extensive (with Authentication) on page 1444
show bfd session summary on page 1445
show bfd session subscriber on page 1445
show bfd session subscriber address on page 1445
show bfd session subscriber extensive on page 1445
show bfd session subscriber discriminator extensive on page 1446

Output Fields

Table 30 on page 1438 describes the output fields for the **show bfd session** command. Output fields are listed in the approximate order in which they appear.

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Table 30: show bfd session Output Fields

Field Name	Field Description	Level of Output
Address	Address on which the BFD session is active.	**brief detail extensive** none
State	State of the BFD session: **Up**, **Down**, **Init** (initializing), or **Failing**.	**brief detail extensive** none
Interface	Interface on which the BFD session is active.	**brief detail extensive** none
Detect Time	Negotiated time interval, in seconds, used to detect BFD control packets.	**brief detail extensive** none
Transmit Interval	Time interval, in seconds, used by the transmitting system to send BFD control packets.	**brief detail extensive** none
Multiplier	Negotiated multiplier by which the time interval is multiplied to determine the detection time for the transmitting system.	**detail extensive**
Session up time	How long a BFD session has been established.	**detail extensive**
Client	Protocol or process for which the BFD session is active: **ISIS**, **OSPF**, **DHCP**, **Static**, or **VGD**.	**detail extensive**
TX interval	Time interval, in seconds, used by the host system to transmit BFD control packets.	**brief detail extensive** none
RX interval	Time interval, in seconds, used by the host system to receive BFD control packets.	**brief detail extensive** none
Authenticate	Indicates that BFD authentication is configured.	**detail extensive**
keychain	Name of the security authentication keychain being used by a specific client. BFD authentication information for a client is provided in a single line and includes the **keychain**, **algo**, and **mode** parameters. Multiple clients can be configured on a BFD session.	**extensive**
algo	BFD authentication algorithm being used for a specific client: **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**. BFD authentication information for a client is provided in a single line and includes the **keychain**, **algo**, and **mode** parameters. Multiple clients can be configured on a BFD session.	**extensive**

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Table 30: show bfd session Output Fields (continued)

Field Name	Field Description	Level of Output
mode	Level of BFD authentication enforcement being used by a specific client: **strict** or **loose**. Strict enforcement indicates that authentication is configured at both ends of the session (the default). Loose enforcement indicates that one end of the session might not be authenticated. BFD authentication information for a client is provided in a single line and includes the **keychain**, **algo**, and **mode** parameters. Multiple clients can be configured on a BFD session.	**extensive**
Local diagnostic	Local diagnostic information about failing BFD sessions. Following are the expected values for Local Diagnostic output field: • **None**—No diagnostic • **CtlExpire**—Control detection time expired • **EchoExpire**—Echo detection time expired • **NbrSignal**—Neighbor signalled session down • **FwdPlaneReset**—Forwarding plane reset • **PathDown**—Path down • **ConcatPathDown**—Concatenated path down • **AdminDown**—Administratively down	**detail extensive**
Remote diagnostic	Remote diagnostic information about failing BFD sessions. Following are the expected values for Remote Diagnostic output field: • **None**—No diagnostic • **CtlExpire**—Control detection time expired • **EchoExpire**—Echo detection time expired • **NbrSignal**—Neighbor signalled session down • **FwdPlaneReset**—Forwarding plane reset • **PathDown**—Path down • **ConcatPathDown**—Concatenated path down • **AdminDown**—Administratively down	**detail extensive**
Remote state	Reports whether the remote system's BFD packets have been received and whether the remote system is receiving transmitted control packets.	**detail extensive**
Version	BFD version: **0** or **1**.	**extensive**
Replicated	The **replicated** flag appears when nonstop routing or graceful Routing Engine switchover is configured and the BFD session has been replicated to the backup Routing Engine.	**detail extensive**
Min async interval	Minimum amount of time, in seconds, between asynchronous control packet transmissions across the BFD session.	**extensive**
Min slow interval	Minimum amount of time, in seconds, between synchronous control packet transmissions across the BFD session.	**extensive**

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Table 30: show bfd session Output Fields (continued)

Field Name	Field Description	Level of Output
Adaptive async TX interval	Transmission interval being used because of adaptation.	**extensive**
RX interval	Minimum required receive interval.	**extensive**
Local min TX interval	Minimum amount of time, in seconds, between control packet transmissions on the local system.	**extensive**
Local min RX interval	Minimum amount of time, in seconds, between control packet detections on the local system.	**extensive**
Remote min TX interval	Minimum amount of time, in seconds, between control packet transmissions on the remote system.	**extensive**
Remote min TX interval	Minimum amount of time, in seconds, between control packet detections on the remote system.	**extensive**
Threshold transmission interval	Threshold for notification if the transmission interval increases.	**extensive**
Threshold for detection time	Threshold for notification if the detection time increases.	**extensive**
Local discriminator	Authentication code used by the local system to identify that BFD session.	**extensive**
Remote discriminator	Authentication code used by the remote system to identify that BFD session.	**extensive**
Echo mode	Information about the state of echo transmissions on the BFD session.	**extensive**
Prefix	LDP FEC address associated with the BFD session.	All levels
Egress, Destination	Displays the LDP FEC destination address. This field is displayed only on a router at the egress of an LDP FEC, where the BFD session has an LDP Operation, Administration, and Maintenance (OAM) client.	All levels
Remote is control-plane independent	The BFD session on the remote peer is running on its Packet Forwarding Engine. In this case, when the remote node undergoes a graceful restart, the local peer can help the remote peer with the graceful restart. The following BFD sessions are not distributed to the Packet Forwarding Engine: tunnel-encapsulated sessions, and sessions over integrated routing and bridging (IRB) interfaces.	**extensive**

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Table 30: show bfd session Output Fields (continued)

Field Name	Field Description	Level of Output
Authentication	Summary status of BFD authentication: • **status**—**enabled/active** indicates authentication is configured and active. **enabled/inactive** indicates authentication is configured but not active. This only occurs when the remote end of the session does not support authentication and loose checking is configured. • **keychain**—Name of the security authentication keychain associated with the specified BFD session. • **algo**—BFD authentication algorithm being used: **keyed-md5**, **keyed-sha-1**, **meticulous-keyed-md5**, **meticulous-keyed-sha-1**, or **simple-password**. • **mode**—Level of BFD authentication enforcement: **strict** or **loose**. Strict enforcement indicates authentication is configured at both ends of the session (the default). Loose enforcement indicates that one end of the session might not be authenticated. This information is only shown if BFD authentication is configured.	**extensive**
Session ID	The BFD session ID number that represents the protection using MPLS fast reroute (FRR) and loop-free alternate (LFA).	**detail extensive**
sessions	Total number of active BFD sessions.	All levels
clients	Total number of clients that are hosting active BFD sessions.	All levels
Cumulative transmit rate	Total number of BFD control packets transmitted per second on all active sessions.	All levels
Cumulative receive rate	Total number of BFD control packets received per second on all active sessions.	All levels
Multi-hop, min-recv-TTL	Minimum time to live (TTL) accepted if the session is configured for multihop.	**extensive**
route table	Route table used if the session is configured for multihop.	**extensive**
local address	Local address of the source used if the session is configured for multihop. The source IP address for outgoing BFD packets from the egress side of an MPLS BFD session is based on the outgoing interface IP address.	**extensive**

Sample Output

show bfd session

```
user@host> show bfd session

                                                   Transmit
Address                 State     Interface     Detect Time  Interval  Multiplier
10.9.1.33               Up        so-7/1/0.0          0.600     0.200       3
10.9.1.29               Up        ge-4/0/0.0          0.600     0.200       3
```

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```
2 sessions, 2 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

show bfd session brief

The output for the **show bfd session brief** command is identical to that for the **show bfd session** command.

show bfd session detail

```
user@host> show bfd session detail
                                                  Transmit
Address              State     Interface     Detect Time  Interval  Multiplier
10.9.1.33            Up        so-7/1/0.0          0.600     0.200      3
  Client OSPF, TX interval 0.200, RX interval 0.200, multiplier 3
  Session up time 3d 00:34:02
  Local diagnostic None, remote diagnostic None
  Remote state Up, version 1
  Replicated
10.9.1.29            Up        ge-4/0/0.0          0.600     0.200      3
  Client ISIS L2, TX interval 0.200, RX interval 0.200, multiplier 3
  Session up time 3d 00:29:04, previous down time 00:00:01
  Local diagnostic NbrSignal, remote diagnostic AdminDown
  Remote state Up, version 1

2 sessions, 2 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

show bfd session detail (with Authentication)

```
user@host> show bfd session detail
                                                  Transmit
Address              State     Interface     Detect Time  Interval  Multiplier
10.9.1.33            Up        so-7/1/0.0          0.600     0.200      3
  Client OSPF, TX interval 0.200, RX interval 0.200, multiplier 3, Authenticate
  Session up time 3d 00:34:18
  Local diagnostic None, remote diagnostic None
  Remote state Up, version 1
  Replicated
10.9.1.29            Up        ge-4/0/0.0          0.600     0.200      3
  Client ISIS L2, TX interval 0.200, RX interval 0.200, multiplier 3
  Session up time 3d 00:29:12, previous down time 00:00:01
  Local diagnostic NbrSignal, remote diagnostic AdminDown
  Remote state Up, version 1

2 sessions, 2 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

show bfd session address extensive

```
user@host> show bfd session 10.255.245.212 extensive
                                                  Transmit
Address              State     Interface     Detect Time  Interval  Multiplier
10.255.245.212       Up                          1.200     0.400      3
  Client Static, TX interval 0.400, RX interval 0.400, multiplier 3
```


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```
  Session up time 00:17:03, previous down time 00:00:14
  Local diagnostic CtlExpire, remote diagnostic NbrSignal
  Remote state Up, version 1
  Replicated
  Min async interval 0.400, min slow interval 1.000
  Adaptive async tx interval 0.400, rx interval 0.400
  Local min tx interval 0.400, min rx interval 0.400, multiplier 3
  Remote min tx interval 0.400, min rx interval 0.400, multiplier 3
  Threshold transmission interval 0.000, Threshold for detection time 0.000
  Local discriminator 6, remote discriminator 16
  Echo mode disabled/inactive
  Multi-hop, min-recv-TTL 255, route-table 0, local-address 10.255.245.205


1 sessions, 1 clients
Cumulative transmit rate 2.5 pps, cumulative receive rate 2.5 pps
```

show bfd session client rsvp-oam

```
user@host> show bfd session client rsvp-oam
                                                 Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier

192.168.0.223            Up                       540.000   180.000      3

1 Up sessions, 0 Down sessions
1 sessions, 1 clients
Cumulative transmit rate 0.0 pps, cumulative receive rate 0.0 pps
```

show bfd session client vpls-oam summary

```
user@host> show bfd session client vpls-oam summary
1 Up sessions, 1 Down sessions
 2 sessions, 2 clients
 Cumulative transmit rate 2.0 pps, cumulative receive rate 1.0 pps
```

show bfd session client vpls-oam instance instance-name

```
user@host> show bfd session client vpls-oam instance vpls
                                                 Detect   Transmit
Address                  State     Interface      Time     Interval  Multiplier

127.0.0.1                Up        ae9.0          3.000     1.000        3

1 Up Sessions, 0 Down Sessions
1 sessions, 1 clients
Cumulative transmit rate 1.0 pps, cumulative receive rate 1.0 pps
```

show bfd session extensive

```
user@host> show bfd session extensive
                                               Detect   Transmit
Address                State     Interface      Time     Interval  Multiplier
10.31.1.2              Up        ge-2/1/8.0     0.030     0.010        3
 Client OSPF realm ospf-v2 Area 0.0.0.0, TX interval 0.010, RX interval 0.010
```

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```
 Session up time 00:10:13
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Replicated
 Min async interval 0.010, min slow interval 1.000
 Adaptive async TX interval 0.010, RX interval 0.010
 Local min TX interval 0.010, minimum RX interval 0.010, multiplier 3
 Remote min TX interval 0.010, min RX interval 0.010, multiplier 3
 Local discriminator 12, remote discriminator 4
 Echo mode disabled/inactive
 Remote is control-plane independent
  Session ID: 0x201
  Micro-BFD Session
                                                 Detect   Transmit
Address                 State     Interface      Time     Interval  Multiplier
10.31.2.2               Up        ge-2/1/4.0     0.030     0.010        3
 Client OSPF realm ospf-v2 Area 0.0.0.0, TX interval 0.010, RX interval 0.010
 Session up time 00:10:14
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
 Min async interval 0.010, min slow interval 1.000
 Adaptive async TX interval 0.010, RX interval 0.010
 Local min TX interval 0.010, minimum RX interval 0.010, multiplier 3
 Remote min TX interval 0.010, min RX interval 0.010, multiplier 3
 Local discriminator 13, remote discriminator 5
 Echo mode disabled/inactive
 Remote is control-plane independent
  Session ID: 0x202

2 sessions, 2 clients
Cumulative transmit rate 200.0 pps, cumulative receive rate 200.0 pps
```

show bfd session extensive (with Authentication)

```
user@host> show bfd session extensive
                                             Detect   Transmit
Address                 State     Interface      Time     Interval  Multiplier
192.168.208.26          Up        so-1/0/0.0     2.400     0.800        10
 Client Static, TX interval 0.600, RX interval 0.600, Authenticate
       keychain bfd, algo keyed-md5, mode loose
 Session up time 00:18:07
 Local diagnostic None, remote diagnostic NbrSignal
 Remote state Up, version 1
 Replicated
 Min async interval 0.600, min slow interval 1.000
 Adaptive async TX interval 0.600, RX interval 0.600
 Local min TX interval 0.600, minimum RX interval 0.600, multiplier 10
 Remote min TX interval 0.800, min RX interval 0.800, multiplier 3
 Local discriminator 2, remote discriminator 3
 Echo mode disabled/inactive
 Authentication enabled/active, keychain bfd, algo keyed-md5, mode loose


1 sessions, 1 clients
Cumulative transmit rate 1.2 pps, cumulative receive rate 1.2 pps
```


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show bfd session summary

```
user@host> show bfd session summary
```

```
2 sessions, 2 clients
Cumulative transmit rate 10.0 pps, cumulative receive rate 10.0 pps
```

show bfd session subscriber

```
user@host> show bfd session subscriber
```

```
     Detect  Transmit
Address   State  Interface  Time  Interval  Multiplier
1.0.0.2   Up   ae0.0  90.000  30.000   3
1.0.0.6   Up  ae0.1  90.000  30.000  3
1.0.0.10 Up  ae0.2  90.000 30.000   3
1.0.0.14 Up  ae0.3  90.000  30.000   3
1.0.0.18 Up   ae0.4  90.000  30.000   3

20 sessions, 20 clients
```

show bfd session subscriber address

```
user@host> show bfd session subscriber address 1.0.0.2
```

```
    Detect  Transmit
Address  State  Interface Time  Interval  Multiplier
1.0.0.2  Up   ae0.0  90.000  30.000   3

1 sessions, 1 clients
Cumulative transmit rate 5.0 pps, cumulative receive rate 5.0 pps
```

show bfd session subscriber extensive

```
user@host> show bfd session subscriber extensive
```

```
    Detect   Transmit
Address  State  Interface Time   Interval  Multiplier
1.0.0.2  Up   ae0.0  90.000   30.000   3

Client DHCP, TX interval 30.000, RX interval 30.000
Session up time 09:11:50
Local diagnostic None, remote diagnostic NbrSignal
Remote state Up, version 1
Replicated
Min async interval 30.000, min slow interval 30.000
Adaptive async TX interval 30.000, RX interval 30.000
Local min TX interval 30.000, minimum RX interval 30.000, multiplier 3
Remote min TX interval 30.000, min RX interval 30.000, multiplier 3
Local discriminator 20, remote discriminator 16
Echo mode disabled/inactive
Remote is control-plane independent
Session ID: 0x1

    Detect   Transmit
Address  State  Interface  Time   Interval  Multiplier
1.0.0.6  Up   ae0.1  90.000   30.000   3

Client DHCP, TX interval 30.000, RX interval 30.000
Session up time 09:11:50
```

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```
Local diagnostic None, remote diagnostic NbrSignal
Remote state Up, version 1
Replicated
Min async interval 30.000, min slow interval 30.000
Adaptive async TX interval 30.000, RX interval 30.000
Local min TX interval 30.000, minimum RX interval 30.000, multiplier 3
Remote min TX interval 30.000, min RX interval 30.000, multiplier 3
Local discriminator 21, remote discriminator 17
Echo mode disabled/inactive
Remote is control-plane independent
Session ID: 0x2
```

show bfd session subscriber discriminator extensive

```
user@host> show bfd session subscriber discriminator 20 extensive
```

```
    Detect   Transmit
Address  State  Interface  Time   Interval  Multiplier
1.0.0.2  Up   ae0.0  90.000   30.000   3

Client DHCP, TX interval 30.000, RX interval 30.000
Session up time 09:11:50
Local diagnostic None, remote diagnostic NbrSignal
Remote state Up, version 1
Replicated
Min async interval 30.000, min slow interval 30.000
Adaptive async TX interval 30.000, RX interval 30.000
Local min TX interval 30.000, minimum RX interval 30.000, multiplier 3
Remote min TX interval 30.000, min RX interval 30.000, multiplier 3
Local discriminator 20, remote discriminator 16
Echo mode disabled/inactive
Remote is control-plane independent
Session ID: 0x1

1 sessions, 1 clients
Cumulative transmit rate 5.0 pps, cumulative receive rate 5.0 pps
```


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show bgp bmp

Syntax **show bgp bmp**

Release Information Command introduced in Junos OS Release 9.5.
Command introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Display information about the BGP Monitoring Protocol (BMP).

Options This command has no options.

Required Privilege Level view

List of Sample Output show bgp bmp on page 1447

Output Fields Table 31 on page 1447 lists the output fields for the **show bgp bmp** command. Output fields are listed in the approximate order in which they appear.

Table 31: show bgp bmp Output Fields

Field Name	Field Description
BMP station address/port	IP address and port number of the monitoring station to which BGP Monitoring Protocol (BMP) statistics are sent.
BMP session state	Status of the BMP session: **UP** or **DOWN**.
Statistics timeout	Amount of time, in seconds, between transmissions of BMP data to the monitoring station.

Sample Output

show bgp bmp

```
user@host> show bgp bmp
BMP station address/port: 172.24.24.157+5454
BMP session state: DOWN
  Statistics timeout: 15
```

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show bgp group

List of Syntax

Syntax on page 1448
Syntax (EX Series Switch and QFX Series) on page 1448

Syntax

```
show bgp group
<brief | detail | summary>
<group-name>
<exact-instance instance-name>
<instance instance-name>
<logical-system (all | logical-system-name)>
<rtf>
```

Syntax (EX Series Switch and QFX Series)

```
show bgp group
<brief | detail | summary>
<group-name>
<exact-instance instance-name>
<instance instance-name>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
exact-instance option introduced in Junos OS Release 11.4.
From Junos OS release 18.4 onwards, **show bgp group *group-name*** does an exact match and displays groups with names matching exactly with that of the specified group-name. For all Junos OS releases preceding 18.4, the implemenation was performed using the prefix matches (example: if there are two groups grp1, grp2 and the CLI command **show bgp group grp** was issued, then both grp1, grp2 were displayed).

Description

Display information about the configured BGP groups.

Options

none—Display group information about all BGP groups.

brief | detail | summary—(Optional) Display the specified level of output.

group-name—(Optional) Display group information for the specified group.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

instance *instance-name*—(Optional) Display information about BGP groups for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp group instance cust1** command). The instance name can be master for the main instance, or any valid configured instance name or its prefix.

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logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

rtf—(Optional) Display BGP group route targeting information.

Required Privilege Level view

List of Sample Output

show bgp group on page 1452
show bgp group on page 1452
show bgp group brief on page 1453
show bgp group detail on page 1453
show bgp group rtf detail on page 1455
show bgp group summary on page 1455

Output Fields Table 32 on page 1449 describes the output fields for the **show bgp group** command. Output fields are listed in the approximate order in which they appear.

Table 32: show bgp group Output Fields

Field Name	Field Description	Level of Output
Group Type or **Group**	Type of BGP group: **Internal** or **External**.	All levels
group-index	Index number for the BGP peer group. The index number differentiates between groups when a single BGP group is split because of different configuration options at the group and peer levels.	**rtf detail**
AS	AS number of the peer. For internal BGP (IBGP), this number is the same as **Local AS**.	**brief detail** none
Local AS	AS number of the local routing device.	**brief detail** none
Name	Name of a specific BGP group.	**brief detail** none
Options	The Network Layer Reachability Information (NLRI) format used for BGP VPN multicast.	**none** none
Index	Unique index number of a BGP group.	**brief detail** none
Flags	Flags associated with the BGP group. This field is used by Juniper Networks customer support.	**brief detail** none
BGP-Static Advertisement Policy	Policies configured for the BGP group with the **advertise-bgp-static policy** statement.	**brief** none

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Table 32: show bgp group Output Fields (continued)

Field Name	Field Description	Level of Output
Remove-private options	Options associated with the remove-private statement.	**brief detail** none
Holdtime	Maximum number of seconds allowed to elapse between successive keepalive or update messages that BGP receives from a peer in the BGP group, after which the connection to the peer is closed and routing devices through that peer become unavailable.	**brief detail** none
Export	Export policies configured for the BGP group with the **export** statement.	**brief detail** none
Optimal Route Reflection	Client nodes (primary and backup) configured in the BGP group.	**brief detail** none
MED tracks IGP metric update delay	Time, in seconds, that updates to multiple exit discriminator (MED) are delayed. Also displays the time remaining before the interval is set to expire	All levels
Traffic Statistics Interval	Time between sample periods for labeled-unicast traffic statistics, in seconds.	**brief detail** none
Total peers	Total number of peers in the group.	**brief detail** none
Established	Number of peers in the group that are in the established state.	All levels
Active/Received/Accepted/Damped	Multipurpose field that displays information about BGP peer sessions. The field's contents depend upon whether a session is established and whether it was established in the main routing device or in a routing instance. • If a peer is not established, the field shows the state of the peer session: **Active**, **Connect**, or **Idle**. • If a BGP session is established in the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the **inet.0** (main) and **inet.2** (multicast) routing tables. For example, **8/10/10/2 and 2/4/4/0** indicate the following: ◦ 8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the **inet.0** routing table. ◦ 2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the **inet.2** routing table.	**summary**
ip-addresses	List of peers who are members of the group. The address is followed by the peer's port number.	All levels

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Table 32: show bgp group Output Fields (continued)

Field Name	Field Description	Level of Output
Route Queue Timer	Number of seconds until queued routes are sent. If this time has already elapsed, this field displays the number of seconds by which the updates are delayed.	**detail**
Route Queue	Number of prefixes that are queued up for sending to the peers in the group.	**detail**
inet.*number*	Number of active, received, accepted, and damped routes in the routing table. For example, **inet.0: 7/10/9/0** indicates the following: • 7 active routes, 10 received routes, 9 accepted routes, and no damped routes from a BGP peer appear in the **inet.0** routing table.	none
Table inet.*number*	Information about the routing table. • **Received prefixes**—Total number of prefixes from the peer, both active and inactive, that are in the routing table. • **Active prefixes**—Number of prefixes received from the peer that are active in the routing table. • **Suppressed due to damping**—Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols. • **Advertised prefixes**—Number of prefixes advertised to a peer. • **Received external prefixes**—Total number of prefixes from the external BGP (EBGP) peers, both active and inactive, that are in the routing table. • **Active external prefixes**—Number of prefixes received from the EBGP peers that are active in the routing table. • **Externals suppressed**—Number of routes received from EBGP peers currently inactive because of damping or other reasons. • **Received internal prefixes**—Total number of prefixes from the IBGP peers, both active and inactive, that are in the routing table. • **Active internal prefixes**—Number of prefixes received from the IBGP peers that are active in the routing table. • **Internals suppressed**—Number of routes received from IBGP peers currently inactive because of damping or other reasons. • **RIB State**—Status of the graceful restart process for this routing table: **BGP restart is complete**, **BGP restart in progress**, **VPN restart in progress**, or **VPN restart is complete**.	**detail**
Groups	Total number of groups.	All levels
Peers	Total number of peers.	All levels
External	Total number of external peers.	All levels
Internal	Total number of internal peers.	All levels
Down peers	Total number of unavailable peers.	All levels

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Table 32: show bgp group Output Fields (continued)

Field Name	Field Description	Level of Output
Flaps	Total number of flaps that occurred.	All levels
Table	Name of a routing table.	**brief**, none
Tot Paths	Total number of routes.	**brief**, none
Act Paths	Number of active routes.	**brief**, none
Suppressed	Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.	**brief**, none
History	Number of withdrawn routes stored locally to keep track of damping history.	**brief**, none
Damp State	Number of active routes with a figure of merit greater than zero, but lower than the threshold at which suppression occurs.	**brief**, none
Pending	Routes being processed by the BGP import policy.	**brief**, none
Group	Group the peer belongs to in the BGP configuration.	**detail**
Receive mask	Mask of the received target included in the advertised route.	**detail**
Entries	Number of route entries received.	**detail**
Target	Route target that is to be passed by route-target filtering. If a route advertised from the provider edge (PE) routing device matches an entry in the route-target filter, the route is passed to the peer.	**detail**
Mask	Mask which specifies that the peer receive routes with the given route target.	**detail**

Sample Output

show bgp group

```
user@host> show bgp group
Group Type: Internal AS: 200 Local AS: 200
Name: ibgp Index: 0 Flags: <>
Options: Preference LocalAddress Cluster AddressFamily Refresh
```

show bgp group

```
user@host> show bgp group
```


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```
Group Type: Internal    AS: 1001                  Local AS: 1001
  Name: ibgp            Index: 2                  Flags: Export Eval
  Holdtime: 0
  Optimal Route Reflection: igp-primary 1.1.1.1, igp-backup 1.1.2.1
  Total peers: 1        Established: 1
  1.1.1.2+179
  Trace options:  all
  Trace file: /var/log/bgp-log size 10485760 files 10
  bgp.l3vpn.2: 0/0/0/0
  vpn-1.inet.2: 0/0/0/0

Group Type: Internal    AS: 1001                  Local AS: 1001
  Name: ibgp            Index: 3                  Flags: Export Eval
  Options: RFC6514CompliantSafi129
  Holdtime: 0
  Optimal Route Reflection: igp-primary 1.1.1.1, igp-backup 1.1.2.1
  Total peers: 1        Established: 1
  1.1.1.5+61698
  Trace options:  all
  Trace file: /var/log/bgp-log size 10485760 files 10
  bgp.l3vpn.2: 2/2/2/0
  vpn-1.inet.2: 2/2/2/0

Groups: 2  Peers: 2    External: 0    Internal: 2    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.2
                       2          2          0          0          0          0
vpn-1.inet.0
                       0          0          0          0          0          0
vpn-1.inet.2
                       2          2          0          0          0          0
vpn-1.inet6.0
                       0          0          0          0          0          0
vpn-1.mdt.0
                       0          0          0          0          0          0
```

show bgp group brief

```
user@host> show bgp group brief
```

```
Groups: 2  Peers: 2    External: 0    Internal: 2    Down peers: 1   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending

inet.0
                       0          0          0          0          0          0

bgp.l3vpn.0
                       0          0          0          0          0          0

bgp.rtarget.0
                       2          0          0          0          0          0
```

show bgp group detail

```
user@host> show bgp group detail
```

```
Group Type: Internal    AS: 1                     Local AS: 1
  Name: ibgp            Index: 0                  Flags: <Export Eval>
  Holdtime: 0
```

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```
  Optimal Route Reflection: igp-primary 1.1.1.1, igp-backup 1.1.2.1
  Total peers: 3        Established: 0
  22.0.0.2
  22.0.0.8
  22.0.0.5

Groups: 1  Peers: 3    External: 0    Internal: 3    Down peers: 3   Flaps: 3
  Table bgp.l3vpn.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table bgp.mdt.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table VPN-A.inet.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
  Table VPN-A.mdt.0
    Received prefixes:            0
    Accepted prefixes:            0
    Active prefixes:              0
    Suppressed due to damping:    0
    Received external prefixes:   0
    Active external prefixes:     0
    Externals suppressed:         0
    Received internal prefixes:   0
    Active internal prefixes:     0
    Internals suppressed:         0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
```


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show bgp group rtf detail

user@host> **show bgp group rtf detail**

```
Group: internal (group-index: 0)
    Receive mask: 00000002
    Table: bgp.rtarget.0                                        Entries: 2
        Target                          Mask
        100:100/64                      00000002
        200:201/64                      (Group)
Group: internal (group-index: 1)
    Table: bgp.rtarget.0                                        Entries: 1
        Target                          Mask
        200:201/64                      (Group)
```

show bgp group summary

user@host> **show bgp group summary**

```
Group        Type       Peers     Established    Active/Received/Accepted/Damped
ibgp         Internal   3         0

Groups: 1  Peers: 3    External: 0    Internal: 3    Down peers: 3   Flaps: 3
  bgp.l3vpn.0      : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  bgp.mdt.0        : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  VPN-A.inet.0     : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
  VPN-A.mdt.0      : 0/0/0/0 External: 0/0/0/0 Internal: 0/0/0/0
```

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show bgp group output-queues

Syntax

```
show bgp group output-queues
<group-name>
<fabric>
<logical-system>
```

Release Information Statement introduced in Junos OS Release 16.1 for the ACX Series, M Series, MX Series, PTX Series, QFabric systems, and QFX Series.

Description Show per group summaries of BGP prioritized output queues. The output includes the number of tokens assigned per queue and the number of routes currently queued within each prioritized queue.

Options

none—Display output queue summaries for all BGP groups defined in the system.

group-name—Limit the display of queue summaries to the specified group.

fabric—Display output queue summaries for the specified fabric.

logical-system—Display output queue information within a specified logical system or for all logical systems.

Required Privilege Level view

Related Documentation

- show bgp neighbor on page 1463

List of Sample Output

show bgp group output-queues on page 1457
show bgp group output-queues <group-name> on page 1458

Output Fields Table 33 on page 1456 describes the output fields for the **show bgp group output-queues** command. Output fields are listed in the approximate order in which they appear. Some output fields are self-explanatory and so are not shown in the table.

Table 33: show bgp group output-queues Output Fields

Field Name	Field Description
Index	Group's index number.
Options	Options set within the BGP group definition.
NLRI	Address family for which BGP route prioritization has been implemented within the BGP group.
OutQ	Output priority queue designated for this address family within this group.

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Table 33: show bgp group output-queues Output Fields (continued)

Field Name	Field Description
RRQ	Route refresh priority queue designated for this address family within this group.
WDQ	Withdraw priority queue designated for this address family within this group.
Class	Shows the name of the priority queues. There are always 16 numbered priority queues and the expedited queue for a total of 17 priority queues.
Tokens	Shows the number of tokens assigned to each priority queue.
Total Routes	Shows the number of routes currently in each priority queue (class).

Sample Output

show bgp group output-queues

```
user@host> show bgp group output-queues
Group Type: Internal    AS: 64512                  Local AS: 64512
  Name: bgp-group-1             Index: 0                   Flags: <Export Eval>
  Export: [ match-all ]
  Options: <LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
    OutQ: priority 1 RRQ: priority 1 WDQ: priority 1
    Class         Tokens  Total Routes
    ------------  ------  ------------
    Priority   1       1             0
    Priority   2      10             0
    Priority   3      15             0
    Priority   4      20             0
    Priority   5      25             0
    Priority   6      30             0
    Priority   7      35             0
    Priority   8      40             0
    Priority   9      45             0
    Priority  10      50             0
    Priority  11      55             0
    Priority  12      60             0
    Priority  13      65             0
    Priority  14      70             0
    Priority  15      75             0
    Priority  16      80             0
    Expedited        100             0
  Total peers: 1        Established: 1
  192.0.2.2+179
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                                  0          0
Group Type: External                              Local AS: 69
  Name: reflector       Index: 1                  Flags: <Export Eval>
  Options: <Multihop LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
```

```
    OutQ: priority 1 RRQ: priority 1 WDQ: priority 1
    Class         Tokens  Total Routes
    ------------  ------  ------------
    Priority   1       1             0
    Priority   2      10             0
    Priority   3      15             0
    Priority   4      20             0
    Priority   5      25             0
    Priority   6      30             0
    Priority   7      35             0
    Priority   8      40             0
    Priority   9      45             0
    Priority  10      50             0
    Priority  11      55             0
    Priority  12      60             0
    Priority  13      65             0
    Priority  14      70             0
    Priority  15      75             0
    Priority  16      80             0
    Expedited        100             0
  Total peers: 1        Established: 1
  192.0.2.71+179
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                            584195          0

Groups: 2  Peers: 2    External: 1    Internal: 1    Down peers: 0   Flaps: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                   584198     584195          0          0          0          0
inet.3
                        0          0          0          0          0          0
bgp.l3vpn.0
                        0          0          0          0          0          0
```

show bgp group output-queues <group-name>

```
user@host> show bgp group output-queues bgp-group-2
```

```
Group Type: External                              Local AS: 102
  Name: bgp-group-2             Index: 2                  Flags: <>
  Options: <LocalAS>
  Holdtime: 0
  NLRI inet-unicast:
    OutQ: priority 6 RRQ: priority 3 WDQ: priority 3
    Class         Tokens  Total Routes
    ------------  ------  ------------
    Priority   1       1             0
    Priority   2       1             0
    Priority   3      20             0
    Priority   4       1             0
    Priority   5       1             0
    Priority   6      30             0
    Priority   7       1             0
    Priority   8       1             0
    Priority   9      50             0
    Priority  10       1             0
    Priority  11       1             0
    Priority  12       1             0
    Priority  13       1             0
```


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```
  Priority  14       1             0
  Priority  15       1             0
  Priority  16       1             0
  Expedited          1             0
Total peers: 1       Established: 1
192.0.2.3+179
```

show bgp group traffic-statistics

Syntax

```
show bgp group traffic-statistics
<brief | detail>
<group-name>
<labeled-path label label>
<logical-system (all | logical-system-name)>
```

Release Information

Command introduced before Junos OS Release 7.4.
labeled-path option introduced in Junos OS Release 18.1R1 for the MX Series.

Description

Display the traffic statistics for configured Border Gateway Protocol (BGP) groups.

Options

none—Display traffic statistics for all BGP groups.

brief | detail—(Optional) Display the specified level of output.

group-name—(Optional) Display BGP traffic statistics for only the specified group.

label-path—(Optional) Display labeled unicast traffic statistics at the ingress.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show bgp group traffic-statistics (Per-Group-Label Not Configured) on page 1461
show bgp group traffic-statistics (Per-Group-Label Configured) on page 1461
show bgp group traffic-statistics labeled-path (Labeled Unicast) on page 1462

Output Fields

Table 34 on page 1460 describes the output fields for the **show bgp group traffic-statistics** command. Output fields are listed in the approximate order in which they appear.

Table 34: show bgp group traffic-statistics Output Fields

Field Name	Field Description
Group name	Name of a specific BGP group.
Group Index	Index number for the BGP group.
NLRI	Network layer reachability information (NLRI) indicating the source of the traffic statistics for the BGP group.
FEC	Forwarding equivalence classes (FECs) associated with the BGP group.
Packets	Number of packets sent through each FEC.

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Table 34: show bgp group traffic-statistics Output Fields (continued)

Field Name	Field Description
Bytes	Number of bytes transmitted through each FEC.
EgressAS	Autonomous system (AS) number of the egress router.
AdvLabel	Label associated with each FEC.

Sample Output

show bgp group traffic-statistics (Per-Group-Label Not Configured)

```
user@host> show bgp group traffic-statistics

Group Name: ext1       Group Index: 0          NLRI: inet-labeled-unicast
FEC                  Packets              Bytes     EgressAS    AdvLabel
10.255.245.55              0                  0            I      100224
10.255.245.57              0                  0            I      100240
100.101.0.0              550              48400           25      100256
100.102.0.0              550              48400           25      100256
100.103.0.0              550              48400           25      100272
100.104.0.0              550              48400           25      100272
192.168.25.0               0                  0            I      100288

Group Name: ext2       Group Index: 1          NLRI: inet-labeled-unicast
FEC                  Packets              Bytes     EgressAS    AdvLabel
10.255.245.55              0                  0            I      100224
10.255.245.57              0                  0            I      100240
100.101.0.0              550              48400           25      100256
100.102.0.0              550              48400           25      100256
100.103.0.0              550              48400           25      100272
100.104.0.0              550              48400           25      100272
192.168.25.0               0                  0            I      100288
```

show bgp group traffic-statistics (Per-Group-Label Configured)

```
user@host> show bgp group traffic-statistics

Group Name: ext1       Group Index: 0          NLRI: inet-labeled-unicast
FEC                  Packets              Bytes     EgressAS    AdvLabel
10.255.245.55              0                  0            I      100384
10.255.245.57              0                  0            I      100400
100.101.0.0              101               8888           25      100416
100.102.0.0              101               8888           25      100416
100.103.0.0                0                  0           25      100432
100.104.0.0                0                  0           25      100432
192.168.25.0               0                  0            I      100448

Group Name: ext2       Group Index: 1          NLRI: inet-labeled-unicast
FEC                  Packets              Bytes     EgressAS    AdvLabel
10.255.245.55              0                  0            I      100304
10.255.245.57              0                  0            I      100320
100.101.0.0                0                  0           25      100336
100.102.0.0                0                  0           25      100336
100.103.0.0              101               8888           25      100352
```

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```
100.104.0.0              101              8888          25      100352
192.168.25.0               0                 0           I      100368
```

show bgp group traffic-statistics labeled-path (Labeled Unicast)

```
user@host> show bgp group traffic-statistics labeled-path

Labels               NextHop            Packets               Bytes
3(top)             10.1.1.1                   0                   0
299840(top)        40.1.1.1                   0                   0
110001(top)        40.1.1.1                   2                 168
110002
110003
110001(top)        40.1.1.1                   0                   0
110072
110073
110071(top)        40.1.1.1                   0                   0
110072
110073
120001(top)        40.1.1.1                   0                   0
120002
120003
1000002(top)       40.1.1.1                   2                 168
1000003
1000004
```


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show bgp neighbor

List of Syntax

Syntax on page 1463
Syntax (EX Series Switch, QFX Series, and OCX Series) on page 1463

Syntax

```
show bgp neighbor
<exact-instance instance-name>
<instance instance-name>
<logical-system (all | logical-system-name)>
<neighbor-address>
<output-queue>
<orf (detail | neighbor-address)
```

Syntax (EX Series Switch, QFX Series, and OCX Series)

```
show bgp neighbor
<instance instance-name>
<exact-instance instance-name>
<neighbor-address>
<orf (neighbor-address | detail)
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1x53-D20 for the OCX Series.
orf option introduced in Junos OS Release 9.2.
exact-instance option introduced in Junos OS Release 11.4.
output-queue option introduced in Junos OS Release 16.1
DontGRHelpFateSharingBfdDown is added to the **options** field of the command output in Junos OS Release 18.3R1.

Description

Display information about BGP peers.

Options

none—Display information about all BGP peers.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

instance *instance-name*—(Optional) Display information about BGP peers for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp neighbor instance cust1** command).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor-address—(Optional) Display information for only the BGP peer at the specified IP address.

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orf (detail | *neighbor-address*)—(Optional) Display outbound route-filtering information for all BGP peers or only for the BGP peer at the specified IP address. The default is to display brief output. Use the **detail** option to display detailed output.

output-queue—(Optional) Display information regarding the number of routes currently queued in the 17 prioritized BGP output queues.

Additional Information

For information about the **local-address, nlri**, **hold-time,** and **preference** statements, see the *Junos OS Routing Protocols Library*.

Required Privilege Level

view

Related Documentation

- clear bgp neighbor on page 1403

List of Sample Output

show bgp neighbor on page 1472
show bgp neighbor (dont-help-shared-fate-bfd-down is configured) on page 1473
show bgp neighbor (CLNS) on page 1474
show bgp neighbor (Layer 2 VPN) on page 1475
show bgp neighbor (Layer 3 VPN) (Not supported on the OCX Series.) on page 1477
show bgp neighbor neighbor-address on page 1478
show bgp neighbor neighbor-address on page 1478
show bgp neighbor neighbor-address (BGP Graceful Restart Enabled) on page 1479
show bgp neighbor neighbor-address (BGP Long-Lived Graceful Restart) on page 1480
show bgp neighbor orf neighbor-address detail on page 1480
show bgp neighbor logical-system on page 1481
show bgp neighbor output-queue on page 1481
show bgp neighbor (Segment Routing Traffic Engineering) on page 1482

Output Fields

Table 35 on page 1464 describes the output fields for the **show bgp neighbor** command. Output fields are listed in the approximate order in which they appear.

Table 35: show bgp neighbor Output Fields

Field Name	Field Description
Peer	Address of the BGP neighbor. The address is followed by the neighbor port number.
AS	AS number of the peer.
Local	Address of the local routing device. The address is followed by the peer port number.
Type	Type of peer: **Internal** or **External**.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
State	Current state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer. • **route reflector client**—The BGP session is established with a route reflector client.
Flags	Internal BGP flags: • **Aggregate Label**—BGP has aggregated a set of incoming labels (labels received from the peer) into a single forwarding label. • **CleanUp**—The peer session is being shut down. • **Delete**—This peer has been deleted. • **Idled**—This peer has been permanently idled. • **ImportEval**—At the last commit operation, this peer was identified as needing to reevaluate all received routes. • **Initializing**—The peer session is initializing. • **SendRtn**—Messages are being sent to the peer. • **Sync**—This peer is synchronized with the rest of the peer group. • **RSync**—This peer in the backup Routing Engine is synchronized with the BGP peer in the master Routing Engine for nonstop active routing. • **TryConnect**—Another attempt is being made to connect to the peer. • **Unconfigured**—This peer is not configured. • **WriteFailed**—An attempt to write to this peer failed.
Last state	Previous state of the BGP session: • **Active**—BGP is initiating a transport protocol connection in an attempt to connect to a peer. If the connection is successful, BGP sends an Open message. • **Connect**—BGP is waiting for the transport protocol connection to be completed. • **Established**—The BGP session has been established, and the peers are exchanging update messages. • **Idle**—This is the first stage of a connection. BGP is waiting for a Start event. • **OpenConfirm**—BGP has acknowledged receipt of an open message from the peer and is waiting to receive a keepalive or notification message. • **OpenSent**—BGP has sent an open message and is waiting to receive an open message from the peer.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Last event	Last activity that occurred in the BGP session: • **Closed**—The BGP session closed. • **ConnectRetry**—The transport protocol connection failed, and BGP is trying again to connect. • **HoldTime**—The session ended because the hold timer expired. • **KeepAlive**—The local routing device sent a BGP keepalive message to the peer. • **Open**—The local routing device sent a BGP open message to the peer. • **OpenFail**—The local routing device did not receive an acknowledgment of a BGP open message from the peer. • **RecvKeepAlive**—The local routing device received a BGP keepalive message from the peer. • **RecvNotify**—The local routing device received a BGP notification message from the peer. • **RecvOpen**—The local routing device received a BGP open message from the peer. • **RecvUpdate**—The local routing device received a BGP update message from the peer. • **Start**—The peering session started. • **Stop**—The peering session stopped. • **TransportError**—A TCP error occurred.
Last error	Last error that occurred in the BGP session: • **Cease**—An error occurred, such as a version mismatch, that caused the session to close. • **Finite State Machine Error**—In setting up the session, BGP received a message that it did not understand. • **Hold Time Expired**—The session's hold time expired. • **Message Header Error**—The header of a BGP message was malformed. • **Open Message Error**—A BGP open message contained an error. • **None**—No errors occurred in the BGP session. • **Update Message Error**—A BGP update message contained an error.
Export	Name of the export policy that is configured on the peer.
Import	Name of the import policy that is configured on the peer.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Options	Configured BGP options: • **AddressFamily**—Configured address family: inet or inet-vpn. • **AdvertiseBGPStatic**—Configured BGP static routes are advertised. • **AutheKeyChain**—Authentication key change is enabled. • **BfdEnabled**—Status of BFD. • **DontGRHelpFateSharingBfdDown**—Status of the **dont-help-shared-fate-bfd-down** option. If this option is configured the device does not go into graceful restart helper mode. • **DropPathAttributes**—Certain path attributes are configured to be dropped from neighbor updates during inbound processing. • **GracefulRestart**—Graceful restart is configured. • **HoldTime**—Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent. • **IgnorePathAttributes**—Certain path attributes are configured to be ignored in neighbor updates during inbound processing. • **Local Address**—Address configured with the **local-address** statement. • **LLGR**—BGP long-lived graceful restart capability is configured. • **LLGRHelperDisabled**—BGP long-lived graceful restart is completely disabled for a neighbor. • **Multihop**—Allow BGP connections to external peers that are not on a directly connected network. • **NLRI**—Configured MBGP state for the BGP group: **multicast**, **unicast**, or both if you have configured **nlri any**. • **Peer AS**—Configured peer autonomous system (AS). • **Preference**—Preference value configured with the **preference** statement. • **Refresh**—Configured to refresh automatically when the policy changes. • **Rib-group**—Configured routing table group. • **RFC6514CompliantSafi129**—Configured SAFI 129 according to RFC 6514 (BGP VPN multicast used to use SAFI 128).
Path-attributes dropped	Path attribute codes that are dropped from neighbor updates.
Path-attributes ignored	Path attribute codes that are ignored during neighbor updates.
Peer does not support LLGR Restarter or Receiver functionality	BGP neighbor does not support long-lived graceful restart (LLGR) restarter mode completely.
Peer does not support LLGR Restarter functionality	BGP neighbor does not support long-lived graceful restart (LLGR) restarter mode for any family.
Authentication key change	(Appears only if the **authentication-keychain** statement has been configured) Name of the authentication keychain enabled.
Authentication algorithm	(Appears only if the **authentication-algorithm** statement has been configured) Type of authentication algorithm enabled: **hmac** or **md5**.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Address families configured	Names of configured address families for the VPN.
BGP-Static Advertisement Policy	Name of the BGP static policy that is configured on the peer.
Local Address	Address of the local routing device.
Remove-private options	Options associated with the remove-private statement.
Holdtime	Hold time configured with the **hold-time** statement. The hold time is three times the interval at which keepalive messages are sent.
Flags for NLRI inet-label-unicast	Flags related to labeled-unicast: • **TrafficStatistics**—Collection of statistics for labeled-unicast traffic is enabled.
Traffic statistics	Information about labeled-unicast traffic statistics: • **Options**—Options configured for collecting statistics about labeled-unicast traffic. • **File**—Name and location of statistics log files. • **size**—Size of all the log files, in bytes. • **files**—Number of log files.
Traffic Statistics Interval	Time between sample periods for labeled-unicast traffic statistics, in seconds.
Preference	Preference value configured with the **preference** statement.
Outbound Timer	Time for which the route is available in Junos OS routing table before it is exported to BGP. This field is displayed in the output only if the **out-delay** parameter is configured to a non-zero value.
Number of flaps	Number of times the BGP session has gone down and then come back up.
Peer ID	Router identifier of the peer.
Group index	Index number for the BGP peer group. The index number differentiates between groups when a single BGP group is split because of different configuration options at the group and peer levels.
Peer index	Index that is unique within the BGP group to which the peer belongs.
Local ID	Router identifier of the local routing device.
Local Interface	Name of the interface on the local routing device.
Active holdtime	Hold time that the local routing device negotiated with the peer.
Keepalive Interval	Keepalive interval, in seconds.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
BFD	Status of BFD failure detection.
Local Address	Name of directly connected interface over which direct EBGP peering is established.
NLRI and times for LLGR configured on peer	Names of address families and stale time for BGP long-lived graceful restart configured on the BGP peer or neighbor. Times are displayed using the routing protocol daemon (rpd) %#0T format: **<weeks>w<days>d <hours>:<minutes>:<seconds>** Zero leading elements are omitted, for example, a value less than one week do not include the weeks.
NLRI and times that peer supports LLGR Restarter for	Names of address families and stale time that the BGP peer supports for restarter mode for BGP long-lived graceful restart. Times are displayed using the routing protocol daemon (rpd) %#0T format: **<weeks>w<days>d <hours>:<minutes>:<seconds>** Zero leading elements are omitted, for example, a value less than one week do not include the weeks.
NLRI that peer saved LLGR forwarding for	Name of the address family for which the BGP peer saved BGP long-lived graceful restart forwarding.
Graceful Restart Details	Amount of time that is remaining until LLGR expires and the time remaining on the GR stale timer, along with RIB details, are displayed while LLGR receiver mode is active (a peer that negotiated LLGR has disconnected and not yet reconnected).
NLRI we are holding stale routes for	Names of address families (NLRIs) for which that stale routes are held or preserved when BGP graceful restart receiver mode is active for a neighbor.
Time until end-of-rib is assumed for stale routes	Amount of time remaining on the stale timer until which end-of-RIB (EoR) markers are assumed when BGP graceful restart receiver mode is active for a neighbor. Time is displayed in Coordinated Universal Time (UTC) format (YYYY-MM-DD-HH:MM:SS). Note that the stale timer display ('Time until end-of-rib is assumed') is also present when a session is active, but the neighbor as not yet sent all of the end-of-rib indications.
Time until stale routes are deleted or become long-lived stale	Amount of time up to which stale routes are deleted or become long-lived stale routes when BGP graceful restart receiver mode is active for a neighbor.
NLRI for restart configured on peer	Names of address families configured for restart.
NLRI advertised by peer	Address families supported by the peer: **unicast** or **multicast**.
NLRI for this session	Address families being used for this session.
Peer supports Refresh capability	Remote peer's ability to send and request full routing table readvertisement (route refresh capability). For more information, see RFC 2918, *Route Refresh Capability for BGP-4*.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Restart time configured on peer	Configured time allowed for restart on the neighbor.
Stale routes from peer are kept for	When graceful restart is negotiated, the maximum time allowed to hold routes from neighbors after the BGP session has gone down.
Peer does not support Restarter functionality	Graceful restart restarter-mode is disabled on the peer.
Peer does not support Receiver functionality	Graceful restart helper-mode is disabled on the peer.
Restart time requested by this peer	Restart time requested by this neighbor during capability negotiation.
Restart flag received from the peer	When this field appears, the BGP speaker has restarted (Restarting), and this peer should not wait for the **end-of-rib** marker from the speaker before advertising routing information to the speaker.
NLRI that peer supports restart for	Neighbor supports graceful restart for this address family.
NLRI peer can save forwarding state	Neighbor supporting this address family saves all forwarding states.
NLRI that peer saved forwarding for	Neighbor saves all forwarding states for this address family.
NLRI that restart is negotiated for	Router supports graceful restart for this address family.
NLRI of received end-of-rib markers	Address families for which end-of-routing-table markers are received from the neighbor.
NLRI of all end-of-rib markers sent	Address families for which end-of-routing-table markers are sent to the neighbor.
Peer supports 4 byte AS extension (peer-as 1)	Peer understands 4-byte AS numbers in BGP messages. The peer is running Junos OS Release 9.1 or later.
NLRIs for which peer can receive multiple paths	Appears in the command output of the local router if the downstream peer is configured to receive multiple BGP routes to a single destination, instead of only receiving the active route. Possible value is inet-unicast.
NLRIs for which peer can send multiple paths: inet-unicast	Appears in the command output of the local router if the upstream peer is configured to send multiple BGP routes to a single destination, instead of only sending the active route. Possible value is inet-unicast.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Table inet.*number*	Information about the routing table: • **RIB State**—BGP is in the graceful restart process for this routing table: **restart is complete** or **restart in progress**. • **Bit**—Number that represents the entry in the routing table for this peer. • **Send state**—State of the BGP group: **in sync**, **not in sync**, or **not advertising**. • **Active prefixes**—Number of prefixes received from the peer that are active in the routing table. • **Received prefixes**—Total number of prefixes from the peer, both active and inactive, that are in the routing table. • **Accepted prefixes**—Total number of prefixes from the peer that have been accepted by a routing policy. • **Suppressed due to damping**—Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.
Last traffic (seconds)	Last time any traffic was received from the peer or sent to the peer, and the last time the local routing device checked.
Input messages	Messages that BGP has received from the receive socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Output messages	Messages that BGP has written to the transmit socket buffer, showing the total number of messages, number of update messages, number of times a policy is changed and refreshed, and the buffer size in octets. The buffer size is 16 KB.
Input dropped path attributes	Information about dropped path attributes: • Code—Path attribute code. • Count—Path attribute count.
Input ignored path attributes	Information about ignored path attributes: • Code—Path attribute code. • Count—Path attribute count.
Output queue	Number of BGP packets that are queued to be transmitted to a particular neighbor for a particular routing table. Output queue **0** is for unicast NLRIs, and queue **1** is for multicast NLRIs. It also specifies the routing table name and the NLRI that the table was advertised through, in the format (***routing table name***, ***NLRI***). NOTE: The output queue of routing tables that are not advertised, will only show up at **extensive** output level.
Trace options	Configured tracing of BGP protocol packets and operations.
Trace file	Name of the file to receive the output of the tracing operation.

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Table 35: show bgp neighbor Output Fields (continued)

Field Name	Field Description
Filter Updates recv	(**orf** option only) Number of outbound-route filters received for each configured address family. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.
Immediate	(**orf** option only) Number of route updates received with the immediate flag set. The immediate flag indicates that the BGP peer should readvertise the updated routes. NOTE: The counter is cumulative. For example, the counter is increased after the remote peer either resends or clears the outbound route filtering prefix list.
Filter	(**orf** option only) Type of prefix filter received: **prefix-based** or **extended-community**.
Received filter entries	(**orf** option only) List of received filters displayed.
seq	(**orf** option only) Numerical order assigned to this prefix entry among all the received outbound route filter prefix entries.
prefix	(**orf** option only) Address for the prefix entry that matches the filter.
minlength	(**orf** option only) Minimum prefix length, in bits, required to match this prefix.
maxlength	(**orf** option only) Maximum prefix length, in bits, required to match this prefix.
match	(**orf** option only) For this prefix match, whether to **permit** or **deny** route updates.

Sample Output

show bgp neighbor

`user@host >` **show bgp neighbor**

For M Series, MX Series, and T Series routers running Junos OS Release 16.1 or later, the **show bgp neighbor** output includes the BGP group the peer belongs to, the routing instance (if any) that the peer is configured in, and the routing instance that the peer is using for the forwarding context (if applicable). An example follows.

```
Peer: 10.255.7.250+179 AS 10   Local: 10.255.7.248+63740 AS 10
  Group: toAsbr2               Routing-Instance: master
  Forwarding routing-instance: toAs2
    Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ redist_static ]
  Options: <Preference LocalAddress PeerAS Refresh>
  Options: <AdvertiseBGPStatic>
  Local Address: 10.255.7.248 Holdtime: 90 Preference: 170 Outbound Timer: 50
  Number of flaps: 0
  Peer ID: 10.255.7.250    Local ID: 10.255.7.248      Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  BFD: disabled, down
```


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```
  NLRI for restart configured on peer: inet-unicast
  NLRI advertised by peer: inet-unicast
  NLRI for this session: inet-unicast
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  NLRI that restart is negotiated for: inet-unicast
  NLRI of received end-of-rib markers: inet-unicast
  NLRI of all end-of-rib markers sent: inet-unicast
  Peer supports 4 byte AS extension (peer-as 10)
  Peer does not support Addpath
  NLRI that we support extended nexthop encoding for: inet-unicast
  NLRI that peer supports extended nexthop encoding for: inet-unicast

  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            1
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          1
  Last traffic (seconds): Received 9    Sent 5    Checked 5
  Input messages:  Total 36     Updates 2       Refreshes 0     Octets 718
  Output messages: Total 37     Updates 1       Refreshes 0     Octets 796
  Output Queue[0]: 0  (inet.0, inet-unicast)
```

```
Peer: 10.255.162.214+52193 AS 100 Local: 10.255.167.205+179 AS 100
   Type: Internal    State: Established  (route reflector client)Flags: <Sync>
   Last State: OpenConfirm   Last Event: RecvKeepAlive
   Last Error: None
   Options: <Preference LocalAddress Cluster AddressFamily Rib-group Refresh>
   Address families configured: inet-unicast inet-vpn-unicast route-target
   Local Address: 10.255.167.205 Holdtime: 90 Preference: 170
   Number of flaps: 0
   Peer ID: 10.255.162.214  Local ID: 10.255.167.205    Active Holdtime: 90
   Keepalive Interval: 30         Group index: 0    Peer index: 1
```

show bgp neighbor (dont-help-shared-fate-bfd-down is configured)

```
user@host> show bgp neighbor
```

```
Peer: 10.1.1.1 AS 200          Local: unspecified AS 17
  Group: one                   Routing-Instance: master
  Forwarding routing-instance: master
  Type: External    State: Idle           Flags: <PeerInterfaceError>
  Last State: NoState       Last Event: NoEvent
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Options: <BfdEnabled>
  Options: <DontGRHelpFateSharingBfdDown>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Trace options: bridge
  Trace file: /var/log/bgp-log size 131072 files 10

Peer: 20.1.1.1 AS 200          Local: unspecified AS 17
  Group: one                   Routing-Instance: master
```

```
  Forwarding routing-instance: master
  Type: External    State: Idle           Flags: <PeerInterfaceError>
  Last State: NoState       Last Event: NoEvent
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Options: <BfdEnabled>
  Options: <DontGRHelpFateSharingBfdDown>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Trace options: bridge
  Trace file: /var/log/bgp-log size 131072 files 10

Peer: 30.1.1.1 AS 200          Local: unspecified AS 17
  Group: two                   Routing-Instance: master
  Forwarding routing-instance: master
  Type: External    State: Idle           Flags: <PeerInterfaceError>
  Last State: NoState       Last Event: NoEvent
  Last Error: None
  Options: <Preference PeerAS Refresh>
  Options: <BfdEnabled>
  Options: <DontGRHelpFateSharingBfdDown>
  Holdtime: 90 Preference: 170
  Number of flaps: 0
  Trace options: bridge
  Trace file: /var/log/bgp-log size 131072 files 10
```

show bgp neighbor (CLNS)

```
user@host> show bgp neighbor
```

```
Peer: 10.245.245.1+179 AS 200  Local: 10.245.245.3+3770 AS 100
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Multihop Preference LocalAddress HoldTime AddressFamily PeerAS
Rib-group Refresh>
  Address families configured: iso-vpn-unicast
  Local Address: 10.245.245.3 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.245.245.1     Local ID: 10.245.245.3     Active Holdtime: 90
  Keepalive Interval: 30         Peer index: 0
  NLRI advertised by peer: iso-vpn-unicast
  NLRI for this session: iso-vpn-unicast
  Peer supports Refresh capability (2)
  Table bgp.isovpn.0 Bit: 10000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:              3
    Received prefixes:            3
    Suppressed due to damping:    0
    Advertised prefixes:          3
  Table aaaa.iso.0
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: not advertising
    Active prefixes:              3
    Received prefixes:            3
    Suppressed due to damping:    0
  Last traffic (seconds): Received 6    Sent 5    Checked 5
```


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```
  Input messages:  Total 1736   Updates 4       Refreshes 0     Octets 33385
  Output messages: Total 1738   Updates 3       Refreshes 0     Octets 33305
  Output Queue[0]: 0  (bgp.isovpn.0, iso-vpn-unicast)
  Output Queue[1]: 0  (aaaa.iso.0, iso-vpn-unicast)
```

show bgp neighbor (Layer 2 VPN)

user@host> **show bgp neighbor**

```
Peer: 10.69.103.2     AS 65536 Local: 10.69.103.1     AS 65539
  Type: External    State: Active         Flags: <ImportEval>
  Last State: Idle          Last Event: Start
  Last Error: None
  Export: [ BGP-INET-import ]
 Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily   PeerAS
 Refresh>
  Address families configured: inet-unicast
  Local Address: 10.69.103.1 Holdtime: 90 Preference: 170
  Number of flaps: 0
Peer: 10.69.104.2     AS 65539 Local: 10.69.104.1     AS 65539
  Type: External    State: Active         Flags: <ImportEval>
  Last State: Idle          Last Event: Start
  Last Error: None
  Export: [ BGP-L-import ]
 Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily PeerAS
 Refresh>
  Address families configured: inet-labeled-unicast
  Local Address: 10.69.104.1 Holdtime: 90 Preference: 170
  Number of flaps: 0
Peer: 10.255.14.182+179 AS 69    Local: 10.255.14.176+2131 AS 69
  Type: Internal    State: Established    Flags: <ImportEval>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
  Rib-group Refresh>
  Address families configured: inet-vpn-unicast l2vpn
  Local Address: 10.255.14.176 Holdtime: 90 Preference: 170
  Number of flaps: 0
  Peer ID: 10.255.14.182    Local ID: 10.255.14.176    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI for restart configured on peer: inet-vpn-unicast l2vpn
  NLRI advertised by peer: inet-vpn-unicast l2vpn
  NLRI for this session: inet-vpn-unicast l2vpn
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-vpn-unicast l2vpn
  NLRI peer can save forwarding state: inet-vpn-unicast l2vpn
  NLRI that peer saved forwarding for: inet-vpn-unicast l2vpn
  NLRI that restart is negotiated for: inet-vpn-unicast l2vpn
  NLRI of received end-of-rib markers: inet-vpn-unicast l2vpn
  Table bgp.l3vpn.0 Bit: 10000
    RIB State: BGP restart in progress
    RIB State: VPN restart in progress
    Send state: in sync
    Active prefixes:            10
    Received prefixes:          10
    Suppressed due to damping:  0
  Table bgp.l2vpn.0 Bit: 20000
```

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```
  RIB State: BGP restart in progress
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            1
  Received prefixes:          1
  Suppressed due to damping:  0
Table BGP-INET.inet.0 Bit: 30000
  RIB State: BGP restart in progress
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Table BGP-L.inet.0 Bit: 40000
  RIB State: BGP restart in progress
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Table LDP.inet.0 Bit: 50000
  RIB State: BGP restart is complete
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            1
  Received prefixes:          1
  Suppressed due to damping:  0
Table OSPF.inet.0 Bit: 60000
  RIB State: BGP restart is complete
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Table RIP.inet.0 Bit: 70000
  RIB State: BGP restart is complete
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            2
  Received prefixes:          2
  Suppressed due to damping:  0
Table STATIC.inet.0 Bit: 80000
  RIB State: BGP restart is complete
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            1
  Received prefixes:          1
  Suppressed due to damping:  0
Table L2VPN.l2vpn.0 Bit: 90000
  RIB State: BGP restart is complete
  RIB State: VPN restart in progress
  Send state: in sync
  Active prefixes:            1
  Received prefixes:          1
  Suppressed due to damping:  0
Last traffic (seconds): Received 0    Sent 0    Checked 0
Input messages:  Total 14     Updates 13      Refreshes 0     Octets 1053
Output messages: Total 3      Updates 0       Refreshes 0     Octets 105
Output Queue[0]: 0  (bgp.l3vpn.0, inet-vpn-unicast)
Output Queue[1]: 0  (bgp.l2vpn.0, inet-vpn-unicast)
```


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```
  Output Queue[2]: 0  (BGP-INET.inet.0, inet-vpn-unicast)
  Output Queue[3]: 0  (BGP-L.inet.0, inet-vpn-unicast)
  Output Queue[4]: 0  (LDP.inet.0, inet-vpn-unicast)
  Output Queue[5]: 0  (OSPF.inet.0, inet-vpn-unicast)
  Output Queue[6]: 0  (RIP.inet.0, inet-vpn-unicast)
  Output Queue[7]: 0  (STATIC.inet.0, inet-vpn-unicast)
  Output Queue[8]: 0  (L2VPN.l2vpn.0, inet-vpn-unicast)
```

show bgp neighbor (Layer 3 VPN) (Not supported on the OCX Series.)

```
user@host> show bgp neighbor
```

```
Peer: 192.0.2.0.179     AS 10045 Local: 192.0.2.1+1214    AS 10045
  Type: Internal    State: Established    Flags: <ImportEval>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Export: [ match-all ] Import: [ match-all ]
  Options: <Preference LocalAddress HoldTime GracefulRestart AddressFamily
   Rib-group Refresh>
  Address families configured: inet-vpn-unicast
  Local Address: 192.0.2.1 Holdtime: 90 Preference: 170
  Flags for NLRI inet-labeled-unicast: TrafficStatistics
  Traffic Statistics: Options: all File: /var/log/bstat.log
                                       size 131072 files 10
  Traffic Statistics Interval: 60
  Number of flaps: 0
  Peer ID: 192.168.1.110    Local ID: 192.168.1.111    Active Holdtime: 90
  Keepalive Interval: 30
  NLRI for restart configured on peer: inet-vpn-unicast
  NLRI advertised by peer: inet-vpn-unicast
  NLRI for this session: inet-vpn-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 120
  Stale routes from peer are kept for: 300
  Restart time requested by this peer: 120
  NLRI that peer supports restart for: inet-vpn-unicast
  NLRI peer can save forwarding state: inet-vpn-unicast
  NLRI that peer saved forwarding for: inet-vpn-unicast
  NLRI that restart is negotiated for: inet-vpn-unicast
  NLRI of received end-of-rib markers: inet-vpn-unicast
  NLRI of all end-of-rib markers sent: inet-vpn-unicast
  Table bgp.l3vpn.0 Bit: 10000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Table vpn-green.inet.0 Bit: 20001
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: in sync
    Active prefixes:            2
    Received prefixes:          2
    Suppressed due to damping:  0
  Last traffic (seconds): Received 15   Sent 20   Checked 20
  Input messages:  Total 40     Updates 2       Refreshes 0     Octets 856
  Output messages: Total 44     Updates 2       Refreshes 0     Octets 1066
  Output Queue[0]: 0  (bgp.l3vpn.0, inet-vpn-unicast)
  Output Queue[1]: 0  (vpn-green.inet.0, inet-vpn-unicast)
```

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```
  Trace options: detail packets
  Trace file: /var/log/bgpgr.log size 131072 files 10
```

show bgp neighbor neighbor-address

```
user@host> show bgp neighbor 192.168.1.111
```

```
Peer: 10.255.245.12+179 AS 35  Local: 10.255.245.13+2884 AS 35
  Type: Internal    State: Established  (route reflector client)Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress HoldTime Cluster AddressFamily Rib-group
  Refresh>
  Options: RFC6514CompliantSafi129
  Address families configured: inet-vpn-unicast inet-labeled-unicast
  Local Address: 10.255.245.13 Holdtime: 90 Preference: 170
  Flags for NLRI inet-vpn-unicast: AggregateLabel
  Flags for NLRI inet-labeled-unicast: AggregateLabel
  Number of flaps: 0
  Peer ID: 10.255.245.12    Local ID: 10.255.245.13    Active Holdtime: 90
  Keepalive Interval: 30
BFD: disabled
  NLRI advertised by peer: inet-vpn-unicast inet-labeled-unicast
  NLRI for this session: inet-vpn-unicast inet-labeled-unicast
  Peer supports Refresh capability (2)
  Restart time configured on the peer: 300
  Stale routes from peer are kept for: 60
  Restart time requested by this peer: 300
  NLRI that peer supports restart for: inet-unicast inet6-unicast
  NLRI that restart is negotiated for: inet-unicast inet6-unicast
  NLRI of received end-of-rib markers: inet-unicast inet6-unicast
  NLRI of all end-of-rib markers sent: inet-unicast inet6-unicast
  Table inet.0 Bit: 10000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 4
    Received prefixes: 6
    Suppressed due to damping: 0
  Table inet6.0 Bit: 20000
    RIB State: restart is complete
    Send state: in sync
    Active prefixes: 0
    Received prefixes: 2
    Suppressed due to damping: 0
  Last traffic (seconds): Received 3    Sent 3    Checked 3
  Input messages:  Total 9      Updates 6       Refreshes 0     Octets 403
  Output messages: Total 7      Updates 3       Refreshes 0     Octets 365
  Output Queue[0]: 0  (inet.0, inet-unicast)
  Output Queue[1]: 0  (inet6.0, inet6-unicast)
  Trace options: detail packets
  Trace file: /var/log/bgpgr size 131072 files 10
```

show bgp neighbor neighbor-address

```
user@host> show bgp neighbor 192.168.4.222
```

```
Peer: 192.168.4.222+4902 AS 65501 Local: 192.168.4.221+179 AS 65500
  Type: External    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
```


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```
Last Error: Cease
Export: [ export-policy ] Import: [ import-policy ]
Options: <Preference HoldTime AddressFamily PeerAS PrefixLimit Refresh>
Address families configured: inet-unicast inet-multicast
Holdtime: 60000 Preference: 170
Number of flaps: 4
Last flap event: RecvUpdate
Error: 'Cease' Sent: 5 Recv: 0
Peer ID: 10.255.245.6     Local ID: 10.255.245.5     Active Holdtime: 60000
Keepalive Interval: 20000      Peer index: 0
BFD: disabled, down
Local Interface: fxp0.0
NLRI advertised by peer: inet-unicast inet-multicast
NLRI for this session: inet-unicast inet-multicast
Peer supports Refresh capability (2)
Table inet.0 Bit: 10000
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              8
  Received prefixes:            10
  Accepted prefixes:            10
  Suppressed due to damping:    0
  Advertised prefixes:          3
Table inet.2 Bit: 20000
  RIB State: BGP restart is complete
  Send state: in sync
  Active prefixes:              0
  Received prefixes:            0
  Accepted prefixes:            0
  Suppressed due to damping:    0
  Advertised prefixes:          0
Last traffic (seconds): Received 357  Sent 357  Checked 357
Input messages:  Total 4 Updates 2  Refreshes 0  Octets 211
Output messages: Total 4 Updates 1  Refreshes 0  Octets 147
Output Queue[0]: 0  (inet.0, inet-unicast)
Output Queue[1]: 0  (inet.2, inet-multiicast)
Trace options:  all
Trace file: /var/log/bgp size 10485760 files 10
```

show bgp neighbor neighbor-address (BGP Graceful Restart Enabled)

```
user@router> show bgp neighbor 10.255.255.16
```

```
Peer: 10.255.255.16 AS 100     Local: 10.255.255.12 AS 100
  Type: Internal    State: Active         Flags: <>
  Last State: Idle          Last Event: Start
  Last Error: None
  Options: <Preference LocalAddress AddressFamily Rib-group Refresh>
  Options: <LLGR>
  Address families configured: l2vpn
  Local Address: 10.255.255.12 Holdtime: 90 Preference: 170
  NLRI l2vpn:
  Number of flaps: 6
  Last flap event: Restart
  NLRI we are holding stale routes for: inet-vpn-unicast
  Time until stale routes are deleted or become long-lived stale: 00:01:57
  Time until end-of-rib is assumed for stale routes: 00:04:43
  Table bgp.l3vpn.0
    RIB State: BGP restart is complete
```

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```
    RIB State: VPN restart is complete
    Send state: not advertising
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
  Table foo.inet.0 Bit: 30000
    RIB State: BGP restart is complete
    RIB State: VPN restart is complete
    Send state: not in sync
    Active prefixes:              0
    Received prefixes:            7
    Accepted prefixes:            7
    Suppressed due to damping:    0
```

show bgp neighbor neighbor-address (BGP Long-Lived Graceful Restart)

```
user@router> show bgp neighbor 10.4.12.11
```

```
 Peer: 10.4.12.11 AS 100        Local: 10.6.128.225 AS 100
   Type: Internal    State: Active         Flags: <>
   Last State: Idle          Last Event: Start
   Last Error: None
   Export: [ foo ]
   Options: <Preference LocalAddress Refresh GracefulRestart>
   Options: <LLGR>
   Local Address: 10.6.128.225 Holdtime: 90 Preference: 170
   Number of flaps: 3
   Last flap event: Restart
   Error: 'Cease' Sent: 0 Recv: 1
   Time until long-lived stale routes deleted: inet-vpn-unicast 10:00:22
route-target 10:00:22
   Table bgp.l3vpn.0
     RIB State: BGP restart is complete
     RIB State: VPN restart is complete
     Send state: not advertising
     Active prefixes:              0
     Received prefixes:            7
     Accepted prefixes:            7
     Suppressed due to damping:    0
   Table foo.inet.0 Bit: 30000
     RIB State: BGP restart is complete
     RIB State: VPN restart is complete
     Send state: not in sync
     Active prefixes:              0
     Received prefixes:            7
     Accepted prefixes:            7
     Suppressed due to damping:    0
```

show bgp neighbor orf neighbor-address detail

```
user@host > show bgp neighbor orf 192.168.165.56 detail
```

```
Peer: 192.168.165.56+179 Type: External
  Group: ext1

  inet-unicast
    Filter updates recv:          1 Immediate:          1
```


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```
    Filter: prefix-based  receive
      Received filter entries:
        seq 1: prefix 2.2.2.2/32: minlen 32: maxlen 32: match deny:

  inet6-unicast
    Filter updates recv:          0 Immediate:          1
    Filter: prefix-based  receive
      Received filter entries:
        *:*
```

show bgp neighbor logical-system

user@host > **show bgp neighbor logical-system ITR1**

```
Peer: 10.79.8.2+179 AS 65536   Local: 10.79.8.1+50891 AS 65500
  Description: MX1
  Type: External    State: Established    Flags: <ImportEval Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
 ....
  Table inet.0 Bit: 10000
    RIB State: BGP restart is complete
    Send state: in sync
    Active prefixes:              1
    Received prefixes:            1
    Accepted prefixes:            1
    Suppressed due to damping:    0
    Advertised prefixes:          10
    Stale prefixes:               4: <=new, line only appears if count is non-0
It is the Number of prefixes marked as stale;
    LLGR-stale prefixes:          5: <=new, line only appears if count is non-0
It is the Number of prefixes marked as LLGR-stale
```

show bgp neighbor output-queue

user@host > **show bgp neighbor output-queue**

```
Peer: 192.0.2.2+179 AS 103       Local: 192.0.2.1+50799 AS 102
  Output Queue[0]: 0            (inet.0, inet-unicast)
    Priority 1 :   0
    Priority 2 :   0
    Priority 3 :   0
    Priority 4 :   0
    Priority 5 :   0
    Priority 6 :   0
    Priority 7 :   0
    Priority 8 :   0
    Priority 9 :   0
    Priority 10:   0
    Priority 11:   0
    Priority 12:   0
    Priority 13:   0
    Priority 14:   0
    Priority 15:   0
    Priority 16:   0
    Expedited  :   0
```

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show bgp neighbor (Segment Routing Traffic Engineering)

```
user@host > show bgp neighbor
```

```
run show bgp neighbor 1.1.1.254
   Peer: 1.1.1.254+60180 AS 100   Local: 1.1.1.1+179 AS 100
  Group: toB                   Routing-Instance: master
  Forwarding routing-instance: master
  Type: Internal    State: Established    Flags: <Sync>
  Last State: OpenConfirm   Last Event: RecvKeepAlive
  Last Error: None
  Options: <Preference LocalAddress>
  Address families configured: inet-segment-routing-te
  Local Address: 1.1.1.1 Holdtime: 90 Preference: 170 Local AS: 100 Local System
 AS: 0
  Number of flaps: 0
  Peer ID: 128.9.150.15    Local ID: 128.9.150.110     Active Holdtime: 90
  Keepalive Interval: 30         Group index: 0    Peer index: 0
  I/O Session Thread: bgpio-0 State: Enabled
  BFD: disabled, down
  NLRI for restart configured on peer: inet-segment-routing-te
  NLRI advertised by peer: inet-segment-routing-te
  NLRI for this session: inet-segment-routing-te
  Peer supports Refresh capability (2)
  Stale routes from peer are kept for: 300
  Peer does not support Restarter functionality
  Restart flag received from the peer: Notification
  NLRI that restart is negotiated for: inet-segment-routing-te
  Peer does not support LLGR Restarter functionality
  Peer supports 4 byte AS extension (peer-as 100)
  Peer does not support Addpath
  Last traffic (seconds): Received 17628 Sent 25  Checked 17628
  Input messages:  Total 2      Updates 0       Refreshes 0     Octets 82
  Output messages: Total 1      Updates 0       Refreshes 0     Octets 19
  Trace options:  all
  Trace file: /var/log/bgp.log size 10485760 files 10
```


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show bgp output-scheduler

Syntax

```
show bgp output-scheduler
<exact-instance instance-name>
<fabric <exact-instance instance-name | instance (instance-name | prefix)>>
<instance (instance-name | prefix)>
<logical-system (all | logical-system-name)>
```

Release Information Command introduced in Junos OS Release 16.1 on ACX Series, M Series, MX Series, QFabric, QFX Series, and T Series

Description Display output scheduler information including the number of tokens assigned to each priority output queue. Output queues are shown as classes.

Options

none—Display the number of tokens assigned to each of the 17 BGP priority output queues for the master routing instance.

exact-instance *instance-name*—(Optional) Display the number of tokens assigned to each of the 17 BGP priority output queues for the specified routing instance name.

fabric —(Optional) Display the internal fabric state. The exact-instance and instance options can be used along with the fabric option.

instance *instance-name*—(Optional) Display information about BGP peers for all routing instances whose name begins with the *instance-name* string. (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp output-scheduler instance cust1** command).

logical-system *logical-system-name.*—(Optional) Display the number of tokens assigned to each of the 17 BGP priority queues within the specified logical-system. The instance and exact-instance options can be used along with the logical-system option.

Required Privilege Level routing

Related Documentation

- show bgp group output-queues on page 1456

List of Sample Output command-name (optional-text) on page 1483

Output Fields

Sample Output

command-name (optional-text)

```
user@host> show bgp output-scheduler
```

```
Instance: master
  Class         Tokens
  ------------  ------
  Priority  1        1
  Priority  2       10
  Priority  3       15
  Priority  4       20
  Priority  5       25
  Priority  6       30
  Priority  7       35
  Priority  8       40
  Priority  9       45
  Priority 10       50
  Priority 11       55
  Priority 12       60
  Priority 13       65
  Priority 14       70
  Priority 15       75
  Priority 16       80
  Expedited        100

  Priority  Class
  --------  ------------
  low       Priority  1
  medium    Priority 10
  high      Expedited
```


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show bgp replication

Syntax **show bgp replication**

Release Information Command introduced in Junos OS Release 8.5.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Support for **logical-system** option introduced in Junos OS Release 13.3.

Description Displays the status of BGP state replication between the master and backup Routing Engines on devices that have nonstop active routing configured on them.

CAUTION: Before attempting nonstop active routing switchover, check the output of **show bgp replication** to confirm that BGP routing table synchronization has completed on the backup Routing Engine. The **complete** status in the output of **show task replication** only indicates that the socket replication has completed and the BGP synchronization is in progress.

To determine whether BGP synchronization is complete, you must check the **Protocol state** and **Synchronization state** fields in the output of **show bgp replication** on the master Routing Engine. The **Protocol state** must be **idle** and the **Synchronization state** must be **complete**. If you perform NSR switchover before the BGP synchronization has completed, the BGP session might flap.

Options This command has no options.

Required Privilege Level view

Related Documentation
- show bgp replication logical-system on page 1488

List of Sample Output
show bgp replication (for Master) on page 1487
show bgp replication (for Backup) on page 1487

Output Fields Table 36 on page 1486 lists the output fields for the **show bgp replication** command. Output fields are listed in the approximate order in which they appear.

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Table 36: show bgp replication Output Fields

Field Name	Field Description
Precision timer registration	State of BGP precision timer feature in the kernel. • **Registered**—BGP registers with the precision-timer feature in the kernel for auto keepalive generation after switchover. • **NotRegistered**—Keepalive format of BGP is not registered.
session state	State of the current internal BGP state replication session, Up or Down, and the duration for which the session has been in the indicated state.
flaps	Total number of flaps that occurred.
protocol state	Current state of the protocol operation, Active, Connect, Idle, and the duration for which the protocol has been in the indicated state.
synchronization state	Synchronization state at the time of executing the command. The states can be: • **Idle** • **Neighbor**—Indicates that the neighbor state synchronization is in progress. • **AckWait**—Indicates that the request processing is over. • **ORF**—Indicates that the outbound routing filter synchronization is in progress. • **RIB**—Indicates that the routing table synchronization is in progress. • **Complete**
number of peers waiting	Total number of peers waiting for various messages: • **AckWait**—Number of peers waiting for a connection establishment or completed acknowledgment messages. • **SoWait**—Number of peers waiting for TCP socket-related operations. • **Scheduled**—Number of peers being synchronized.
messages sent	Number of various types of messages that have been sent since internal replication session became active: • **Open**—Number of Open messages sent. • **Establish**—Number of connection establishment acknowledgment messages sent. • **Update**—Number of update messages sent. • **Error**—Number of error messages sent. • **Complete**—Number of connection complete acknowledgment messages sent.

messages received	Total number of messages received:
	• **Open**—Number of Open messages received.
	• **Request**—Number of request messages received:
	  ◦ **Wildcard**—Number of requests received that used wildcards in the target address.
	  ◦ **Targeted**—Number of requests received that used a specific address.
	• **EstablishAck**—Number of connection establishment acknowledgement messages received.
	• **CompleteAck**—Number of connection completed acknowledgement messages received.

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Sample Output

show bgp replication (for Master)

```
user@host> show bgp replication
```

```
Synchronization master:
  Precision timer registration: Registered
  Session state: Up, Since: 10:14
  Flaps: 1, Last flap reason: Backup closed connection
  Protocol state: Idle, Since: 10:14
  Synchronization state: Complete
  Number of peers waiting: AckWait: 0, SoWait: 0, Scheduled: 0
  Messages sent: Open 1, Establish 11, GrHelper 0, Update 0, GrStaleLabel 0 Error
 0, Complete 1
  Messages received: Open 1, Request 1 wildcard 0 targeted, EstablishAck 11,
GrHelperAck 0, CompleteAck 1
```

show bgp replication (for Backup)

```
user@host> show bgp replication
```

```
Synchronization backup:
  State: Established 13 ago
  , Unsync timer: 2

    Unsync entry queue:
        Instance: 0 Neighbor: 30.30.30.1 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.3 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.4 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.5 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.6 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.1 elapsed: 7
        Instance: 0 Neighbor: 40.40.40.2 elapsed: 7
```

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show bgp replication logical-system

Syntax

```
show bgp replication logical-system
<logical-system-name>
```

Release Information Command introduced in Junos OS Release 13.3.

Description Display logical system-specific BGP state replication between the master and backup logical system on Routing Engines that have nonstop active routing configured on them.

Options This command has no options.

Required Privilege Level View

Related Documentation

- show bgp replication on page 1485

List of Sample Output show bgp replication logical-system on page 1489

Output Fields Table 37 on page 1488 lists the output fields for the **show bgp replication logical-system** command. Output fields are listed in the approximate order in which they appear.

Table 37: show bgp replication logical-system Output Fields

Field Name	Field Description
session state	State of the current internal BGP state replication session, Up or Down, and the duration for which the session has been in the indicated state.
flaps	Total number of flaps that occurred.
protocol state	Current state of the protocol operation (Active, Connect, Idle) and the duration for which the protocol has been in the indicated state.
synchronization state	Synchronization state at the time of executing the command. The states can be: • **Idle** • **Neighbor**—Indicates that the neighbor state synchronization is in progress. • **AckWait**—Indicates that the request processing is over. • **ORF**—Indicates that the outbound routing filter synchronization is in progress. • **RIB**—Indicates that the routing table synchronization is in progress. • **Complete**

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Table 37: show bgp replication logical-system Output Fields (continued)

Field Name	Field Description
number of peers waiting	Total number of peers waiting for various messages: • **AckWait**—Number of peers waiting for connection establishment or completed acknowledgment messages. • **SoWait**—Number of peers waiting for TCP socket-related operations. • **Scheduled**—Number of peers being synchronized.
messages sent	Number of various types of messages that have been sent since internal replication session became active: • **Open**—Number of Open messages sent. • **Establish**—Number of connection establishment acknowledgment messages sent. • **Update**—Number of update messages sent. • **Error**—Number of error messages sent. • **Complete**—Number of connection complete acknowledgment messages sent.

messages received	Total number of messages received:
	• **Open**—Number of Open messages received.
	• **Request**—Number of request messages received:
	  • **Wildcard**—Number of requests received that used wildcards in the target address.
	  • **Targeted**—Number of requests received that used a specific address.
	• **EstablishAck**—Number of connection establishment acknowledged messages received.
	• **CompleteAck**—Number of connection completed acknowledged messages received.

Sample Output

show bgp replication logical-system

```
user@host> show bgp replication logical-system lr2
Synchronization master:
  Session state: Up, Since: 24:53
  Flaps: 0
  Protocol state: Idle, Since: 2
  Synchronization state: Complete
  Number of peers waiting: AckWait: 0, SoWait: 0, Scheduled: 0
  Messages sent: Open 1, Establish 145, Update 0, Error 1, Complete 145
  Messages received: Open 1, Request 1 wildcard 144 targeted, EstablishAck 0,
CompleteAck 145
```

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show bgp summary

List of Syntax

Syntax on page 1490
Syntax (EX Series Switch and QFX Series) on page 1490

Syntax

```
show bgp summary
<exact-instance instance-name>
<group group-name>
<instance instance-name>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switch and QFX Series)

```
show bgp summary
<exact-instance instance-name>
<instance instance-name>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.
exact-instance option introduced in Junos OS Release 11.4.
group option introduced in Junos OS Release 13.3.

Description

Display BGP summary information.

Options

none—Display BGP summary information for all routing instances.

exact-instance *instance-name*—(Optional) Display information for the specified instance only.

group—Display overview of bgp information for a particular group

instance *instance-name*—(Optional) Display information for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp summary instance cust1** command). The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show bgp summary (When a Peer Is Not Established) on page 1493
show bgp summary (When a Peer Is Established) on page 1493
show bgp summary (CLNS) on page 1493
show bgp summary (Layer 2 VPN) on page 1494

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show bgp summary (Layer 3 VPN) on page 1494
show bgp summary group on page 1494
show bgp summary (BGP Graceful Restart or Long-Lived Graceful Restart) on page 1495

Output Fields Table 38 on page 1491 describes the output fields for the **show bgp summary** command. Output fields are listed in the approximate order in which they appear.

Table 38: show bgp summary Output Fields

Field Name	Field Description
Groups	Number of BGP groups.
Peers	Number of BGP peers.
Down peers	Number of down BGP peers.
Table	Name of routing table.
Tot Paths	Total number of paths.
Act Paths	Number of active routes.
Suppressed	Number of routes currently inactive because of damping or other reasons. These routes do not appear in the forwarding table and are not exported by routing protocols.
History	Number of withdrawn routes stored locally to keep track of damping history.
Damp State	Number of routes with a figure of merit greater than zero, but still active because the value has not reached the threshold at which suppression occurs.
Pending	Routes in process by BGP import policy.
Peer	Address of each BGP peer. Each peer has one line of output.
AS	Peer's AS number.
InPkt	Number of packets received from the peer.
OutPkt	Number of packets sent to the peer.
OutQ	Number of BGP packets that are queued to be transmitted to a particular neighbor. It normally is **0** because the queue usually is emptied quickly.
Flaps	Number of times the BGP session has gone down and then come back up.
Last Up/Down	Last time since the neighbor transitioned to or from the established state.

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Table 38: show bgp summary Output Fields (continued)

Field Name	Field Description
State|#Active /Received/Accepted /Damped	Multipurpose field that displays information about BGP peer sessions. The field's contents depend upon whether a session is established and whether it was established on the main routing device or in a routing instance. • If a peer is not established, the field shows the state of the peer session: **Active**, **Connect**, or **Idle**. In general, the Idle state is the first stage of a connection. BGP is waiting for a Start event. A session can be idle for other reasons as well. The reason that a session is idle is sometimes displayed. For example: **Idle (Removal in progress)** or **Idle (LicenseFailure)**. • If a BGP session is established on the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the **inet.0** (main) and **inet.2** (multicast) routing tables. For example, **8/10/10/2 and 2/4/4/0** indicate the following: ◦ 8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the **inet.0** routing table. ◦ 2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the **inet.2** routing table. • If a BGP session is established in a routing instance, the field indicates the established **(Establ)** state, identifies the specific routing table that receives BGP updates, and shows the number of active, received, and damped routes that are received from a neighbor. For example, **Establ VPN-AB.inet.0: 2/4/0** indicates the following: ◦ The BGP session is established. ◦ Routes are received in the **VPN-AB.inet.0** routing table. ◦ The local routing device has two active routes, four received routes, and no damped routes from a BGP peer. When a BGP session is established, the peers are exchanging update messages. NOTE: When graceful restart or LLGR helper mode is active, the RIB information is now displayed by the **show bgp summary** command. If a BGP session is established on the main routing device, the field shows the number of active, received, accepted, and damped routes that are received from a neighbor and appear in the inet.0 (main) and inet.2 (multicast) routing tables. For example, 8/10/10/2 and 2/4/4/0 indicate the following: • 8 active routes, 10 received routes, 10 accepted routes, and 2 damped routes from a BGP peer appear in the inet.0 routing table. • 2 active routes, 4 received routes, 4 accepted routes, and no damped routes from a BGP peer appear in the inet.2 routing table.

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Sample Output

show bgp summary (When a Peer Is Not Established)

```
user@host> show bgp summary
Groups: 2 Peers: 4 Down peers: 1
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0                 6          4          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.0.0.3        65002         86         90       0       2       42:54 0/0/0

0/0/0
10.0.0.4        65002         90         91       0       1       42:54 0/2/0

0/0/0
10.0.0.6        65002         87         90       0       3           3 Active
10.1.12.1       65001         89         89       0       1       42:54 4/4/0

0/0/0
```

show bgp summary (When a Peer Is Established)

```
user@host> show bgp summary

Groups: 1 Peers: 1 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.12.78.2            64531         27         26       0       0       10:49
Establ
  inet.0: 0/0/0/0
```

```
user@host> show bgp summary logical-system R3
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0
                       2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
1.1.1.2                  2        204        206       0       0     1:30:59
Establ
  bgp.l3vpn.0: 2/2/2/0
  red.inet.0: 2/2/2/0
10.1.1.10                3        206        207       0       0     1:31:36
Establ
  red.inet.0: 2/2/2/0
```

show bgp summary (CLNS)

```
user@host> show bgp summary
Groups: 1 Peers: 1 Down peers: 0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
```

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```
10.245.245.1      200       1735       1737       0       0    14:26:12 Establ
  bgp.isovpn.0: 3/3/0
  aaaa.iso.0: 3/3/0
```

show bgp summary (Layer 2 VPN)

```
user@host> show bgp summary
Groups: 1 Peers: 5 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l2vpn.0            1          1          0          0          0          0
inet.0                 0          0          0          0          0          0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last
Up/Dwn State|#Active/Received/Damped...
10.255.245.35    65299         72         74       0       1       19:00 Establ
  bgp.l2vpn.0: 1/1/0
  frame-vpn.l2vpn.0: 1/1/0
10.255.245.36    65299       2164       2423       0       4       19:50 Establ
  bgp.l2vpn.0: 0/0/0
  frame-vpn.l2vpn.0: 0/0/0
10.255.245.37    65299         36         37       0       4       17:07 Establ
  inet.0: 0/0/0
10.255.245.39    65299        138        168       0       6       53:48 Establ
  bgp.l2vpn.0: 0/0/0
  frame-vpn.l2vpn.0: 0/0/0
10.255.245.69    65299        134        140       0       6       53:42 Establ
  inet.0: 0/0/0
```

show bgp summary (Layer 3 VPN)

```
user@host> show bgp summary
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State Pending
bgp.l3vpn.0            2          2          0          0          0       0
Peer               AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Damped...
10.39.1.5           2         21         22       0       0        6:26 Establ
  VPN-AB.inet.0: 1/1/0
10.255.71.15        1         19         21       0       0        6:17 Establ
  bgp.l3vpn.0: 2/2/0
  VPN-A.inet.0: 1/1/0
  VPN-AB.inet.0: 2/2/0
  VPN-B.inet.0: 1/1/0
```

show bgp summary group

```
user@host> show bgp summary group Group2
Groups: 3 Peers: 3 Down peers: 3
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
inet.0
                       0          0          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.0.0.1                56          0          0       0       0          51
Idle
```

```
user@host> show bgp summary logical-system R3 group toR4
```


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```
Groups: 2 Peers: 2 Down peers: 0
Table          Tot Paths  Act Paths Suppressed    History Damp State    Pending
bgp.l3vpn.0
                       2          2          0          0          0          0
Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
10.1.1.10                 3        207        207       0       0     1:31:40
Establ
  red.inet.0: 2/2/2/0
```

show bgp summary (BGP Graceful Restart or Long-Lived Graceful Restart)

```
user@router> show route receive-protocol bgp 10.4.12.11 detail
```

```
  Groups: 2 Peers: 9 Down peers: 1
  ...
  Peer                     AS      InPkt     OutPkt    OutQ   Flaps Last Up/Dwn
State|#Active/Received/Accepted/Damped...
  10.255.255.16           100          7          6       0       4           4
Idle
    bgp.l3vpn.0: 0/7/7/0
    foo.inet.0: 0/7/7/0
```

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show dynamic-tunnels pfe-tunnel-localization

Syntax show dynamic-tunnels pfe-tunnel-localization

Release Information Command introduced in Junos OS Release 17.3R1 on the MX Series.

Description Display dynamic tunnel Packet Forwarding Engine (PFE) localization information such as tunnel count of an anchor PFE, the GENCFG blobs that are sent to the kernel for each IPv6 source, the aggregate routes connected to the anchor PFE, the IPv6 routes that are mapped to this anchor PFE. When the PFE goes down BGP withdraws all the aggregate routes and the IPv6 sources.

NOTE: PFE localization needs to be configured to display output for this command. This command throws back an error if there are no PFE localization entries to display.

Options **none**—Display dynamic tunnel localization information for the Packet Forwarding Engine tunnel.

Required Privilege Level view

Related Documentation

- *dynamic-tunnels*
- extended-nexthop on page 1164
- tunnel-attributes on page 1386
- show v4ov6-tunnels on page 1747
- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676

List of Sample Output

show dynamic-tunnels pfe-tunnel-localization (Master) on page 1497
show dynamic-tunnels pfe-tunnel-localization (Backup) on page 1499
show dynamic-tunnels pfe-tunnel-localization (Localization) on page 1500

Output Fields Table 39 on page 1496 lists the output fields for the **show dynamic-tunnels pfe-tunnel-localization** command. Output fields are listed in the approximate order in which they appear.

Table 39: show dynamic-tunnels pfe-tunnel-localization Output Fields

Field Name	Field Description
Anchor PFE Name	Name of the PFE in pfe-x/y/z format.

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Table 39: show dynamic-tunnels pfe-tunnel-localization Output Fields (continued)

Field Name	Field Description
Reference count	Number of the dynamic tunnels that are currently anchored to a particular PFE. Each tunnel prefix and each Gencfg takes one reference count.
Gencfg keyid	The key ID of a Gencfg blob that is returned by the kernel.
Gencfg tunnel type: UDP	Tunnel count anchored to a particular anchor Packet Forwarding Engine (reference count).
Gencfg last index	The last know index value of the Gencfg blob.
Gencfg current index	The current index value of the Gencfg blob.
Gencfg last state	Last state of the tunnel: **Up**, or **Dn** (down).
Gencfg current state	Current state of the tunnel: **Up**, or **Dn** (down).
Gencfg V6 source address	Source IP address of the Gencfg blob IPv6 tunnel.
Gencfg backup lock	Backup count of the Gencfg blob. This value is displayed in the backup routing protocol process. Each gencfg takes a backup reference count, which is decremented when tunnel is deleted or after NSR switchover and backup becomes new master.
Gencfg kqp	Reference count of Gencfg entries in the KRTQ.
Gencfg Reference count	Each prefix using a particular IPv6 source takes reference count on the Gencfg corresponding to that V6 source. If the Gencfg is added to the kernel and it has key ID, then it has additional reference count of 1. When Gencfg operation is queued in KRTQ then krt q entry takes one ref count on Gencfg.
Aggregate	All aggregate routes that are connected with this anchor PFE. When the PFE goes down, BGP withdraws all these aggregates.
Aggregate refcnt	Reference count of aggregate routes.
V6 source address	All IPv6 source routes that are connected to this anchor PFE. When the PFE goes down, BGP withdraws all these IPv6 sources.
V6 source refcnt	Reference count of IPv6 source routes.

Sample Output

show dynamic-tunnels pfe-tunnel-localization (Master)

```
user@host> show dynamic-tunnels pfe-tunnel-localization
```

```
Anchor PFE Name: pfe-0/0/0
    Reference count: 8

    Gencfg keyid: 1
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 66:66:00:00:00:00:00:00:00:00:00:00:00:00:66:66
      Gencfg backup lock: 0
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x2

    Gencfg keyid: 2
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 77:77:00:00:00:00:00:00:00:00:00:00:00:00:77:77
      Gencfg backup lock: 0
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x2

    Gencfg keyid: 3
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 88:88:00:00:00:00:00:00:00:00:00:00:00:00:88:88
      Gencfg backup lock: 0
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x2

    Gencfg keyid: 4
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 99:99:00:00:00:00:00:00:00:00:00:00:00:00:99:99
      Gencfg backup lock: 0
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x2

    Aggregate: 4.4.4.0/24
    Aggregate refcnt: 1

    Aggregate: 1.1.1.0/24
    Aggregate refcnt: 1

    Aggregate: 2.2.2.0/24
    Aggregate refcnt: 1

    Aggregate: 3.3.3.0/24
    Aggregate refcnt: 1

    V6 source address: 9999::9999/128
    V6 source refcnt: 1

    V6 source address: 8888::8888/128
    V6 source refcnt: 1
```


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```
    V6 source address: 7777::7777/128
    V6 source refcnt: 1

    V6 source address: 6666::6666/128
    V6 source refcnt: 1

{master}
regress@10.102.171.225>
```

show dynamic-tunnels pfe-tunnel-localization (Backup)

```
user@host> show dynamic-tunnels pfe-tunnel-localization
```

```
Anchor PFE Name: pfe-0/0/0
    Reference count: 16

    Gencfg keyid: 1
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 66:66:00:00:00:00:00:00:00:00:00:00:00:66:66
      Gencfg backup lock: 1
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x3

    Gencfg keyid: 2
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 77:77:00:00:00:00:00:00:00:00:00:00:00:77:77
      Gencfg backup lock: 1
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x3

    Gencfg keyid: 3
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 88:88:00:00:00:00:00:00:00:00:00:00:00:88:88
      Gencfg backup lock: 1
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x3

    Gencfg keyid: 4
      Gencfg last index: 145
      Gencfg current index: 145
      Gencfg last state: UP
      Gencfg current state: UP
      Gencfg V6 source address: 99:99:00:00:00:00:00:00:00:00:00:00:00:99:99
      Gencfg backup lock: 1
      Gencfg kqp: 0x0
      Gencfg Reference count: 0x3

    Aggregate: 1.1.1.0/24
    Aggregate refcnt: 1
```

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```
   Aggregate: 2.2.2.0/24
   Aggregate refcnt: 1

   Aggregate: 3.3.3.0/24
   Aggregate refcnt: 1

   Aggregate: 4.4.4.0/24
   Aggregate refcnt: 1

   V6 source address: 8888::8888/128
   V6 source refcnt: 1

   V6 source address: 7777::7777/128
   V6 source refcnt: 1

   V6 source address: 6666::6666/128
   V6 source refcnt: 1

   V6 source address: 9999::9999/128
   V6 source refcnt: 1
```

show dynamic-tunnels pfe-tunnel-localization (Localization)

```
user@host> show dynamic-tunnels pfe-tunnel-localization
```

```
Anchor PFE Name: pfe-0/0/0
 Reference count: 12
 Gencfg keyid: 1
   Gencfg tunnel type: UDP
   Gencfg last index: 142
   Gencfg current index: 142
   Gencfg last state: UP
   Gencfg current state: UP
   Gencfg backup lock: 0
   Gencfg kqp: 0x0
   Gencfg Reference count: 14
```


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show nonstop-routing

Syntax show nonstop-routing

Release Information Command introduced in Junos OS Release 13.3.

Description Display the status of nonstop active routing that includes the automerge statistics and state.

Required Privilege Level View

Related Documentation
- *nonstop-routing*

List of Sample Output
show nonstop-routing (MX Series Router) on page 1502
show nonstop-routing (MX Series Router) on page 1503

Output Fields Table 40 on page 1501 describes the output fields for the **show nonstop-routing** command. Output fields are listed in the approximate order in which they appear.

Table 40: show nonstop-routing Output Fields

Field Name	Field Description
Nonstop Routing	State of NSR.
Precision Timers state	State of precision timer feature in the kernel. • **Enabled**—By default, autokeepalive precision timers are enabled on the kernel after switchover. • **Disabled**—Autokeepalive precision timers are disabled. • **Inactive**—Precision timer is inactive if it is disabled. • **Ready**—Kernel precision timer is ready but is never activated. • **InProcess**—Kernel precision timer is operational and is generating keepalives on behalf of the RPD after switchover. The / count indicates the number of sessions being serviced against the total sessions. • **Completed**—Kernel has completed keepalive generation for all the sessions after switchover, and RPD has taken over all of them successfully. • **Error**—Error while retrieving the precision timer status of the kernel.
Precision Timers max period	Maximum period, in seconds, after the switchover from standby to master event for which the kernel autogenerates keepalives on behalf of BGP.

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Table 40: show nonstop-routing Output Fields (continued)

Field Name	Field Description
Automerge	Status of the automerge. • **Active**—Automerge of sockets by the kernel after switchover is active. • **Inactive**—Automerge of sockets by the kernel after switchover is inactive.
Batching	Status of Batching. • **Yes**—Automerge of sockets by the kernel after a switchover. • **No**—Automerge of sockets by the kernel after switchover is inactive.
Batch count	Number of sockets merged per batch.
Batch count adjust	Speed at which the batch count is adjusted. • **Slow**—Number of sockets merged per batch is incremented additively. • **Exp**—Number of sockets merged per batch is incremented exponentially. • **None**—Number of sockets merged per batch remains constant.
Batch interval	Time interval between batches of automerge operation.
Batch interval adjust	Speed at which the batch interval is adjusted. • **Exp**—Time interval between automerge of batches is increased exponentially. • **None**—Time interval between automerge of batches is not adjusted.
Automerge State	State of the automerge • **Ready**—Ready to automerge socket pairs from secondary to primary routing engine • **InProgress**—Kernel is performing automerge after switchover • **Switchover Completed**—Sessions merged after switchover
Sessions Processed	Count of sessions that are automerged.

Sample Output

show nonstop-routing (MX Series Router)

```
user@host show nonstop-routing
```

```
Nonstop Routing : Enabled
  Precision Timers state: Enabled: Completed - 0/0
  Precision Timers max period: 200
```


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```
 Automerge : Active
 Batching: No
 Batch count: 200
 Batch count adjust: Exponential
 Batch interval: 20 msec
 Batch interval adjust: None
 Automerge State: Ready
 Sessions Processed: 0
```

show nonstop-routing (MX Series Router)

```
user@host> show nonstop-routing
```

```
Nonstop Routing : Enabled
       Automerge : Active
       Batching: Yes
       Batch count: 500
       Batch count adjust: Slow
       Batch interval: 50 msec
       Batch interval adjust: None
       Automerge State: Ready
       Sessions Processed: 0
```

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show (ospf | ospf3) bgp-orr

Syntax

```
show (ospf | ospf3) bgp-orr
<abr>
<asbr>
<brief | detail | extensive>
<extern>
<group group-name>
<instance instance-name>
<inter>
<intra>
<logical-system (all | logical-system-name)>
<network>
<router>
<topology>
```

Release Information Command introduced in Junos OS Release 16.2 for MX Series.

Description Display information about OSPF BGP-ORR metric (RIB).

Options

none—Display group information about all OSPF BGP groups.

abr —(Optional) Display OSPF routes to area border routers.

asbr —(Optional) Display OSPF routes to autonomous systems border routers.

brief | detail | extensive—(Optional) Display the specified level of output.

extern—(Optional) Display external OSPF routes.

group *group-name*—(Optional) Display group information for the specified group.

instance *instance-name*—(Optional) Display information about BGP groups for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show bgp group instance cust1** command). The instance name can be master for the main instance, or any valid configured instance name or its prefix.

inter—(Optional) Display inter-area OSPF routes.

intra—(Optional) Display intra-area OSPF routes.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

network—(Optional) Display routes to networks.

router—(Optional) Display routes to all routers.

topology—(Optional) Name of topology.

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Required Privilege Level view

List of Sample Output show ospf bgp-orr on page 1505
show ospf3 bgp-orr on page 1505

Output Fields Table 41 on page 1505 describes the output fields for the **show ospf bgp-orr** command. Output fields are listed in the approximate order in which they appear.

Table 41: show bgp group Output Fields

Field Name	Field Description	Level of Output
BGP ORR Peer Group	Name of the BGP ORR peer group.	All levels
Primary	Primary node (igp-primary) in a BGP peer group.	All levels
Backup	Backup node (igp-backup) in a BGP peer group, which is used when the primary node (igp-primary) goes down or becomes unreachable.	All levels
Prefix	Destination of the route.	All levels
Path Type	Display the route learned path (inter-area route or intra-area route).	All levels
Route Type	Display the type of router from which the route was learned (Router or Transit).	All levels
Metric	IGP metric value.	All levels

Sample Output

show ospf bgp-orr

```
user@host> show ospf bgp-orr
Topology default Route Table:

BGP ORR Peer Group: toClients
  Primary: 1.1.1.1, active
  Backup: 5.5.5.5
Prefix             Path  Route      Metric
                   Type  Type
1.1.1.2            Intra Router        100
1.1.1.3            Intra Router        130
1.1.1.1/32         Intra Network         0
1.1.1.2/32         Intra Network       100
10.1.1.0/30        Intra Network       100
10.1.1.4/30        Intra Network       130
```

show ospf3 bgp-orr

```
user@host> show ospf3 bgp-orr
```

```
BGP ORR Peer Group: toClients
  Primary: 1.1.1.1, active
Prefix                                      Path  Route      Metric
                                            Type  Type
1.1.1.2                                     Intra Router     100
1.1.1.2;0.0.0.4                             Intra Transit    100
1.1.1.3                                     Intra Router     130
1.1.1.3;0.0.0.2                             Intra Transit    130
::1.1.1.1/128                               Intra Network    0
::1.1.1.2/128                               Intra Network    100
::1.1.1.3/128                               Intra Network    130
```


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show policy

List of Syntax

Syntax on page 1507
Syntax (EX Series Switches) on page 1507

Syntax

```
show policy
<logical-system (all | logical-system-name)>
<policy-name>
<statistics >
```

Syntax (EX Series Switches)

```
show policy
<policy-name>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
statistics option introduced in Junos OS Release 16.1 for MX Series routers.

Description

Display information about configured routing policies.

Options

none—List the names of all configured routing policies.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

policy-name—(Optional) Show the contents of the specified policy.

statistics—(Optional) Use in conjunction with the **test policy** command to show the length of time (in microseconds) required to evaluate a given policy and the number of times it has been executed. This information can be used, for example, to help structure a policy so it is evaluated efficiently. Timers shown are per route; times are not cumulative. Statistics are incremented even when the router is learning (and thus evaluating) routes from peering routers.

Required Privilege Level

view

Related Documentation

- show policy damping on page 1512
- test policy on page 1749

List of Sample Output

show policy on page 1508
show policy policy-name on page 1508
show policy statistics policy-name on page 1508
show policy (Multicast Scoping) on page 1509
show policy (Route Filter and source Address Filter Lists) on page 1509

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Output Fields Table 42 on page 1508 lists the output fields for the **show policy** command. Output fields are listed in the approximate order in which they appear.

Table 42: show policy Output Fields

Field Name	Field Description
policy-name	Name of the policy listed.
term	Name of the user-defined policy term. The term name **unnamed** is used for policy elements that occur outside of user defined terms
from	Match condition for the policy.
then	Action for the policy.

Sample Output

show policy

```
user@host> show policy
Configured policies:
__vrf-export-red-internal__
__vrf-import-red-internal__
red-export
rf-test-policy
multicast-scoping
```

show policy policy-name

```
user@host> show policy vrf-import-red-internal
Policy vrf-import-red-internal:
    from
         203.0.113.0/28  accept
         203.0.113.32/28  accept
    then reject
```

show policy statistics policy-name

```
user@host> show policy statistics iBGP-v4-RR-Import
Policy iBGP-v4-RR-Import:
    [1243328] Term Lab-Infra:
        from [1243328 0]  proto BGP
             [28 0] route filter:
                 10.11.0.0/8 orlonger
                 10.13.0.0/8 orlonger
        then [28 0] accept
    [1243300] Term External:
        from [1243300 1]  proto BGP
         [1243296 0]  community Ext-Com1 [64496:1515 ]
         [1243296 0]  prefix-list-filter Customer-Routes
         [1243296 0]  aspath AS6221
             [1243296 1] route filter:
```


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```
                172.16.49.0/12 orlonger
                172.16.50.0/12 orlonger
                172.16.51.0/12 orlonger
                172.16.52.0/12 orlonger
                172.16.56.0/12 orlonger
                172.16.60.0/12 orlonger
        then [1243296 2] community + Ext-Com2 [64496:2000 ] [1243296 0] accept
    [4] Term Final:
        then [4 0] reject
```

show policy (Multicast Scoping)

```
user@host> show policy multicast-scoping
```

```
Policy multicast-scoping:
    from
         multicast-scope == 8
  then
    accept
```

show policy (Route Filter and source Address Filter Lists)

```
user@host> show policy rf-test-policy
```

```
Policy rf-test-policy:
    Term term1:
        from source-address-filter-list saf-list-1
             source-address filter:
                 192.0.2.0/29 longer
                 192.0.2.64/28 exact
                 192.0.2.128/28 exact
                 192.0.2.160/28 orlonger
    Term term2:
        from route-filter-list rf-list-1
             route filter:
                 198.51.100.0/29 upto 198.51.100.0/30
                 198.51.100.8/29 upto 198.51.100.8/30 accept
    Term unnamed:
        then reject
```

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show policy conditions

Syntax

```
show policy conditions
<condition-name>
<detail>
<dynamic>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show policy conditions
<condition-name>
<detail>
<dynamic>
```

Release Information Command introduced in Junos OS Release 9.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description Display all the configured conditions as well as the routing tables with which the configuration manager is interacting. If the **detail** keyword is included, the output also displays dependent routes for each condition.

Options

none—Display all configured conditions and associated routing tables.

condition-name—(Optional) Display information about the specified condition only.

detail—(Optional) Display the specified level of output.

dynamic—(Optional) Display information about the conditions in the dynamic database.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level view

List of Sample Output show policy conditions detail on page 1511

Output Fields Table 43 on page 1510 lists the output fields for the **show policy conditions** command. Output fields are listed in the approximate order in which they appear.

Table 43: show policy conditions Output Fields

Field Name	Field Description	Level of Output
Condition	Name of configured condition.	All levels
event	Condition type. If the **if-route-exists** option is configured, the event type is: **Existence of a route in a specific routing table**.	All levels

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Table 43: show policy conditions Output Fields (continued)

Field Name	Field Description	Level of Output
Dependent routes	List of routes dependent on the condition, along with the latest generation number.	**detail**
Condition tables	List of routing tables associated with the condition, along with the latest generation number and number of dependencies.	All levels
If-route-exists conditions	List of conditions configured to look for a route in the specified table.	All levels

Sample Output

show policy conditions detail

```
user@host> show policy conditions detail
Configured conditions:
Condition cond1, event: Existence of a route in a specific routing table
Dependent routes:
 172.16.4.4/32, generation 3
 6.6.6.6/32, generation 3
 10.10.10.10/32, generation 3

Condition cond2, event: Existence of a route in a specific routing table
Dependent routes:
None

Condition tables:
Table inet.0, generation 4, dependencies 3, If-route-exists conditions: cond1
(static) cond2 (static)
```

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show policy damping

List of Syntax

Syntax on page 1512
Syntax (EX Series Switch and QFX Series) on page 1512

Syntax

```
show policy damping
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switch and QFX Series)

```
show policy damping
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Display information about BGP route flap damping parameters.

Options

none—Display information about BGP route flap damping parameters.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

In the output from this command, figure-of-merit values correlate with the probability of future instability of a routing device. Routes with higher figure-of-merit values are suppressed for longer periods of time. The figure-of-merit value decays exponentially over time. A figure-of-merit value of zero is assigned to each new route. The value is increased each time the route is withdrawn or readvertised, or when one of its path attributes changes.

Required Privilege Level

view

Related Documentation

- "Configuring BGP Flap Damping Parameters" in the *Routing Policies, Firewall Filters, and Traffic Policers Feature Guide*
- clear bgp damping on page 1402
- show route damping on page 1560

List of Sample Output

show policy damping on page 1513

Output Fields

Table 44 on page 1513 describes the output fields for the **show policy damping** command. Output fields are listed in the approximate order in which they appear.

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Table 44: show policy damping Output Fields

Field Name	Field Description
Halflife	Decay half-life, in minutes. The value represents the period during which the accumulated figure-of-merit value is reduced by half if the route remains stable. If a route has flapped, but then becomes stable, the figure-of-merit value for the route decays exponentially. For example, for a route with a figure-of-merit value of 1500, if no incidents occur, its figure-of-merit value is reduced to 750 after 15 minutes and to 375 after another 15 minutes.
Reuse merit	Figure-of-merit value below which a suppressed route can be used again. A suppressed route becomes reusable when its figure-of-merit value decays to a value below a reuse threshold, and the route once again is considered usable and can be installed in the forwarding table and exported from the routing table.
Suppress/cutoff merit	Figure-of-merit value above which a route is suppressed for use or inclusion in advertisements. When a route's figure-of-merit value reaches a particular level, called the cutoff or suppression threshold, the route is suppressed. When a route is suppressed, the routing table no longer installs the route into the forwarding table and no longer exports this route to any of the routing protocols.
Maximum suppress time	Maximum hold-down time, in minutes. The value represents the maximum time that a route can be suppressed no matter how unstable it has been before this period of stability.
Computed values	• **Merit ceiling**—Maximum merit that a flapping route can collect. • **Maximum decay**—Maximum decay half-life, in minutes.

Sample Output

show policy damping

```
user@host> show policy damping
Default damping information:
  Halflife: 15 minutes
  Reuse merit: 750 Suppress/cutoff merit: 3000
  Maximum suppress time: 60 minutes
  Computed values:
    Merit ceiling: 12110
    Maximum decay: 6193
Damping information for "standard-damping":
  Halflife: 10 minutes
  Reuse merit: 4000 Suppress/cutoff merit: 8000
  Maximum suppress time: 30 minutes
  Computed values:
    Merit ceiling: 32120
    Maximum decay: 12453
```

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show route

List of Syntax

Syntax on page 1514
Syntax (EX Series Switches) on page 1514

Syntax

```
show route
<all>
<destination-prefix>
<logical-system (all | logical-system-name)>
<private>
<te-ipv4-prefix-ip  te-ipv4-prefix-ip>
<te-ipv4-prefix-node-ip te-ipv4-prefix-node-ip>
<te-ipv4-prefix-node-iso te-ipv4-prefix-node-iso>
```

Syntax (EX Series Switches)

```
show route
<all>
<destination-prefix>
<private>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Option **private** introduced in Junos OS Release 9.5.
Option **private** introduced in Junos OS Release 9.5 for EX Series switches.
Command introduced in Junos OS Release 15.1R3 on MX Series routers for enhanced subscriber management.
Option **display-client-data** introduced in Junos OS Release 16.2R1 on MX80, MX104, MX240, MX480, MX960, MX2010, MX2020, vMX Series routers.
Options **te-ipv4-prefix-ip**, **te-ipv4-prefix-node-ip**, and **te-ipv4-prefix-node-iso** introduced in Junos OS Release 17.2R1 on MX Series and PTX Series.

Description

Display the active entries in the routing tables.

Options

none—Display brief information about all active entries in the routing tables.

all—(Optional) Display information about all routing tables, including private, or internal, routing tables.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

private—(Optional) Display information only about all private, or internal, routing tables.

display-client-data —(Optional) Display client id and cookie information for routes installed by the routing protocol process client applications.

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te-ipv4-prefix-ip ***te-ipv4-prefix-ip***—(Optional) Display IPv4 address of the traffic-engineering prefix, without the mask length if present in the routing table.

te-ipv4-prefix-node-ip ***te-ipv4-prefix-node-ip***—(Optional) Display all prefixes that have originated from the traffic-engineering node. You can filter IPv4 node addresses from the traffic-engineered routes in the **lsdist.0** table.

te-ipv4-prefix-node-iso ***te-ipv4-prefix-node-iso***—(Optional) Display all prefixes that have originated from the traffic-engineering node. You can filter IPv4 routes with the specified ISO circuit ID from the **lsdist.0** table.

Required Privilege Level view

Related Documentation

- *Understanding IS-IS Configuration*
- *Example: Configuring IS-IS*
- *Examples: Configuring Internal BGP Peering*
- *Examples: Configuring External BGP Peering*
- *Examples: Configuring OSPF Routing Policy*
- *Verifying and Managing Junos OS Enhanced Subscriber Management*

List of Sample Output

show route on page 1518
show route (VPN) on page 1519
show route (with Destination Prefix) on page 1519
show route destination-prefix detail on page 1519
show route extensive on page 1519
show route extensive (ECMP) on page 1520
show route extensive (Multipath Resolution) on page 1520
show route (Enhanced Subscriber Management) on page 1525
show route (IPv6 Flow Specification) on page 1525
show route display-client-data detail on page 1525
show route te-ipv4-prefix-ip on page 1526
show route te-ipv4-prefix-ip extensive on page 1527
show route te-ipv4-prefix-node-iso on page 1529
show route te-ipv4-prefix-node-iso extensive on page 1530
show route te-ipv4-prefix-node-iso detail on page 1532

Output Fields Table 45 on page 1515 describes the output fields for the **show route** command. Output fields are listed in the approximate order in which they appear.

Table 45: show route Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).

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Table 45: show route Output Fields (continued)

Field Name	Field Description
***number* destinations**	Number of destinations for which there are routes in the routing table.
***number* routes**	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active). • **holddown** (routes that are in the pending state before being declared inactive). A holddown route was once the active route and is no longer the active route. The route is in the holddown state because a protocol still has interest in the route, meaning that the interest bit is set. A protocol might have its interest bit set on the previously active route because the protocol is still advertising the route. The route will be deleted after all protocols withdraw their advertisement of the route and remove their interest bit. A persistent holddown state often means that the interested protocol is not releasing its interest bit properly. However, if you have configured advertisement of multiple routes (with the add-path or advertise-inactive statement), the holddown bit is most likely set because BGP is advertising the route as an active route. In this case, you can ignore the holddown state because nothing is wrong. • **hidden** (routes that are not used because of a routing policy).

destination-prefix	Route destination (for example:10.0.0.1/24). Sometimes the route information is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id* :*source*** (Layer 2 circuit only. For example, 10.1.1.195:NoCtrlWord:1:1:Local/96):
	  • ***neighbor-address***—Address of the neighbor.
	  • ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  • ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  • ***vc-id***—Virtual circuit identifier.
	  • ***source***—Source of the advertisement: **Local** or **Remote**.

[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.
weeks*:*days* *hours*:*minutes*:*seconds	How long the route been known (for example, **2w4d 13:11:14**, or 2 weeks, 4 days, 13 hours, 11 minutes, and 14 seconds).

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Table 45: show route Output Fields (continued)

Field Name	Field Description
metric	Cost value of the indicated route. For routes within an AS, the cost is determined by the IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
localpref	Local preference value included in the route.
from	Interface from which the route was received.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device, or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.
encapsulated	Extended next-hop encoding capability enabled for the specified BGP community for routing IPv4 traffic over IPv6 tunnels. When BGP receives routes without the tunnel community, IPv4-0ver IPv6 tunnels are not created and BGP routes are resolved without encapsulation.
Route Labels	Stack of labels carried in the BGP route update.
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Unverified**—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
to	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route. If the destination is **Discard**, traffic is dropped.

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Table 45: show route Output Fields (continued)

Field Name	Field Description
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • **Weight**—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • **Balance**—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing. • ***lsp-path-name***—Name of the LSP used to reach the next hop. • ***label-action***—MPLS label and operation occurring at the next hop. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label). For VPNs, expect to see multiple **push** operations, corresponding to the inner and outer labels required for VPN routes (in the case of a direct PE-to-PE connection, the VPN route would have the inner label push only).
Private unicast	(Enhanced subscriber management for MX Series routers) Indicates that an access-internal route is managed by enhanced subscriber management. By contrast, access-internal routes *not* managed by enhanced subscriber management are displayed with associated next-hop and media access control (MAC) address information.
balance	Distribution of the load based on the underlying operational interface bandwidth for equal-cost multipaths (ECMP) across the nexthop gateways in percentages.

Sample Output

show route

```
user@host> show route
inet.0: 11 destinations, 12 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:65500:1:10.0.0.20/240
                   *[MVPN/70] 19:53:41, metric2 1
                      Indirect
1:65500:1:10.0.0.40/240
                   *[BGP/170] 19:53:29, localpref 100, from 10.0.0.30
                      AS path: I
                    > to 10.0.24.4 via lt-0/3/0.24, label-switched-path toD
                    [BGP/170] 19:53:26, localpref 100, from 10.0.0.33
                      AS path: I
                    > to 10.0.24.4 via lt-0/3/0.24, label-switched-path toD
1:65500:1:10.0.0.60/240
                   *[BGP/170] 19:53:29, localpref 100, from 10.0.0.30
                      AS path: I
                    > to 10.0.28.8 via lt-0/3/0.28, label-switched-path toF
                    [BGP/170] 19:53:25, localpref 100, from 10.0.0.33
                      AS path: I
                    > to 10.0.28.8 via lt-0/3/0.28, label-switched-path toF
```


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show route (VPN)

The following sample output shows a VPN route with composite next hops enabled. The first **Push** operation corresponds to the outer label. The second **Push** operation corresponds to the inner label.

```
user@host> show route 192.0.2.0

13979:665001.inet.0: 871 destinations, 3556 routes (871 active, 0 holddown, 0
hidden)
+ = Active Route, - = Last Active, * = Both

192.0.2.0/24        [BGP/170] 00:28:32, localpref 100, from 10.9.9.160
                      AS path: 13980 ?, validation-state: unverified
                    > to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
                    [BGP/170] 00:28:28, localpref 100, from 10.9.9.169
                      AS path: 13980 ?, validation-state: unverified
                    > to 10.100.0.42 via ae2.0, Push 126016, Push 300368(top)
                   #[Multipath/255] 00:28:28, metric2 102
                    > to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
                      to 10.100.0.42 via ae2.0, Push 16, Push 300368(top)
```

show route (with Destination Prefix)

```
user@host> show route 192.168.0.0/12

inet.0: 10 destinations, 10 routes (9 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.0.0/12      *[Static/5] 2w4d 12:54:27
                    > to 192.168.167.254 via fxp0.0
```

show route destination-prefix detail

```
user@host> show route 198.51.100.0 detail

inet.0: 15 destinations, 20 routes (15 active, 0 holddown, 0 hidden)
198.51.100.0/24 (2 entries, 2 announced)
        *BGP    Preference: 170/-101
         ...
         BGP-Static Preference: 4294967292
               Next hop type: Discard
                 Address: 0x9041ae4
                 Next-hop reference count: 2
                 State: <NoReadvrt Int Ext AlwaysFlash>
        Inactive reason: Route Preference
        Local AS:   200
        Age: 4d 1:40:40
        Validation State: unverified
        Task: RT
        Announcement bits (1): 2-BGP_RT_Background
        AS path: 4 5 6 I
```

show route extensive

```
user@host> show route extensive
```

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```
v1.mvpn.0: 5 destinations, 8 routes (5 active, 1 holddown, 0 hidden)
1:65500:1:10.0.0.40/240 (1 entry, 1 announced)
    *BGP   Preference: 170/-101
           PMSI: Flags 0x0: Label[0:0:0]: PIM-SM: Sender 10.0.0.40 Group
203.0.113.1
           Next hop type: Indirect
           Address: 0x92455b8
           Next-hop reference count: 2
           Source: 10.0.0.30
           Protocol next hop: 10.0.0.40
           Indirect next hop: 2 no-forward
           State: <Active Int Ext>
                    Local AS: 64510 Peer AS: 64511
           Age: 3  Metric2: 1
          Validation State: unverified
           Task: BGP_64510.10.0.0.30+179
           Announcement bits (2): 0-PIM.v1 1-mvpn global task
           AS path: I (Originator) Cluster list:  10.0.0.30
           AS path:  Originator ID: 10.0.0.40
           Communities: target:64502:100 encapsulation:0L:14           Import
Accepted
           Localpref: 100
           Router ID: 10.0.0.30
           Primary Routing Table bgp.mvpn.0
           Indirect next hops: 1
                Protocol next hop: 10.0.0.40 Metric: 1
                Indirect next hop: 2 no-forward
                Indirect path forwarding next hops: 1
                      Next hop type: Router
                      Next hop: 10.0.24.4 via lt-0/3/0.24 weight 0x1
                10.0.0.40/32 Originating RIB: inet.3
                      Metric: 1                      Node path count: 1
                      Forwarding nexthops: 1
                         Nexthop: 10.0.24.4 via lt-0/3/0.24
```

show route extensive (ECMP)

```
user@host> show route extensive
```

```
*IS-IS Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 1048577
                Address: 0xXXXXXXXXXX
                Next-hop reference count: YY
                Next hop: 198.51.100.2 via ae1.0 balance 43%, selected
                Session Id: 0x141
                Next hop: 192.0.2.2 via ae0.0 balance 57%
```

show route extensive (Multipath Resolution)

```
user@host> show route extensive
```

```
inet.0: 37 destinations, 37 routes (36 active, 0 holddown, 1 hidden)
10.1.1.2/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.1.1.2/32 -> {indirect(1048574)}
        *Static Preference: 5
                Next hop type: Indirect, Next hop index: 0
                Address: 0xb39d1b0
```


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```
                Next-hop reference count: 2
                Next hop type: Router, Next hop index: 581
                Next hop: 10.1.1.2 via ge-2/0/1.0, selected
                Session Id: 0x144
                Next hop: 10.2.1.2 via ge-2/0/2.0, selected
                Session Id: 0x145
                Protocol next hop: 10.1.1.1
                Indirect next hop: 0xb2b20f0 1048574 INH Session ID: 0x143
                State: <Active Int Ext>
                Age: 2:53  Metric2: 0
                Validation State: unverified
                Task: RT
                Announcement bits (2): 0-KRT 2-Resolve tree 1
                AS path: I
                Indirect next hops: 1
                        Protocol next hop: 10.1.1.1
                      Indirect next hop: 0xb2b20f0 1048574 INH Session ID: 0x143

                        Indirect path forwarding next hops: 2
                                Next hop type: Router
                                Next hop: 10.1.1.2 via ge-2/0/1.0
                                Session Id: 0x144
                                Next hop: 10.2.1.2 via ge-2/0/2.0
                                Session Id: 0x145
                     10.1.1.1/32 Originating RIB: inet.0
                        Node path count: 1
                          Node flags: 1
                        Forwarding nexthops: 2 (Merged)
                        Nexthop: 10.1.1.2 via ge-2/0/1.0
                         Nexthop: 10.2.1.2 via ge-2/0/2.0
```

```
user@host> show route active-path extensive
```

```
user@host> show route 198.51.100.1 active-path extensive

inet.0: 1000061 destinations, 1000082 routes (1000061 active, 0 holddown, 0 hidden)
198.51.100.1/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 198.51.100.1/32 -> {indirect(1051215)}
unicast reverse-path: 0
[ae0.0 ae1.0]
Page 0 idx 0, (group Internet-IPv4 type External) Type 1 val 0xbb2e53d8 (adv_entry)
Advertised metrics:
Nexthop: Self
AS path: [500] 410 I
Communities:
Path 198.51.100.1 from 10.0.0.11 Vector len 4. Val: 0
*BGP Preference: 170/-101
Next hop type: Indirect, Next hop index: 0
Address: 0x2e9aacdc
Next-hop reference count: 500000
Source: 10.0.0.11
Next hop type: Router, Next hop index: 0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Label operation: Push 3851, Push 25, Push 20(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 25: None; Label 20: None;
Label element ptr: 0xb5dc1780
Label parent element ptr: 0x18d48080
Label element references: 2
Label element child references: 0
```

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```
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Label operation: Push 3851, Push 25, Push 22(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 25: None; Label 22: None;
Label element ptr: 0xb5dc1700
Label parent element ptr: 0x18d41000
Label element references: 2
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Label operation: Push 3851, Push 24, Push 48(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 24: None; Label 48: None;
Label element ptr: 0x18d40800
Label parent element ptr: 0x18d49780
Label element references: 3
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Label operation: Push 3851, Push 24, Push 49(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 24: None; Label 49: None;
Label element ptr: 0xb5dc1680
Label parent element ptr: 0x18d48f00
Label element references: 2
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Label operation: Push 3851, Push 25, Push 21(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 25: None; Label 21: None;
Label element ptr: 0xb5dc1600
Label parent element ptr: 0x18d44d80
Label element references: 2
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Label operation: Push 3851, Push 25, Push 25(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 25: None; Label 25: None;
Label element ptr: 0xb5dc1580
Label parent element ptr: 0x18d3da80
Label element references: 2
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1, selected
Label operation: Push 3851, Push 24, Push 68(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 24: None; Label 68: None;
Label element ptr: 0x18d41500
Label parent element ptr: 0x18d49000
Label element references: 3
Label element child references: 0
```


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```
Label element lsp id: 0
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Label operation: Push 3851, Push 24, Push 69(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 3851: None; Label 24: None; Label 69: None;
Label element ptr: 0xb5dc1500
Label parent element ptr: 0x18d48300
Label element references: 2
Label element child references: 0
Label element lsp id: 0
Session Id: 0x0
Protocol next hop: 10.0.0.11
Label operation: Push 3851
Label TTL action: prop-ttl
Load balance label: Label 3851: None;
Indirect next hop: 0x1883e200 1051215 INH Session ID: 0xb0d
State:
Local AS: 500 Peer AS: 500
Age: 1:40:03 Metric2: 2
Validation State: unverified
Task: BGP_500.10.0.0.11
Announcement bits (5): 0-KRT 8-KRT 9-BGP_RT_Background 10-Resolve tree 5 11-Resolve
 tree 8
AS path: 410 I
Accepted
Route Label: 3851
Localpref: 100
Router ID: 10.0.0.11
Indirect next hops: 1
Protocol next hop: 10.0.0.11 Metric: 2
Label operation: Push 3851
Label TTL action: prop-ttl
Load balance label: Label 3851: None;
Indirect next hop: 0x1883e200 1051215 INH Session ID: 0xb0d
Indirect path forwarding next hops (Merged): 8
Next hop type: Router
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.12.2 via ae0.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Session Id: 0x0
Next hop: 10.0.13.3 via ae1.0 weight 0x1
Session Id: 0x0
10.0.0.11/32 Originating RIB: inet.3
Metric: 1 Node path count: 4
Node flags: 1
Indirect nexthops: 4
Protocol Nexthop: 10.0.0.4 Metric: 1 Push 24
Indirect nexthop: 0x1880f200 1048597 INH Session ID: 0xb0c
Path forwarding nexthops link: 0x36120400
```

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```
Path inh link: 0x0
Indirect path forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
10.0.0.4/32 Originating RIB: inet.3
Metric: 1 Node path count: 1
Forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
Protocol Nexthop: 10.0.0.5 Metric: 1 Push 24
Indirect nexthop: 0x18810000 1048596 INH Session ID: 0xb0b
Path forwarding nexthops link: 0x1545be00
Path inh link: 0x0
Indirect path forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
10.0.0.5/32 Originating RIB: inet.3
Metric: 1 Node path count: 1
Forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
Protocol Nexthop: 10.0.0.6 Metric: 1 Push 25
Indirect nexthop: 0x1880e600 1048588 INH Session ID: 0xb0a
Path forwarding nexthops link: 0x3611f440
Path inh link: 0x0
Indirect path forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
10.0.0.6/32 Originating RIB: inet.3
Metric: 1 Node path count: 1
Forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
Protocol Nexthop: 10.0.0.7 Metric: 1 Push 25
Indirect nexthop: 0x1880dc00 1048586 INH Session ID: 0xb09
Path forwarding nexthops link: 0x15466d80
Path inh link: 0x0
Indirect path forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
10.0.0.7/32 Originating RIB: inet.3
Metric: 1 Node path count: 1
Forwarding nexthops: 2
Nexthop: 10.0.12.2 via ae0.0
Session Id: 0
```


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```
Nexthop: 10.0.13.3 via ae1.0
Session Id: 0
```

show route (Enhanced Subscriber Management)

```
user@host> show route
inet.0: 41 destinations, 41 routes (40 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

198.51.100.11/24    *[Access-internal/12] 00:00:08
                  > to #0 10.0.0.1.93.65 via demux0.1073741824
198.51.100.12/24    *[Access-internal/12] 00:00:08
                  Private unicast
```

show route (IPv6 Flow Specification)

```
user@host> show route
inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2001:db8::10:255:185:19/128
                   *[Direct/0] 05:11:27
                    > via lo0.0
2001:db8::11:11:11:0/120
                   *[BGP/170] 00:28:58, localpref 100
                      AS path: 2000 I, validation-state: unverified
                    > to 2001:db8::13:14:2:2 via ge-1/1/4.0
2001:db8::13:14:2:0/120*[Direct/0] 00:45:07
                    > via ge-1/1/4.0
2001:db8::13:14:2:1/128*[Local/0] 00:45:18
                      Local via ge-1/1/4.0
fe80::2a0:a50f:fc71:71d5/128
                   *[Direct/0] 05:11:27
                    > via lo0.0
fe80::5e5e:abff:feb0:933e/128
                   *[Local/0] 00:45:18
                      Local via ge-1/1/4.0

inet6flow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2001:db8::11:11:11:10/128,*,proto=6,dstport=80,srcport=65535/term:1
                   *[BGP/170] 00:28:58, localpref 100, from 2001:db8::13:14:2:2
                      AS path: 2000 I, validation-state: unverified
                      Fictitious
2001:db8::11:11:11:30/128,*,icmp6-type=128,len=100,dscp=10/term:2
                   *[BGP/170] 00:20:54, localpref 100, from 2001:db8::13:14:2:2
                      AS path: 2000 I, validation-state: unverified
                      Fictitious
```

show route display-client-data detail

```
user@host> show route 198.51.100.0/24 display-client-data detail
inet.0: 59 destinations, 70 routes (59 active, 0 holddown, 0 hidden)
198.51.100.0/24 (1 entry, 1 announced)
```

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```
       State: <FlashAll>
       *BGP-Static Preference: 5/-101
               Next hop type: Indirect, Next hop index: 0
               Address: 0xa5c2af8
               Next-hop reference count: 2
               Next hop type: Router, Next hop index: 1641
               Next hop: 192.0.2.1 via ge-2/1/1.0, selected
               Session Id: 0x160
               Protocol next hop: 192.0.2.1
               Indirect next hop: 0xa732cb0 1048621 INH Session ID: 0x17e
               State: <Active Int Ext AlwaysFlash NSR-incapable Programmed>
               Age: 3:13       Metric2: 0
               Validation State: unverified
               Announcement bits (3): 0-KRT 5-LDP 6-Resolve tree 3
               AS path: I
               Client id: 1, Cookie: 1
```

show route te-ipv4-prefix-ip

```
user@host> show route te-ipv4-prefix-ip 10.10.10.10

lsdist.0: 283 destinations, 283 routes (283 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both


PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L1:0
 }/1152
                   *[IS-IS/15] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0101.0101.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0202.0202.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0303.0303.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0404.0404.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0505.0505.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0606.0606.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0707.0707.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                   *[IS-IS/18] 00:01:01
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
```


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```
                    *[IS-IS/18] 00:01:01
                       Fictitious
```

show route te-ipv4-prefix-ip extensive

user@host>**show route te-ipv4-prefix-ip 10.10.10.10 extensive**

```
lsdist.0: 298 destinations, 298 routes (298 active, 0 holddown, 0 hidden)
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
                State:<Active NotInstall>
                Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0x40, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0101.0101.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
       State: <Active NotInstall
       Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0>

PREFIX { Node { AS:64496 ISO:0100.0202.0202.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
                State: <Active NotInstall>
       Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0303.0303.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
```

```
                Next-hop reference count: 298
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0404.0404.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0505.0505.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0606.0606.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 298
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 7:58
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0707.0707.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
```


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```
       *IS-IS  Preference: 18
               Level: 2
               Next hop type: Fictitious, Next hop index: 0
               Address: 0xa1a2ac4
               Next-hop reference count: 298
               Next hop:
               State: <Active NotInstall>
               Local AS:   64496
               Age: 7:58
               Validation State: unverified
               Task: IS-IS
               AS path: I
               Prefix SID: 1000, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
       *IS-IS  Preference: 18
               Level: 2
               Next hop type: Fictitious, Next hop index: 0
               Address: 0xa1a2ac4
               Next-hop reference count: 298
               Next hop:
               State: <Active NotInstall>
               Local AS:   64496
               Age: 7:58
               Validation State: unverified
               Task: IS-IS
               AS path: I
               Prefix SID: 1000, Flags: 0x40, Algo: 0
```

show route te-ipv4-prefix-node-iso

```
user@host> show route te-ipv4-prefix-node-iso 0100.0a0a.0a0a.00

lsdist.0: 283 destinations, 283 routes (283 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L1:0
 }/1152
                   *[IS-IS/15] 00:05:20
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.1.1.1/32 } ISIS-L2:0
}/1152
                   *[IS-IS/18] 00:05:20
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.2.2.2/32 } ISIS-L2:0
}/1152
                   *[IS-IS/18] 00:05:20
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.3.3.3/32 } ISIS-L2:0
}/1152
                   *[IS-IS/18] 00:05:20
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.4.4.4/32 } ISIS-L2:0
}/1152
                   *[IS-IS/18] 00:05:20
                      Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.5.5.5/32 } ISIS-L2:0
}/1152
                   *[IS-IS/18] 00:05:20
```

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```
                    Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.6.6.6/32 } ISIS-L2:0
}/1152
                 *[IS-IS/18] 00:05:20
                    Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.7.7.7/32 } ISIS-L2:0
}/1152
                 *[IS-IS/18] 00:05:20
                    Fictitious
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152
                 *[IS-IS/18] 00:05:20
                    Fictitious
```

show route te-ipv4-prefix-node-iso extensive

user@host> **show route te-ipv4-prefix-node-iso 0100.0a0a.0a0a.00 extensive**

```
lsdist.0: 283 destinations, 283 routes (283 active, 0 holddown, 0 hidden)
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L1:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0x40, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.1.1.1/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1001, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.2.2.2/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
```


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```
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1002, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.3.3.3/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1003, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.4.4.4/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1004, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.5.5.5/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1005, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.6.6.6/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
```

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```
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1006, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.7.7.7/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1007, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:47
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0x40, Algo: 0
```

show route te-ipv4-prefix-node-iso detail

```
user@host> show route te-ipv4-prefix-node-iso 0100.0a0a.0a0a.00 detail

lsdist.0: 283 destinations, 283 routes (283 active, 0 holddown, 0 hidden)
PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L1:0
 }/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
```


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```
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1000, Flags: 0x40, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.1.1.1/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1001, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.2.2.2/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1002, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.3.3.3/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1003, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.4.4.4/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
```

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```
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1004, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.5.5.5/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1005, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.6.6.6/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1006, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.7.7.7/32 } ISIS-L2:0
}/1152 (1 entry, 0 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Fictitious, Next hop index: 0
                Address: 0xa1a2ac4
                Next-hop reference count: 283
                Next hop:
                State: <Active NotInstall>
                Local AS:   64496
                Age: 6:54
                Validation State: unverified
                Task: IS-IS
                AS path: I
                Prefix SID: 1007, Flags: 0xe0, Algo: 0

PREFIX { Node { AS:64496 ISO:0100.0a0a.0a0a.00 } { IPv4:10.10.10.10/32 } ISIS-L2:0
 }/1152 (1 entry, 0 announced)
```


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```
      *IS-IS  Preference: 18
              Level: 2
              Next hop type: Fictitious, Next hop index: 0
              Address: 0xa1a2ac4
              Next-hop reference count: 283
              Next hop:
              State: <Active NotInstall>
              Local AS:   64496
              Age: 6:54
              Validation State: unverified
              Task: IS-IS
              AS path: I
              Prefix SID: 1000, Flags: 0x40, Algo: 0
```

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show route active-path

List of Syntax
Syntax on page 1536
Syntax (EX Series Switches) on page 1536

Syntax

```
show route active-path
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route active-path
<brief | detail | extensive | terse>
```

Release Information
Command introduced in Junos OS Release 8.0.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display all active routes for destinations. An active route is a route that is selected as the best path. Inactive routes are not displayed.

Options
none—Display all active routes.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show route active-path on page 1536
show route active-path brief on page 1537
show route active-path detail on page 1537
show route active-path extensive on page 1538
show route active-path terse on page 1540

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route active-path

```
user@host> show route active-path

inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
```


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```
+ = Active Route, - = Last Active, * = Both

10.255.70.19/32    *[Direct/0] 21:33:52
                    > via lo0.0
10.255.71.50/32    *[IS-IS/15] 00:18:13, metric 10
                    > to 172.16.100.1 via so-2/1/3.0
172.16.100.1/24       *[Direct/0] 00:18:36
                    > via so-2/1/3.0
172.16.100.1/32       *[Local/0] 00:18:41
                      Local via so-2/1/3.0
192.168.64.0/21    *[Direct/0] 21:33:52
                    > via fxp0.0
192.168.70.19/32   *[Local/0] 21:33:52
                      Local via fxp0.0
```

show route active-path brief

The output for the **show route active-path brief** command is identical to that for the **show route active-path** command. For sample output, see show route active-path on page 1536.

show route active-path detail

```
user@host> show route active-path detail

inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)

10.255.70.19/32 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via lo0.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

10.255.71.50/32 (1 entry, 1 announced)
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 397
                Next-hop reference count: 4
                Next hop: 172.16.100.1 via so-2/1/3.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 21:31      Metric: 10
                Task: IS-IS
                Announcement bits (4): 0-KRT 2-IS-IS 5-Resolve tree 2 6-Resolve
tree 3
                AS path: I

172.16.100.0/24 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via so-2/1/3.0, selected
```

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```
                State: ‹Active Int›
                Local AS:   200
                Age: 21:54
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

172.16.100.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: so-2/1/3.0
                State: ‹Active NoReadvrt Int›
                Local AS:   200
                Age: 21:59
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.64.0/21 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via fxp0.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.70.19/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: fxp0.0
                State: ‹Active NoReadvrt Int›
                Local AS:   200
                Age: 21:37:10
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I
```

show route active-path extensive

```
user@host> show route active-path extensive

inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
10.255.70.19/32 (1 entry, 1 announced)
TSI:
IS-IS level 1, LSP fragment 0
IS-IS level 2, LSP fragment 0
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via lo0.0, selected
                State: ‹Active Int›
                Local AS:   200
```


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```
                Age: 21:39:47
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

10.255.71.50/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.255.71.50/32 -> {172.16.100.1}
IS-IS level 2, LSP fragment 0
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 397
                Next-hop reference count: 4
                Next hop: 172.16.100.1 via so-2/1/3.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 24:08      Metric: 10
                Task: IS-IS
                Announcement bits (4): 0-KRT 2-IS-IS 5-Resolve tree 2 6-Resolve
tree 3
                AS path: I

172.16.100.1/24 (1 entry, 1 announced)
TSI:
IS-IS level 1, LSP fragment 0
IS-IS level 2, LSP fragment 0
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via so-2/1/3.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 24:31
                Task: IF
                Announcement bits (3): 2-IS-IS 5-Resolve tree 2 6-Resolve tree 3

                AS path: I

172.16.100.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: so-2/1/3.0
                State: ‹Active NoReadvrt Int›
                Local AS:   200
                Age: 24:36
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.64.0/21 (1 entry, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 3
                Next hop: via fxp0.0, selected
                State: ‹Active Int›
                Local AS:   200
                Age: 21:39:47
                Task: IF
```

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```
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I

192.168.70.19/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 11
                Interface: fxp0.0
                State: ‹Active NoReadvrt Int›
                Local AS:   200
                Age: 21:39:47
                Task: IF
                Announcement bits (2): 5-Resolve tree 2 6-Resolve tree 3
                AS path: I
```

show route active-path terse

user@host> **show route active-path terse**

```
inet.0: 7 destinations, 7 routes (6 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.19/32    D   0                       >lo0.0
* 10.255.71.50/32    I  15         10            >172.16.100.1.
* 172.16.100.0/24       D   0                       >so-2/1/3.0
* 172.16.100.2/32       L   0                        Local
* 192.168.64.0/21    D   0                       >fxp0.0
* 192.168.70.19/32   L   0                        Local
```


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show route advertising-protocol

Syntax

```
show route advertising-protocol protocol neighbor-address
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Release Information Command introduced before Junos OS Release 7.4.

Description Display the routing information as it has been prepared for advertisement to a particular neighbor of a particular dynamic routing protocol.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

neighbor-address—Address of the neighboring router to which the route entry is being transmitted.

protocol—Protocol transmitting the route:

- **bgp**—Border Gateway Protocol
- **dvmrp**—Distance Vector Multicast Routing Protocol
- **msdp**—Multicast Source Discovery Protocol
- **pim**—Protocol Independent Multicast
- **rip**—Routing Information Protocol
- **ripng**—Routing Information Protocol next generation

Additional Information Routes displayed are routes that the routing table has exported into the routing protocol and that have been filtered by the associated protocol's **export** routing policy statements. Starting with Junos OS Release 13.3, you can display the routing instance table **foo** for any address family, on a VPN route reflector, or a VPN AS boundary router that is advertising local VPN routes. However, If you do not specify the **table** in the command, the output displays each VRF prefix twice.

Required Privilege Level view

Related Documentation

- Example: Configuring the MED Attribute That Determines the Exit Point in an AS on page 258

List of Sample Output show route advertising-protocol bgp (Layer 3 VPN) on page 1544

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show route advertising-protocol bgp detail on page 1544
show route advertising-protocol bgp detail (Aggregate Extended Community Bandwidth) on page 1544
show route advertising-protocol bgp detail (Labeled Unicast) on page 1545
show route advertising-protocol bgp detail (Layer 2 VPN) on page 1545
show route advertising-protocol bgp detail (Layer 3 VPN) on page 1545
show route advertising-protocol bgp extensive all (Next Hop Self with RIB-out IP Address) on page 1546

Output Fields Table 46 on page 1542 lists the output fields for the **show route advertising-protocol** command. Output fields are listed in the approximate order in which they appear.

Table 46: show route advertising-protocol Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, inet.0.	All levels
number **destinations**	Number of destinations for which there are routes in the routing table.	All levels
number **routes**	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)	All levels
Prefix	Destination prefix.	**brief** none
destination-prefix **(entry , announced)**	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
BGP group and type	BGP group name and type (**Internal** or **External**).	**detail extensive**
Route Distinguisher	Unique 64-bit prefix augmenting each IP subnet.	**detail extensive**
Advertised Label	Incoming label advertised by the Label Distribution Protocol (LDP). When an IP packet enters a label-switched path (LSP), the ingress router examines the packet and assigns it a label based on its destination, placing the label in the packet's header. The label transforms the packet from one that is forwarded based on its IP routing information to one that is forwarded based on information associated with the label.	**detail extensive**
Label-Base, range	First label in a block of labels and label block size. A remote PE router uses this first label when sending traffic toward the advertising PE router.	**detail extensive**
VPN Label	Virtual private network (VPN) label. Packets are sent between CE and PE routers by advertising VPN labels. VPN labels transit over either a Resource Reservation Protocol (RSVP) or a Label Distribution Protocol (LDP) label-switched path (LSP) tunnel.	**detail extensive**

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Table 46: show route advertising-protocol Output Fields (continued)

Field Name	Field Description	Level of Output
Nexthop	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route. If the next-hop advertisement to the peer is **Self**, and the RIB-out next hop is a specific IP address, the RIB-out IP address is included in the extensive output. See show route advertising-protocol bgp extensive all (Next Hop Self with RIB-out IP Address) on page 1546.	All levels
MED	Multiple exit discriminator value included in the route.	**brief**
Lclpref or **Localpref**	Local preference value included in the route.	All levels
Queued	When BGP route prioritization is enabled and a route is present in a priority queue, this shows which priority queue the route is in.	All levels except **brief**
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if configured on the router, or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
Route Labels	Stack of labels carried in the BGP route update.	**detail extensive**
Cluster list	(For route reflected output only) Cluster ID sent by the route reflector.	**detail extensive**
Originator ID	(For route reflected output only) Address of routing device that originally sent the route to the route reflector.	**detail extensive**
Communities	Community path attribute for the route. See the output field table for the show route detail command for all possible values for this field.	**detail extensive**
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.	**detail extensive**

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Table 46: show route advertising-protocol Output Fields (continued)

Field Name	Field Description	Level of Output
Attrset AS	Number, local preference, and path of the autonomous system (AS) that originated the route. These values are stored in the **Attrset** attribute at the originating router.	**detail extensive**
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).	**detail extensive**
control flags	Control flags: **none** or **Site Down**.	**detail extensive**
mtu	Maximum transmission unit (MTU) of the Layer 2 circuit.	**detail extensive**

Sample Output

show route advertising-protocol bgp (Layer 3 VPN)

```
user@host> show route advertising-protocol bgp 10.255.14.171

     VPN-A.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     10.255.14.172/32   Self                    1        100 I
     VPN-B.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     10.255.14.181/32   Self                    2        100 I
```

show route advertising-protocol bgp detail

```
user@host> show route advertising-protocol bgp 111.222.1.3 detail

bgp20.inet.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
111.222.1.11/32 (1 entry, 1 announced)
 BGP group pe-pe type Internal
     Route Distinguisher: 111.255.14.11:69
     Advertised Label: 100000
     next hop: Self
     Localpref: 100
     AS path: 2 I
     Communities: target:69:20
     AIGP 210
111.8.0.0/16 (1 entry, 1 announced)
 BGP group pe-pe type Internal
     Route Distinguisher: 111.255.14.11:69
     Advertised Label: 100000
     Next hop: Self
     Localpref: 100
     AS path: 2 I
     Communities: target:69:20
     AIGP 210
```

show route advertising-protocol bgp detail (Aggregate Extended Community Bandwidth)

```
user@host> show route advertising-protocol bgp 10.0.4.2 10.0.2.0/30 detail

inet.0: 20 destinations, 26 routes (20 active, 0 holddown, 0 hidden)
* 10.0.2.0/30 (2 entries, 1 announced)
```


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```
BGP group external2 type External
    Nexthop: Self
    AS path: [65000] 65001 I
    Communities: bandwidth:65000:80000000
```

show route advertising-protocol bgp detail (Labeled Unicast)

```
user@host>show route advertising bgp 1.1.1.3 detail
inet.0: 69 destinations, 70 routes (69 active, 0 holddown, 0 hidden)
* 1.1.1.8/32 (2 entries, 2 announced)
BGP group ibgp type Internal
Route Labels: 1000123(top) 1000124 1000125 1000126
Nexthop: 1.1.1.4
MED: 7
Localpref: 100
AS path: [5] I
Cluster ID: 3.3.3.3
Originator ID: 1.1.1.1
Entropy label capable
inet6.0: 26 destinations, 28 routes (26 active, 0 holddown, 0 hidden)
* 100::1/128 (2 entries, 1 announced)
BGP group ibgp type Internal
Labels: 1000123(top) 1000124 1000125 1000126
Nexthop: ::ffff:1.1.1.4
Localpref: 100
AS path: [5] I
Cluster ID: 3.3.3.3
Originator ID: 1.1.1.1
```

show route advertising-protocol bgp detail (Layer 2 VPN)

```
user@host> show route advertising-protocol bgp 192.168.24.1 detail
vpn-a.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
192.168.16.1:1:1:1/96 (1 entry, 1 announced)
 BGP group int type Internal
     Route Distinguisher: 192.168.16.1:1
     Label-base : 32768, range : 3
     Nexthop: Self
     Localpref: 100
     AS path: I
     Communities: target:65412:100
     AIGP 210
     Layer2-info: encaps:VLAN, control flags:, mtu:
```

show route advertising-protocol bgp detail (Layer 3 VPN)

```
user@host>  show route advertising-protocol bgp 10.255.14.176 detail
vpna.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
* 10.49.0.0/30 (1 entry, 1 announced)
 BGP group ibgp type Internal
     Route Distinguisher: 10.255.14.174:2
     VPN Label: 101264
     Nexthop: Self
     Localpref: 100
     AS path: I
     Communities: target:200:100
```

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```
    AIGP 210
    AttrSet AS: 100
        Localpref: 100
        AS path: I
...
```

show route advertising-protocol bgp extensive all (Next Hop Self with RIB-out IP Address)

```
user@host> show route advertising-protocol bgp 200.0.0.2 170.0.1.0/24 extensive all

inet.0: 13 destinations, 19 routes (13 active, 0 holddown, 6 hidden)
  170.0.1.0/24 (2 entries, 1 announced)
 BGP group eBGP-INTEROP type External
    Nexthop: Self (rib-out 10.100.3.2)
    AS path: [4713] 200 I
...
```


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show route all

List of Syntax

Syntax on page 1547
Syntax (EX Series Switches) on page 1547

Syntax

```
show route all
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route all
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display information about all routes in all routing tables, including private, or internal, tables.

Options

none—Display information about all routes in all routing tables, including private, or internal, tables.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show route brief on page 1554
- show route detail on page 1565

List of Sample Output

show route all on page 1547

Output Fields

In Junos OS Release 9.5 and later, only the output fields for the **show route all** command display all routing tables, including private, or hidden, routing tables. The output field table of the show route command does not display entries for private, or hidden, routing tables in Junos OS Release 9.5 and later.

Sample Output

show route all

The following example displays a snippet of output from the **show route** command and then displays the same snippet of output from the **show route all** command:

```
user@host> show route
```

```
mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
0                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
1                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
2                  *[MPLS/0] 2d 02:24:39, metric 1
                      Receive
800017             *[VPLS/7] 1d 14:00:16
                    > via vt-3/2/0.32769, Pop
800018             *[VPLS/7] 1d 14:00:26
                    > via vt-3/2/0.32772, Pop
```

user@host> **show route all**

```
mpls.0: 7 destinations, 7 routes (5 active, 0 holddown, 2 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
0                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
1                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
2                  *[MPLS/0] 2d 02:19:12, metric 1
                      Receive
800017             *[VPLS/7] 1d 13:54:49
                    > via vt-3/2/0.32769, Pop
800018             *[VPLS/7] 1d 13:54:59
                    > via vt-3/2/0.32772, Pop
vt-3/2/0.32769      [VPLS/7] 1d 13:54:49
                      Unusable
vt-3/2/0.32772      [VPLS/7] 1d 13:54:59
                      Unusable
```


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show route aspath-regex

List of Syntax

Syntax on page 1549
Syntax (EX Series Switches) on page 1549

Syntax

```
show route aspath-regex regular-expression
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route aspath-regex regular-expression
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the routing table that match the specified autonomous system (AS) path regular expression.

Options

regular-expression—Regular expression that matches an entire AS path.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

You can specify a regular expression as:

- An individual AS number
- A period wildcard used in place of an AS number
- An AS path regular expression that is enclosed in parentheses

You also can include the operators described in the table of AS path regular expression operators in the *Junos Policy Framework Configuration Guide*. The following list summarizes these operators:

- ***{m,n}***—At least *m* and at most *n* repetitions of the AS path term.
- ***{m}***—Exactly *m* repetitions of the AS path term.
- ***{m,}***—*m* or more repetitions of the AS path term.
- *******—Zero or more repetitions of an AS path term.
- ***+***—One or more repetitions of an AS path term.
- ***?***—Zero or one repetition of an AS path term.
- ***aspath_term | aspath_term***—Match one of the two AS path terms.

  When you specify more than one AS number or path term, or when you include an operator in the regular expression, enclose the entire regular expression in quotation marks. For example, to match any path that contains AS number 234, specify the following command:

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```
show route aspath-regex ".* 234 .*"
```

Required Privilege Level view

Related Documentation
- *Example: Using AS Path Regular Expressions*

List of Sample Output
show route aspath-regex (Matching a Specific AS Number) on page 1550
show route aspath-regex (Matching Any Path with Two AS Numbers) on page 1550

Output Fields For information about output fields, see the output field table for the show route command.

Sample Output

show route aspath-regex (Matching a Specific AS Number)

```
user@host> show route aspath-regex 65477
inet.0: 46411 destinations, 46411 routes (46409 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

111.222.1.0/25     *[BGP/170] 00:08:48, localpref 100, from 111.222.2.24
                   AS Path: [65477] ({65548 65536}) IGP
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
111.222.1.128/25   *[IS-IS/15] 09:15:37, metric 37, tag 1
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
                    [BGP/170] 00:08:48, localpref 100, from 111.222.2.24
                   AS Path: [65477] ({65548 65536}) IGP
                     to 111.222.18.225 via fpa0.0(111.222.18.233)
...
```

show route aspath-regex (Matching Any Path with Two AS Numbers)

```
user@host> show route aspath-regex ".* 234 3561 .*"

inet.0: 46351 destinations, 46351 routes (46349 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

9.20.0.0/17        *[BGP/170] 01:35:00, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 2685 2686 Incomplete
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
12.10.231.0/24     *[BGP/170] 01:35:00, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 5696 7369 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
24.64.32.0/19      *[BGP/170] 01:34:59, localpref 100, from 131.103.20.49
                   AS Path: [666] 234 3561 6327 IGP
                     to 192.156.169.1 via 192.156.169.14(so-0/0/0)
...
```


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show route best

List of Syntax

Syntax on page 1551
Syntax (EX Series Switches) on page 1551

Syntax

```
show route best destination-prefix
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route best destination-prefix
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route in the routing table that is the best route to the specified address or range of addresses. The best route is the longest matching route.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

destination-prefix—Address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

Related Documentation

- show route brief on page 1554
- show route detail on page 1565

List of Sample Output

show route best on page 1552
show route best detail on page 1552
show route best extensive on page 1553
show route best terse on page 1553

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

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Sample Output

show route best

```
user@host> show route best 10.255.70.103
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
10.255.70.103/32   *[OSPF/10] 1d 13:19:20, metric 2
                    > to 10.31.1.6 via ge-3/1/0.0
                      via so-0/3/0.0

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
10.255.70.103/32   *[RSVP/7] 1d 13:20:13, metric 2
                    > via so-0/3/0.0, label-switched-path green-r1-r3

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
10.0.0.0/8         *[Direct/0] 2d 01:43:34
                    > via fxp2.0
                    [Direct/0] 2d 01:43:34
                    > via fxp1.0
```

show route best detail

```
user@host> show route best 10.255.70.103 detail
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
10.255.70.103/32 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                Next hop: via so-0/3/0.0
                State: <Active Int>
                Local AS:    69
                Age: 1d 13:20:06        Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 5
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100016
                State: <Active Int>
                Local AS:    69
                Age: 1d 13:20:59        Metric: 2
                Task: RSVP
                Announcement bits (1): 1-Resolve tree 2
                AS path: I
```


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```
private1__inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
10.0.0.0/8 (2 entries, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp2.0, selected
                State: <Active Int>
                Age: 2d 1:44:20
                Task: IF
                AS path: I
         Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp1.0, selected
                State: <NotBest Int>
                Inactive reason: No difference
                Age: 2d 1:44:20
                Task: IF
                AS path: I
```

show route best extensive

The output for the **show route best extensive** command is identical to that for the **show route best detail** command. For sample output, see show route best detail on page 1552.

show route best terse

```
user@host> show route best 10.255.70.103 terse
inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.103/32   O  10          2            >10.31.1.6
                                                   so-0/3/0.0

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.70.103/32   R   7          2            >so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.0.0.0/8         D   0                        >fxp2.0
                     D   0                        >fxp1.0
```

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show route brief

List of Syntax
Syntax on page 1554
Syntax (EX Series Switches) on page 1554

Syntax

```
show route brief
<destination-prefix>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route brief
<destination-prefix>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display brief information about the active entries in the routing tables.

Options
none—Display all active entries in the routing table.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

Related Documentation
- show route all on page 1547
- show route best on page 1551

List of Sample Output
show route brief on page 1554

Output Fields
For information about output fields, see the Output Field table of the show route command.

Sample Output

show route brief

```
user@host> show route brief
inet.0: 10 destinations, 10 routes (9 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 1w5d 20:30:29
```


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```
                      Discard
10.255.245.51/32   *[Direct/0] 2w4d 13:11:14
                    > via lo0.0
172.16.0.0/12      *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.0.0/18      *[Static/5] 1w5d 20:30:29
                    > to 192.168.167.254 via fxp0.0
192.168.40.0/22    *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.64.0/18    *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
192.168.164.0/22   *[Direct/0] 2w4d 13:11:14
                    > via fxp0.0
192.168.164.51/32  *[Local/0] 2w4d 13:11:14
                      Local via fxp0.0
207.17.136.192/32  *[Static/5] 2w4d 13:11:14
                    > to 192.168.167.254 via fxp0.0
green.inet.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
100.101.0.0/16     *[Direct/0] 1w5d 20:30:28
                    > via fe-0/0/3.0
100.101.2.3/32     *[Local/0] 1w5d 20:30:28
                      Local via fe-0/0/3.0
172.16.233.5/32       *[OSPF/10] 1w5d 20:30:29, metric 1
                      MultiRecv
```

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show route community

List of Syntax

Syntax on page 1556
Syntax (EX Series Switches) on page 1556

Syntax

```
show route community as-number:community-value
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route community as-number:community-value
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the route entries in each routing table that are members of a Border Gateway Protocol (BGP) community.

Options

as-number:community-value—One or more community identifiers. ***as-number*** is the AS number, and ***community-value*** is the community identifier. When you specify more than one community identifier, enclose the identifiers in double quotation marks. Community identifiers can include wildcards.

For example:

```
user@host> show route table inet.0 protocol bgp community "12083:6015"
  community "12083:65551"
```

or

```
user@host> show route table inet.0 protocol bgp community [12083:6014
  12083:65551]
```

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Additional Information

Specifying the community option displays all routes matching the community found within the routing table. The community option does not limit the output to only the routes being advertised to the neighbor after any egress routing policy.

Required Privilege Level

view

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Related Documentation

- show route detail on page 1565

List of Sample Output

show route community on page 1557

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route community

```
user@host> show route community 234:80

inet.0: 46511 destinations, 46511 routes (46509 active, 0 holddown, 2 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.4.0/8          *[BGP/170] 03:33:07, localpref 100, from 131.103.20.49
                    AS Path: {666} 234 2548 1 IGP
                      to 192.156.169.1 via 192.156.169.14(so-0/0/0)
172.16.6.0/8          *[BGP/170] 03:33:07, localpref 100, from 131.103.20.49
                    AS Path: {666} 234 2548 568 721 Incomplete
                      to 192.156.169.1 via 192.156.169.14(so-0/0/0)
172.16.92.0/16         *[BGP/170] 03:33:06, localpref 100, from 131.103.20.49
                    AS Path: {666} 234 2548 1673 1675 1747 IGP
                      to 192.156.169.1 via 192.156.169.14(so-0/0/0)
```

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show route community-name

List of Syntax
Syntax on page 1558
Syntax (EX Series Switches) on page 1558

Syntax

```
show route community-name community-name
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route community-name community-name
<brief | detail | extensive | terse>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display the route entries in each routing table that are members of a Border Gateway Protocol (BGP) community, specified by a community name.

Options
community-name—Name of the community.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show route community-name on page 1558

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route community-name

```
user@host> show route community-name red-com
inet.0: 17 destinations, 17 routes (16 active, 0 holddown, 1 hidden)

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

instance1.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
10.255.245.212/32  *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: 300 I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix
172.16.20.20/32     *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix
172.16.100.0/24       *[BGP/170] 00:04:40, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

bgp.l3vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.245.204:10:10.255.245.212/32
                   *[BGP/170] 00:06:40, localpref 100, from 10.255.245.204
                      AS path: 300 I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix
10.255.245.204:10:172.16.20.20/32
                   *[BGP/170] 00:36:02, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix
10.255.245.204:10:100.1.4.0/24
                   *[BGP/170] 00:36:02, localpref 100, from 10.255.245.204
                      AS path: I
                    > to 172.16.100.1 via ge-1/1/0.0, label-switched-path to_fix

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

instance1.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

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show route damping

List of Syntax

Syntax on page 1560
Syntax (EX Series Switch and QFX Series) on page 1560

Syntax

```
show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switch and QFX Series)

```
show route damping (decayed | history | suppressed)
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Display the BGP routes for which updates might have been reduced because of route flap damping.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

decayed—Display route damping entries that might no longer be valid, but are not suppressed.

history—Display entries that have already been withdrawn, but have been logged.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

suppressed—Display entries that have been suppressed and are no longer being installed into the forwarding table or exported by routing protocols.

Required Privilege Level

view

Related Documentation

- clear bgp damping on page 1402
- show policy damping on page 1512

List of Sample Output

show route damping decayed detail on page 1563
show route damping history on page 1564
show route damping history detail on page 1564

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Output Fields Table 47 on page 1561 lists the output fields for the **show route damping** command. Output fields are listed in the approximate order in which they appear.

Table 47: show route damping Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, **inet.0**.	All levels
destinations	Number of destinations for which there are routes in the routing table.	All levels
number **routes**	Number of routes in the routing table and total number of routes in the following states: • **active** • **holddown** (routes that are in a pending state before being declared inactive) • **hidden** (the routes are not used because of a routing policy)	All levels
destination-prefix **(entry, announced)**	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
[*protocol***,** *preference***]**	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the LocalPref value for Route 1 is 100, the Preference2 value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.	All levels
Next-hop reference count	Number of references made to the next hop.	**detail extensive**
Source	IP address of the route source.	**detail extensive**
Next hop	Network layer address of the directly reachable neighboring system.	**detail extensive**
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**detail extensive**
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.	**detail extensive**
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.	**detail extensive**

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Table 47: show route damping Output Fields (continued)

Field Name	Field Description	Level of Output
State	Flags for this route. For a description of possible values for this field, see the output field table for the show route detail command.	**detail extensive**
Local AS	AS number of the local routing device.	**detail extensive**
Peer AS	AS number of the peer routing device.	**detail extensive**
Age	How long the route has been known.	**detail extensive**
Metric	Metric for the route.	**detail extensive**
Task	Name of the protocol that has added the route.	**detail extensive**
Announcement bits	List of protocols that announce this route. ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.	**detail extensive**
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
to	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.	**brief** none
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the interface that is actually used is followed by the word **Selected**.	**brief** none
Communities	Community path attribute for the route. See the output field table for the show route detail command.	**detail extensive**

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Table 47: show route damping Output Fields (continued)

Field Name	Field Description	Level of Output
Localpref	Local preference value included in the route.	All levels
Router ID	BGP router ID as advertised by the neighbor in the open message.	**detail extensive**
Merit (last update/now)	Last updated and current figure-of-merit value.	**detail extensive**
damping-parameters	Name that identifies the damping parameters used, which is defined in the damping statement at the **[edit policy-options]** hierarchy level.	**detail extensive**
Last update	Time of most recent change in path attributes.	**detail extensive**
First update	Time of first change in path attributes, which started the route damping process.	**detail extensive**
Flaps	Number of times the route has gone up or down or its path attributes have changed.	**detail extensive**
Suppressed	(**suppressed** keyword only) This route is currently suppressed. A suppressed route does not appear in the forwarding table and routing protocols do not export it.	All levels
Reusable in	(**suppressed** keyword only) Time when a suppressed route will again be available.	All levels
Preference will be	(**suppressed** keyword only) Preference value that will be applied to the route when it is again active.	All levels

Sample Output

show route damping decayed detail

```
user@host> show route damping decayed detail

inet.0: 173319 destinations, 1533668 routes (172625 active, 4 holddown, 108083
hidden)
10.0.111.0/24 (7 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 151973
                Source: 172.23.2.129
                Next hop: via so-1/2/0.0
                Next hop: via so-5/1/0.0, selected
                Next hop: via so-6/0/0.0
                Protocol next hop: 172.23.2.129
                Indirect next hop: 89a1a00 264185
                State: <Active Ext>
                Local AS: 64500 Peer AS:   64490
                Age: 3:28       Metric2: 0
                Task: BGP_64490.172.23.2.129+179
                Announcement bits (6): 0-KRT 1-RT 4-KRT 5-BGP.0.0.0.0+179

         6-Resolve tree 2 7-Resolve tree 3
                AS path: 64499 64510 645511 645511 645511 645511 I ()
```

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```
                Communities: 65551:390 65551:2000 65551:3000 65550:701
                Localpref: 100
                Router ID: 172.23.2.129
                Merit (last update/now): 1934/1790
                damping-parameters: damping-high
                Last update:       00:03:28 First update:       00:06:40
                Flaps: 2
```

show route damping history

```
user@host> show route damping history
```

```
inet.0: 173320 destinations, 1533529 routes (172624 active, 6 holddown, 108122
hidden)
+ = Active Route, - = Last Active, * = Both

10.108.0.0/15       [BGP ] 2d 22:47:58, localpref 100
                      AS path: 64220 65541 65542 I
                    > to 192.168.60.85 via so-3/1/0.0
```

show route damping history detail

```
user@host> show route damping history detail
```

```
inet.0: 173319 destinations, 1533435 routes (172627 active, 2 holddown, 108105
hidden)
10.108.0.0/15 (3 entries, 1 announced)
         BGP                 /-101
                Next-hop reference count: 69058
                Source: 192.168.60.85
                Next hop: 192.168.60.85 via so-3/1/0.0, selected
                State: <Hidden Ext>
                Inactive reason: Unusable path
                Local AS: 64500 Peer AS:  64220
                Age: 2d 22:48:10
                Task: BGP_64220.192.168.60.85+179
                AS path: 64220 65541 65542 I ()
                Communities: 65541:390 65541:2000 65541:3000 65504:3561
                Localpref: 100
                Router ID: 192.168.80.25
                Merit (last update/now): 1000/932
                damping-parameters: set-normal
                Last update:       00:01:05 First update:       00:01:05
                Flaps: 1
```


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show route detail

List of Syntax
Syntax on page 1565
Syntax (EX Series Switches) on page 1565

Syntax

```
show route detail
<destination-prefix>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route detail
<destination-prefix>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 13.2X51-D15 for the QFX Series.
Comand introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description
Display detailed information about the active entries in the routing tables.

Options
none—Display all active entries in the routing table on all systems.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show route detail on page 1576
show route detail (with BGP Multipath) on page 1582
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 1583
show route label detail (Multipoint LDP with Multicast-Only Fast Reroute) on page 1583
show route detail (Flexible VXLAN Tunnel Profile) on page 1584

Output Fields
Table 48 on page 1565 describes the output fields for the **show route detail** command. Output fields are listed in the approximate order in which they appear.

Table 48: show route detail Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number **destinations**	Number of destinations for which there are routes in the routing table.

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
***number* routes**	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)

***route-destination* (entry, announced)**	Route destination (for example:10.0.0.1/24). The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

label stacking	**(**Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of 2 or more exits this routing device with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • ***—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value. **Preference2** values are signed integers, that is, **Preference2** values can be either positive or negative values. However, Junos OS evaluates **Preference2** values as unsigned integers that are represented by positive values. Based on the **Preference2** values, Junos OS evaluates a preferred route differently in the following scenarios: • **Both Signed Preference2 values** ◦ Route A = -101 ◦ Route B = -156 Where both the **Preference2** values are signed, Junos OS evaluates only the unsigned value of **Preference2** and Route A, which has a lower **Preference2** value is preferred. • **Unsigned Preference2 values** Now consider both unsigned **Preference2** values: ◦ Route A = 4294967096 ◦ Route B = 200 Here, Junos OS considers the lesser **Preference2** value and Route B with a **Preference2** value of 200 is preferred because it is less than 4294967096. • **Combination of signed and unsigned Preference2 values** When **Preference2** values of two routes are compared, and for one route the **Preference2** is a signed value, and for the other route it is an unsigned value, Junos OS prefers the route with the positive **Preference2** value over the negative **Preference2** value. For example, consider the following signed and unsigned **Preference2** values: ◦ Route A = -200 ◦ Route B = 200 In this case, Route B with a **Preference2** value of 200 is preferred although this value is greater than -200, because Junos OS evaluates only the unsigned value of the **Preference2** value.
Level	(IS-IS only). In IS-IS, a single AS can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.
PMSI	Provider multicast service interface (MVPN routing table).

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
Next-hop type	Type of next hop. For a description of possible values for this field, see Table 49 on page 1571.
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path *lsp-path-name*	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.
State	State of the route (a route can be in more than one state). See Table 50 on page 1573.
Local AS	AS number of the local routing device.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
Metric*n*	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
MED-plus-IGP	Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.
TTL-Action	For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances. For sample output, see show route table.
Task	Name of the protocol that has added the route.
Announcement bits	The number of BGP peers or protocols to which Junos OS has announced this route, followed by the list of the recipients of the announcement. Junos OS can also announce the route to the KRT for installing the route into the Packet Forwarding Engine, to a resolve tree, a L2 VC, or even a VPN. For example, ***n*-Resolve inet** indicates that the specified route is used for route resolution for next hops found in the routing table. • ***n***—An index used by Juniper Networks customer support only.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **Recorded**—The AS path is recorded by the sample process (sampled). • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used in the AS-path merge process, as defined in RFC 4893. • **[ ]**—If more than one AS number is configured on the routing device, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Unverified**—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
ORR Generation-ID	Displays the optimal route reflection (ORR) generation identifier. ISIS and OSPF interior gateway protocol (IGP) updates filed whenever any of the corresponding ORR route has its metric valued changed, or if the ORR route is added or deleted.
FECs bound to route	Point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.
Primary Upstream	When multipoint LDP with multicast-only fast reroute (MoFRR) is configured, the primary upstream path. MoFRR transmits a multicast join message from a receiver toward a source on a primary path, while also transmitting a secondary multicast join message from the receiver toward the source on a backup path.
RPF Nexthops	When multipoint LDP with MoFRR is configured, the reverse-path forwarding (RPF) next-hop information. Data packets are received from both the primary path and the secondary paths. The redundant packets are discarded at topology merge points due to the RPF checks.
Label	Multiple MPLS labels are used to control MoFRR stream selection. Each label represents a separate route, but each references the same interface list check. Only the primary label is forwarded while all others are dropped. Multiple interfaces can receive packets using the same label.
weight	Value used to distinguish MoFRR primary and backup routes. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible.
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Prefixes bound to route	Forwarding equivalent class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See Table 51 on page 1575 for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).
control flags	Control flags: **none** or **Site Down**.
mtu	Maximum transmission unit (MTU) information.

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Table 48: show route detail Output Fields (continued)

Field Name	Field Description
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).
Accepted Multipath	Current active path when BGP multipath is configured.
Accepted LongLivedStale	The LongLivedStale flag indicates that the route was marked LLGR-stale by this router, as part of the operation of LLGR receiver mode. Either this flag or the LongLivedStaleImport flag may be displayed for a route. Neither of these flags are displayed at the same time as the Stale (ordinary GR stale) flag.
Accepted LongLivedStaleImport	The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy. Either this flag or the LongLivedStale flag may be displayed for a route. Neither of these flags are displayed at the same time as the Stale (ordinary GR stale) flag. Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and import into the inet.0 routing table
ImportAccepted LongLivedStaleImport	Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and imported into the inet.0 routing table The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy.
Accepted MultipathContrib	Path currently contributing to BGP multipath.
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.

Table 49 on page 1571 describes all possible values for the Next-hop Types output field.

Table 49: Next-hop Types Output Field Values

Next-Hop Type	Description
Broadcast (bcast)	Broadcast next hop.
Deny	Deny next hop.
Discard	Discard next hop.
Dynamic List	Dynamic list next hop

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Table 49: Next-hop Types Output Field Values (continued)

Next-Hop Type	Description
Flood	Flood next hop. Consists of components called branches, up to a maximum of 32 branches. Each flood next-hop branch sends a copy of the traffic to the forwarding interface. Used by point-to-multipoint RSVP, point-to-multipoint LDP, point-to-multipoint CCC, and multicast.
Hold	Next hop is waiting to be resolved into a unicast or multicast type.
Indexed (idxd)	Indexed next hop.
Indirect (indr)	Used with applications that have a protocol next hop address that is remote. You are likely to see this next-hop type for internal BGP (IBGP) routes when the BGP next hop is a BGP neighbor that is not directly connected.
Interface	Used for a network address assigned to an interface. Unlike the router next hop, the interface next hop does not reference any specific node on the network.
Local (locl)	Local address on an interface. This next-hop type causes packets with this destination address to be received locally.
Multicast (mcst)	Wire multicast next hop (limited to the LAN).
Multicast discard (mdsc)	Multicast discard.
Multicast group (mgrp)	Multicast group member.
Receive (recv)	Receive.
Reject (rjct)	Discard. An ICMP unreachable message was sent.
Resolve (rslv)	Resolving next hop.
Routed multicast (mcrt)	Regular multicast next hop.
Router	A specific node or set of nodes to which the routing device forwards packets that match the route prefix. To qualify as next-hop type router, the route must meet the following criteria: • Must not be a direct or local subnet for the routing device. • Must have a next hop that is directly connected to the routing device.

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Table 49: Next-hop Types Output Field Values (continued)

Next-Hop Type	Description
Software	Next hop added to the Routing Engine forwarding table for remote IP addresses with prefix /32 for Junos OS Evolved only.
Table	Routing table next hop.
Unicast (ucst)	Unicast.
Unilist (ulst)	List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.

Table 50 on page 1573 describes all possible values for the State output field. A route can be in more than one state (for example, **<Active NoReadvrt Int Ext>**).

Table 50: State Output Field Values

Value	Description
Accounting	Route needs accounting.
Active	Route is active.
Always Compare MED	Path with a lower multiple exit discriminator (MED) is available.
AS path	Shorter AS path is available.
Cisco Non-deterministic MED selection	Cisco nondeterministic MED is enabled, and a path with a lower MED is available.
Clone	Route is a clone.
Cluster list length	Length of cluster list sent by the route reflector.
Delete	Route has been deleted.
Ex	Exterior route.
Ext	BGP route received from an external BGP neighbor.
FlashAll	Forces all protocols to be notified of a change to any route, active or inactive, for a prefix. When not set, protocols are informed of a prefix only when the active route changes.
Hidden	Route not used because of routing policy.
IfCheck	Route needs forwarding RPF check.

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Table 50: State Output Field Values (continued)

Value	Description
IGP metric	Path through next hop with lower IGP metric is available.
Inactive reason	Flags for this route, which was not selected as best for a particular destination.
Initial	Route being added.
Int	Interior route.
Int Ext	BGP route received from an internal BGP peer or a BGP confederation peer.
Interior > Exterior > Exterior via Interior	Direct, static, IGP, or EBGP path is available.
Local Preference	Path with a higher local preference value is available.
Martian	Route is a martian (ignored because it is obviously invalid).
MartianOK	Route exempt from martian filtering.
Next hop address	Path with lower metric next hop is available.
No difference	Path from neighbor with lower IP address is available.
NoReadvrt	Route not to be advertised.
NotBest	Route not chosen because it does not have the lowest MED.
Not Best in its group	Incoming BGP AS is not the best of a group (only one AS can be the best).
NotInstall	Route not to be installed in the forwarding table.
Number of gateways	Path with a greater number of next hops is available.
Origin	Path with a lower origin code is available.
Pending	Route pending because of a hold-down configured on another route.
Programmed	Route installed programatically by on-box or off-box applications using API.
Release	Route scheduled for release.
RIB preference	Route from a higher-numbered routing table is available.

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Table 50: State Output Field Values (continued)

Value	Description
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.
Route Metric or MED comparison	Route with a lower metric or MED is available.
Route Preference	Route with lower preference value is available
Router ID	Path through a neighbor with lower ID is available.
Secondary	Route not a primary route.
Unusable path	Path is not usable because of one of the following conditions: • The route is damped. • The route is rejected by an import policy. • The route is unresolved.
Update source	Last tiebreaker is the lowest IP address value.
ProtectionCand	Indicates paths requesting protection.
ProtectionPath	Indicates the route entry that can be used as a protection path.

Table 51 on page 1575 describes the possible values for the Communities output field.

Table 51: Communities Output Field Values

Value	Description
area-number	4 bytes, encoding a 32-bit area number. For AS-external routes, the value is **0**. A nonzero value identifies the route as internal to the OSPF domain, and as within the identified area. Area numbers are relative to a particular OSPF domain.
bandwidth: ***local AS number:link-bandwidth-number***	Link-bandwidth community value used for unequal-cost load balancing. When BGP has several candidate paths available for multipath purposes, it does not perform unequal-cost load balancing according to the link-bandwidth community unless all candidate paths have this attribute.
domain-id	Unique configurable number that identifies the OSPF domain.
domain-id-vendor	Unique configurable number that further identifies the OSPF domain.
link-bandwidth-number	Link-bandwidth number: from **0** through **4,294,967,295** (bytes per second).
local AS number	Local AS number: from **1** through **65,535**.
options	1 byte. Currently this is only used if the route type is **5** or **7**. Setting the least significant bit in the field indicates that the route carries a type 2 metric.

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Table 51: Communities Output Field Values (continued)

Value	Description
origin	(Used with VPNs) Identifies where the route came from.
ospf-route-type	1 byte, encoded as **1** or **2** for intra-area routes (depending on whether the route came from a type 1 or a type 2 LSA); **3** for summary routes; **5** for external routes (area number must be**0**); **7** for NSSA routes; or **129** for sham link endpoint addresses.
route-type-vendor	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x8000**. The format is ***area-number:ospf-route-type:options***.
rte-type	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x0306**. The format is ***area-number:ospf-route-type:options***.
target	Defines which VPN the route participates in; **target** has the format ***32-bit IP address:16-bit number***. For example, 10.19.0.0:100.
unknown IANA	Incoming IANA codes with a value between **0x1** and **0x7fff**. This code of the BGP extended community attribute is accepted, but it is not recognized.
unknown OSPF vendor community	Incoming IANA codes with a value above **0x8000**. This code of the BGP extended community attribute is accepted, but it is not recognized.

Sample Output

show route detail

```
user@host> show route detail

inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:31:43
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

10.31.1.0/30 (2 entries, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 2
                Next hop: via so-0/3/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:30:17
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
```


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```
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:    69
                Age: 1:30:17    Metric: 1
                ORR Generation-ID: 1
     Area: 0.0.0.0
                Task: OSPF
                AS path: I

10.31.1.1/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 7
                Interface: so-0/3/0.0
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:30:20
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I

...

10.31.2.0/30 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: via so-0/3/0.0
                Next hop: 10.31.1.6 via ge-3/1/0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:29:56    Metric: 2
                Area: 0.0.0.0
                ORR Generation-ID: 1
     Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

172.16.233.2/32 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

172.16.233.22/32 (1 entry, 1 announced)
        *IGMP   Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
```

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```
                Age: 1:31:43
                Task: IGMP
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.255.70.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100096
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 2
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

10.255.71.238/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r2
                State: <Active Int>
                Local AS:    69
                Age: 1:25:49    Metric: 1
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

private__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

47.0005.80ff.f800.0000.0108.0001.0102.5507.1052/152 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
0   (1 entry, 1 announced)
        *MPLS   Preference: 0
                Next hop type: Receive
                Next-hop reference count: 6
                State: <Active Int>
                Local AS:    69
                Age: 1:31:45    Metric: 1
                Task: MPLS
                Announcement bits (1): 0-KRT
                AS path: I
```


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```
...

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

  299840 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 299840 /52 -> {indirect(1048575)}
          *RSVP   Preference: 7/2
                  Next hop type: Flood
                  Address: 0x9174a30
                  Next-hop reference count: 4
                  Next hop type: Router, Next hop index: 798
                  Address: 0x9174c28
                  Next-hop reference count: 2
                  Next hop: 172.16.0.2 via lt-1/2/0.9 weight 0x1
                  Label-switched-path R2-to-R4-2p2mp
                  Label operation: Pop
                  Next hop type: Router, Next hop index: 1048574
                  Address: 0x92544f0
                  Next-hop reference count: 2
                  Next hop: 172.16.0.2 via lt-1/2/0.7 weight 0x1
                  Label-switched-path R2-to-R200-p2mp
                  Label operation: Pop
                  Next hop: 172.16.0.2 via lt-1/2/0.5 weight 0x8001
                  Label operation: Pop
                  State: <Active Int>
                  Age: 1:29       Metric: 1
                  Task: RSVP
                  Announcement bits (1): 0-KRT
                  AS path: I...

800010 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: via vt-3/2/0.32769, selected
                Label operation: Pop
                State: <Active Int>
                Age: 1:29:30
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

vt-3/2/0.32769 (1 entry, 1 announced)
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: 10.31.1.6 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 800012, Push 100096(top)
                Protocol next hop: 10.255.70.103
                Push 800012
                Indirect next hop: 87272e4 1048574
                State: <Active Int>
                Age: 1:29:30    Metric2: 2
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
```

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```
inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

abcd::10:255:71:52/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:44
                Task: IF
                AS path: I

ff02::2/128 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::d/128 (1 entry, 1 announced)
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:45
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::16/128 (1 entry, 1 announced)
        *MLD    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    69
                Age: 1:31:43
                Task: MLD
                Announcement bits (1): 0-KRT
                AS path: I

private.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
```


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```
                Next hop: via lo0.16385, selected
                State: <Active NoReadvrt Int>
                Age: 1:31:44
                Task: IF
                AS path: I

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

10.255.70.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.70.103:1
                Next-hop reference count: 7
                Source: 10.255.70.103
                Protocol next hop: 10.255.70.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    69 Peer AS:    69
                Age: 1:25:49    Metric2: 1
                AIGP 210
                Task: BGP_69.10.255.70.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 10.255.70.103
                Primary Routing Table bgp.l2vpn.0

10.255.71.52:1:1:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-1
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8, status-vector: 0x9F

10.255.71.52:1:5:1/96 (1 entry, 1 announced)
        *L2VPN  Preference: 170/-101
                Next-hop reference count: 5
                Protocol next hop: 10.255.71.52
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:31:40    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:, mtu: 0
                Label-base: 800008, range: 8, status-vector: 0x9F

...

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
```

```
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512

inet.0: 45 destinations, 47 routes (44 active, 0 holddown, 1 hidden)
1.1.1.3/32 (1 entry, 1 announced)
        *IS-IS  Preference: 18
                Level: 2
                Next hop type: Router, Next hop index: 580
                Address: 0x9db6ed0
                Next-hop reference count: 8
                Next hop: 10.1.1.6 via lt-1/0/10.5, selected
                Session Id: 0x18a
                State: <Active Int>
                Local AS:     2
                Age: 1:32       Metric: 10
                Validation State: unverified
                ORR Generation-ID: 1
                Task: IS-IS
                Announcement bits (3): 0-KRT 5-Resolve tree 4 6-Resolve_IGP_FRR
task
                AS path: I

inet.0: 61 destinations, 77 routes (61 active, 1 holddown, 0 hidden)
1.1.1.1/32 (2 entries, 1 announced)
        *OSPF   Preference: 10
                Next hop type: Router, Next hop index: 673
                Address: 0xc008830
                Next-hop reference count: 3
                Next hop: 10.1.1.1 via ge-0/0/2.0, selected
                Session Id: 0x1b7
                State: <Active Int>
                Local AS:     1
                Age: 3:06:59    Metric: 100
                Validation State: unverified
                ORR Generation-ID: 1
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 1-KRT 9-Resolve tree 2
                AS path: I
```

show route detail (with BGP Multipath)

```
user@host> show route detail

10.1.1.8/30 (2 entries, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Router, Next hop index: 262142
                Address: 0x901a010
                Next-hop reference count: 2
```


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```
               Source: 10.1.1.2
               Next hop: 10.1.1.2 via ge-0/3/0.1, selected
               Next hop: 10.1.1.6 via ge-0/3/0.5
               State: <Active Ext>
               Local AS:     1 Peer AS:     2
               Age: 5:04:43
              Validation State: unverified
               Task: BGP_2.10.1.1.2+59955
               Announcement bits (1): 0-KRT
               AS path: 2 I
               Accepted Multipath
               Localpref: 100
               Router ID: 172.16.1.2
        BGP    Preference: 170/-101
               Next hop type: Router, Next hop index: 678
               Address: 0x8f97520
               Next-hop reference count: 9
               Source: 10.1.1.6
               Next hop: 10.1.1.6 via ge-0/3/0.5, selected
               State: <NotBest Ext>
               Inactive reason: Not Best in its group - Active preferred
               Local AS:     1 Peer AS:     2
               Age: 5:04:43
           Validation State: unverified
               Task: BGP_2.10.1.1.6+58198
               AS path: 2 I
               Accepted MultipathContrib
               Localpref: 100
               Router ID: 172.16.1.3
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
```

```
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  1001
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 10.255.72.166, grp 232.1.1.1,
 src 192.168.142.2
```

show route label detail (Multipoint LDP with Multicast-Only Fast Reroute)

```
user@host> show route label 301568 detail
```

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```
mpls.0: 18 destinations, 18 routes (18 active, 0 holddown, 0 hidden)
301568 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Address: 0x2735208
                Next-hop reference count: 3
                Next hop type: Router, Next hop index: 1397
                Address: 0x2735d2c
                Next-hop reference count: 3
                Next hop: 1.3.8.2 via ge-1/2/22.0
                Label operation: Pop
                Load balance label:  None;
                Next hop type: Router, Next hop index: 1395
                Address: 0x2736290
                Next-hop reference count: 3
                Next hop: 1.3.4.2 via ge-1/2/18.0
                Label operation: Pop
                Load balance label:  None;
                State: <Active Int AckRequest MulticastRPF>
                Local AS:    10
                Age: 54:05      Metric: 1
                Validation State: unverified
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                FECs bound to route: P2MP root-addr 172.16.1.1, grp: 232.1.1.1,
src: 192.168.219.11
                Primary Upstream : 172.16.1.3:0--172.16.1.2:0
                   RPF Nexthops  :
                        ge-1/2/15.0, 1.2.94.1, Label: 301568, weight: 0x1
                        ge-1/2/14.0, 1.2.3.1, Label: 301568, weight: 0x1
                Backup Upstream : 172.16.1.3:0--172.16.1.6:0
                   RPF Nexthops :
                        ge-1/2/20.0, 1.2.96.1, Label: 301584, weight: 0xfffe
                        ge-1/2/19.0, 1.3.6.1, Label: 301584, weight: 0xfffe
```

show route detail (Flexible VXLAN Tunnel Profile)

user@host> **show route 192.168.0.2 detail**

```
...
CUSTOMER_0001.inet.0: 5618 destinations, 6018 routes (5618 active, 0 holddown, 0
 hidden)

192.168.0.2/32 (1 entry, 1 announced)
        *Static Preference: 5/100
                Next hop type: Router, Next hop index: 74781
                Address: 0x5d9b03cc
                Next-hop reference count: 363
                Next hop: via fti0.6, selected
                Session Id: 0x24c8
                State: <Active Int NSR-incapable OpaqueData Programmed>
                Age: 1:25:53
                Validation State: unverified
                        Tag: 10000001   Tag2: 1
                Announcement bits (2): 1-KRT 3-Resolve tree 30
                AS path: I
                Flexible IPv6 VXLAN tunnel profile
                    Action: Encapsulate
```


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```
                    Interface: fti0.6 (Index: 10921)
                    VNI: 10000001
                    Source Prefix: 2001:db8:255::2/128
                    Source UDP Port Range: 54614 - 60074
                    Destination Address: 2001:db8:80:1:1:1:0:1
                    Destination UDP Port: 4790
                    VXLAN Flags: 0x08
...
```

show route exact

List of Syntax

Syntax on page 1586
Syntax (EX Series Switches) on page 1586

Syntax

```
show route exact destination-prefix
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route exact destination-prefix
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display only the routes that exactly match the specified address or range of addresses.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

destination-prefix—Address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route exact on page 1586
show route exact detail on page 1587
show route exact extensive on page 1587
show route exact terse on page 1587

Output Fields

For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route exact

```
user@host> show route exact 207.17.136.0/24

inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
```


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```
207.17.136.0/24    *[Static/5] 2d 03:30:22
                    > to 192.168.71.254 via fxp0.0
```

show route exact detail

```
user@host> show route exact 207.17.136.0/24 detail

inet.0: 24 destinations, 25 routes (23 active, 0 holddown, 1 hidden)
Restart Complete
207.17.136.0/24 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2d 3:30:26
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I
```

show route exact extensive

```
user@host> show route exact 207.17.136.0/24 extensive
inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
207.17.136.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.0/24 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 1:25:18
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I
```

show route exact terse

```
user@host> show route exact 207.17.136.0/24 terse

inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both
A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 207.17.136.0/24    S   5                      >192.168.71.254
```

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show route export

List of Syntax

Syntax on page 1588
Syntax (EX Series Switches) on page 1588

Syntax

```
show route export
<brief | detail>
<instance <instance-name> | routing-table-name>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route export
<brief | detail>
<instance <instance-name> | routing-table-name>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display policy-based route export information. Policy-based export simplifies the process of exchanging route information between routing instances.

Options

none—(Same as **brief**.) Display standard information about policy-based export for all instances and routing tables on all systems.

brief | detail—(Optional) Display the specified level of output.

instance <*instance-name*>—(Optional) Display a particular routing instance for which policy-based export is currently enabled.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

routing-table-name—(Optional) Display information about policy-based export for all routing tables whose name begins with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route export inet** command).

Required Privilege Level

view

List of Sample Output

show route export on page 1589
show route export detail on page 1589
show route export instance detail on page 1590

Output Fields

Table 52 on page 1589 lists the output fields for the **show route export** command. Output fields are listed in the approximate order in which they appear.

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Table 52: show route export Output Fields

Field Name	Field Description	Level of Output
Table or *table-name*	Name of the routing tables that either import or export routes.	All levels
Routes	Number of routes exported from this table into other tables. If a particular route is exported to different tables, the counter will only increment by one.	**brief** none
Export	Whether the table is currently exporting routes to other tables: **Y** or **N** (Yes or No).	**brief** none
Import	Tables currently importing routes from the originator table. (Not displayed for tables that are not exporting any routes.)	**detail**
Flags	(**instance** keyword only) Flags for this feature on this instance: • **config auto-policy**—The policy was deduced from the configured IGP export policies. • **cleanup**—Configuration information for this instance is no longer valid. • **config**—The instance was explicitly configured.	**detail**
Options	(**instance** keyword only) Configured option displays the type of routing tables the feature handles: • **unicast**—Indicates *instance*.inet.0. • **multicast**—Indicates *instance*.inet.2. • **unicast multicast**—Indicates *instance*.inet.0 and *instance*.inet.2.	**detail**
Import policy	(**instance** keyword only) Policy that **route export** uses to construct the import-export matrix. Not displayed if the instance type is **vrf**.	**detail**
Instance	(**instance** keyword only) Name of the routing instance.	**detail**
Type	(**instance** keyword only) Type of routing instance: **forwarding**, **non-forwarding**, or **vrf**.	**detail**

Sample Output

show route export

```
user@host> show route export

Table                           Export          Routes
inet.0                          N                    0
black.inet.0                    Y                    3
red.inet.0                      Y                    4
```

show route export detail

```
user@host> show route export detail

inet.0                                          Routes:        0
black.inet.0                                    Routes:        3
  Import: [ inet.0 ]
```

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```
red.inet.0                                          Routes:        4
  Import: [ inet.0 ]
```

show route export instance detail

```
user@host> show route export instance detail
```

```
Instance: master                          Type: forwarding
  Flags: <config auto-policy> Options: <unicast multicast>
  Import policy: [ (ospf-master-from-red || isis-master-from-black) ]
Instance: black                           Type: non-forwarding
Instance: red                             Type: non-forwarding
```


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show route extensive

List of Syntax

Syntax on page 1591
Syntax (EX Series Switches) on page 1591

Syntax

```
show route extensive
<destination-prefix>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route extensive
<destination-prefix>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display extensive information about the active entries in the routing tables.

Options

none—Display all active entries in the routing table.

destination-prefix—(Optional) Display active entries for the specified address or range of addresses.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route extensive on page 1598
show route extensive (Access Route) on page 1605
show route extensive (BGP PIC Edge) on page 1606
show route extensive (FRR and LFA) on page 1606
show route extensive (IS-IS) on page 1607
show route extensive (Route Reflector) on page 1607
show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs) on page 1608
show route label detail (Multipoint LDP with Multicast-Only Fast Reroute) on page 1608
show route extensive (Flexible VXLAN Tunnel Profile) on page 1609

Output Fields

Table 53 on page 1591 describes the output fields for the **show route extensive** command. Output fields are listed in the approximate order in which they appear.

Table 53: show route extensive Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
number **destinations**	Number of destinations for which there are routes in the routing table.
number **routes**	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active). • **holddown** (routes that are in the pending state before being declared inactive). • **hidden** (routes that are not used because of a routing policy).

route-destination **(entry, announced)**	Route destination (for example: 10.0.0.1/24). The **entry** value is the number of route for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  ◦ ***neighbor-address***—Address of the neighbor.
	  ◦ ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  ◦ ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  ◦ ***vc-id***—Virtual circuit identifier.
	  ◦ ***source***—Source of the advertisement: **Local** or **Remote**.

TSI	Protocol header information.
label stacking	(Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of two or more exits this router with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
Level	(IS-IS only). In IS-IS, a single autonomous system (AS) can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.
PMSI	Provider multicast service interface (MVPN routing table).
Next-hop type	Type of next hop. For a description of possible values for this field, see the Output Field table in the show route detail command.
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path *lsp-path-name*	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Offset	Whether the metric has been increased or decreased by an offset value.
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to recursively derive a forwarding next hop.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
label-operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Indirect next hops	When present, a list of nodes that are used to resolve the path to the next-hop destination, in the order that they are resolved. When BGP PIC Edge is enabled, the output lines that contain **Indirect next hop: weight** follow next hops that the software can use to repair paths where a link failure occurs. The next-hop weight has one of the following values: • 0x1 indicates active next hops. • 0x4000 indicates passive next hops.
State	State of the route (a route can be in more than one state). See the Output Field table in the show route detail command.
Session ID	The BFD session ID number that represents the protection using MPLS fast reroute (FRR) and loop-free alternate (LFA).
Weight	Weight for the backup path. If the weight of an indirect next hop is larger than zero, the weight value is shown. For sample output, see show route table.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
Inactive reason	If the route is inactive, the reason for its current state is indicated. Typical reasons include: • **Active preferred**—Currently active route was selected over this route. • **Always compare MED**—Path with a lower multiple exit discriminator (MED) is available. • **AS path**—Shorter AS path is available. • **Cisco Non-deterministic MED selection**—Cisco nondeterministic MED is enabled and a path with a lower MED is available. • **Cluster list length**—Path with a shorter cluster list length is available. • **Forwarding use only**—Path is only available for forwarding purposes. • **IGP metric**—Path through the next hop with a lower IGP metric is available. • **IGP metric type**—Path with a lower OSPF link-state advertisement type is available. • **Interior > Exterior > Exterior via Interior**—Direct, static, IGP, or EBGP path is available. • **Local preference**—Path with a higher local preference value is available. • **Next hop address**—Path with a lower metric next hop is available. • **No difference**—Path from a neighbor with a lower IP address is available. • **Not Best in its group**—Occurs when multiple peers of the same external AS advertise the same prefix and are grouped together in the selection process. When this reason is displayed, an additional reason is provided (typically one of the other reasons listed). • **Number of gateways**—Path with a higher number of next hops is available. • **Origin**—Path with a lower origin code is available. • **OSPF version**—Path does not support the indicated OSPF version. • **RIB preference**—Route from a higher-numbered routing table is available. • **Route destinguisher**—64-bit prefix added to IP subnets to make them unique. • **Route metric or MED comparison**—Route with a lower metric or MED is available. • **Route preference**—Route with a lower preference value is available. • **Router ID**—Path through a neighbor with a lower ID is available. • **Unusable path**—Path is not usable because of one of the following conditions: the route is damped, the route is rejected by an import policy, or the route is unresolved. • **Update source**—Last tiebreaker is the lowest IP address value.
Local AS	Autonomous system (AS) number of the local routing device.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.
Metric	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
MED-plus-IGP	Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.
TTL-Action	For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances. For sample output, see show route table.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
Task	Name of the protocol that has added the route.
Announcement bits	List of protocols that are consumers of the route. Using the following output as an example, **Announcement bits (3): 0-KRT 5-Resolve tree 2 8-BGP RT Background** there are (3) announcement bits to reflect the three clients (protocols) that have state for this route: Kernel (0-KRT), 5 (resolution tree process 2), and 8 (BGP). The notation ***n*-Resolve inet** indicates that the route is used for route resolution for next hops found in the routing table. ***n*** is an index used by Juniper Networks customer support only.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **Recorded**—The AS path is recorded by the sample process (sampled). • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the local AS number associated with the AS path if more than one AS number is configured on the routing device, or if AS path prepending is configured. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Unverified**—Indicates that origin validation is not enabled for the BGP peers. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
FECs bound to route	Point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.
AS path: I <Originator>	(For route reflected output only) Originator ID attribute set by the route reflector.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
route status	Indicates the status of a BGP route: • **Accepted**—The specified BGP route is imported by the default BGP policy. • **Import**—The route is imported into a Layer 3 VPN routing instance. • **Import-Protect**—A remote instance egress that is protected. • **Multipath**—A BGP multipath active route. • **MultipathContrib**—The route is not active but contributes to the BGP multipath. • **Protect**—An egress route that is protected. • **Stale**—A route that is marked stale due to graceful restart.
Primary Upstream	When multipoint LDP with multicast-only fast reroute (MoFRR) is configured, the primary upstream path. MoFRR transmits a multicast join message from a receiver toward a source on a primary path, while also transmitting a secondary multicast join message from the receiver toward the source on a backup path.
RPF Nexthops	When multipoint LDP with MoFRR is configured, the reverse-path forwarding (RPF) next-hop information. Data packets are received from both the primary path and the secondary paths. The redundant packets are discarded at topology merge points due to the RPF checks.
Label	Multiple MPLS labels are used to control MoFRR stream selection. Each label represents a separate route, but each references the same interface list check. Only the primary label is forwarded while all others are dropped. Multiple interfaces can receive packets using the same label.
weight	Value used to distinguish MoFRR primary and backup routes. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible.
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Cluster list	(For route reflected output only) Cluster ID sent by the route reflector.
Originator ID	(For route reflected output only) Address of router that originally sent the route to the route reflector.
Prefixes bound to route	Forwarding Equivalent Class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See the Output Field table in the show route detail command for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).
control flags	Control flags: **none** or Site Down.
mtu	Maximum transmission unit (MTU) information.
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.

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Table 53: show route extensive Output Fields (continued)

Field Name	Field Description
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.
Originating RIB	Name of the routing table whose active route was used to determine the forwarding next-hop entry in the resolution database. For example, in the case of inet.0 resolving through inet.0 and inet.3, this field indicates which routing table, inet.0 or inet.3, provided the best path for a particular prefix.
Node path count	Number of nodes in the path.
Forwarding nexthops	Number of forwarding next hops. The forwarding next hop is the network layer address of the directly reachable neighboring system (if applicable) and the interface used to reach it.

Sample Output

show route extensive

```
user@host> show route extensive
inet.0: 22 destinations, 23 routes (21 active, 0 holddown, 1 hidden)
203.0.113.10/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 203.0.113.10/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 29
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    64496
                Age: 1:34:06
                Task: RT
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

203.0.113.30/30 (2 entries, 1 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 2
                Next hop: via so-0/3/0.0, selected
                State: <Active Int>
                Local AS:    64496
                Age: 1:32:40
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
```


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```
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:    64496
                Age: 1:32:40    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

203.0.113.103/32 (1 entry, 1 announced)
        *Local  Preference: 0
                Next hop type: Local
                Next-hop reference count: 7
                Interface: so-0/3/0.0
                State: <Active NoReadvrt Int>
                Local AS:    644969
                Age: 1:32:43
                Task: IF
                Announcement bits (1): 3-Resolve tree 2
                AS path: I

...

203.0.113.203/30 (1 entry, 1 announced)
TSI:
KRT in-kernel 203.0.113.203/30 -> {203.0.113.216}
        *OSPF   Preference: 10
                Next-hop reference count: 9
                Next hop: via so-0/3/0.0
                Next hop: 203.0.113.216 via ge-3/1/0.0, selected
                State: <Active Int>
                Local AS:    64496
                Age: 1:32:19    Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

198.51.100.2/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 198.51.100.2/32 -> {}
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    64496
                Age: 1:34:08
                Task: PIM Recv
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

...

198.51.100.22/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 198.51.100.22/32 -> {}
        *IGMP   Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
```

```
                Local AS:    64496
                Age: 1:34:06
                Task: IGMP
                Announcement bits (2): 0-KRT 3-Resolve tree 2
                AS path: I

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

203.0.113.103/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: 203.0.113.216 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 100096
                State: <Active Int>
                Local AS:    64496
                Age: 1:28:12    Metric: 2
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

203.0.113.238/32 (1 entry, 1 announced)
        State: <FlashAll>
        *RSVP   Preference: 7
                Next-hop reference count: 6
                Next hop: via so-0/3/0.0 weight 0x1, selected
                Label-switched-path green-r1-r2
                State: <Active Int>
                Local AS:    64496
                Age: 1:28:12    Metric: 1
                Task: RSVP
                Announcement bits (2): 1-Resolve tree 1 2-Resolve tree 2
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

...

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

47.0005.80ff.f800.0000.0108.0001.0102.5507.1052/152 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    64496
                Age: 1:34:07
                Task: IF
                AS path: I

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

0   (1 entry, 1 announced)
TSI:
KRT in-kernel 0      /36 -> {}
        *MPLS   Preference: 0
                Next hop type: Receive
                Next-hop reference count: 6
```


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```
                State: <Active Int>
                Local AS:    64496
                Age: 1:34:08    Metric: 1
                Task: MPLS
                Announcement bits (1): 0-KRT
                AS path: I

...

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  299840 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 299840 /52 -> {indirect(1048575)}
          *RSVP   Preference: 7/2
                  Next hop type: Flood
                  Address: 0x9174a30
                  Next-hop reference count: 4
                  Next hop type: Router, Next hop index: 798
                  Address: 0x9174c28
                  Next-hop reference count: 2
                  Next hop: 198.51.100.2 via lt-1/2/0.9 weight 0x1
                  Label-switched-path R2-to-R4-2p2mp
                  Label operation: Pop
                  Next hop type: Router, Next hop index: 1048574
                  Address: 0x92544f0
                  Next-hop reference count: 2
                  Next hop: 198.51.100.2 via lt-1/2/0.7 weight 0x1
                  Label-switched-path R2-to-R200-p2mp
                  Label operation: Pop
                  Next hop: 198.51.100.2 via lt-1/2/0.5 weight 0x8001
                  Label operation: Pop
                  State: <Active Int>
                  Age: 1:29       Metric: 1
                  Task: RSVP
                  Announcement bits (1): 0-KRT
                  AS path: I...

800010 (1 entry, 1 announced)

TSI:
KRT in-kernel 800010 /36 -> {vt-3/2/0.32769}
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: via vt-3/2/0.32769, selected
                Label operation: Pop
                State: <Active Int>
                Age: 1:31:53
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

vt-3/2/0.32769 (1 entry, 1 announced)
TSI:
KRT in-kernel vt-3/2/0.32769.0      /16 -> {indirect(1048574)}
        *VPLS   Preference: 7
                Next-hop reference count: 2
                Next hop: 203.0.113.216 via ge-3/1/0.0 weight 0x1, selected
                Label-switched-path green-r1-r3
                Label operation: Push 800012, Push 100096(top)
                Protocol next hop: 203.0.113.103
```

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```
                Push 800012
                Indirect next hop: 87272e4 1048574
                State: <Active Int>
                Age: 1:31:53    Metric2: 2
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Indirect next hops: 1
                        Protocol next hop: 203.0.113.103 Metric: 2
                        Push 800012
                        Indirect next hop: 87272e4 1048574
                        Indirect path forwarding next hops: 1
                               Next hop: 203.0.113.216 via ge-3/1/0.0 weight 0x1

                        203.0.113.103/32 Originating RIB: inet.3
                          Metric: 2                       Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 203.0.113.216 via ge-3/1/0.0

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

2001:db8::10:255:71:52/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active Int>
                Local AS:    64496
                Age: 1:34:07
                Task: IF
                AS path: I

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Active NoReadvrt Int>
                Local AS:    64496
                Age: 1:34:07
                Task: IF
                AS path: I

ff02::2/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::2/128 -> {}
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    64496
                Age: 1:34:08
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::d/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::d/128 -> {}
```


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```
        *PIM    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    64496
                Age: 1:34:08
                Task: PIM Recv6
                Announcement bits (1): 0-KRT
                AS path: I

ff02::16/128 (1 entry, 1 announced)
TSI:
KRT in-kernel ff02::16/128 -> {}
        *MLD    Preference: 0
                Next-hop reference count: 18
                State: <Active NoReadvrt Int>
                Local AS:    64496
                Age: 1:34:06
                Task: MLD
                Announcement bits (1): 0-KRT
                AS path: I

private.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

fe80::280:42ff:fe10:f179/128 (1 entry, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.16385, selected
                State: <Active NoReadvrt Int>
                Age: 1:34:07
                Task: IF
                AS path: I

green.l2vpn.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)

203.0.113.103:1:3:1/96 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 203.0.113.103:1
                Next-hop reference count: 7
                Source: 203.0.113.103
                Protocol next hop: 203.0.113.103
                Indirect next hop: 2 no-forward
                State: <Secondary Active Int Ext>
                Local AS:    64496 Peer AS:    64496
                Age: 1:28:12    Metric2: 1
                Task: BGP_69.203.0.113.103+179
                Announcement bits (1): 0-green-l2vpn
                AS path: I
                Communities: target:11111:1 Layer2-info: encaps:VPLS,
                control flags:, mtu: 0
                Label-base: 800008, range: 8
                Localpref: 100
                Router ID: 203.0.113.103
                Primary Routing Table bgp.l2vpn.0

203.0.113.152:1:1:1/96 (1 entry, 1 announced)
TSI:
Page 0 idx 0 Type 1 val 8699540
        *L2VPN  Preference: 170/-1
                Next-hop reference count: 5
```

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```
                Protocol next hop: 203.0.113.152
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:34:03    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:Site-Down,
                mtu: 0
                Label-base: 800016, range: 8, status-vector: 0x9F

203.0.113.152:1:5:1/96 (1 entry, 1 announced)
TSI:
Page 0 idx 0 Type 1 val 8699528
        *L2VPN  Preference: 170/-101
                Next-hop reference count: 5
                Protocol next hop: 203.0.113.152
                Indirect next hop: 0 -
                State: <Active Int Ext>
                Age: 1:34:03    Metric2: 1
                Task: green-l2vpn
                Announcement bits (1): 1-BGP.0.0.0.0+179
                AS path: I
                Communities: Layer2-info: encaps:VPLS, control flags:, mtu: 0
                Label-base: 800008, range: 8, status-vector: 0x9F

...

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

TSI:

203.0.113.163:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 203.0.113.163 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    64499
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512


203.0.113.55/24 (1 entry, 1 announced)
TSI:
KRT queued (pending) add
  198.51.100.0/24 -> {Push 300112}
        *BGP    Preference: 170/-101
                Next hop type: Router
                Address: 0x925c208
                Next-hop reference count: 2
                Source: 203.0.113.9
                Next hop: 203.0.113.9 via ge-1/2/0.15, selected
                Label operation: Push 300112
                Label TTL action: prop-ttl
                State: <Active Ext>
```


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```
                Local AS:  64509 Peer AS: 65539
                Age: 1w0d 23:06:56
                AIGP: 25
                Task: BGP_65539.203.0.113.9+56732
                Announcement bits (1): 0-KRT
                AS path: 65539 64508 I
                Accepted
                Route Label: 300112
                Localpref: 100
                Router ID: 213.0.113.99
```

show route extensive (Access Route)

user@host> **show route 203.0.113.102 extensive**

```
inet.0: 39256 destinations, 39258 routes (39255 active, 0 holddown, 1 hidden)
203.0.113.102/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 203.0.113.102/32 -> {192.0.2.2}
OSPF area : 0.0.0.0, LSA ID : 203.0.113.102, LSA type : Extern
        *Access Preference: 13
                Next-hop reference count: 78472
                Next hop: 192.0.2.2 via fe-0/0/0.0, selected
                State: <Active Int>
       Age: 12
                Task: RPD Unix Domain Server./var/run/rpd_serv.local
                Announcement bits (2): 0-KRT 1-OSPFv2
                AS path: I
```

user@host> **show route 2001:db8:4641:1::/48 extensive**

```
inet6.0: 75 destinations, 81 routes (75 active, 0 holddown, 0 hidden)
  2001:db8:4641:1::/48 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 2001:db8:4641:1::/48 -> {#0 0.13.1.0.0.1}
          *Access Preference: 13
                  Next hop type: Router, Next hop index: 74548
                  Address: 0x1638c1d8
                  Next-hop reference count: 6
                  Next hop: #0 0.13.1.0.0.1 via demux0.1073753267, selected
                  Session Id: 0x0
                  State: <Active Int>
                  Age: 4:17
                  Validation State: unverified
                  Task: RPD Unix Domain Server./var/run/rpd_serv.local
                  Announcement bits (2): 0-KRT 4-Resolve tree 2
                  AS path: I
2001:db8:4641:1::/128 (1 entry, 1 announced)
  TSI:
  KRT in-kernel 2001:db8:4641:1::/128 -> {#0 0.13.1.0.0.1}
          *Access-internal Preference: 12
                  Next hop type: Router, Next hop index: 74548
                  Address: 0x1638c1d8
                  Next-hop reference count: 6
                  Next hop: #0 0.13.1.0.0.1 via demux0.1073753267, selected
                  Session Id: 0x0
                  State: <Active Int>
                  Age: 4:17
```

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```
                Validation State: unverified
                Task: RPD Unix Domain Server./var/run/rpd_serv.local
                Announcement bits (2): 0-KRT 4-Resolve tree 2
                AS path: I
```

show route extensive (BGP PIC Edge)

user@host> **show route 198.51.100.6 extensive**

```
ed.inet.0: 6 destinations, 9 routes (6 active, 0 holddown, 0 hidden)
  198.51.100.6/32 (3 entries, 2 announced)
         State: <CalcForwarding>
  TSI:
  KRT in-kernel 198.51.100.6/32 -> {indirect(1048574), indirect(1048577)}
  Page 0 idx 0 Type 1 val 9219e30
      Nexthop: Self
      AS path: [2] 3 I
      Communities: target:2:1
  Path 198.51.100.6 from 198.51.100.4 Vector len 4.  Val: 0
..
          #Multipath Preference: 255
                Next hop type: Indirect
                Address: 0x93f4010
                Next-hop reference count: 2
..
                Protocol next hop: 198.51.1001.4
                Push 299824
                Indirect next hop: 944c000 1048574 INH Session ID: 0x3
                Indirect next hop: weight 0x1
                Protocol next hop: 198.51.100.5
                Push 299824
                Indirect next hop: 944c1d8 1048577 INH Session ID: 0x4
                Indirect next hop: weight 0x4000
                State: <ForwardingOnly Int Ext)>
                Inactive reason: Forwarding use only
                Age: 25         Metric2: 15
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: 3 I
                Communities: target:2:1
```

show route extensive (FRR and LFA)

user@host> **show route 203.0.113.20 extensive**

```
inet.0: 46 destinations, 49 routes (45 active, 0 holddown, 1 hidden)
203.0.113.20/24 (2 entries, 1 announced)
        State: FlashAll
TSI:
KRT in-kernel 203.0.113.20/24 -> {Push 299776, Push 299792}
        *RSVP   Preference: 7/1
                Next hop type: Router, Next hop index: 1048574
                Address: 0xbbbc010
                Next-hop reference count: 5
                Next hop: 203.0.113.112 via ge-2/1/8.0 weight 0x1, selected
                Label-switched-path europa-d-to-europa-e
                Label operation: Push 299776
                Label TTL action: prop-ttl
```


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```
                Session Id: 0x201
                Next hop: 203.0.113.122 via ge-2/1/4.0 weight 0x4001
                Label-switched-path europa-d-to-europa-e
                Label operation: Push 299792
                Label TTL action: prop-ttl
                Session Id: 0x202
                State: Active Int
                Local AS:   64500
                Age: 5:31  Metric: 2
                Task: RSVP
                Announcement bits (1): 0-KRT
                AS path: I
        OSPF    Preference: 10
                Next hop type: Router, Next hop index: 615
                Address: 0xb9d78c4
                Next-hop reference count: 7
                Next hop: 203.0.113.112 via ge-2/1/8.0, selected
                Session Id: 0x201
                State: Int
                Inactive reason: Route Preference
                Local AS:   64500
                Age: 5:35  Metric: 3
                Area: 0.0.0.0
                Task: OSPF
                AS path: I
```

show route extensive (IS-IS)

```
user@host> show route extensive
```

```
IS-IS Preference: 15
                Level: 1
                Next hop type: Router, Next hop index: 1048577
                Address: 0xXXXXXXXXXX
                Next-hop reference count: YY
                Next hop: 203.0.113.22 via ae1.0 balance 43%, selected
                Session Id: 0x141
                Next hop: 203.0.113.22 via ae0.0 balance 57%
```

show route extensive (Route Reflector)

```
user@host> show route extensive
```

```
203.0.113.0/8 (1 entry, 1 announced)

TSI:
KRT in-kernel 203.0.113.0/8 -> {indirect(40)}
        *BGP    Preference: 170/-101
                Source: 192.168.4.214
                Protocol next hop: 198.51.100.192 Indirect next hop: 84ac908 40
                State: <Active Int Ext>
                Local AS: 65548 Peer AS: 65548
                Age: 3:09       Metric: 0       Metric2: 0
                Task: BGP_65548.192.168.4.214+1033
                Announcement bits (2): 0-KRT 4-Resolve inet.0
                AS path: 65544 64507 I <Originator>
                Cluster list:  198.51.100.1
                Originator ID: 203.0.113.88
                Communities: 7777:7777
```

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```
                Localpref: 100
                Router ID: 203.0.113.4
                Indirect next hops: 1
                        Protocol next hop: 203.0.113.192 Metric: 0
                        Indirect next hop: 84ac908 40
                        Indirect path forwarding next hops: 0
                                Next hop type: Discard
```

show route label detail (Multipoint LDP Inband Signaling for Point-to-Multipoint LSPs)

```
user@host> show route label 299872 detail
```

```
mpls.0: 13 destinations, 13 routes (13 active, 0 holddown, 0 hidden)
299872 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Next-hop reference count: 3
                Address: 0x9097d90
                Next hop: via vt-0/1/0.1
                Next-hop index: 661
                Label operation: Pop
                Address: 0x9172130
                Next hop: via so-0/0/3.0
                Next-hop index: 654
                Label operation: Swap 299872
                State: **Active Int>
                Local AS:  64511
                Age: 8:20       Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
              FECs bound to route: P2MP root-addr 203.0.113.166, grp 203.0.113.1,
 src 192.168.142.2
```

show route label detail (Multipoint LDP with Multicast-Only Fast Reroute)

```
user@host> show route label 301568 detail
```

```
mpls.0: 18 destinations, 18 routes (18 active, 0 holddown, 0 hidden)
301568 (1 entry, 1 announced)
        *LDP    Preference: 9
                Next hop type: Flood
                Address: 0x2735208
                Next-hop reference count: 3
                Next hop type: Router, Next hop index: 1397
                Address: 0x2735d2c
                Next-hop reference count: 3
                Next hop: 203.0.113.82 via ge-1/2/22.0
                Label operation: Pop
                Load balance label:  None;
                Next hop type: Router, Next hop index: 1395
                Address: 0x2736290
                Next-hop reference count: 3
                Next hop: 203.0.113.2 via ge-1/2/18.0
                Label operation: Pop
                Load balance label:  None;
                State: <Active Int AckRequest MulticastRPF>
                Local AS:    64500
```


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```
                Age: 54:05      Metric: 1
                Validation State: unverified
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
               FECs bound to route: P2MP root-addr 198.51.100.1, grp: 203.0.113.1,
 src: 192.168.219.11
                Primary Upstream : 198.51.100.3:0--198.51.100.2:0
                   RPF Nexthops  :
                        ge-1/2/15.0, 10.2.94.1, Label: 301568, weight: 0x1
                        ge-1/2/14.0, 10.2.3.1, Label: 301568, weight: 0x1
                Backup Upstream : 198.51.100.3:0--198.51.100.6:0
                   RPF Nexthops :
                       ge-1/2/20.0, 198.51.100.96, Label: 301584, weight: 0xfffe

                       ge-1/2/19.0, 198.51.100.36, Label: 301584, weight: 0xfffe
```

show route extensive (Flexible VXLAN Tunnel Profile)

user@host> **show route 192.168.0.2 extensive**

```
...
CUSTOMER_0001.inet.0: 5618 destinations, 6018 routes (5618 active, 0 holddown, 0
 hidden)

192.168.0.2/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.0.2/32 -> {fti0.6 Flags NSR-incapable}
Opaque data client: FLEX-TNL
Address: 0xd00eee8
Opaque-data reference count: 2
Opaque data: Flexible IPv6 VXLAN tunnel profile
        *Static Preference: 5/100
                Next hop type: Router, Next hop index: 74781
                Address: 0x5d9b03cc
                Next-hop reference count: 363
                Next hop: via fti0.6, selected
                Session Id: 0x24c8
                State: <Active Int NSR-incapable OpaqueData Programmed>
                Age: 1:34:00
                Validation State: unverified
                        Tag: 10000001   Tag2: 1
                Announcement bits (2): 1-KRT 3-Resolve tree 30
                AS path: I
                Flexible IPv6 VXLAN tunnel profile
                    Action: Encapsulate
                    Interface: fti0.6 (Index: 10921)
                    VNI: 10000001
                    Source Prefix: 2001:db8:255::2/128
                    Source UDP Port Range: 54614 - 60074
                    Destination Address: 2001:db8:80:1:1:1:0:1
                    Destination UDP Port: 4790
                    VXLAN Flags: 0x08
...
```

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show route flow validation

List of Syntax
Syntax on page 1610
Syntax (EX Series Switches) on page 1610

Syntax

```
show route flow validation
<brief | detail>
<ip-prefix>
<table table-name>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route flow validation
<brief | detail>
<ip-prefix>
<table table-name>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display flow route information.

Options
none—Display flow route information.

brief | detail—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

ip-prefix—(Optional) IP address for the flow route.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

table *table-name*—(Optional) Display flow route information for all routing tables whose name begins with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route flow validation inet** command).

Required Privilege Level
view

List of Sample Output
show route flow validation on page 1611
show route flow validation (IPv6) on page 1611

Output Fields
Table 54 on page 1611 lists the output fields for the **show route flow validation** command. Output fields are listed in the approximate order in which they appear.

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Table 54: show route flow validation Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table (for example, inet.0).	All levels
prefix	Route address.	All levels
Active unicast route	Active route in the routing table.	All levels
Dependent flow destinations	Number of flows for which there are routes in the routing table.	All levels
Origin	Source of the route flow.	All levels
Neighbor AS	Autonomous system identifier of the neighbor.	All levels
Flow destination	Number of entries and number of destinations that match the route flow.	All levels
Unicast best match	Destination that is the best match for the route flow.	All levels
Flags	Information about the route flow.	All levels

Sample Output

show route flow validation

```
user@host> show route flow validation

inet.0:
10.0.5.0/24Active unicast route
Dependent flow destinations: 1
Origin: 192.168.224.218, Neighbor AS: 64501
Flow destination (3 entries, 1 match origin)
Unicast best match: 10.0.5.0/24
Flags: SubtreeApex Consistent
```

show route flow validation (IPv6)

```
user@host> show route flow validation

inet6.0:
2001:db8::11:11:11:0/120
                Active unicast route
                    Dependent flow destinations: 2
                    Origin: 2001:db8::13:14:2:2, Neighbor AS: 2000
2001:db8::11:11:11:10/128
                Flow destination (1 entries, 1 match origin, next-as)
                    Unicast best match: 2001:db8::11:11:11:0/120
                    Flags: Consistent
2001:db8::11:11:11:30/128
                Flow destination (1 entries, 1 match origin, next-as)
```

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```
                    Unicast best match: 2001:db8::11:11:11:0/120
                    Flags: Consistent
```


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show route forwarding-table

List of Syntax

Syntax on page 1613
Syntax (MX Series Routers) on page 1613
Syntax (TX Matrix and TX Matrix Plus Routers) on page 1613

Syntax

```
show route forwarding-table
<detail | extensive | summary>
<all>
<ccc interface-name>
<destination destination-prefix>
<family family | matching matching>
<interface-name interface-name>
<label name>
<matching matching>
<multicast>
<table (default | logical-system-name/routing-instance-name | routing-instance-name)>
<vlan (all | vlan-name)>
<vpn vpn>
```

Syntax (MX Series Routers)

```
show route forwarding-table
<detail | extensive | summary>
<all>
<bridge-domain (all | domain-name)>
<ccc interface-name>
<destination destination-prefix>
<family family | matching matching>
<interface-name interface-name>
<label name>
<learning-vlan-id learning-vlan-id>
<matching matching>
<multicast>
<table (default | logical-system-name/routing-instance-name | routing-instance-name)>
<vlan (all | vlan-name)>
<vpn vpn>
```

Syntax (TX Matrix and TX Matrix Plus Routers)

```
show route forwarding-table
<detail | extensive | summary>
<all>
<ccc interface-name>
<destination destination-prefix>
<family family | matching matching>
<interface-name interface-name>
<matching matching>
<label name>
<lcc number>
<multicast>
<table routing-instance-name>
<vpn vpn>
```

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Release Information Command introduced before Junos OS Release 7.4.
Option **bridge-domain** introduced in Junos OS Release 7.5
Option **learning-vlan-id** introduced in Junos OS Release 8.4
Options **all** and **vlan** introduced in Junos OS Release 9.6.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description Display the Routing Engine's forwarding table, including the network-layer prefixes and their next hops. This command is used to help verify that the routing protocol process has relayed the correction information to the forwarding table. The Routing Engine constructs and maintains one or more routing tables. From the routing tables, the Routing Engine derives a table of active routes, called the forwarding table.

NOTE: The Routing Engine copies the forwarding table to the Packet Forwarding Engine, the part of the router that is responsible for forwarding packets. To display the entries in the Packet Forwarding Engine's forwarding table, use the **show pfe route** command.

Options **none**—Display the routes in the forwarding tables. By default, the **show route forwarding-table** command does not display information about private, or internal, forwarding tables.

detail | extensive | summary—(Optional) Display the specified level of output.

all—(Optional) Display routing table entries for all forwarding tables, including private, or internal, tables.

bridge-domain (all | *bridge-domain-name*)—(MX Series routers only) (Optional) Display route entries for all bridge domains or the specified bridge domain.

ccc *interface-name*—(Optional) Display route entries for the specified circuit cross-connect interface.

destination *destination-prefix*—(Optional) Destination prefix.

family *family*—(Optional) Display routing table entries for the specified family: **bridge (ccc | destination | detail | extensive | interface-name | label | learning-vlan-id | matching | multicast | summary | table | vlan | vpn)**, **ethernet-switching**, **evpn**, **fibre-channel**, **fmembers**, **inet**, **inet6**, **iso**, **mcsnoop-inet**, **mcsnoop-inet6**, **mpls**, **satellite-inet**, **satellite-inet6**, **satellite-vpls**, **tnp**, **unix**, **vpls**, or **vlan-classification**.

interface-name *interface-name*—(Optional) Display routing table entries for the specified interface.

label *name*—(Optional) Display route entries for the specified label.

lcc *number*—(TX Matrix and TX matrix Plus routers only) (Optional) On a routing matrix composed of a TX Matrix router and T640 routers, display information for the

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specified T640 router (or line-card chassis) connected to the TX Matrix router. On a routing matrix composed of the TX Matrix Plus router and T1600 or T4000 routers, display information for the specified router (line-card chassis) connected to the TX Matrix Plus router.

Replace *number* with the following values depending on the LCC configuration:

- 0 through 3, when T640 routers are connected to a TX Matrix router in a routing matrix.
- 0 through 3, when T1600 routers are connected to a TX Matrix Plus router in a routing matrix.
- 0 through 7, when T1600 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.
- 0, 2, 4, or 6, when T4000 routers are connected to a TX Matrix Plus router with 3D SIBs in a routing matrix.

learning-vlan-id *learning-vlan-id*—(MX Series routers only) (Optional) Display learned information for all VLANs or for the specified VLAN.

matching *matching*—(Optional) Display routing table entries matching the specified prefix or prefix length.

multicast—(Optional) Display routing table entries for multicast routes.

table —(Optional) Display route entries for all the routing tables in the main routing instance or for the specified routing instance. If your device supports logical systems, you can also display route entries for the specified logical system and routing instance. To view the routing instances on your device, use the show route instance command.

vlan (all | *vlan-name*)—(Optional) Display information for all VLANs or for the specified VLAN.

vpn *vpn*—(Optional) Display routing table entries for a specified VPN.

Required Privilege Level view

List of Sample Output

show route forwarding-table on page 1620
show route forwarding-table detail on page 1621
show route forwarding-table destination extensive (Weights and Balances) on page 1621
show route forwarding-table extensive on page 1622
show route forwarding-table extensive (RPF) on page 1623
show route forwarding-table extensive (PIM using point-to-multipoint mode) on page 1624
show route forwarding-table (dynamic list next hop) on page 1624
show route forwarding-table family mpls on page 1625
show route forwarding-table family mpls ccc ge-0/0/1.1004 on page 1625
show route forwarding-table family vpls on page 1626

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show route forwarding-table vpls (Broadcast, unknown unicast, and multicast (BUM) hashing is enabled) on page 1626
show route forwarding-table vpls (Broadcast, unknown unicast, and multicast (BUM) hashing is enabled with MAC Statistics) on page 1626
show route forwarding-table family vpls extensive on page 1627
show route forwarding-table table default on page 1628
show route forwarding-table table logical-system-name/routing-instance-name on page 1629
show route forwarding-table vpn on page 1630

Output Fields Table 55 on page 1616 lists the output fields for the **show route forwarding-table** command. Output fields are listed in the approximate order in which they appear. Field names might be abbreviated (as shown in parentheses) when no level of output is specified, or when the **detail** keyword is used instead of the **extensive** keyword.

Table 55: show route forwarding-table Output Fields

Field Name	Field Description	Level of Output
Logical system	Name of the logical system. This field is displayed if you specify the **table** ***logical-system-name/routing-instance-name*** option on a device that is configured for and supports logical systems.	All levels
Routing table	Name of the routing table (for example, inet, inet6, mpls).	All levels

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Table 55: show route forwarding-table Output Fields (continued)

Field Name	Field Description	Level of Output
Enabled protocols	The features and protocols that have been enabled for a given routing table. This field can contain the following values: • BUM hashing—BUM hashing is enabled. • MAC Stats—Mac Statistics is enabled. • Bridging—Routing instance is a normal layer 2 bridge. • No VLAN—No VLANs are associated with the bridge domain. • All VLANs—The **vlan-id all** statement has been enabled for this bridge domain. • Single VLAN—Single VLAN ID is associated with the bridge domain. • MAC action drop—New MACs will be dropped when the MAC address limit is reached. • Dual VLAN—Dual VLAN tags are associated with the bridge domain • No local switching—No local switching is enabled for this routing instance.. • Learning disabled—Layer 2 learning is disabled for this routing instance. • MAC limit reached—The maximum number of MAC addresses that was configured for this routing instance has been reached. • VPLS—The VPLS protocol is enabled. • No IRB l2-copy—The no-irb-layer-2-copy feature is enabled for this routing instance. • ACKed by all peers—All peers have acknowledged this routing instance. • BUM Pruning—BUM pruning is enabled on the VPLS instance. • Def BD VXLAN—VXLAN is enabled for the default bridge domain. • EVPN—EVPN protocol is enabled for this routing instance. • Def BD OVSDB—Open vSwitch Database (OVSDB) is enabled on the default bridge domain. • Def BD Ingress replication—VXLAN ingress node replication is enabled on the default bridge domain. • L2 backhaul—Layer 2 backhaul is enabled. • FRR optimize—Fast reroute optimization • MAC pinning—MAC pinning is enabled for this bridge domain. • MAC Aging Timer—The MAC table aging time is set per routing instance. • EVPN VXLAN—This routing instance supports EVPN with VXLAN encapsulation. • PBBN—This routing instance is configured as a provider backbone bridged network. • PBN—This routing instance is configured as a provider bridge network. • ETREE—The ETREE protocol is enabled on this EVPN routing instance. • ARP/NDP suppression—EVPN ARP NDP suppression is enabled in this routing instance. • Def BD EVPN VXLAN—EVPN VXLAN is enabled for the default bridge domain. • MPLS control word—Control word is enabled for this MPLS routing instance.	All levels
Address family	Address family (for example, **IP**, **IPv6**, **ISO**, **MPLS**, and **VPLS**).	All levels
Destination	Destination of the route.	**detail extensive**

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Table 55: show route forwarding-table Output Fields (continued)

Field Name	Field Description	Level of Output
Route Type (Type)	How the route was placed into the forwarding table. When the **detail** keyword is used, the route type might be abbreviated (as shown in parentheses): • **cloned** (**clon**)—(TCP or multicast only) Cloned route. • **destination** (**dest**)—Remote addresses directly reachable through an interface. • **destination down** (**iddn**)—Destination route for which the interface is unreachable. • **interface cloned** (**ifcl**)—Cloned route for which the interface is unreachable. • **route down** (**ifdn**)—Interface route for which the interface is unreachable. • **ignore** (**ignr**)—Ignore this route. • **interface** (**intf**)—Installed as a result of configuring an interface. • **permanent** (**perm**)—Routes installed by the kernel when the routing table is initialized. • **user**—Routes installed by the routing protocol process or as a result of the configuration.	All levels
Route Reference (RtRef)	Number of routes to reference.	**detail extensive**
Flags	Route type flags: • **none**—No flags are enabled. • **accounting**—Route has accounting enabled. • **cached**—Cache route. • **incoming-iface** ***interface-number***—Check against incoming interface. • **prefix load balance**—Load balancing is enabled for this prefix. • **rt nh decoupled**—Route has been decoupled from the next hop to the destination. • **sent to PFE**—Route has been sent to the Packet Forwarding Engine. • **static**—Static route.	**extensive**
Next hop	IP address of the next hop to the destination. NOTE: For static routes that use point-to-point (P2P) outgoing interfaces, the next-hop address is not displayed in the output.	**detail extensive**

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Table 55: show route forwarding-table Output Fields (continued)

Field Name	Field Description	Level of Output
Next hop Type (Type)	Next-hop type. When the **detail** keyword is used, the next-hop type might be abbreviated (as indicated in parentheses): • **broadcast (bcst)**—Broadcast. • **deny**—Deny. • **discard (dscd)** —Discard. • **hold**—Next hop is waiting to be resolved into a unicast or multicast type. • **indexed (idxd)**—Indexed next hop. • **indirect (indr)**—Indirect next hop. • **local (locl)**—Local address on an interface. • **routed multicast (mcrt)**—Regular multicast next hop. • **multicast (mcst)**—Wire multicast next hop (limited to the LAN). • **multicast discard (mdsc)**—Multicast discard. • **multicast group (mgrp)**—Multicast group member. • **receive (recv)**—Receive. • **reject (rjct)**—Discard. An ICMP unreachable message was sent. • **resolve (rslv)**—Resolving the next hop. • **unicast (ucst)**—Unicast. • **unilist (ulst)**—List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.	**detail extensive**
Index	Software index of the next hop that is used to route the traffic for a given prefix.	**detail extensive** none
Route interface-index	Logical interface index from which the route is learned. For example, for interface routes, this is the logical interface index of the route itself. For static routes, this field is zero. For routes learned through routing protocols, this is the logical interface index from which the route is learned.	**extensive**
Reference (NhRef)	Number of routes that refer to this next hop.	**detail extensive** none
Next-hop interface (Netif)	Interface used to reach the next hop.	**detail extensive** none
Weight	Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible (see the **Balance** field description).	**extensive**
Balance	Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a router is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.	**extensive**
RPF interface	List of interfaces from which the prefix can be accepted. Reverse path forwarding (RPF) information is displayed only when **rpf-check** is configured on the interface.	**extensive**

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Sample Output

show route forwarding-table

```
user@host> show route forwarding-table
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    46     4
0.0.0.0/32         perm     0                    dscd    44     1
172.16.1.0/24         ifdn     0                    rslv   608     1 ge-2/0/1.0
172.16.1.0/32         iddn     0 172.16.1.0           recv   606     1 ge-2/0/1.0
172.16.1.1/32         user     0                    rjct    46     4
172.16.1.1/32         intf     0 172.16.1.1           locl   607     2
172.16.1.1/32         iddn     0 172.16.1.1           locl   607     2
172.16.1.255/32       iddn     0 ff:ff:ff:ff:ff:ff  bcst   605     1 ge-2/0/1.0
10.0.0.0/24        intf     0                    rslv   616     1 ge-2/0/0.0
10.0.0.0/32        dest     0 10.0.0.0           recv   614     1 ge-2/0/0.0
10.0.0.1/32        intf     0 10.0.0.1           locl   615     2
10.0.0.1/32        dest     0 10.0.0.1           locl   615     2
10.0.0.255/32      dest     0 10.0.0.255         bcst   613     1 ge-2/0/0.0
10.1.1.0/24        ifdn     0                    rslv   612     1 ge-2/0/1.0
10.1.1.0/32        iddn     0 10.1.1.0           recv   610     1 ge-2/0/1.0
10.1.1.1/32        user     0                    rjct    46     4
10.1.1.1/32        intf     0 10.1.1.1           locl   611     2
10.1.1.1/32        iddn     0 10.1.1.1           locl   611     2
10.1.1.255/32      iddn     0 ff:ff:ff:ff:ff:ff  bcst   609     1 ge-2/0/1.0
10.206.0.0/16      user     0 10.209.63.254      ucst   419    20 fxp0.0
10.209.0.0/16      user     1 0:12:1e:ca:98:0    ucst   419    20 fxp0.0
10.209.0.0/18      intf     0                    rslv   418     1 fxp0.0
10.209.0.0/32      dest     0 10.209.0.0         recv   416     1 fxp0.0
10.209.2.131/32    intf     0 10.209.2.131       locl   417     2
10.209.2.131/32    dest     0 10.209.2.131       locl   417     2
10.209.17.55/32    dest     0 0:30:48:5b:78:d2   ucst   435     1 fxp0.0
10.209.63.42/32    dest     0 0:23:7d:58:92:ca   ucst   434     1 fxp0.0
10.209.63.254/32   dest     0 0:12:1e:ca:98:0    ucst   419    20 fxp0.0
10.209.63.255/32   dest     0 10.209.63.255      bcst   415     1 fxp0.0
10.227.0.0/16      user     0 10.209.63.254      ucst   419    20 fxp0.0

...

Routing table: iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                   rjct    27     1
47.0005.80ff.f800.0000.0108.0003.0102.5524.5220.00
intf     0                   locl    28     1

Routing table: inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                   rjct     6     1
ff00::/8           perm     0                   mdsc     4     1
ff02::1/128        perm     0 ff02::1           mcst     3     1

Routing table: ccc
MPLS:
Interface.Label    Type RtRef Next hop           Type Index NhRef Netif
```


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```
default            perm     0                   rjct 16     1
100004(top)fe-0/0/1.0
```

show route forwarding-table detail

```
user@host> show route forwarding-table detail
```

```
Routing table: inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            user     2 0:90:69:8e:b1:1b   ucst   132     4 fxp0.0
default            perm     0                    rjct    14     1
10.1.1.0/24        intf     0 ff.3.0.21          ucst   322     1 so-5/3/0.0
10.1.1.0/32        dest     0 10.1.1.0           recv   324     1 so-5/3/0.0
10.1.1.1/32        intf     0 10.1.1.1           locl   321     1
10.1.1.255/32      dest     0 10.1.1.255         bcst   323     1 so-5/3/0.0
10.21.21.0/24      intf     0 ff.3.0.21          ucst   326     1 so-5/3/0.0
10.21.21.0/32      dest     0 10.21.21.0         recv   328     1 so-5/3/0.0
10.21.21.1/32      intf     0 10.21.21.1         locl   325     1
10.21.21.255/32    dest     0 10.21.21.255       bcst   327     1 so-5/3/0.0
127.0.0.1/32       intf     0 127.0.0.1          locl   320     1
172.17.28.19/32    clon     1 192.168.4.254      ucst   132     4 fxp0.0
172.17.28.44/32    clon     1 192.168.4.254      ucst   132     4 fxp0.0

...

Routing table: private1__.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    46     1
10.0.0.0/8         intf     0                    rslv   136     1 fxp1.0
10.0.0.0/32        dest     0 10.0.0.0           recv   134     1 fxp1.0
10.0.0.4/32        intf     0 10.0.0.4           locl   135     2
10.0.0.4/32        dest     0 10.0.0.4           locl   135     2

...

Routing table: iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    38     1

Routing table: inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    22     1
ff00::/8           perm     0                    mdsc    21     1
ff02::1/128        perm     0 ff02::1            mcst    17     1

...

Routing table: mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct 28     1
```

show route forwarding-table destination extensive (Weights and Balances)

```
user@host> show route forwarding-table destination 3.4.2.1 extensive
```

```
Routing table: inet [Index 0]
Internet:

Destination:  3.4.2.1/32
  Route type: user
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: unilist                Index: 262143   Reference: 1
  Nexthop: 172.16.4.4
  Next-hop type: unicast                Index: 335      Reference: 2
  Next-hop interface: so-1/1/0.0        Weight: 22      Balance: 3
  Nexthop: 145.12.1.2
  Next-hop type: unicast                Index: 337      Reference: 2
  Next-hop interface: so-0/1/2.0        Weight: 33      Balance: 33
```

show route forwarding-table extensive

```
user@host> show route forwarding-table extensive
Routing table: inet [Index 0]
Internet:

Destination:  default
  Route type: user
  Route reference: 2                    Route interface-index: 0
  Flags: sent to PFE
  Nexthop: 00:00:5E:00:53:1b
  Next-hop type: unicast                Index: 132      Reference: 4
  Next-hop interface: fxp0.0

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: none
  Next-hop type: reject                 Index: 14       Reference: 1

Destination:  127.0.0.1/32
  Route type: interface
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Nexthop: 127.0.0.1
  Next-hop type: local                  Index: 320      Reference: 1

...

Routing table: private1__.inet [Index 1]
Internet:

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                 Index: 46       Reference: 1

Destination:  10.0.0.0/8
  Route type: interface
  Route reference: 0                    Route interface-index: 3
  Flags: sent to PFE
  Next-hop type: resolve                Index: 136      Reference: 1
  Next-hop interface: fxp1.0
```


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```
...

Routing table: iso [Index 0]
ISO:

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                 Index: 38       Reference: 1

Routing table: inet6 [Index 0]
Internet6:

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                 Index: 22       Reference: 1

Destination:  ff00::/8
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: multicast discard      Index: 21       Reference: 1

...

Routing table: private1__.inet6 [Index 1]
Internet6:

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Next-hop type: reject                 Index: 54       Reference: 1

Destination:  fe80::2a0:a5ff:fe3d:375/128
  Route type: interface
  Route reference: 0                    Route interface-index: 0
  Flags: sent to PFE
  Nexthop: fe80::2a0:a5ff:fe3d:375
  Next-hop type: local                  Index: 75       Reference: 1

...
```

show route forwarding-table extensive (RPF)

The next example is based on the following configuration, which enables an RPF check on all routes that are learned from this interface, including the interface route:

```
so-1/1/0 {
    unit 0 {
        family inet {
            rpf-check;
            address 192.0.2.2/30;
        }
```

```
    }
}
```

```
user@host> show route forwarding-table extensive
```

```
Routing table: inet [Index 0]
Internet:
...
...
Destination:  192.0.2.3/32
  Route type: destination
  Route reference: 0                    Route interface-index: 67
  Flags: sent to PFE
  Nexthop: 192.0.2.3
  Next-hop type: broadcast              Index: 328      Reference: 1
  Next-hop interface: so-1/1/0.0
  RPF interface: so-1/1/0.0
```

show route forwarding-table extensive (PIM using point-to-multipoint mode)

```
user@host> show route forwarding-table extensive
```

```
Destination:  198.51.100.0/24
  Route type: user
  Route reference: 0                    Route interface-index: 335
  Multicast RPF nh index: 0
  P2mpidx: 0
  Flags: cached, check incoming interface , accounting, sent to PFE, rt nh
decoupled
  Next-hop type: indirect               Index: 1048575  Reference: 4
  Nexthop:
  Next-hop type: composite              Index: 627      Reference: 1
  Next-hop type: unicast                Index: 1048574  Reference: 2
  Next-hop interface: st0.1, 192.0.2.0
```

show route forwarding-table (dynamic list next hop)

The **show route forwarding table** output shows the two next hop elements for a multihomed EVPN destination.

```
user@host> show route forwarding-table label 299952 extensive
```

```
MPLS:

Destination:  299952
  Route type: user
  Route reference: 0                    Route interface-index: 0
  Multicast RPF nh index: 0
  P2mpidx: 0
  Flags: sent to PFE, rt nh decoupled
  Next-hop type: indirect               Index: 1048575  Reference: 2
  Nexthop:
  Next-hop type: composite              Index: 601      Reference: 2
  Next-hop type: indirect               Index: 1048574  Reference: 3
  Nexthop: 1.0.0.4
  Next-hop type: Push 301632, Push 299776(top) Index: 600 Reference: 2
  Load Balance Label: None
```


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```
  Next-hop interface: ge-0/0/1.0
  Next-hop type: indirect              Index: 1048577  Reference: 3
  Nexthop: 1.0.0.4
  Next-hop type: Push 301344, Push 299792(top) Index: 619 Reference: 2
  Load Balance Label: None
  Next-hop interface: ge-0/0/1.0
```

After one of the PE router has been disabled in the EVPN multihomed network, the same **show route forwarding table** output command shows one next hop element and one empty next hop element.

```
user@host> show route forwarding-table label 299952 extensive
```

```
Routing table: default.mpls [Index 0]
MPLS:

Destination:  299952
  Route type: user
  Route reference: 0                   Route interface-index: 0
  Multicast RPF nh index: 0
  P2mpidx: 0
  Flags: sent to PFE, rt nh decoupled
  Next-hop type: indirect              Index: 1048575  Reference: 2
  Nexthop:
  Next-hop type: composite             Index: 601      Reference: 2
  Next-hop type: indirect              Index: 1048577  Reference: 3
  Nexthop: 1.0.0.4
  Next-hop type: Push 301344, Push 299792(top) Index: 619 Reference: 2
  Load Balance Label: None
  Next-hop interface: ge-0/0/1.0
```

show route forwarding-table family mpls

```
user@host> show route forwarding-table family mpls
```

```
Routing table: mpls
MPLS:
Destination        Type RtRef Next hop          Type Index NhRef Netif
default            perm     0                   rjct    19     1
0                  user     0                   recv    18     3
1                  user     0                   recv    18     3
2                  user     0                   recv    18     3
100000             user     0 10.31.1.6         swap  100001     fe-1/1/0.0
800002             user     0                   Pop              vt-0/3/0.32770

vt-0/3/0.32770 (VPLS)
                   user     0                   indr   351     4
                                                Push 800000, Push 100002(top)
so-0/0/0.0
```

show route forwarding-table family mpls ccc ge-0/0/1.1004

```
user@host>show route forwarding-table mpls ccc ge-0/0/1.1004
```

```
Routing table: default.mpls
MPLS:
Destination        Type RtRef Next hop          Type  Index    NhRef Netif
ge-0/0/1.1004  (CCC) user     0                    ulst   1048577     2
                                                  comp       754         3
```

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```
                                                comp      755        3
                                               comp      756        3

Routing table: __mpls-oam__.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index    NhRef Netif
default            perm     0                    dscd      556     1
```

show route forwarding-table family vpls

```
user@host> show route forwarding-table family vpls
```

```
Routing table: green.vpls
VPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            dynm     0                    flood   353     1
default            perm     0                    rjct    298     1
fe-0/1/0.0         dynm     0                    flood   355     1
00:00:5E:00:53:1f/48              <<<<<Remote CE

                   dynm     0                    indr   351     4
                                                 Push 800000, Push 100002(top)
so-0/0/0.0
00:00:5E:00:53:1f/48              <<<<<<Local CE

                   dynm     0                    ucst   354     2 fe-0/1/0.0
```

show route forwarding-table vpls (Broadcast, unknown unicast, and multicast (BUM) hashing is enabled)

```
user@host> show route forwarding-table vpls
```

```
Routing table: green.vpls
VPLS:
Enabled protocols: BUM hashing
Destination        Type RtRef Next hop           Type Index    NhRef Netif
default            perm     0                    dscd      519     1
lsi.1048832        intf     0                    indr  1048574     4
                              172.16.3.2          Push 262145      621     2
ge-3/0/0.0
00:00:5E:00:53:01/48 user     0                  ucst      590     5 ge-2/3/9.0
0x30003/51         user     0                    comp      627     2
ge-2/3/9.0         intf     0                    ucst      590     5 ge-2/3/9.0
ge-3/1/3.0         intf     0                    ucst      619     4 ge-3/1/3.0
0x30002/51         user     0                    comp      600     2
0x30001/51         user     0                    comp      597     2
```

show route forwarding-table vpls (Broadcast, unknown unicast, and multicast (BUM) hashing is enabled with MAC Statistics)

```
user@host> show route forwarding-table vpls
```

```
Routing table: green.vpls
VPLS:
Enabled protocols: BUM hashing, MAC Stats
Destination        Type RtRef Next hop           Type Index    NhRef Netif
default            perm     0                    dscd      519     1
lsi.1048834        intf     0                    indr  1048574     4
                              172.16.3.2          Push 262145      592     2
```


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```
ge-3/0/0.0
00:19:e2:25:d0:01/48 user     0                    ucst      590     5 ge-2/3/9.0
0x30003/51           user     0                    comp      630     2
ge-2/3/9.0           intf     0                    ucst      590     5 ge-2/3/9.0
ge-3/1/3.0           intf     0                    ucst      591     4 ge-3/1/3.0
0x30002/51           user     0                    comp      627     2
0x30001/51           user     0                    comp      624     2
```

show route forwarding-table family vpls extensive

```
user@host> show route forwarding-table family vpls extensive
```

```
Routing table: green.vpls [Index 2]
VPLS:

Destination:  default
  Route type: dynamic
  Route reference: 0                    Route interface-index: 72
  Flags: sent to PFE
  Next-hop type: flood                  Index: 289      Reference: 1
  Next-hop type: unicast                Index: 291      Reference: 3
  Next-hop interface: fe-0/1/3.0
  Next-hop type: unicast                Index: 290      Reference: 3
  Next-hop interface: fe-0/1/2.0

Destination:  default
  Route type: permanent
  Route reference: 0                    Route interface-index: 0
  Flags: none
  Next-hop type: discard                Index: 341      Reference: 1

Destination:  fe-0/1/2.0
  Route type: dynamic
  Route reference: 0                    Route interface-index: 69
  Flags: sent to PFE
  Next-hop type: flood                  Index: 293      Reference: 1
  Next-hop type: indirect               Index: 363      Reference: 4
  Next-hop type: Push 800016
  Next-hop interface: at-1/0/1.0
  Next-hop type: indirect               Index: 301      Reference: 5
  Next hop: 10.31.3.2
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
  Next-hop type: unicast                Index: 291      Reference: 3
  Next-hop interface: fe-0/1/3.0

Destination:  fe-0/1/3.0
  Route type: dynamic
  Route reference: 0                    Route interface-index: 70
  Flags: sent to PFE
  Next-hop type: flood                  Index: 292      Reference: 1
  Next-hop type: indirect               Index: 363      Reference: 4
  Next-hop type: Push 800016
  Next-hop interface: at-1/0/1.0
  Next-hop type: indirect               Index: 301      Reference: 5
  Next hop: 10.31.3.2
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
  Next-hop type: unicast                Index: 290      Reference: 3
  Next-hop interface: fe-0/1/2.0
```

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```
Destination:  00:00:5E:00:53:01/48
  Route type: dynamic
  Route reference: 0                    Route interface-index: 70
  Flags: sent to PFE, prefix load balance
  Next-hop type: unicast                Index: 291      Reference: 3
  Next-hop interface: fe-0/1/3.0
  Route used as destination:
    Packet count:         6640    Byte count:      675786
  Route used as source
    Packet count:         6894    Byte count:      696424

Destination:  00:00:5E:00:53:04/48
  Route type: dynamic
  Route reference: 0                    Route interface-index: 69
  Flags: sent to PFE, prefix load balance
  Next-hop type: unicast                Index: 290      Reference: 3
  Next-hop interface: fe-0/1/2.0
  Route used as destination:
    Packet count:           96    Byte count:        8079
  Route used as source:
    Packet count:          296    Byte count:       24955

Destination:  00:00:5E:00:53:05/48
  Route type: dynamic
  Route reference: 0                    Route interface-index: 74
  Flags: sent to PFE, prefix load balance
  Next-hop type: indirect               Index: 301      Reference: 5
  Next hop: 10.31.3.2
  Next-hop type: Push 800000
  Next-hop interface: fe-0/1/1.0
```

show route forwarding-table table default

```
user@host> show route forwarding-table table default
```

```
Routing table: default.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    36     2
0.0.0.0/32         perm     0                    dscd    34     1
10.0.60.0/30       user     0 10.0.60.13         ucst   713     5 fe-0/1/3.0
10.0.60.12/30      intf     0                    rslv   688     1 fe-0/1/3.0
10.0.60.12/32      dest     0 10.0.60.12         recv   686     1 fe-0/1/3.0
10.0.60.13/32      dest     0 0:5:85:8b:bc:22    ucst   713     5 fe-0/1/3.0
10.0.60.14/32      intf     0 10.0.60.14         locl   687     2
10.0.60.14/32      dest     0 10.0.60.14         locl   687     2
10.0.60.15/32      dest     0 10.0.60.15         bcst   685     1 fe-0/1/3.0
10.0.67.12/30      user     0 10.0.60.13         ucst   713     5 fe-0/1/3.0
10.0.80.0/30       ifdn     0 ff.3.0.21          ucst   676     1 so-0/0/1.0
10.0.80.0/32       dest     0 10.0.80.0          recv   678     1 so-0/0/1.0
10.0.80.2/32       user     0                    rjct    36     2
10.0.80.2/32       intf     0 10.0.80.2          locl   675     1
10.0.80.3/32       dest     0 10.0.80.3          bcst   677     1 so-0/0/1.0
10.0.90.12/30      intf     0                    rslv   684     1 fe-0/1/0.0
10.0.90.12/32      dest     0 10.0.90.12         recv   682     1 fe-0/1/0.0
10.0.90.14/32      intf     0 10.0.90.14         locl   683     2
10.0.90.14/32      dest     0 10.0.90.14         locl   683     2
10.0.90.15/32      dest     0 10.0.90.15         bcst   681     1 fe-0/1/0.0
10.5.0.0/16        user     0 192.168.187.126    ucst   324    15 fxp0.0
```


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```
10.10.0.0/16       user     0 192.168.187.126    ucst   324    15 fxp0.0
10.13.10.0/23      user     0 192.168.187.126    ucst   324    15 fxp0.0
10.84.0.0/16       user     0 192.168.187.126    ucst   324    15 fxp0.0
10.150.0.0/16      user     0 192.168.187.126    ucst   324    15 fxp0.0
10.157.64.0/19     user     0 192.168.187.126    ucst   324    15 fxp0.0
10.209.0.0/16      user     0 192.168.187.126    ucst   324    15 fxp0.0

...

Routing table: default.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    60     1

Routing table: default.inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct    44     1
::/128             perm     0                    dscd    42     1
ff00::/8           perm     0                    mdsc    43     1
ff02::1/128        perm     0 ff02::1            mcst    39     1

Routing table: default.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    dscd    50     1
```

show route forwarding-table table logical-system-name/routing-instance-name

```
user@host> show route forwarding-table table R4/vpn-red
```

```
Logical system: R4
Routing table: vpn-red.inet
Internet:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   563     1
0.0.0.0/32         perm     0                    dscd   561     2
172.16.0.1/32         user     0                    dscd   561     2
172.16.2.0/24         intf     0                    rslv   771     1 ge-1/2/0.3
172.16.2.0/32        dest     0 172.16.2.0           recv   769     1 ge-1/2/0.3
172.16.2.1/32         intf     0 172.16.2.1           locl   770     2
172.16.2.1/32         dest     0 172.16.2.1           locl   770     2
172.16.2.2/32         dest     0 0.4.80.3.0.1b.c0.d5.e4.bd.0.1b.c0.d5.e4.bc.8.0
                                                    ucst   789     1 ge-1/2/0.3
172.16.2.255/32      dest     0 172.16.2.255         bcst   768     1 ge-1/2/0.3
172.16.233.0/4        perm     1                    mdsc   562     1
172.16.233.1/32       perm     0 172.16.233.1         mcst   558     1
255.255.255.255/32 perm     0                    bcst   559     1

Logical system: R4
Routing table: vpn-red.iso
ISO:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   608     1

Logical system: R4
Routing table: vpn-red.inet6
Internet6:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    rjct   708     1
```

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```
::/128             perm     0                    dscd   706     1
ff00::/8           perm     0                    mdsc   707     1
ff02::1/128        perm     0 ff02::1            mcst   704     1

Logical system: R4
Routing table: vpn-red.mpls
MPLS:
Destination        Type RtRef Next hop           Type Index NhRef Netif
default            perm     0                    dscd   638
```

show route forwarding-table vpn

```
user@host> show route forwarding-table vpn VPN-A
```

```
      Routing table:: VPN-A.inet
Internet:
      Destination        Type RtRef Nexthop           Type Index NhRef Netif
      default            perm     0                   rjct     4     4
      10.39.10.20/30     intf     0 ff.3.0.21         ucst    40     1
      so-0/0/0.0
      10.39.10.21/32     intf     0 10.39.10.21       locl    36     1
      10.255.14.172/32   user     0                   ucst    69     2
      so-0/0/0.0
      10.255.14.175/32   user     0                   indr    81     3
                                                      Push 100004, Push
      100004(top) so-1/0/0.0
      172.16.233.0/4        perm     2                   mdsc     5     3
      172.16.233.1/32       perm     0 172.16.233.1         mcst     1     8
      172.16.233.5/32       user     1 172.16.233.5         mcst     1     8
      255.255.255.255/32 perm     0                   bcst     2     3
```

On QFX5200, the results for this command look like this:

```
show route forwarding-table family mpls
```

```
Routing table: default.mpls
MPLS:
Destination Type RtRef Next hop Type Index NhRef Netif
default perm 0 dscd 65 1
0 user 0 recv 64 4
1 user 0 recv 64 4
2 user 0 recv 64 4
13 user 0 recv 64 4
300384 user 0 9.1.1.1 Pop 1711 2 xe-0/0/34.0
300384(S=0) user 0 9.1.1.1 Pop 1712 2 xe-0/0/34.0
300400 user 0 ulst 131071 2
                              10.1.1.2 Pop 1713 1 xe-0/0/38.0
                              172.16.11.2 Pop 1714 1 xe-0/0/40.0
300400(S=0) user 0 ulst 131072 2
                              10.1.1.2 Pop 1715 1 xe-0/0/38.0
                              172.16.11.2 Pop 1716 1 xe-0/0/40.0

Routing table: __mpls-oam__.mpls
MPLS:
Destination Type RtRef Next hop Type Index NhRef Netif
default perm 0 dscd 1681 1
```


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show route hidden

Syntax

```
show route hidden
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Release Information Command introduced before Junos OS Release 7.4.

Description Display only hidden route information. A hidden route is unusable, even if it is the best path.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level view

Related Documentation

- Understanding Hidden Routes on page 972

List of Sample Output

show route hidden on page 1631
show route hidden detail on page 1632
show route hidden extensive on page 1632
show route hidden terse on page 1633

Output Fields For information about output fields, see the output field table for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route hidden

```
user@host> show route hidden

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
127.0.0.1/32        [Direct/0] 04:26:38
                    > via lo0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
```

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```
10.5.5.5/32         [BGP/170] 03:44:10, localpref 100, from 10.4.4.4
                      AS path: 100 I
                      Unusable
10.12.1.0/24        [BGP/170] 03:44:10, localpref 100, from 10.4.4.4
                      AS path: 100 I
                      Unusable
10.12.80.4/30       [BGP/170] 03:44:10, localpref 100, from 10.4.4.4
                      AS path: I
                      Unusable
...
```

show route hidden detail

```
user@host> show route hidden detail

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
127.0.0.1/32 (1 entry, 0 announced)
         Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Hidden Martian Int>
                Local AS:     1
                Age: 4:27:37
                Task: IF
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete

10.5.5.5/32 (1 entry, 0 announced)
         BGP    Preference: 170/-101
                Route Distinguisher: 10.4.4.4:4
                Next hop type: Unusable
                Next-hop reference count: 6
                State: <Secondary Hidden Int Ext>
                Local AS:     1 Peer AS:     1
                Age: 3:45:09
                Task: BGP_1.10.4.4.4+2493
                AS path: 100 I
                Communities: target:1:999
                VPN Label: 100064
                Localpref: 100
                Router ID: 10.4.4.4
                Primary Routing Table bgp.l3vpn.0

...
```

show route hidden extensive

The output for the **show route hidden extensive** command is identical to that of the **show route hidden detail** command. For sample output, see show route hidden detail on page 1632.

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show route hidden terse

```
user@host> show route hidden terse

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  127.0.0.1/32       D   0                     >lo0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.5.5.5/32        B 170        100             Unusable        100 I
  10.12.1.0/24       B 170        100             Unusable        100 I
  10.12.80.4/30      B 170        100             Unusable        I

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

bgp.l3vpn.0: 3 destinations, 3 routes (0 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.4.4.4:4:10.5.5.5/32
                     B 170        100             Unusable        100 I
  10.4.4.4:4:10.12.1.0/24
                     B 170        100             Unusable        100 I
  10.4.4.4:4:10.12.80.4/30
                     B 170        100             Unusable        I

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

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show route inactive-path

List of Syntax
Syntax on page 1634
Syntax (EX Series Switches) on page 1634

Syntax

```
show route inactive-path
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route inactive-path
<brief | detail | extensive | terse>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display routes for destinations that have no active route. An inactive route is a route that was not selected as the best path.

Options
none—Display all inactive routes.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

Related Documentation
- show route active-path on page 1536

List of Sample Output
show route inactive-path on page 1634
show route inactive-path detail on page 1635
show route inactive-path extensive on page 1636
show route inactive-path terse on page 1636

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route inactive-path

```
user@host> show route inactive-path
```


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```
inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.12.100.12/30     [OSPF/10] 03:57:28, metric 1
                    > via so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.0/8          [Direct/0] 04:39:56
                    > via fxp1.0

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

10.12.80.0/30       [BGP/170] 04:38:17, localpref 100
                      AS path: 100 I
                    > to 10.12.80.1 via ge-6/3/2.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

bgp.l3vpn.0: 3 destinations, 3 routes (0 active, 0 holddown, 3 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route inactive-path detail

```
user@host> show route inactive-path detail
```

```
inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete

10.12.100.12/30 (2 entries, 1 announced)
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/3/0.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Local AS:     1
                Age: 3:58:24    Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

10.0.0.0/8 (2 entries, 0 announced)
         Direct Preference: 0
```

```
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via fxp1.0, selected
                State: <NotBest Int>
                Inactive reason: No difference
                Age: 4:40:52
                Task: IF
                AS path: I

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete

10.12.80.0/30 (2 entries, 1 announced)
         BGP    Preference: 170/-101
                Next-hop reference count: 6
                Source: 10.12.80.1
                Next hop: 10.12.80.1 via ge-6/3/2.0, selected
                State: <Ext>
                Inactive reason: Route Preference
                Peer AS:   100
                Age: 4:39:13
                Task: BGP_100.10.12.80.1+179
                AS path: 100 I
                Localpref: 100
                Router ID: 10.0.0.0
```

show route inactive-path extensive

The output for the **show route inactive-path extensive** command is identical to that of the **show route inactive-path detail** command. For sample output, see show route inactive-path detail on page 1635.

show route inactive-path terse

```
user@host> show route inactive-path terse


inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.12.100.12/30    O  10          1            >so-0/3/0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.0.0.0/8         D   0                     >fxp1.0

red.inet.0: 6 destinations, 8 routes (4 active, 0 holddown, 3 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  10.12.80.0/30      B 170        100            >10.12.80.1      100 I
```


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```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

bgp.l3vpn.0: 3 destinations, 3 routes (0 active, 0 holddown, 3 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

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show route inactive-prefix

List of Syntax
Syntax on page 1638
Syntax (EX Series Switches) on page 1638

Syntax

```
show route inactive-prefix
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route inactive-prefix
<brief | detail | extensive | terse>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display inactive route destinations in each routing table.

Options
none—Display all inactive route destination.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to brief.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show route inactive-prefix on page 1638
show route inactive-prefix detail on page 1639
show route inactive-prefix extensive on page 1639
show route inactive-prefix terse on page 1639

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route inactive-prefix

```
user@host> show route inactive-prefix

inet.0: 14 destinations, 14 routes (13 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
127.0.0.1/32        [Direct/0] 00:04:54
                    > via lo0.0
```

show route inactive-prefix detail

```
user@host> show route inactive-prefix detail

inet.0: 14 destinations, 14 routes (13 active, 0 holddown, 1 hidden)
127.0.0.1/32 (1 entry, 0 announced)
         Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via lo0.0, selected
                State: <Hidden Martian Int>
                Age: 4:51
                Task: IF
                AS path: I00:04:54
                    > via lo0.0
```

show route inactive-prefix extensive

The output for the **show route inactive-prefix extensive** command is identical to that of the **show route inactive-path detail** command. For sample output, see show route inactive-prefix detail on page 1639.

show route inactive-prefix terse

```
user@host> show route inactive-prefix terse

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  127.0.0.1/32       D   0                     >lo0.0
```

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show route instance

List of Syntax

Syntax on page 1640
Syntax (EX Series Switches and QFX Series) on page 1640

Syntax

```
show route instance
<brief | detail | summary>
<instance-name>
<logical-system (all | logical-system-name)>
<operational>
```

Syntax (EX Series Switches and QFX Series)

```
show route instance
<brief | detail | summary>
<instance-name>
<operational>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Command introduced in Junos OS Release 11.3 for the QFX Series.
Command introduced in Junos OS Release 14.1X53-D20 for the OCX Series.

Description

Display routing instance information.

Options

none—(Same as **brief**) Display standard information about all routing instances.

brief | detail | summary—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**. (These options are not available with the **operational** keyword.)

instance-name—(Optional) Display information for all routing instances whose name begins with this string (for example, **cust1**, **cust11**, and **cust111** are all displayed when you run the **show route instance cust1** command).

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

operational—(Optional) Display operational routing instances.

Required Privilege Level

view

Related Documentation

- *Example: Transporting IPv6 Traffic Across IPv4 Using Filter-Based Tunneling*
- *Example: Configuring the Helper Capability Mode for OSPFv3 Graceful Restart*

List of Sample Output

show route instance on page 1642
show route instance detail (Graceful Restart Complete) on page 1642

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show route instance detail (Graceful Restart Incomplete) on page 1644
show route instance detail (VPLS Routing Instance) on page 1646
show route instance operational on page 1646
show route instance summary on page 1646

Output Fields Table 56 on page 1641 lists the output fields for the **show route instance** command. Output fields are listed in the approximate order in which they appear.

Table 56: show route instance Output Fields

Field Name	Field Description	Level of Output
Instance or *instance-name*	Name of the routing instance.	All levels
Operational Routing Instances	(**operational** keyword only) Names of all operational routing instances.	—
Type	Type of routing instance: **forwarding**, **l2vpn**, **no-forwarding**, **vpls**, **virtual-router**, or **vrf**.	All levels
State	State of the routing instance: **active** or **inactive**.	**brief detail** none
Interfaces	Name of interfaces belonging to this routing instance.	**brief detail** none
Restart State	Status of graceful restart for this instance: **Pending** or **Complete**.	**detail**
Path selection timeout	Maximum amount of time, in seconds, remaining until graceful restart is declared complete. The default is **300**.	**detail**
Tables	Tables (and number of routes) associated with this routing instance.	**brief detail** none
Route-distinguisher	Unique route distinguisher associated with this routing instance.	**detail**
Vrf-import	VPN routing and forwarding instance import policy name.	**detail**
Vrf-export	VPN routing and forwarding instance export policy name.	**detail**
Vrf-import-target	VPN routing and forwarding instance import target community name.	**detail**
Vrf-export-target	VPN routing and forwarding instance export target community name.	**detail**
Vrf-edge-protection-id	Context identifier configured for edge-protection.	**detail**
Fast-reroute-priority	Fast reroute priority setting for a VPLS routing instance: **high**, **medium**, or **low**. The default is **low**.	**detail**
Restart State	Restart state: • **Pending:*protocol-name***—List of protocols that have not yet completed graceful restart for this routing table. • **Complete**—All protocols have restarted for this routing table.	**detail**

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Table 56: show route instance Output Fields (continued)

Field Name	Field Description	Level of Output
Primary rib	Primary table for this routing instance.	**brief** none **summary**
Active/holddown/hidden	Number of active, hold-down, and hidden routes.	All levels

Sample Output

show route instance

```
user@host> show route instance
Instance             Type
        Primary RIB                                  Active/holddown/hidden
master               forwarding
        inet.0                                       16/0/1
        iso.0                                        1/0/0
        mpls.0                                       0/0/0
        inet6.0                                      2/0/0
        l2circuit.0                                  0/0/0
__juniper_private1__ forwarding
        __juniper_private1__.inet.0                  12/0/0
        __juniper_private1__.inet6.0                 1/0/0
```

show route instance detail (Graceful Restart Complete)

```
user@host> show route instance detail
master:
  Router ID: 10.255.14.176
  Type: forwarding        State: Active
  Restart State: Complete Path selection timeout: 300
  Tables:
    inet.0                : 17 routes (15 active, 0 holddown, 1 hidden)
    Restart Complete
    inet.3                : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    iso.0                 : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
    mpls.0                : 19 routes (19 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l3vpn.0           : 10 routes (10 active, 0 holddown, 0 hidden)
    Restart Complete
    inet6.0               : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l2vpn.0           : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
BGP-INET:
  Router ID: 10.69.103.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.103
  Route-distinguisher: 10.255.14.176:103
  Vrf-import: [ BGP-INET-import ]
  Vrf-export: [ BGP-INET-export ]
```


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```
  Tables:
    BGP-INET.inet.0        : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
BGP-L:
  Router ID: 10.69.104.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.104
  Route-distinguisher: 10.255.14.176:104
  Vrf-import: [ BGP-L-import ]
  Vrf-export: [ BGP-L-export ]
  Tables:
    BGP-L.inet.0           : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
    BGP-L.mpls.0           : 3 routes (3 active, 0 holddown, 0 hidden)
    Restart Complete
L2VPN:
  Router ID: 0.0.0.0
  Type: l2vpn             State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.512
  Route-distinguisher: 10.255.14.176:512
  Vrf-import: [ L2VPN-import ]
  Vrf-export: [ L2VPN-export ]
  Tables:
    L2VPN.l2vpn.0          : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
LDP:
  Router ID: 10.69.105.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.105
  Route-distinguisher: 10.255.14.176:105
  Vrf-import: [ LDP-import ]
  Vrf-export: [ LDP-export ]
  Tables:
    LDP.inet.0             : 5 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
OSPF:
  Router ID: 10.69.101.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.101
  Route-distinguisher: 10.255.14.176:101
  Vrf-import: [ OSPF-import ]
  Vrf-export: [ OSPF-export ]
  Vrf-import-target: [ target:11111
  Tables:
    OSPF.inet.0            : 8 routes (7 active, 0 holddown, 0 hidden)
    Restart Complete
RIP:
  Router ID: 10.69.102.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.102
```

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```
  Route-distinguisher: 10.255.14.176:102
  Vrf-import: [ RIP-import ]
  Vrf-export: [ RIP-export ]
  Tables:
    RIP.inet.0             : 6 routes (6 active, 0 holddown, 0 hidden)
    Restart Complete
STATIC:
  Router ID: 10.69.100.1
  Type: vrf               State: Active
  Restart State: Complete Path selection timeout: 300
  Interfaces:
    t3-0/0/0.100
  Route-distinguisher: 10.255.14.176:100
  Vrf-import: [ STATIC-import ]
  Vrf-export: [ STATIC-export ]
  Tables:
    STATIC.inet.0          : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Complete
```

show route instance detail (Graceful Restart Incomplete)

```
user@host> show route instance detail
```

```
master:
  Router ID: 10.255.14.176
  Type: forwarding        State: Active
  Restart State: Pending  Path selection timeout: 300
  Tables:
    inet.0                 : 17 routes (15 active, 1 holddown, 1 hidden)
    Restart Pending: OSPF LDP
    inet.3                 : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: OSPF LDP
    iso.0                  : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Complete
    mpls.0                 : 23 routes (23 active, 0 holddown, 0 hidden)
    Restart Pending: LDP VPN
    bgp.l3vpn.0            : 10 routes (10 active, 0 holddown, 0 hidden)
    Restart Pending: BGP VPN
    inet6.0                : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Complete
    bgp.l2vpn.0            : 1 routes (1 active, 0 holddown, 0 hidden)
    Restart Pending: BGP VPN
BGP-INET:
  Router ID: 10.69.103.1
  Type: vrf               State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.103
  Route-distinguisher: 10.255.14.176:103
  Vrf-import: [ BGP-INET-import ]
  Vrf-export: [ BGP-INET-export ]
  Tables:
    BGP-INET.inet.0        : 6 routes (5 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
BGP-L:
  Router ID: 10.69.104.1
  Type: vrf               State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.104
```


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```
  Route-distinguisher: 10.255.14.176:104
  Vrf-import: [ BGP-L-import ]
  Vrf-export: [ BGP-L-export ]
  Tables:
    BGP-L.inet.0           : 6 routes (5 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
    BGP-L.mpls.0           : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
L2VPN:
  Router ID: 0.0.0.0
  Type: l2vpn              State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.512
  Route-distinguisher: 10.255.14.176:512
  Vrf-import: [ L2VPN-import ]
  Vrf-export: [ L2VPN-export ]
  Tables:
    L2VPN.l2vpn.0          : 2 routes (2 active, 0 holddown, 0 hidden)
    Restart Pending: VPN L2VPN
LDP:
  Router ID: 10.69.105.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.105
  Route-distinguisher: 10.255.14.176:105
  Vrf-import: [ LDP-import ]
  Vrf-export: [ LDP-export ]
  Tables:
    LDP.inet.0             : 5 routes (4 active, 1 holddown, 0 hidden)
    Restart Pending: OSPF LDP VPN
OSPF:
  Router ID: 10.69.101.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.101
  Route-distinguisher: 10.255.14.176:101
  Vrf-import: [ OSPF-import ]
  Vrf-export: [ OSPF-export ]
  Tables:
    OSPF.inet.0            : 8 routes (7 active, 1 holddown, 0 hidden)
    Restart Pending: OSPF VPN
RIP:
  Router ID: 10.69.102.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
  Interfaces:
    t3-0/0/0.102
  Route-distinguisher: 10.255.14.176:102
  Vrf-import: [ RIP-import ]
  Vrf-export: [ RIP-export ]
  Tables:
    RIP.inet.0             : 8 routes (6 active, 2 holddown, 0 hidden)
    Restart Pending: RIP VPN
STATIC:
  Router ID: 10.69.100.1
  Type: vrf                State: Active
  Restart State: Pending  Path selection timeout: 300
```

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```
  Interfaces:
    t3-0/0/0.100
  Route-distinguisher: 10.255.14.176:100
  Vrf-import: [ STATIC-import ]
  Vrf-export: [ STATIC-export ]
  Tables:
    STATIC.inet.0          : 4 routes (4 active, 0 holddown, 0 hidden)
    Restart Pending: VPN
```

show route instance detail (VPLS Routing Instance)

```
user@host> show route instance detail test-vpls
```

```
test-vpls:
  Router ID: 0.0.0.0
  Type: vpls              State: Active
  Interfaces:
    lsi.1048833
    lsi.1048832
    fe-0/1/0.513
  Route-distinguisher: 10.255.37.65:1
  Vrf-import: [ __vrf-import-test-vpls-internal__ ]
  Vrf-export: [ __vrf-export-test-vpls-internal__ ]
  Vrf-import-target: [ target:300:1 ]
  Vrf-export-target: [ target:300:1 ]
  Vrf-edge-protection-id:  166.1.3.1  Fast-reroute-priority: high
  Tables:
    test-vpls.l2vpn.0          : 3 routes (3 active, 0 holddown, 0 hidden)
```

show route instance operational

```
user@host> show route instance operational
```

```
Operational Routing Instances:

master
default
```

show route instance summary

```
user@host> show route instance summary
```

```
Instance           Type           Primary rib            Active/holddown/hidden
master             forwarding
                                  inet.0                 15/0/1
                                  iso.0                  1/0/0
                                  mpls.0                 35/0/0
                                  l3vpn.0                0/0/0
                                  inet6.0                2/0/0
                                  l2vpn.0                0/0/0
                                  l2circuit.0            0/0/0
BGP-INET           vrf
                                  BGP-INET.inet.0        5/0/0
                                  BGP-INET.iso.0         0/0/0
                                  BGP-INET.inet6.0       0/0/0
BGP-L              vrf
                                  BGP-L.inet.0           5/0/0
                                  BGP-L.iso.0            0/0/0
                                  BGP-L.mpls.0           4/0/0
```


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```
                                BGP-L.inet6.0           0/0/0
L2VPN               l2vpn
                                L2VPN.inet.0            0/0/0
                                L2VPN.iso.0             0/0/0
                                L2VPN.inet6.0           0/0/0
                                L2VPN.l2vpn.0           2/0/0
LDP                 vrf
                                LDP.inet.0              4/0/0
                                LDP.iso.0               0/0/0
                                LDP.mpls.0              0/0/0
                                LDP.inet6.0             0/0/0
                                LDP.l2circuit.0         0/0/0
OSPF                vrf
                                OSPF.inet.0             7/0/0
                                OSPF.iso.0              0/0/0
                                OSPF.inet6.0            0/0/0
RIP                 vrf
                                RIP.inet.0              6/0/0
                                RIP.iso.0               0/0/0
                                RIP.inet6.0             0/0/0
STATIC              vrf
                                STATIC.inet.0           4/0/0
                                STATIC.iso.0            0/0/0
                                STATIC.inet6.0          0/0/0
```

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show route next-hop

List of Syntax
Syntax on page 1648
Syntax (EX Series Switches) on page 1648

Syntax

```
show route next-hop next-hop
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route next-hop next-hop
<brief | detail | extensive | terse>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display the entries in the routing table that are being sent to the specified next-hop address.

Options
brief | detail | extensive | terse—(Optional) Display the specified level of ouput.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

next-hop—Next-hop address.

Required Privilege Level
view

List of Sample Output
show route next-hop on page 1648
show route next-hop detail on page 1649
show route next-hop extensive on page 1651
show route next-hop terse on page 1653

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route next-hop

```
user@host> show route next-hop 192.168.71.254

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both
```


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```
10.10.0.0/16       *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
10.209.0.0/16      *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
172.16.0.0/12      *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
192.168.0.0/16     *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
192.168.102.0/23   *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
207.17.136.0/24    *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0
207.17.136.192/32  *[Static/5] 06:26:25
                    > to 192.168.71.254 via fxp0.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop detail

```
user@host> show route next-hop 192.168.71.254 detail

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
Restart Complete
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I
```

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```
172.16.0.0/12 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

192.168.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

192.168.102.0/23 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

207.17.136.0/24 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

207.17.136.192/32 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 36
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:     1
                Age: 6:27:41
                Task: RT
                Announcement bits (3): 0-KRT 3-Resolve tree 1 5-Resolve tree 2
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete
```


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```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop extensive

```
user@host> show route next-hop 192.168.71.254 extensive

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.209.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

172.16.0.0/12 (1 entry, 1 announced)
TSI:
KRT in-kernel 172.16.0.0/12 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

192.168.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
```

```
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

192.168.102.0/23 (1 entry, 1 announced)
TSI:
KRT in-kernel 192.168.102.0/23 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

207.17.136.0/24 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.0/24 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

207.17.136.192/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 207.17.136.192/32 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:02:28
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

green.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```


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```
red.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route next-hop terse

```
user@host> show route next-hop 192.168.71.254 terse

inet.0: 25 destinations, 26 routes (24 active, 0 holddown, 1 hidden)
Restart Complete
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.10.0.0/16       S   5                     >192.168.71.254
* 10.209.0.0/16      S   5                     >192.168.71.254
* 172.16.0.0/12      S   5                     >192.168.71.254
* 192.168.0.0/16     S   5                     >192.168.71.254
* 192.168.102.0/23   S   5                     >192.168.71.254
* 207.17.136.0/24    S   5                     >192.168.71.254
* 207.17.136.192/32  S   5                     >192.168.71.254

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

red.inet.0: 4 destinations, 5 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Restart Complete

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Restart Complete
private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

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show route no-community

List of Syntax
Syntax on page 1654
Syntax (EX Series Switches) on page 1654

Syntax

```
show route no-community
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route no-community
<brief | detail | extensive | terse>
```

Release Information
Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description
Display the route entries in each routing table that are not associated with any community.

Options
none—(Same as **brief**) Display the route entries in each routing table that are not associated with any community.

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level
view

List of Sample Output
show route no-community on page 1654
show route no-community detail on page 1655
show route no-community extensive on page 1655
show route no-community terse on page 1656

Output Fields
For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route no-community

```
user@host> show route no-community

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.10.0.0/16       *[Static/5] 00:36:27
                    > to 192.168.71.254 via fxp0.0
```


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```
10.209.0.0/16      *[Static/5] 00:36:27
                    > to 192.168.71.254 via fxp0.0
10.255.71.52/32    *[Direct/0] 00:36:27
                    > via lo0.0
10.255.71.63/32    *[OSPF/10] 00:04:39, metric 1
                    > to 35.1.1.2 via ge-3/1/0.0
10.255.71.64/32    *[OSPF/10] 00:00:08, metric 2
                    > to 35.1.1.2 via ge-3/1/0.0
10.255.71.240/32   *[OSPF/10] 00:05:04, metric 2
                      via so-0/1/2.0
                    > via so-0/3/2.0
10.255.71.241/32   *[OSPF/10] 00:05:14, metric 1
                    > via so-0/1/2.0
10.255.71.242/32   *[OSPF/10] 00:05:19, metric 1
                    > via so-0/3/2.0
172.16.12.0/24       *[OSPF/10] 00:05:14, metric 2
                    > via so-0/3/2.0
172.16.14.0/24       *[OSPF/10] 00:00:08, metric 3
                    > to 35.1.1.2 via ge-3/1/0.0
                      via so-0/1/2.0
                      via so-0/3/2.0
172.16.16.0/24       *[OSPF/10] 00:05:14, metric 2
                    > via so-0/1/2.0
.....
```

show route no-community detail

```
user@host> show route no-community detail

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 38:08
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Age: 38:08
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I
....
```

show route no-community extensive

```
user@host> show route no-community extensive

inet.0: 18 destinations, 18 routes (17 active, 0 holddown, 1 hidden)
10.10.0.0/16 (1 entry, 1 announced)
```

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```
TSI:
KRT in-kernel 10.10.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:03:33
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.209.0.0/16 (1 entry, 1 announced)
TSI:
KRT in-kernel 10.209.0.0/16 -> {192.168.71.254}
        *Static Preference: 5
                Next-hop reference count: 22
                Next hop: 192.168.71.254 via fxp0.0, selected
                State: <Active NoReadvrt Int Ext>
                Local AS:    69
                Age: 2:03:33
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I
```

show route no-community terse

```
user@host> show route no-community terse

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.10.0.0/16       S   5                       >192.168.71.254
* 10.209.0.0/16      S   5                       >192.168.71.254
* 10.255.71.52/32    D   0                       >lo0.0
* 10.255.71.63/32    O  10          1            >35.1.1.2
* 10.255.71.64/32    O  10          2            >35.1.1.2
* 10.255.71.240/32   O  10          2             so-0/1/2.0
                                                 >so-0/3/2.0
* 10.255.71.241/32   O  10          1            >so-0/1/2.0
* 10.255.71.242/32   O  10          1            >so-0/3/2.0
* 172.16.12.0/24        O  10          2            >so-0/3/2.0
* 172.16.14.0/24        O  10          3            >35.1.1.2
                                                  so-0/1/2.0
                                                  so-0/3/2.0
* 172.16.16.0/24        O  10          2            >so-0/1/2.0
...
```


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show route output

List of Syntax

Syntax on page 1657
Syntax (EX Series Switches) on page 1657

Syntax

```
show route output (address ip-address | interface interface-name)
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route output (address ip-address | interface interface-name)
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the entries in the routing table learned through static routes and interior gateway protocols that are to be sent out the interface with either the specified IP address or specified name.

To view routes advertised to a neighbor or received from a neighbor for the BGP protocol, use the **show route advertising-protocol bgp** and **show route receive-protocol bgp** commands instead.

Options

address *ip-address*—Display entries in the routing table that are to be sent out the interface with the specified IP address.

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

interface *interface-name*—Display entries in the routing table that are to be sent out the interface with the specified name.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route output address on page 1658
show route output address detail on page 1658
show route output address extensive on page 1659
show route output address terse on page 1659
show route output interface on page 1659
show route output interface detail on page 1660
show route output interface extensive on page 1660
show route output interface terse on page 1660

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Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route output address

```
user@host> show route output address 172.16.36.1/24

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.36.0/24         *[Direct/0] 00:19:56
                      > via so-0/1/2.0
                      [OSPF/10] 00:19:55, metric 1
                      > via so-0/1/2.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route output address detail

```
user@host> show route output address 172.16.36.1 detail

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
172.16.36.0/24 (2 entries, 0 announced)
        *Direct Preference: 0
                Next hop type: Interface
                Next-hop reference count: 1
                Next hop: via so-0/1/2.0, selected
                State: <Active Int>
                Age: 23:00
                Task: IF
                AS path: I
         OSPF   Preference: 10
                Next-hop reference count: 1
                Next hop: via so-0/1/2.0, selected
                State: <Int>
                Inactive reason: Route Preference
                Age: 22:59      Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                AS path: I

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
```


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```
inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route output address extensive

The output for the **show route output address extensive** command is identical to that of the **show route output address detail** command. For sample output, see show route output address detail on page 1658.

show route output address terse

```
user@host> show route output address 172.16.36.1 terse

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 172.16.36.0/24       D   0                     >so-0/1/2.0
                      O  10          1           >so-0/1/2.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route output interface

```
user@host> show route output interface so-0/1/2.0

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.255.71.240/32   *[OSPF/10] 00:13:00, metric 2
                      via so-0/1/2.0
                    > via so-0/3/2.0
10.255.71.241/32   *[OSPF/10] 00:13:10, metric 1
                    > via so-0/1/2.0
172.16.14.0/24        *[OSPF/10] 00:05:11, metric 3
                      to 35.1.1.2 via ge-3/1/0.0
                    > via so-0/1/2.0
                      via so-0/3/2.0
172.16.16.0/24        *[OSPF/10] 00:13:10, metric 2
                    > via so-0/1/2.0
172.16.36.0/24        *[Direct/0] 00:13:21
                    > via so-0/1/2.0
                    [OSPF/10] 00:13:20, metric 1
                    > via so-0/1/2.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)
```

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```
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

show route output interface detail

```
user@host> show route output interface so-0/1/2.0 detail

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
10.255.71.240/32 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 2
                Next hop: via so-0/1/2.0
                Next hop: via so-0/3/2.0, selected
                State: <Active Int>
                Age: 14:52      Metric: 2
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (1): 0-KRT
                AS path: I

10.255.71.241/32 (1 entry, 1 announced)
        *OSPF   Preference: 10
                Next-hop reference count: 4
                Next hop: via so-0/1/2.0, selected
                State: <Active Int>
                Age: 15:02      Metric: 1
                Area: 0.0.0.0
                Task: OSPF
                Announcement bits (1): 0-KRT
                AS path: I
...
```

show route output interface extensive

The output for the **show route output interface extensive** command is identical to that of the **show route output interface detail** command. For sample output, see show route output interface detail on page 1660.

show route output interface terse

```
user@host> show route output interface so-0/1/2.0 terse

inet.0: 28 destinations, 30 routes (27 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* 10.255.71.240/32   O  10          2             so-0/1/2.0
                                                 >so-0/3/2.0
* 10.255.71.241/32   O  10          1            >so-0/1/2.0
* 172.16.14.0/24        O  10          3             35.1.1.2
```


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```
                                                >so-0/1/2.0
                                                 so-0/3/2.0
* 172.16.16.0/24        O  10          2           >so-0/1/2.0
* 172.16.36.0/24        D   0                      >so-0/1/2.0
                     O  10          1           >so-0/1/2.0

private1__.inet.0: 2 destinations, 3 routes (2 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

private1__.inet6.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```

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show route protocol

List of Syntax

Syntax on page 1662
Syntax (EX Series Switches) on page 1662

Syntax

```
show route protocol protocol
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route protocol protocol
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
ospf2 and **ospf3** options introduced in Junos OS Release 9.2.
ospf2 and **ospf3** options introduced in Junos OS Release 9.2 for EX Series switches.
flow option introduced in Junos OS Release 10.0.
flow option introduced in Junos OS Release 10.0 for EX Series switches.

Description

Display the route entries in the routing table that were learned from a particular protocol.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output. If you do not specify a level of output, the system defaults to **brief**.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

protocol—Protocol from which the route was learned:

- **access**—Access route for use by DHCP application
- **access-internal**—Access-internal route for use by DHCP application
- **aggregate**—Locally generated aggregate route
- **arp**—Route learned through the Address Resolution Protocol
- **atmvpn**—Asynchronous Transfer Mode virtual private network
- **bgp**—Border Gateway Protocol
- **ccc**—Circuit cross-connect
- **direct**—Directly connected route
- **dvmrp**—Distance Vector Multicast Routing Protocol
- **esis**—End System-to-Intermediate System
- **flow**—Locally defined flow-specification route
- **frr**—Precomputed protection route or backup route used when a link goes down

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- **isis**—Intermediate System-to-Intermediate System
- **ldp**—Label Distribution Protocol
- **l2circuit**—Layer 2 circuit
- **l2vpn**—Layer 2 virtual private network
- **local**—Local address
- **mpls**—Multiprotocol Label Switching
- **msdp**—Multicast Source Discovery Protocol
- **ospf**—Open Shortest Path First versions 2 and 3
- **ospf2**—Open Shortest Path First versions 2 only
- **ospf3**—Open Shortest Path First version 3 only
- **pim**—Protocol Independent Multicast
- **rip**—Routing Information Protocol
- **ripng**—Routing Information Protocol next generation
- **rsvp**—Resource Reservation Protocol
- **rtarget**—Local route target virtual private network
- **spring-te**—Traffic-engineered Source Packet Routing in Networking (SPRING) or segment routing
- **static**—Statically defined route
- **tunnel**—Dynamic tunnel
- **vpn**—Virtual private network

NOTE: EX Series switches run a subset of these protocols. See the switch CLI for details.

Required Privilege Level view

List of Sample Output

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Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

show route protocol access

```
user@host> show route protocol access

inet.0: 30380 destinations, 30382 routes (30379 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

13.160.0.3/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
13.160.0.4/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
13.160.0.5/32      *[Access/13] 00:00:09
                    > to 13.160.0.2 via fe-0/0/0.0
```

show route protocol access-internal extensive

```
user@host> show route protocol access-internal 13.160.0.19 extensive

inet.0: 100020 destinations, 100022 routes (100019 active, 0 holddown, 1 hidden)
13.160.0.19/32 (1 entry, 1 announced)
TSI:
KRT in-kernel 13.160.0.19/32 -> {13.160.0.2}
        *Access-internal Preference: 12
                Next-hop reference count: 200000
                Next hop: 13.160.0.2 via fe-0/0/0.0, selected
                State: <Active Int>
      Age: 36
                Task: RPD Unix Domain Server./var/run/rpd_serv.local
                Announcement bits (1): 0-KRT
                AS path: I
```

show route protocol arp

```
user@host> show route protocol arp
```


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```
inet.0: 43 destinations, 43 routes (42 active, 0 holddown, 1 hidden)

inet.3: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

cust1.inet.0: 1033 destinations, 2043 routes (1033 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

20.20.1.3/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.4/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.5/32        [ARP/4294967293] 00:04:32, from 20.20.1.1
                      Unusable
20.20.1.6/32        [ARP/4294967293] 00:04:34, from 20.20.1.1
                      Unusable
20.20.1.7/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.8/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.9/32        [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.10/32       [ARP/4294967293] 00:04:35, from 20.20.1.1
                      Unusable
20.20.1.11/32       [ARP/4294967293] 00:04:33, from 20.20.1.1
                      Unusable
20.20.1.12/32       [ARP/4294967293] 00:04:33, from 20.20.1.1
                      Unusable
20.20.1.13/32       [ARP/4294967293] 00:04:33, from 20.20.1.1
                      Unusable
...
```

show route protocol bgp

```
user@host> show route protocol bgp 192.168.64.0/21
```

```
inet.0: 335832 destinations, 335833 routes (335383 active, 0 holddown, 450 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.64.0/21       *[BGP/170] 6d 10:41:16, localpref 100, from 192.168.69.71
                      AS path: 10458 14203 2914 4788 4788 I
                    > to 192.168.167.254 via fxp0.0
```

show route protocol bgp detail

```
user@host> show route protocol bgp 66.117.63.0/24 detail
```

```
inet.0: 335805 destinations, 335806 routes (335356 active, 0 holddown, 450 hidden)
66.117.63.0/24  (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 1006436
                Source: 192.168.69.71
                Next hop type: Router, Next hop index: 324
                Next hop: 192.168.167.254 via fxp0.0, selected
                Protocol next hop: 192.168.69.71
                Indirect next hop: 8e166c0 342
                State: <Active Ext>
                Local AS:    69 Peer AS: 10458
                Age: 6d 10:42:42        Metric2: 0
```

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```
                Task: BGP_10458.192.168.69.71+179
                Announcement bits (3): 0-KRT 2-BGP RT Background 3-Resolve tree
1
                AS path: 10458 14203 2914 4788 4788 I
                Communities: 2914:410 2914:2403 2914:3400
                Accepted
                Localpref: 100
                Router ID: 207.17.136.192
```

show route protocol bgp detail (Labeled Unicast)

```
user@host> show route protocol bgp 1.1.1.8/32 detail
inet.0: 45 destinations, 46 routes (45 active, 0 holddown, 0 hidden)
1.1.1.8/32 (2 entries, 2 announced)
State:
*BGP Preference: 1/-101
Next hop type: Indirect, Next hop index: 0
Address: 0xc007f30
Next-hop reference count: 2
Source: 1.1.1.1
Next hop type: Router, Next hop index: 614
Next hop: 20.1.1.2 via ge-0/0/1.0, selected
Label-switched-path lsp1
Label operation: Push 1000126, Push 1000125, Push 1000124, Push 1000123, Push
299872(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl, prop-ttl, prop-ttl(top)
Load balance label: Label 1000126: None; Label 1000125: None; Label 1000124: None;
 Label 1000123: None; Label 299872: None;
Label element ptr: 0xc007860
Label parent element ptr: 0xc0089a0
Label element references: 1
Label element child references: 0
Label element lsp id: 0
Session Id: 0x140
Protocol next hop: 1.1.1.4
Label operation: Push 1000126, Push 1000125, Push 1000124, Push 1000123(top)
Label TTL action: prop-ttl, prop-ttl, prop-ttl, prop-ttl
Load balance label: Label 1000126: None; Label 1000125: None; Label 1000124: None;
 Label 1000123: None;
Indirect next hop: 0xae8d300 1048576 INH Session ID: 0x142
State:
Local AS: 5 Peer AS: 5
Age: 22:43 Metric2: 2
Validation State: unverified
Task: BGP_5.1.1.1.1
Announcement bits (2): 0-KRT 7-Resolve tree 2
AS path: I
Accepted
Route Labels: 1000123(top) 1000124 1000125 1000126
Localpref: 100
Router ID: 1.1.1.1
```

show route protocol bgp detail (Aggregate Extended Community Bandwidth)

```
user@host> show route 10.0.2.0 protocol bgp detail
inet.0: 20 destinations, 26 routes (20 active, 0 holddown, 0 hidden)
10.0.2.0/30 (2 entries, 1 announced)
```


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```
       *BGP    Preference: 170/-101
               Next hop type: Router, Next hop index: 0
               Address: 0xb618990
               Next-hop reference count: 3
               Source: 10.0.1.1
               Next hop: 10.0.0.2 via ge-0/0/0.0 balance 40%
               Session Id: 0x0
               Next hop: 10.0.1.1 via ge-0/0/1.0 balance 60%, selected
               Session Id: 0x0
               State: <Active Ext>
               Local AS: 65000 Peer AS: 65001
               Age: 20:33
               Validation State: unverified
               Task: BGP_65001.10.0.1.1
               Announcement bits (3): 0-KRT 2-BGP_Listen.0.0.0.0+179
3-BGP_RT_Background
               AS path: 65001 I
               Communities: bandwidth:65000:60000000
         Accepted Multipath
               Localpref: 100
               Router ID: 128.49.121.137
        BGP    Preference: 170/-101
               Next hop type: Router, Next hop index: 595
               Address: 0xb7a1330
               Next-hop reference count: 9
               Source: 10.0.0.2
               Next hop: 10.0.0.2 via ge-0/0/0.0, selected
               Session Id: 0x141
               State: <NotBest Ext>
               Inactive reason: Not Best in its group - Active preferred
               Local AS: 65000 Peer AS: 65001
               Age: 20:33
               Validation State: unverified
               Task: BGP_65001.10.0.0.2
               AS path: 65001 I
               Communities: bandwidth:65000:40000000
               Accepted MultipathContrib
               Localpref: 100
               Router ID: 128.49.121.132
```

show route protocol bgp extensive

```
user@host> show route protocol bgp 192.168.64.0/21 extensive

inet.0: 335827 destinations, 335828 routes (335378 active, 0 holddown, 450 hidden)
192.168.64.0/21 (1 entry, 1 announced)
TSI:
KRT in-kernel 1.9.0.0/16 -> {indirect(342)}
Page 0 idx 1 Type 1 val db31a80
    Nexthop: Self
    AS path: [69] 10458 14203 2914 4788 4788 I
    Communities: 2914:410 2914:2403 2914:3400
Path 1.9.0.0 from 192.168.69.71 Vector len 4.  Val: 1
        *BGP    Preference: 170/-101
                Next hop type: Indirect
                Next-hop reference count: 1006502
                Source: 192.168.69.71
                Next hop type: Router, Next hop index: 324
                Next hop: 192.168.167.254 via fxp0.0, selected
```

```
                Protocol next hop: 192.168.69.71
                Indirect next hop: 8e166c0 342
                State: <Active Ext>
                Local AS:    69 Peer AS: 10458
                Age: 6d 10:44:45        Metric2: 0
                Task: BGP_10458.192.168.69.71+179
                Announcement bits (3): 0-KRT 2-BGP RT Background 3-Resolve tree
1
                AS path: 10458 14203 2914 4788 4788 I
                Communities: 2914:410 2914:2403 2914:3400
                Accepted
                Localpref: 100
                Router ID: 207.17.136.192
                Indirect next hops: 1
                        Protocol next hop: 192.168.69.71
                        Indirect next hop: 8e166c0 342
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 192.168.167.254 via fxp0.0
                        192.168.0.0/16 Originating RIB: inet.0
                          Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 192.168.167.254 via fxp0.0
```

show route protocol bgp terse

```
user@host> show route protocol bgp 192.168.64.0/21 terse

inet.0: 24 destinations, 32 routes (23 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

A Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
  192.168.64.0/21    B 170        100            >172.16.100.1    10023 21 I
```

show route protocol direct

```
user@host> show route protocol direct

inet.0: 335843 destinations, 335844 routes (335394 active, 0 holddown, 450 hidden)
+ = Active Route, - = Last Active, * = Both

172.16.8.0/24         *[Direct/0] 17w0d 10:31:49
                       > via fe-1/3/1.0
10.255.165.1/32     *[Direct/0] 25w4d 04:13:18
                       > via lo0.0
172.16.30.0/24       *[Direct/0] 17w0d 23:06:26
                       > via fe-1/3/2.0
192.168.164.0/22    *[Direct/0] 25w4d 04:13:20
                       > via fxp0.0

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

47.0005.80ff.f800.0000.0108.0001.0102.5516.5001/152
                    *[Direct/0] 25w4d 04:13:21
                       > via lo0.0
```


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```
inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2001:db8::10:255:165:1/128
                   *[Direct/0] 25w4d 04:13:21
                    > via lo0.0
fe80::2a0:a5ff:fe12:ad7/128
                   *[Direct/0] 25w4d 04:13:21
                    > via lo0.0
```

show route protocol frr

```
user@host> show route protocol frr
```

```
inet.0: 43 destinations, 43 routes (42 active, 0 holddown, 1 hidden)

inet.3: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

cust1.inet.0: 1033 destinations, 2043 routes (1033 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

20.20.1.3/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.3 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.4/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.4 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.5/32       *[FRR/200] 00:05:35, from 20.20.1.1
                    > to 20.20.1.5 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.6/32       *[FRR/200] 00:05:37, from 20.20.1.1
                    > to 20.20.1.6 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.7/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.7 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.8/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.8 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.9/32       *[FRR/200] 00:05:38, from 20.20.1.1
                    > to 20.20.1.9 via ge-4/1/0.0
                      to 10.10.15.1 via ge-0/2/4.0, Push 16, Push 299792(top)
20.20.1.10/32      *[FRR/200] 00:05:38, from 20.20.1.1
...
```

show route protocol l2circuit detail

```
user@host> show route protocol l2circuit detail
```

```

mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
100000 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via ge-2/0/0.0, selected
                Label operation: Pop       Offset: 4
                State: <Active Int>
                Local AS:    99
                Age: 9:52
                Task: Common L2 VC
```

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```
                Announcement bits (1): 0-KRT
                AS path: I

ge-2/0/0.0 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000, Push 100000(top)[0] Offset: -4
                Protocol next hop: 10.245.255.63
                Push 100000 Offset: -4
                 Indirect next hop: 86af0c0 298
                State: <Active Int>
                Local AS:    99
                Age: 9:52
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I

l2circuit.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

10.245.255.63:CtrlWord:4:3:Local/96 (1 entry, 1 announced)
        *L2CKT  Preference: 7
                Next hop: via so-1/1/2.0 weight 1, selected
                Label-switched-path my-lsp
                Label operation: Push 100000[0]
                Protocol next hop: 10.245.255.63 Indirect next hop: 86af000 296
                State: <Active Int>
                Local AS:    99
                Age: 10:21
                Task: l2 circuit
                Announcement bits (1): 0-LDP
                AS path: I
                VC Label 100000, MTU 1500, VLAN ID 512
```

show route protocol l2vpn extensive

```
user@host> show route protocol l2vpn extensive

inet.0: 14 destinations, 15 routes (13 active, 0 holddown, 1 hidden)

inet.3: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 7 destinations, 7 routes (7 active, 0 holddown, 0 hidden)
800001 (1 entry, 1 announced)
TSI:
KRT in-kernel 800001 /36 -> {so-0/0/0.0}
        *L2VPN  Preference: 7
                Next hop: via so-0/0/0.0 weight 49087 balance 97%, selected
                Label operation: Pop       Offset: 4
                State: <Active Int>
                Local AS:    69
                Age: 7:48
                Task: Common L2 VC
                Announcement bits (1): 0-KRT
                AS path: I

so-0/0/0.0 (1 entry, 1 announced)
```


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```
TSI:
KRT in-kernel so-0/0/0.0.0      /16 -> {indirect(288)}
        *L2VPN  Preference: 7
                Next hop: via so-0/0/1.0, selected
                Label operation: Push 800000 Offset: -4
                Protocol next hop: 10.255.14.220
                Push 800000 Offset: -4
                 Indirect next hop: 85142a0 288
                State: <Active Int>
                Local AS:    69
                Age: 7:48
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 1-Common L2 VC
                AS path: I
                Communities: target:69:1 Layer2-info: encaps:PPP,
                control flags:2, mtu: 0
```

show route protocol ldp

```
user@host> show route protocol ldp
inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)

inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.16.1/32    *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Push 100000
192.168.17.1/32    *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0

private1__.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100064             *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Pop
100064(S=0)        *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Pop
100080             *[LDP/9] 1d 23:03:35, metric 1
                    > via t1-4/0/0.0, Swap 100000
```

show route protocol ldp extensive

```
user@host> show route protocol ldp extensive
192.168.16.1/32 (1 entry, 1 announced)
        State: <FlashAll>
        *LDP    Preference: 9
                Next-hop reference count: 3
                Next hop: via t1-4/0/0.0, selected
                Label operation: Push 100000
                State: <Active Int>
                Local AS: 64500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (2): 0-Resolve tree 1 2-Resolve tree 2
                AS path: I
```

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```
192.168.17.1/32 (1 entry, 1 announced)
        State: <FlashAll>
        *LDP    Preference: 9
                Next-hop reference count: 3
                Next hop: via t1-4/0/0.0, selected
                State: <Active Int>
                Local AS: 64500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (2): 0-Resolve tree 1 2-Resolve tree 2
                AS path: I

private1__.inet.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

mpls.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)

100064 (1 entry, 1 announced)
TSI:
KRT in-kernel 100064 /36 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                State: <Active Int>
                Local AS: 64500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 192.168.17.1/32

100064(S=0) (1 entry, 1 announced)
TSI:
KRT in-kernel 100064 /40 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                Label operation: Pop
                State: <Active Int>
                Local AS: 64500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I

100080 (1 entry, 1 announced)
TSI:
KRT in-kernel 100080 /36 -> {t1-4/0/0.0}
        *LDP    Preference: 9
                Next-hop reference count: 2
                Next hop: via t1-4/0/0.0, selected
                Label operation: Swap 100000
                State: <Active Int>
                Local AS: 64500
                Age: 1d 23:03:58        Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 192.168.16.1/32
```


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show route protocol ospf (Layer 3 VPN)

```
user@host> show route protocol ospf
inet.0: 40 destinations, 40 routes (39 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.4/30       *[OSPF/10] 00:05:18, metric 4
                    > via t3-3/2/0.0
10.39.1.8/30        [OSPF/10] 00:05:18, metric 2
                    > via t3-3/2/0.0
10.255.14.171/32   *[OSPF/10] 00:05:18, metric 4
                    > via t3-3/2/0.0
10.255.14.179/32   *[OSPF/10] 00:05:18, metric 2
                    > via t3-3/2/0.0
172.16.233.5/32       *[OSPF/10] 20:25:55, metric 1

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.16/30       [OSPF/10] 00:05:43, metric 1
                    > via so-0/2/2.0
10.255.14.173/32   *[OSPF/10] 00:05:43, metric 1
                    > via so-0/2/2.0
172.16.233.5/32       *[OSPF/10] 20:26:20, metric 1
```

show route protocol ospf detail

```
user@host> show route protocol ospf detail
VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.39.1.16/30 (2 entries, 0 announced)
        OSPF   Preference:  10
               Nexthop: via so-0/2/2.0, selected
               State: <Int>
               Inactive reason: Route Preference
               Age: 6:25       Metric: 1
               Area: 0.0.0.0
               Task: VPN-AB-OSPF
               AS path: I
               Communities: Route-Type:0.0.0.0:1:0

...
```

show route protocol rip

```
user@host> show route protocol rip
inet.0: 26 destinations, 27 routes (25 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
10.255.14.177/32   *[RIP/100] 20:24:34, metric 2
                    > to 10.39.1.22 via t3-0/2/2.0
172.16.233.9/32       *[RIP/100] 00:03:59, metric 1
```

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show route protocol rip detail

```
user@host> show route protocol rip detail
```

```
inet.0: 26 destinations, 27 routes (25 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

VPN-AB.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
10.255.14.177/32 (1 entry, 1 announced)
        *RIP    Preference: 100
                Nexthop: 10.39.1.22 via t3-0/2/2.0, selected
                State: <Active Int>
                Age: 20:25:02   Metric: 2
                Task: VPN-AB-RIPv2
                Announcement bits (2): 0-KRT 2-BGP.0.0.0.0+179
                AS path: I
                Route learned from 10.39.1.22 expires in 96 seconds
```

show route protocol ripng table inet6

```
user@host> show route protocol ripng table inet6
```

```
inet6.0: 4215 destinations, 4215 routes (4214 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

1111::1/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::2/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::3/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::4/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::5/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
1111::6/128        *[RIPng/100] 02:13:33, metric 2
                    > to fe80::2a0:a5ff:fe3d:56 via t3-0/2/0.0
```

show route protocol spring-te

```
user@host> show route protocol spring-te
```

```
inet.3: 26 destinations, 28 routes (25 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

202.3.0.3/32       *[SPRING-TE/8] 00:03:32, metric 1, metric2 10
                      to 10.0.100.2 via et-0/0/9:0.0, Push 50031, Push 50021(top)

                   >  to 10.1.100.2 via et-0/0/9:1.0, Push 50031, Push 50021(top)

202.4.0.4/32       *[SPRING-TE/8] 00:03:32, metric 1, metric2 10
                   >  to 20.0.100.2 via et-0/0/5:0.0, Push 50041, Push 50011(top)

                       to 30.1.100.2 via et-0/0/3:0.0, Push 50041, Push 50011,
Push 50021(top)

inetcolor.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
202.3.0.3-2111/64
        *[SPRING-TE/8] 00:02:34, metric 1, metric2 10
                      to 10.0.100.2 via et-0/0/9:0.0, Push 50031, Push 50021(top)

                    >  to 10.1.100.2 via et-0/0/9:1.0, Push 50031, Push 50021(top)

202.3.0.3-1234/64
                     *[SPRING-TE/8] 00:02:34, metric 1, metric2 10
                      to 10.0.100.2 via et-0/0/9:0.0, Push 50031, Push 50021(top)

                    >  to 10.1.100.2 via et-0/0/9:1.0, Push 50031, Push 50021(top)
```

show route protocol static detail

```
user@host> show route protocol static detail
```

```
inet.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
10.5.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.10.0.0/16 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I

10.13.10.0/23 (1 entry, 1 announced)
        *Static Preference: 5
                Next hop type: Router, Next hop index: 324
                Address: 0x9274010
                Next-hop reference count: 27
                Next hop: 192.168.187.126 via fxp0.0, selected
                Session Id: 0x0
                State: <Active NoReadvrt Int Ext>
                Age: 7w3d 21:24:25
                Validation State: unverified
                Task: RT
                Announcement bits (1): 0-KRT
                AS path: I
```

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show route receive-protocol

List of Syntax

Syntax on page 1677
Syntax (EX Series Switches) on page 1677

Syntax

```
show route receive-protocol protocol neighbor-address
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)
```

Syntax (EX Series Switches)

```
show route receive-protocol protocol neighbor-address
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display the routing information as it was received through a particular neighbor using a particular dynamic routing protocol.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

protocol neighbor-address—Protocol transmitting the route (**bgp**, **dvmrp**, **msdp**, **pim**, **rip**, or **ripng**) and address of the neighboring router from which the route entry was received.

Additional Information

The output displays the selected routes and the attributes with which they were received, but does not show the effects of import policy on the routing attributes.

Required Privilege Level

view

List of Sample Output

show route receive-protocol bgp on page 1680
show route receive-protocol bgp extensive on page 1680
show route receive-protocol bgp table extensive on page 1681
show route receive-protocol bgp logical-system extensive on page 1681
show route receive-protocol bgp detail (Layer 2 VPN) on page 1682
show route receive-protocol bgp extensive (Layer 2 VPN) on page 1682
show route receive-protocol bgp (Layer 3 VPN) on page 1683
show route receive-protocol bgp detail (Layer 3 VPN) on page 1683
show route receive-protocol bgp detail (Long-Lived Graceful Restart) on page 1684
show route receive-protocol bgp detail (Labeled Unicast) on page 1685
show route receive-protocol bgp extensive (Layer 3 VPN) on page 1685
Show route receive protocol (Segment Routing Traffic Engineering) on page 1686

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Output Fields Table 57 on page 1678 describes the output fields for the **show route receive-protocol** command. Output fields are listed in the approximate order in which they appear.

Table 57: show route receive-protocol Output Fields

Field Name	Field Description	Level of Output
routing-table-name	Name of the routing table—for example, inet.0.	All levels
number destinations	Number of destinations for which there are routes in the routing table.	All levels
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** • **holddown** (routes that are in pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)	All levels
Prefix	Destination prefix.	none **brief**
MED	Multiple exit discriminator value included in the route.	none **brief**
destination-prefix (entry, announced)	Destination prefix. The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination.	**detail extensive**
Accepted LongLivedStale	The LongLivedStale flag indicates that the route was marked LLGR-stale by this router, as part of the operation of LLGR receiver mode. Either this flag or the LongLivedStaleImport flag may be displayed for a route. Neither of these flags are displayed at the same time as the Stale (ordinary GR stale) flag.	**detail extensive**
Accepted LongLivedStaleImport	The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy. Either this flag or the LongLivedStale flag may be displayed for a route. Neither of these flags are displayed at the same time as the Stale (ordinary GR stale) flag. Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and import into the inet.0 routing table	**detail extensive**
ImportAccepted LongLivedStaleImport	Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and imported into the inet.0 routing table The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy.	**detail extensive**
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.	**detail extensive**
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.	**detail extensive**

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Table 57: show route receive-protocol Output Fields (continued)

Field Name	Field Description	Level of Output
VPN Label	Virtual private network (VPN) label. Packets are sent between CE and PE routing devices by advertising VPN labels. VPN labels transit over either an RSVP or an LDP label-switched path (LSP) tunnel.	**detail extensive**
Next hop	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.	All levels
Localpref or Lclpref	Local preference value included in the route.	All levels
AS path	Autonomous system (AS) path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used the AS-path merge process, as defined in RFC 4893. • **[ ]**—If more than one AS number is configured on the router, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.	All levels
Route Labels	Stack of labels carried in the BGP route update.	**detail extensive**
Cluster list	(For route reflected output only) Cluster ID sent by the route reflector.	**detail extensive**
Originator ID	(For route reflected output only) Address of routing device that originally sent the route to the route reflector.	**detail extensive**
Communities	Community path attribute for the route. See the Output Field table in the show route detail command for all possible values for this field.	**detail extensive**
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.	**detail extensive**
Attrset AS	Number, local preference, and path of the AS that originated the route. These values are stored in the **Attrset** attribute at the originating routing device.	**detail extensive**

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Table 57: show route receive-protocol Output Fields (continued)

Field Name	Field Description	Level of Output
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).	**detail extensive**
control flags	Control flags: **none** or **Site Down**.	**detail extensive**
mtu	Maximum transmission unit (MTU) of the Layer 2 circuit.	**detail extensive**

Sample Output

show route receive-protocol bgp

```
user@host> show route receive-protocol bgp 10.255.245.215

inet.0: 28 destinations, 33 routes (27 active, 0 holddown, 1 hidden)
Prefix                  Next hop              MED     Lclpref    AS path
10.22.1.0/24            10.255.245.215        0       100        I
10.22.2.0/24            10.255.245.215        0       100        I
```

show route receive-protocol bgp extensive

```
user@host> show route receive-protocol bgp 10.255.245.63 extensive
inet.0: 244 destinations, 244 routes (243 active, 0 holddown, 1 hidden)
Prefix             Next hop               MED    Lclpref AS path
172.16.1.0/24 (1 entry, 1 announced)
     Next hop: 10.0.50.3
     Localpref: 100
     AS path: I <Orginator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.45
172.16.163.0/16 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.68
172.16.164.0/16 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.45
172.16.195.0/24 (1 entry, 1 announced)
     Next hop: 111.222.5.254
     Localpref: 100
     AS path: I <Originator>
     Cluster list:  10.2.3.1
     Originator ID: 10.255.245.68
inet.2: 63 destinations, 63 routes (63 active, 0 holddown, 0 hidden)
Prefix             Next hop               MED    Lclpref AS path
inet.3: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix             Next hop               MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
```


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```
Prefix             Next hop                MED    Lclpref AS path
mpls.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
```

show route receive-protocol bgp table extensive

```
user@host> show route receive-protocol bgp 207.17.136.192 table inet.0 66.117.68.0/24 extensive
inet.0: 227315 destinations, 227316 routes (227302 active, 0 holddown, 13 hidden)
* 66.117.63.0/24 (1 entry, 1 announced)
     Nexthop: 207.17.136.29
     Localpref: 100
     AS path: AS2 PA[6]: 14203 2914 3356 29748 33437 AS_TRANS
     AS path: AS4 PA[2]: 33437 393219
     AS path: Merged[6]: 14203 2914 3356 29748 33437 393219 I
     Communities: 2914:420
```

show route receive-protocol bgp logical-system extensive

```
user@host> show route receive-protocol bgp 10.0.0.9 logical-system PE4 extensive
inet.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)
* 10.0.0.0/30 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.0.0.4/30 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

  10.0.0.8/30 (2 entries, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.9.9.1/32 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 10.100.1.1/32 (1 entry, 1 announced)
     Accepted
     Route Label: 3
     Nexthop: 10.0.0.9
     AS path: 13979 I

* 172.16.44.0/24 (1 entry, 1 announced)
     Accepted
     Route Label: 300096
     Nexthop: 10.0.0.9
     AS path: 13979 I
     AIGP: 203

* 172.16.55.0/24 (1 entry, 1 announced)
```

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```
    Accepted
    Route Label: 300112
    Nexthop: 10.0.0.9
    AS path: 13979 7018 I
    AIGP: 25

* 172.16.66.0/24 (1 entry, 1 announced)
    Accepted
    Route Label: 300144
    Nexthop: 10.0.0.9
    AS path: 13979 7018 I

* 172.16.99.0/24 (1 entry, 1 announced)
    Accepted
    Route Label: 300160
    Nexthop: 10.0.0.9
    AS path: 13979 7018 I
```

show route receive-protocol bgp detail (Layer 2 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171 detail
inet.0: 68 destinations, 68 routes (67 active, 0 holddown, 1 hidden)
Prefix             Nexthop               MED    Lclpref AS path
inet.3: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
mpls.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
frame-vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0
hidden)
Prefix             Nexthop               MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 1 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags: 0, mtu: 0
bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 0 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags:0, mtu: 0
```

show route receive-protocol bgp extensive (Layer 2 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171 extensive
inet.0: 68 destinations, 68 routes (67 active, 0 holddown, 1 hidden)
Prefix             Nexthop               MED    Lclpref AS path
inet.3: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
```


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```
Prefix             Nexthop               MED    Lclpref AS path
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
mpls.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
frame-vpn.l2vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 1 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags:0, mtu: 0
bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Prefix             Nexthop               MED    Lclpref AS path
10.255.245.35:1:5:1/96 (1 entry, 0 announced)
     Route Distinguisher: 10.255.245.35:1
     Label-base : 800000, range : 4, status-vector : 0x0
     Nexthop: 10.255.245.35
     Localpref: 100
     AS path: I
     Communities: target:65299:100 Layer2-info: encaps:FRAME RELAY,
     control flags:0, mtu: 0
```

show route receive-protocol bgp (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.171
```

```
     inet.0: 33 destinations, 33 routes (32 active, 0 holddown, 1 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     VPN-A.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     10.255.14.175/32   10.255.14.171                    100 2 I
     10.255.14.179/32   10.255.14.171          2         100 I
     VPN-B.inet.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     10.255.14.175/32   10.255.14.171                    100 2 I
     10.255.14.177/32   10.255.14.171                    100 I
     iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     mpls.0: 9 destinations, 9 routes (9 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     bgp.l3vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     10.255.14.171:300:10.255.14.177/32
                        10.255.14.171                    100 I
     10.255.14.171:100:10.255.14.179/32
                        10.255.14.171          2         100 I
     10.255.14.171:200:10.255.14.175/32
                        10.255.14.171                    100 2 I
```

show route receive-protocol bgp detail (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.14.174 detail
```

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```
inet.0: 16 destinations, 17 routes (15 active, 0 holddown, 1 hidden)
inet.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
vpna.inet.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
* 10.49.0.0/30 (1 entry, 1 announced)
     Route Distinguisher: 10.255.14.176:2
     VPN Label: 101264
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
* 10.255.14.172/32 (1 entry, 1 announced)
     Route Distinguisher: 10.255.14.176:2
     VPN Label: 101280
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
mpls.0: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
bgp.l3vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
* 10.255.14.174:2:10.49.0.0/30 (1 entry, 0 announced)
     Route Distinguisher: 10.255.14.174:2
     VPN Label: 101264
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
* 10.255.14.174:2:10.255.14.172/32 (1 entry, 0 announced)
     Route Distinguisher: 10.255.14.174:2
     VPN Label: 101280
     Nexthop: 10.255.14.174
     Localpref: 100
     AS path: I
     Communities: target:200:100
     AttrSet AS: 100
         Localpref: 100
         AS path: I
inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
```

show route receive-protocol bgp detail (Long-Lived Graceful Restart)

```
user@host> show route receive-protocol bgp 10.4.12.11 detail

  bgp.l2vpn.0: 38 destinations, 39 routes (37 active, 0 holddown, 1 hidden)
  * 172.16.1.4:100:172.16.1.4/96 AD (1 entry, 1 announced)
    Accepted LongLivedStale LongLivedStaleImport
    Nexthop: 10.4.12.11
    Localpref: 100
    AS path: I
```


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show route receive-protocol bgp detail (Labeled Unicast)

```
user@host> show route receive-protocol bgp 1.1.1.1 detail

inet.0: 45 destinations, 46 routes (45 active, 0 holddown, 0 hidden)
* 1.1.1.8/32 (2 entries, 2 announced)
Accepted
Route Labels: 1000123(top) 1000124 1000125 1000126
Nexthop: 1.1.1.4
Localpref: 100
AS path: I
Entropy label capable, next hop field matches route next hop

inet.3: 15 destinations, 21 routes (6 active, 0 holddown, 14 hidden)

iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)

mpls.0: 11 destinations, 11 routes (11 active, 0 holddown, 0 hidden)

inet6.0: 26 destinations, 28 routes (26 active, 0 holddown, 0 hidden)

* 100::1/128 (2 entries, 2 announced)
Accepted
Route Labels: 1000123(top) 1000124 1000125 1000126
Nexthop: ::ffff:1.1.1.4
Localpref: 100
AS path: I

inet6.3: 22 destinations, 23 routes (22 active, 0 holddown, 0 hidden)
```

show route receive-protocol bgp extensive (Layer 3 VPN)

```
user@host> show route receive-protocol bgp 10.255.245.63 extensive

inet.0: 244 destinations, 244 routes (243 active, 0 holddown, 1 hidden)
     Prefix             Nexthop               MED    Lclpref AS path
     172.16.1.0/24 (1 entry, 1 announced)
          Nexthop: 10.0.50.3
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.45
     172.16.163.0/16 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.68
     172.16.164.0/16 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.45
     172.16.195.0/24 (1 entry, 1 announced)
          Nexthop: 111.222.5.254
          Localpref: 100
          AS path: I <Originator>
          Cluster list:  10.2.3.1
          Originator ID: 10.255.245.68
```

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```
    inet.2: 63 destinations, 63 routes (63 active, 0 holddown, 0 hidden)
    Prefix             Nexthop               MED    Lclpref AS path
    inet.3: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
    Prefix             Nexthop               MED    Lclpref AS path
    iso.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
    Prefix             Nexthop               MED    Lclpref AS path
    mpls.0: 48 destinations, 48 routes (48 active, 0 holddown, 0 hidden)
```

Show route receive protocol (Segment Routing Traffic Engineering)

```
show route receive protocol bgp 10.1.1.4
```

```
bgp.inetcolor.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

* 50-4.4.4.4-1234<sr6>/96 (1 entry, 0 announced)
     Import Accepted
     Distinguisher: 50
     Color: 1234
     Nexthop: 10.1.1.4
     Localpref: 100
     AS path: 3 I
     Communities: target:1.1.1.1:1


inetcolor.0: 6 destinations, 7 routes (6 active, 0 holddown, 0 hidden)
* 4.4.4.4-1234<c6>/64 (1 entry, 1 announced)
     Import Accepted
     Color: 1234
     Nexthop: 10.1.1.4
     Localpref: 100
     AS path: 3 I
     Communities: target:1.1.1.1:1
```

```
user@host# run show route receive-protocol bgp 5001:1::4
```

```
bgp.inet6color.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)

* 50-2001:1::4-1234<sr6>/192 (1 entry, 0 announced)
     Import Accepted
     Distinguisher: 50
     Color: 1234
     Nexthop: ::ffff:1.1.1.4
     Localpref: 100
     AS path: 3 I
     Communities: target:1.1.1.1:1


inet6color.0: 6 destinations, 7 routes (6 active, 0 holddown, 0 hidden)
* 2001::5-1234<c6>/160 (1 entry, 1 announced)
     Import Accepted
     Color: 1234
     Nexthop: ::ffff:1.1.1.5
     Localpref: 100
     AS path: 3 I
     Communities: target:2:1
```


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show route table

List of Syntax

Syntax on page 1687
Syntax (EX Series Switches, QFX Series Switches) on page 1687

Syntax

```
show route table routing-table-name
<brief | detail | extensive | terse>
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches, QFX Series Switches)

```
show route table routing-table-name
<brief | detail | extensive | terse>
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.
Statement introduced in Junos OS Release 14.1X53-D15 for QFX Series switches.
Show route table evpn statement introduced in Junos OS Release 15.1X53-D30 for QFX Series switches.

Description

Display the route entries in a particular routing table.

Options

brief | detail | extensive | terse—(Optional) Display the specified level of output.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

routing-table-name—Display route entries for all routing tables whose names begin with this string (for example, inet.0 and inet6.0 are both displayed when you run the **show route table inet** command).

Required Privilege Level

view

Related Documentation

- *show route summary*

List of Sample Output

show route table bgp.l2.vpn on page 1699
show route table bgp.l3vpn.0 on page 1699
show route table bgp.l3vpn.0 detail on page 1699
show route table bgp.rtarget.0 (When Proxy BGP Route Target Filtering Is Configured) on page 1701
show route table bgp.evpn.0 on page 1701
show route table evpna.evpn.0 on page 1702
show route table inet.0 on page 1702
show route table inet.3 on page 1702
show route table inet.3 protocol ospf on page 1702

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show route table inet6.0 on page 1703
show route table inet6.3 on page 1703
show route table inetflow detail on page 1703
show route table inetflow.0 extensive (BGP Flowspec Redirect to IP) on page 1704
show route table lsdist.0 extensive on page 1705
show route table l2circuit.0 on page 1707
show route table lsdist.0 on page 1707
show route table mpls on page 1708
show route table mpls extensive on page 1708
show route table mpls.0 on page 1708
show route table mpls.0 detail (PTX Series) on page 1709
show route table mpls.0 ccc ge-0/0/1.1004 detail on page 1710
show route table mpls.0 protocol evpn on page 1711
show route table mpls.0 protocol ospf on page 1717
show route table mpls.0 extensive (PTX Series) on page 1717
show route table mpls.0 (RSVP Route—Transit LSP) on page 1718
show route table vpls_1 detail on page 1718
show route table vpn-a on page 1719
show route table vpn-a.mdt.0 on page 1719
show route table VPN-A detail on page 1719
show route table VPN-AB.inet.0 on page 1720
show route table VPN_blue.mvpn-inet6.0 on page 1720
show route table vrf1.mvpn.0 extensive on page 1721
show route table inetflow detail on page 1721
show route table bgp.evpn.0 extensive |no-more (EVPN) on page 1724
show route table default-switch.evpn.0 extensive on page 1728
show route table evpn1.evpn-mcsn on page 1728
show route table evpn1 (Multihomed Proxy MAC and IP Address) on page 1728

Output Fields Table 45 on page 1515 describes the output fields for the **show route table** command. Output fields are listed in the approximate order in which they appear.

Table 58: show route table Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).

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Table 58: show route table Output Fields (continued)

Field Name	Field Description

Restart complete	All protocols have restarted for this routing table.
	
	Restart state:
	
	• **Pending:*protocol-name***—List of protocols that have not yet completed graceful restart for this routing table.
	• **Complete**—All protocols have restarted for this routing table.
	
	For example, if the output shows-
	
	• `LDP.inet.0 : 5 routes (4 active, 1 holddown, 0 hidden)`
	`Restart Pending: OSPF LDP VPN`
	
	This indicates that **OSPF**, **LDP**, and **VPN** protocols did not restart for the **LDP.inet.0** routing table.
	• `vpls_1.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)`
	`Restart Complete`
	
	This indicates that all protocols have restarted for the **vpls_1.l2vpn.0** routing table.

number destinations	Number of destinations for which there are routes in the routing table.
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)

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Table 58: show route table Output Fields (continued)

Field Name	Field Description

route-destination (entry, announced)	Route destination (for example:10.0.0.1/24). The **entry** value is the number of routes for this destination, and the **announced** value is the number of routes being announced for this destination. Sometimes the route destination is presented in another format, such as:
	• ***MPLS-label*** (for example, 80001).
	• ***interface-name*** (for example, ge-1/0/2).
	• ***neighbor-address*:*control-word-status*:*encapsulation type*:*vc-id*:*source*** (Layer 2 circuit only; for example, 10.1.1.195:NoCtrlWord:1:1:Local/96).
	  • ***neighbor-address***—Address of the neighbor.
	  • ***control-word-status***—Whether the use of the control word has been negotiated for this virtual circuit: **NoCtrlWord** or **CtrlWord**.
	  • ***encapsulation type***—Type of encapsulation, represented by a number: (1) Frame Relay DLCI, (2) ATM AAL5 VCC transport, (3) ATM transparent cell transport, (4) Ethernet, (5) VLAN Ethernet, (6) HDLC, (7) PPP, (8) ATM VCC cell transport, (10) ATM VPC cell transport.
	  • ***vc-id***—Virtual circuit identifier.
	  • ***source***—Source of the advertisement: **Local** or **Remote**.
	• ***inclusive multicast Ethernet tag route***—Type of route destination represented by (for example, 3:100.100.100.10:100::0::10::100.100.100.10/384):
	  • *route distinguisher*—(8 octets) Route distinguisher (RD) must be the RD of the EVPN instance (EVI) that is advertising the NLRI.
	  • *Ethernet tag ID*—(4 octets) Identifier of the Ethernet tag. Can set to 0 or to a valid Ethernet tag value.
	  • *IP address length*—(1 octet) Length of IP address in bits.
	  • *originating router's IP address*—(4 or 16 octets) Must set to the provider edge (PE) device's IP address. This address should be common for all EVIs on the PE device, and may be the PE device's loopback address.

label stacking	**(**Next-to-the-last-hop routing device for MPLS only) Depth of the MPLS label stack, where the label-popping operation is needed to remove one or more labels from the top of the stack. A pair of routes is displayed, because the pop operation is performed only when the stack depth is two or more labels. • **S=0 route** indicates that a packet with an incoming label stack depth of 2 or more exits this routing device with one fewer label (the label-popping operation is performed). • If there is no **S=** information, the route is a normal MPLS route, which has a stack depth of 1 (the label-popping operation is not performed).
[*protocol*, *preference*]	Protocol from which the route was learned and the preference value for the route. • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.

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Table 58: show route table Output Fields (continued)

Field Name	Field Description
Level	(IS-IS only). In IS-IS, a single AS can be divided into smaller groups called areas. Routing between areas is organized hierarchically, allowing a domain to be administratively divided into smaller areas. This organization is accomplished by configuring Level 1 and Level 2 intermediate systems. Level 1 systems route within an area. When the destination is outside an area, they route toward a Level 2 system. Level 2 intermediate systems route between areas and toward other ASs.
Route Distinguisher	IP subnet augmented with a 64-bit prefix.
PMSI	Provider multicast service interface (MVPN routing table).
Next-hop type	Type of next hop. For a description of possible values for this field, see Table 49 on page 1571.
Next-hop reference count	Number of references made to the next hop.
Flood nexthop branches exceed maximum message	Indicates that the number of flood next-hop branches exceeded the system limit of 32 branches, and only a subset of the flood next-hop branches were installed in the kernel.
Source	IP address of the route source.
Next hop	Network layer address of the directly reachable neighboring system.
via	Interface used to reach the next hop. If there is more than one interface available to the next hop, the name of the interface that is actually used is followed by the word **Selected**. This field can also contain the following information: • Weight—Value used to distinguish primary, secondary, and fast reroute backup routes. Weight information is available when MPLS label-switched path (LSP) link protection, node-link protection, or fast reroute is enabled, or when the standby state is enabled for secondary paths. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible. • Balance—Balance coefficient indicating how traffic of unequal cost is distributed among next hops when a routing device is performing unequal-cost load balancing. This information is available when you enable BGP multipath load balancing.
Label-switched-path *lsp-path-name*	Name of the LSP used to reach the next hop.
Label operation	MPLS label and operation occurring at this routing device. The operation can be **pop** (where a label is removed from the top of the stack), **push** (where another label is added to the label stack), or **swap** (where a label is replaced by another label).
Interface	(Local only) Local interface name.
Protocol next hop	Network layer address of the remote routing device that advertised the prefix. This address is used to derive a forwarding next hop.
Indirect next hop	Index designation used to specify the mapping between protocol next hops, tags, kernel export policy, and the forwarding next hops.
State	State of the route (a route can be in more than one state). See Table 50 on page 1573.

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Table 58: show route table Output Fields (continued)

Field Name	Field Description
Local AS	AS number of the local routing devices.
Age	How long the route has been known.
AIGP	Accumulated interior gateway protocol (AIGP) BGP attribute.
Metric*n*	Cost value of the indicated route. For routes within an AS, the cost is determined by IGP and the individual protocol metrics. For external routes, destinations, or routing domains, the cost is determined by a preference value.
MED-plus-IGP	Metric value for BGP path selection to which the IGP cost to the next-hop destination has been added.
TTL-Action	For MPLS LSPs, state of the TTL propagation attribute. Can be enabled or disabled for all RSVP-signaled and LDP-signaled LSPs or for specific VRF routing instances.
Task	Name of the protocol that has added the route.
Announcement bits	The number of BGP peers or protocols to which Junos OS has announced this route, followed by the list of the recipients of the announcement. Junos OS can also announce the route to the kernel routing table (KRT) for installing the route into the Packet Forwarding Engine, to a resolve tree, a Layer 2 VC, or even a VPN. For example, ***n*-Resolve inet** indicates that the specified route is used for route resolution for next hops found in the routing table. • ***n***—An index used by Juniper Networks customer support only.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **Recorded**—The AS path is recorded by the sample process (sampled). • **?**—Incomplete; typically, the AS path was aggregated. When AS path numbers are included in the route, the format is as follows: • **[ ]**—Brackets enclose the number that precedes the AS path. This number represents the number of ASs present in the AS path, when calculated as defined in RFC 4271. This value is used in the AS-path merge process, as defined in RFC 4893. • **[ ]**—If more than one AS number is configured on the routing device, or if AS path prepending is configured, brackets enclose the local AS number associated with the AS path. • **{ }**—Braces enclose AS sets, which are groups of AS numbers in which the order does not matter. A set commonly results from route aggregation. The numbers in each AS set are displayed in ascending order. • **( )**—Parentheses enclose a confederation. • **([ ])**—Parentheses and brackets enclose a confederation set. NOTE: In Junos OS Release 10.3 and later, the AS path field displays an unrecognized attribute and associated hexadecimal value if BGP receives attribute 128 (attribute set) and you have not configured an independent domain in any routing instance.

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Table 58: show route table Output Fields (continued)

Field Name	Field Description
validation-state	(BGP-learned routes) Validation status of the route: • **Invalid**—Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **Unknown**—Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **Unverified**—Indicates that the origin of the prefix is not verified against the database. This is because the database got populated and the validation is not called for in the BGP import policy, although origin validation is enabled, or the origin validation is not enabled for the BGP peers. • **Valid**—Indicates that the prefix and autonomous system pair are found in the database.
FECs bound to route	Indicates point-to-multipoint root address, multicast source address, and multicast group address when multipoint LDP (M-LDP) inband signaling is configured.
Primary Upstream	When multipoint LDP with multicast-only fast reroute (MoFRR) is configured, indicates the primary upstream path. MoFRR transmits a multicast join message from a receiver toward a source on a primary path, while also transmitting a secondary multicast join message from the receiver toward the source on a backup path.
RPF Nexthops	When multipoint LDP with MoFRR is configured, indicates the reverse-path forwarding (RPF) next-hop information. Data packets are received from both the primary path and the secondary paths. The redundant packets are discarded at topology merge points due to the RPF checks.
Label	Multiple MPLS labels are used to control MoFRR stream selection. Each label represents a separate route, but each references the same interface list check. Only the primary label is forwarded while all others are dropped. Multiple interfaces can receive packets using the same label.
weight	Value used to distinguish MoFRR primary and backup routes. A lower weight value is preferred. Among routes with the same weight value, load balancing is possible.
VC Label	MPLS label assigned to the Layer 2 circuit virtual connection.
MTU	Maximum transmission unit (MTU) of the Layer 2 circuit.
VLAN ID	VLAN identifier of the Layer 2 circuit.
Prefixes bound to route	Forwarding equivalent class (FEC) bound to this route. Applicable only to routes installed by LDP.
Communities	Community path attribute for the route. See Table 51 on page 1575 for all possible values for this field.
Layer2-info: encaps	Layer 2 encapsulation (for example, VPLS).
control flags	Control flags: **none** or **Site Down**.
mtu	Maximum transmission unit (MTU) information.
Label-Base, range	First label in a block of labels and label block size. A remote PE routing device uses this first label when sending traffic toward the advertising PE routing device.
status vector	Layer 2 VPN and VPLS network layer reachability information (NLRI).

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Table 58: show route table Output Fields (continued)

Field Name	Field Description
Accepted Multipath	Current active path when BGP multipath is configured.
Accepted LongLivedStale	The LongLivedStale flag indicates that the route was marked LLGR-stale by this router, as part of the operation of LLGR receiver mode. Either this flag or the LongLivedStaleImport flag might be displayed for a route. Neither of these flags is displayed at the same time as the Stale (ordinary GR stale) flag.
Accepted LongLivedStaleImport	The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy. Either this flag or the LongLivedStale flag might be displayed for a route. Neither of these flags is displayed at the same time as the Stale (ordinary GR stale) flag. Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and import into the inet.0 routing table
ImportAccepted LongLivedStaleImport	Accept all received BGP long-lived graceful restart (LLGR) and LLGR stale routes learned from configured neighbors and imported into the inet.0 routing table The LongLivedStaleImport flag indicates that the route was marked LLGR-stale when it was received from a peer, or by import policy.
Accepted MultipathContrib	Path currently contributing to BGP multipath.
Localpref	Local preference value included in the route.
Router ID	BGP router ID as advertised by the neighbor in the open message.
Primary Routing Table	In a routing table group, the name of the primary routing table in which the route resides.
Secondary Tables	In a routing table group, the name of one or more secondary tables in which the route resides.

Table 49 on page 1571 describes all possible values for the Next-hop Types output field.

Table 59: Next-hop Types Output Field Values

Next-Hop Type	Description
Broadcast (bcast)	Broadcast next hop.
Deny	Deny next hop.
Discard	Discard next hop.
Flood	Flood next hop. Consists of components called branches, up to a maximum of 32 branches. Each flood next-hop branch sends a copy of the traffic to the forwarding interface. Used by point-to-multipoint RSVP, point-to-multipoint LDP, point-to-multipoint CCC, and multicast.

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Table 59: Next-hop Types Output Field Values (continued)

Next-Hop Type	Description
Hold	Next hop is waiting to be resolved into a unicast or multicast type.
Indexed (idxd)	Indexed next hop.
Indirect (indr)	Used with applications that have a protocol next hop address that is remote. You are likely to see this next-hop type for internal BGP (IBGP) routes when the BGP next hop is a BGP neighbor that is not directly connected.
Interface	Used for a network address assigned to an interface. Unlike the router next hop, the interface next hop does not reference any specific node on the network.
Local (locl)	Local address on an interface. This next-hop type causes packets with this destination address to be received locally.
Multicast (mcst)	Wire multicast next hop (limited to the LAN).
Multicast discard (mdsc)	Multicast discard.
Multicast group (mgrp)	Multicast group member.
Receive (recv)	Receive.
Reject (rjct)	Discard. An ICMP unreachable message was sent.
Resolve (rslv)	Resolving next hop.
Routed multicast (mcrt)	Regular multicast next hop.
Router	A specific node or set of nodes to which the routing device forwards packets that match the route prefix. To qualify as a next-hop type router, the route must meet the following criteria: • Must not be a direct or local subnet for the routing device. • Must have a next hop that is directly connected to the routing device.
Table	Routing table next hop.
Unicast (ucst)	Unicast.
Unilist (ulst)	List of unicast next hops. A packet sent to this next hop goes to any next hop in the list.

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Table 50 on page 1573 describes all possible values for the State output field. A route can be in more than one state (for example, **<Active NoReadvrt Int Ext>**).

Table 60: State Output Field Values

Value	Description
Accounting	Route needs accounting.
Active	Route is active.
Always Compare MED	Path with a lower multiple exit discriminator (MED) is available.
AS path	Shorter AS path is available.
Cisco Non-deterministic MED selection	Cisco nondeterministic MED is enabled, and a path with a lower MED is available.
Clone	Route is a clone.
Cluster list length	Length of cluster list sent by the route reflector.
Delete	Route has been deleted.
Ex	Exterior route.
Ext	BGP route received from an external BGP neighbor.
FlashAll	Forces all protocols to be notified of a change to any route, active or inactive, for a prefix. When not set, protocols are informed of a prefix only when the active route changes.
Hidden	Route not used because of routing policy.
IfCheck	Route needs forwarding RPF check.
IGP metric	Path through next hop with lower IGP metric is available.
Inactive reason	Flags for this route, which was not selected as best for a particular destination.
Initial	Route being added.
Int	Interior route.
Int Ext	BGP route received from an internal BGP peer or a BGP confederation peer.
Interior > Exterior > Exterior via Interior	Direct, static, IGP, or EBGP path is available.

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Table 60: State Output Field Values (continued)

Value	Description
Local Preference	Path with a higher local preference value is available.
Martian	Route is a martian (ignored because it is obviously invalid).
MartianOK	Route exempt from martian filtering.
Next hop address	Path with lower metric next hop is available.
No difference	Path from neighbor with lower IP address is available.
NoReadvrt	Route not to be advertised.
NotBest	Route not chosen because it does not have the lowest MED.
Not Best in its group	Incoming BGP AS is not the best of a group (only one AS can be the best).
NotInstall	Route not to be installed in the forwarding table.
Number of gateways	Path with a greater number of next hops is available.
Origin	Path with a lower origin code is available.
Pending	Route pending because of a hold-down configured on another route.
Release	Route scheduled for release.
RIB preference	Route from a higher-numbered routing table is available.
Route Distinguisher	64-bit prefix added to IP subnets to make them unique.
Route Metric or MED comparison	Route with a lower metric or MED is available.
Route Preference	Route with lower preference value is available.
Router ID	Path through a neighbor with lower ID is available.
Secondary	Route not a primary route.
Unusable path	Path is not usable because of one of the following conditions: • The route is damped. • The route is rejected by an import policy. • The route is unresolved.
Update source	Last tiebreaker is the lowest IP address value.

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Table 51 on page 1575 describes the possible values for the Communities output field.

Table 61: Communities Output Field Values

Value	Description
area-number	4 bytes, encoding a 32-bit area number. For AS-external routes, the value is **0**. A nonzero value identifies the route as internal to the OSPF domain, and as within the identified area. Area numbers are relative to a particular OSPF domain.
bandwidth: ***local AS number:link-bandwidth-number***	Link-bandwidth community value used for unequal-cost load balancing. When BGP has several candidate paths available for multipath purposes, it does not perform unequal-cost load balancing according to the link-bandwidth community unless all candidate paths have this attribute.
domain-id	Unique configurable number that identifies the OSPF domain.
domain-id-vendor	Unique configurable number that further identifies the OSPF domain.
link-bandwidth-number	Link-bandwidth number: from **0** through **4,294,967,295** (bytes per second).
local AS number	Local AS number: from **1** through **65,535**.
options	1 byte. Currently this is only used if the route type is **5** or **7**. Setting the least significant bit in the field indicates that the route carries a type 2 metric.
origin	(Used with VPNs) Identifies where the route came from.
ospf-route-type	1 byte, encoded as **1** or **2** for intra-area routes (depending on whether the route came from a type 1 or a type 2 LSA); **3** for summary routes; **5** for external routes (area number must be**0**); **7** for NSSA routes; or **129** for sham link endpoint addresses.
route-type-vendor	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x8000**. The format is ***area-number:ospf-route-type:options***.
rte-type	Displays the area number, OSPF route type, and option of the route. This is configured using the BGP extended community attribute **0x0306**. The format is ***area-number:ospf-route-type:options***.
target	Defines which VPN the route participates in; **target** has the format ***32-bit IP address:16-bit number***. For example, 10.19.0.0:100.
unknown IANA	Incoming IANA codes with a value between **0x1** and **0x7fff**. This code of the BGP extended community attribute is accepted, but it is not recognized.
unknown OSPF vendor community	Incoming IANA codes with a value above **0x8000**. This code of the BGP extended community attribute is accepted, but it is not recognized.
evpn-mcast-flags	Identifies the value in the multicast flags extended community and whether snooping is enabled. A value of 0x1 indicates that the route supports IGMP proxy.

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Table 61: Communities Output Field Values (continued)

Value	Description
evpn-l2-info	Identifies whether Multihomed Proxy MAC and IP Address Route Advertisement is enabled. A value of 0x20 indicates that the proxy bit is set. . Use the **show bridge mac-ip-table extensive** statement to determine whether the MAC and IP address route was learned locally or from a PE device.

Sample Output

show route table bgp.l2.vpn

```
user@host> show route table bgp.l2.vpn

bgp.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

192.168.24.1:1:4:1/96
                   *[BGP/170] 01:08:58, localpref 100, from 192.168.24.1
                      AS path: I
                    > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
```

show route table bgp.l3vpn.0

```
user@host> show route table bgp.l3vpn.0

     bgp.l3vpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
     + = Active Route, - = Last Active, * = Both

     10.255.71.15:100:10.255.71.17/32
                        *[BGP/170] 00:03:59, MED 1, localpref 100, from
     10.255.71.15
                           AS path: I
                         > via so-2/1/0.0, Push 100020, Push 100011(top)
     10.255.71.15:200:10.255.71.18/32
                        *[BGP/170] 00:03:59, MED 1, localpref 100, from
     10.255.71.15
                           AS path: I
                         > via so-2/1/0.0, Push 100021, Push 100011(top)
```

show route table bgp.l3vpn.0 detail

```
user@host> show route table bgp.l3vpn.0 detail

bgp.l3vpn.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)

10.255.245.12:1:172.16.4.0/8 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
         Route Distinguisher: 10.255.245.12:1
         Source: 10.255.245.12
         Next hop: 192.168.208.66 via fe-0/0/0.0, selected
         Label operation: Push 182449
         Protocol next hop: 10.255.245.12
         Push 182449
         Indirect next hop: 863a630 297
         State: <Active Int Ext>
```

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```
        Local AS:    35 Peer AS:    35
        Age: 12:19      Metric2: 1
        Task: BGP_35.10.255.245.12+179
        Announcement bits (1): 0-BGP.0.0.0.0+179
        AS path: 30 10458 14203 2914 3356 I (Atomic) Aggregator: 3356 4.68.0.11

        Communities: 2914:420 target:11111:1 origin:56:78
        VPN Label: 182449
        Localpref: 100
         Router ID: 10.255.245.12

10.255.245.12:1:4.17.225.0/24 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
        Route Distinguisher: 10.255.245.12:1
        Source: 10.255.245.12
        Next hop: 192.168.208.66 via fe-0/0/0.0, selected
        Label operation: Push 182465
        Protocol next hop: 10.255.245.12
        Push 182465
        Indirect next hop: 863a8f0 305
        State: <Active Int Ext>
        Local AS:    35 Peer AS:    35
        Age: 12:19      Metric2: 1
        Task: BGP_35.10.255.245.12+179
        Announcement bits (1): 0-BGP.0.0.0.0+179
AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496 6496 I
               Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
               VPN Label: 182465
               Localpref: 100
               Router ID: 10.255.245.12

10.255.245.12:1:4.17.226.0/23 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
        Route Distinguisher: 10.255.245.12:1
        Source: 10.255.245.12
        Next hop: 192.168.208.66 via fe-0/0/0.0, selected
        Label operation: Push 182465
        Protocol next hop: 10.255.245.12
        Push 182465
        Indirect next hop: 86bd210 330
        State: <Active Int Ext>
        Local AS:    35 Peer AS:    35
        Age: 12:19      Metric2: 1
        Task: BGP_35.10.255.245.12+179
        Announcement bits (1): 0-BGP.0.0.0.0+179
        AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496

        6496 I
        Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
        VPN Label: 182465
        Localpref: 100
        Router ID: 10.255.245.12

10.255.245.12:1:4.17.251.0/24 (1 entry, 1 announced)
  *BGP   Preference: 170/-101
        Route Distinguisher: 10.255.245.12:1
        Source: 10.255.245.12
        Next hop: 192.168.208.66 via fe-0/0/0.0, selected
        Label operation: Push 182465
        Protocol next hop: 10.255.245.12
```


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```
        Push 182465
        Indirect next hop: 86bd210 330
        State: <Active Int Ext>
        Local AS:    35 Peer AS:    35
        Age: 12:19      Metric2: 1
        Task: BGP_35.10.255.245.12+179
        Announcement bits (1): 0-BGP.0.0.0.0+179
        AS path: 30 10458 14203 2914 11853 11853 11853 6496 6496 6496 6496 6496

        6496 I
        Communities: 2914:410 target:12:34 target:11111:1 origin:12:34
        VPN Label: 182465
        Localpref: 100
```

show route table bgp.rtarget.0 (When Proxy BGP Route Target Filtering Is Configured)

```
user@host> show route table bgp.rtarget.o
```

```
bgp.rtarget.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100:100:100/96
                   *[RTarget/5] 00:03:14
                      Type Proxy
                        for 10.255.165.103
                        for 10.255.166.124
                      Local
```

show route table bgp.evpn.0

```
user@host> show route table bgp.evpn.0
```

```
bgp.evpn.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

2:100.100.100.2:100::0::00:26:88:5f:67:b0/304
                   *[BGP/170] 11:00:05, localpref 100, from 100.100.100.2
                      AS path: I, validation-state: unverified
                    > to 100.64.12.2 via xe-2/2/0.0, label-switched-path R0toR1
2:100.100.100.2:100::0::00:51:51:51:51:51/304
                   *[BGP/170] 11:00:05, localpref 100, from 100.100.100.2
                      AS path: I, validation-state: unverified
                    > to 100.64.12.2 via xe-2/2/0.0, label-switched-path R0toR1
2:100.100.100.3:100::0::00:52:52:52:52:52/304
                   *[BGP/170] 10:59:58, localpref 100, from 100.100.100.3
                      AS path: I, validation-state: unverified
                    > to 100.64.13.3 via ge-2/0/8.0, label-switched-path R0toR2
2:100.100.100.3:100::0::a8:d0:e5:5b:01:c8/304
                   *[BGP/170] 10:59:58, localpref 100, from 100.100.100.3
                      AS path: I, validation-state: unverified
                    > to 100.64.13.3 via ge-2/0/8.0, label-switched-path R0toR2
3:100.100.100.2:100::1000::100.100.100.2/304
                   *[BGP/170] 11:00:16, localpref 100, from 100.100.100.2
                      AS path: I, validation-state: unverified
                    > to 100.64.12.2 via xe-2/2/0.0, label-switched-path R0toR1
3:100.100.100.2:100::2000::100.100.100.2/304
                   *[BGP/170] 11:00:16, localpref 100, from 100.100.100.2
                      AS path: I, validation-state: unverified
                    > to 100.64.12.2 via xe-2/2/0.0, label-switched-path R0toR1
```

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show route table evpna.evpn.0

```
user@host> show route table evpna.evpn.0

evpna.evpn.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

3:100.100.100.10:100::0::10::100.100.100.10/384
                   *[EVPN/170] 01:37:09
                      Indirect
3:100.100.100.2:100::2000::100.100.100.2/304
                   *[EVPN/170] 01:37:12
                      Indirect
```

show route table inet.0

```
user@host> show route table inet.0

inet.0: 12 destinations, 12 routes (11 active, 0 holddown, 1 hidden)
+ = Active Route, - = Last Active, * = Both

0.0.0.0/0          *[Static/5] 00:51:57
                    > to 172.16.5.254 via fxp0.0
10.0.0.1/32         *[Direct/0] 00:51:58
                    > via at-5/3/0.0
10.0.0.2/32         *[Local/0] 00:51:58
                     Local
10.12.12.21/32     *[Local/0] 00:51:57
                     Reject
10.13.13.13/32     *[Direct/0] 00:51:58
                    > via t3-5/2/1.0
10.13.13.14/32     *[Local/0] 00:51:58
                     Local
10.13.13.21/32     *[Local/0] 00:51:58
                     Local
10.13.13.22/32     *[Direct/0] 00:33:59
                    > via t3-5/2/0.0
127.0.0.1/32        [Direct/0] 00:51:58
                    > via lo0.0
10.222.5.0/24     *[Direct/0] 00:51:58
                    > via fxp0.0
10.222.5.81/32    *[Local/0] 00:51:58
                     Local
```

show route table inet.3

```
user@host> show route table inet.3

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.0.0.5/32        *[LDP/9] 00:25:43, metric 10, tag 200
                      to 10.2.94.2 via lt-1/2/0.49
                    > to 10.2.3.2 via lt-1/2/0.23
```

show route table inet.3 protocol ospf

```
user@host> show route table inet.3 protocol ospf
```


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```
inet.3: 9 destinations, 18 routes (9 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1.1.1.20/32         [L-OSPF/10] 1d 00:00:56, metric 2
                    > to 10.0.10.70 via lt-1/2/0.14, Push 800020
                      to 10.0.6.60 via lt-1/2/0.12, Push 800020, Push 800030(top)
1.1.1.30/32         [L-OSPF/10] 1d 00:01:01, metric 3
                    > to 10.0.10.70 via lt-1/2/0.14, Push 800030
                      to 10.0.6.60 via lt-1/2/0.12, Push 800030
1.1.1.40/32         [L-OSPF/10] 1d 00:01:01, metric 4
                    > to 10.0.10.70 via lt-1/2/0.14, Push 800040
                      to 10.0.6.60 via lt-1/2/0.12, Push 800040
1.1.1.50/32         [L-OSPF/10] 1d 00:01:01, metric 5
                    > to 10.0.10.70 via lt-1/2/0.14, Push 800050
                      to 10.0.6.60 via lt-1/2/0.12, Push 800050
1.1.1.60/32         [L-OSPF/10] 1d 00:01:01, metric 6
                    > to 10.0.10.70 via lt-1/2/0.14, Push 800060
                      to 10.0.6.60 via lt-1/2/0.12, Pop
```

show route table inet6.0

user@host> **show route table inet6.0**

```
inet6.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Route, * = Both

fec0:0:0:3::/64 *[Direct/0] 00:01:34
>via fe-0/1/0.0

fec0:0:0:3::/128 *[Local/0] 00:01:34
>Local

fec0:0:0:4::/64 *[Static/5] 00:01:34
>to fec0:0:0:3::ffff via fe-0/1/0.0
```

show route table inet6.3

user@router> **show route table inet6.3**

```
inet6.3: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

::10.255.245.195/128
                   *[LDP/9] 00:00:22, metric 1
                    > via so-1/0/0.0
::10.255.245.196/128
                   *[LDP/9] 00:00:08, metric 1
                    > via so-1/0/0.0, Push 100008
```

show route table inetflow detail

user@host> **show route table inetflow detail**

```
inetflow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.12.44.1,*/48 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 2
                State: <Active Ext>
                Local AS: 64502 Peer AS: 64500
```

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```
                Age: 4
                Task: BGP_64500.10.12.99.5+3792
                Announcement bits (1): 0-Flow
                AS path: 64500 I
                Communities: traffic-rate:0:0
                Validation state: Accept, Originator: 10.12.99.5
                Via: 10.12.44.0/24, Active
                Localpref: 100
                Router ID: 10.255.71.161

10.12.56.1,*/48 (1 entry, 1 announced)
        *Flow   Preference: 5
                Next-hop reference count: 2
                State: <Active>
                Local AS: 64502
                Age: 6:30
                Task: RT Flow
                Announcement bits (2): 0-Flow 1-BGP.0.0.0.0+179
                AS path: I
                Communities: 1:1
```

show route table inetflow.0 extensive (BGP Flowspec Redirect to IP)

```
user@host> show route table inetflow.0 extensive
```

```
inetflow.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
2.2.2.2,*/term:1 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Page 0 idx 0, (group ibgp type Internal) Type 1 val 0xb209500 (adv_entry)
Advertised metrics:
Nexthop: 21.1.4.5
Localpref: 100
AS path: [100] I
Communities: redirect-to-ip:21.1.4.5:0
Action(s): accept,count
*Flow Preference: 5
Next hop type: Indirect, Next hop index: 0
Address: 0xa2b931c
Next-hop reference count: 1Next hop:
State: <Active> L
ocal AS: 69
Age: 2
Validation State: unverified
Task: RT Flow
Announcement bits (1): 0-Flow
AS path: I
Communities: redirect-to-ip:21.1.4.5:0
```

```
user@host> show route table inetflow.) extensive
```

```
inetflow.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
2.2.2.2,*/term:1 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Page 0 idx 0, (group ibgp type Internal) Type 1 val 0xb209500 (adv_entry)
Advertised metrics:
Nexthop: 21.1.4.5
Localpref: 100
AS path: [100] I
```


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```
Communities: redirect-to-nexthop
Action(s): accept,count
*Flow Preference: 5
Next hop type: Indirect, Next hop index: 0
Address: 0xa2b931c
Next-hop reference count: 1
Next hop:
State: <Active>
Local AS: 69
Age: 2
Validation State: unverified
Task: RT Flow
Announcement bits (1): 0-Flow
AS path: I
Communities: redirect-to-nexthop
regress@10.102.178.210> show route table inetflow.0 extensive
inetflow.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
4.4.4.4,*/term:1 (1 entry, 1 announced)
TSI:
KRT in dfwd;
Action(s): accept,count
*BGP Preference: 170/-101
Next hop type: Fictitious, Next hop index: 0
Address: 0xc5e3c30
Next-hop reference count: 3
Next hop: 21.1.4.5
State: <Active Int Ext>
Local AS: 100 Peer AS: 100
Age: 10
Validation State: unverified
Task: BGP_100.1.1.1.1+179
Announcement bits (1): 0-Flow
AS path: I
Communities: redirect-to-nexthop
Accepted
Localpref: 100
Router ID: 1.1.1.1
```

show route table lsdist.0 extensive

```
user@host> show route table lsdist.0 extensive
lsdist.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
NODE { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 ISIS-L1:0 }/1152
 (1 entry, 1 announced)
TSI:
Page 0 idx 0, (group ibgp type Internal) Type 1 val 0xa62f378 (adv_entry)
   Advertised metrics:
     Nexthop: Self
     Localpref: 100
     AS path: [4170512532] I
     Communities:
Path NODE { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 ISIS-L1:0 }
 Vector len 4.  Val: 0
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Fictitious, Next hop index: 0
                Address: 0x95dfc64
                Next-hop reference count: 9
                State: <Active NotInstall>
```

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```
               Local AS: 4170512532
               Age: 6:05
               Validation State: unverified
               Task: IS-IS
               Announcement bits (1): 0-BGP_RT_Background
               AS path: I
               IPv4 Router-ids:
                  128.220.11.197
               Area membership:
                  47 00 05 80 ff f8 00 00 00 01 08 00 01
              SPRING-Capabilities:                 - SRGB block [Start: 800000,
 Range: 256, Flags: 0xc0]
               SPRING-Algorithms:
                  - Algo: 0
 LINK { Local { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 }.{
IPv4:8.65.1.105 } Remote { AS:4170512532 BGP-LS ID:4170512532 ISO:4284.3300.5067)
TSI:
Page 0 idx 0, (group ibgp type Internal) Type 1 val 0xa62f3cc (adv_entry)
    Advertised metrics:
      Nexthop: Self
      Localpref: 100
      AS path: [4170512532] I
      Communities:
Path LINK { Local { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 }.{
 IPv4:8.65.1.105 } Remote { AS:4170512532 BGP-LS ID:4170512532 ISO:4284.33000
      *IS-IS  Preference: 15
               Level: 1
               Next hop type: Fictitious, Next hop index: 0
               Address: 0x95dfc64
               Next-hop reference count: 9
               State: <Active NotInstall>
               Local AS: 4170512532
               Age: 6:05
               Validation State: unverified
               Task: IS-IS
               Announcement bits (1): 0-BGP_RT_Background
               AS path: I
               Color: 32768
               Maximum bandwidth: 1000Mbps
               Reservable bandwidth: 1000Mbps
               Unreserved bandwidth by priority:
                  0   1000Mbps
                  1   1000Mbps
                  2   1000Mbps
                  3   1000Mbps
                  4   1000Mbps
                  5   1000Mbps
                  6   1000Mbps
                  7   1000Mbps
                Metric: 10
                TE Metric: 10
                LAN IPV4 Adj-SID -  Label: 299776, Flags: 0x30,
Weight: 0, Nbr: 10.220.1.83

PREFIX { Node { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 } {
IPv4:128.220.11.197/32 } ISIS-L1:0 }/1152 (1 entry, 1 announced) TSI: Page 0 idx
 0, (group ibgp type Internal) Type 1 val 0xa62f43c (adv_entry)
   Advertised metrics:
     Nexthop: Self
     Localpref: 100
```


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```
     AS path: [4170512532] I
     Communities:
Path PREFIX { Node { AS:4170512532 BGP-LS ID:4170512532 ISO:3245.3412.3456.00 }
{ IPv4:128.220.11.197/32 } ISIS-L1:0 } Vector len 4.  Val: 0
        *IS-IS  Preference: 15
                Level: 1
                Next hop type: Fictitious, Next hop index: 0
                Address: 0x95dfc64
                Next-hop reference count: 9
                State:<Active NotInstall>
                Local AS: 4170512532
                Age: 6:05
                Validation State: unverified
                Task: IS-IS
                Announcement bits (1): 0-BGP_RT_Background
                AS path: I
                             Prefix SID: 67, Flags: 0x40, Algo: 0
```

show route table l2circuit.0

user@host> **show route table l2circuit.0**

```
l2circuit.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.195:NoCtrlWord:1:1:Local/96
                   *[L2CKT/7] 00:50:47
                    > via so-0/1/2.0, Push 100049
                      via so-0/1/3.0, Push 100049
10.1.1.195:NoCtrlWord:1:1:Remote/96
                   *[LDP/9] 00:50:14
                      Discard
10.1.1.195:CtrlWord:1:2:Local/96
                   *[L2CKT/7] 00:50:47
                    > via so-0/1/2.0, Push 100049
                      via so-0/1/3.0, Push 100049
10.1.1.195:CtrlWord:1:2:Remote/96
                   *[LDP/9] 00:50:14
                      Discard
```

show route table lsdist.0

user@host> **show route table lsdist.0**

```
lsdist.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

LINK { Local { AS:4 BGP-LS ID:100 IPv4:4.4.4.4 }.{ IPv4:4.4.4.4 } Remote { AS:4
BGP-LS ID:100 IPv4:7.7.7.7 }.{ IPv4:7.7.7.7 } Undefined:0 }/1152
                   *[BGP-LS-EPE/170] 00:20:56
                      Fictitious
LINK { Local { AS:4 BGP-LS ID:100 IPv4:4.4.4.4 }.{ IPv4:4.4.4.4 IfIndex:339 }
Remote { AS:4 BGP-LS ID:100 IPv4:7.7.7.7 }.{ IPv4:7.7.7.7 } Undefined:0 }/1152

                   *[BGP-LS-EPE/170] 00:20:56
                      Fictitious
LINK { Local { AS:4 BGP-LS ID:100 IPv4:4.4.4.4 }.{ IPv4:50.1.1.1 } Remote { AS:4
 BGP-LS ID:100 IPv4:5.5.5.5 }.{ IPv4:50.1.1.2 } Undefined:0 }/1152
```

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```
                    *[BGP-LS-EPE/170] 00:20:56
                       Fictitious
```

show route table mpls

```
user@host> show route table mpls
mpls.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 00:13:55, metric 1
                      Receive
1                  *[MPLS/0] 00:13:55, metric 1
                      Receive
2                  *[MPLS/0] 00:13:55, metric 1
                      Receive
1024               *[VPN/0] 00:04:18
                      to table red.inet.0, Pop
```

show route table mpls extensive

```
user@host> show route table mpls extensive
100000 (1 entry, 1 announced)
TSI:
KRT in-kernel 100000 /36 -> {so-1/0/0.0}
        *LDP    Preference:   9
                Next hop:  via so-1/0/0.0, selected
                Pop
                State: <Active Int>
                Age: 29:50      Metric: 1
                Task: LDP
                Announcement bits (1): 0-KRT
                AS path: I
                Prefixes bound to route: 10.0.0.194/32
```

show route table mpls.0

```
user@host> show route table mpls.0
mpls.0: 18 destinations, 19 routes (18 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 11:39:56, metric 1
                      to table inet.0
0(S=0)             *[MPLS/0] 11:39:56, metric 1
                      to table mpls.0
1                  *[MPLS/0] 11:39:56, metric 1
                      Receive
2                  *[MPLS/0] 11:39:56, metric 1
                      to table inet6.0
2(S=0)             *[MPLS/0] 11:39:56, metric 1
                      to table mpls.0
13                 *[MPLS/0] 11:39:56, metric 1
                      Receive
303168             *[EVPN/7] 11:00:49, routing-instance pbbn10, route-type
Ingress-MAC, ISID 0
                      to table pbbn10.evpn-mac.0
303184             *[EVPN/7] 11:00:53, routing-instance pbbn10, route-type
```


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```
Ingress-IM, ISID 1000
                      to table pbbn10.evpn-mac.0
                    [EVPN/7] 11:00:53, routing-instance pbbn10, route-type
Ingress-IM, ISID 2000
                      to table pbbn10.evpn-mac.0
303264             *[EVPN/7] 11:00:53, remote-pe 100.100.100.2, routing-instance
 pbbn10, route-type Egress-IM, ISID 1000
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303280             *[EVPN/7] 11:00:53, remote-pe 100.100.100.2, routing-instance
 pbbn10, route-type Egress-IM, ISID 2000
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303328             *[EVPN/7] 11:00:49, remote-pe 100.100.100.2, routing-instance
 pbbn10, route-type Egress-MAC, ISID 0
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303344             *[EVPN/7] 11:00:49, remote-pe 100.100.100.2, routing-instance
 pbbn10, route-type Egress-MAC, ISID 0
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303360             *[EVPN/7] 11:00:47, routing-instance pbbn10, route-type
Egress-MAC, ISID 0, BMAC 00:26:88:5f:67:b0
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303376             *[EVPN/7] 11:00:47, routing-instance pbbn10, route-type
Egress-MAC, ISID 0, BMAC 00:51:51:51:51:51
                    > to 100.1.12.2 via xe-2/2/0.0, label-switched-path R0toR1
303392             *[EVPN/7] 11:00:35, remote-pe 100.100.100.3, routing-instance
 pbbn10, route-type Egress-MAC, ISID 0
                    > to 100.1.13.3 via ge-2/0/8.0, label-switched-path R0toR2
303408             *[EVPN/7] 11:00:35, remote-pe 100.100.100.3, routing-instance
 pbbn10, route-type Egress-MAC, ISID 0
                    > to 100.1.13.3 via ge-2/0/8.0, label-switched-path R0toR2
303424             *[EVPN/7] 11:00:33, routing-instance pbbn10, route-type
Egress-MAC, ISID 0, BMAC a8:d0:e5:5b:01:c8
                    > to 100.1.13.3 via ge-2/0/8.0, label-switched-path R0toR2
303440             *[EVPN/7] 11:00:33, routing-instance pbbn10, route-type
Egress-MAC, ISID 0, BMAC 00:52:52:52:52:52
                    > to 100.1.13.3 via ge-2/0/8.0, label-switched-path R0toR2
```

show route table mpls.0 detail (PTX Series)

user@host> **show route table mpls.0 detail**

```
ge-0/0/2.600 (1 entry, 1 announced)
        *L2VPN  Preference: 7
                Next hop type: Indirect
                Address: 0x9438f34
                Next-hop reference count: 2
                Next hop type: Router, Next hop index: 567
                Next hop: 10.0.0.1 via ge-0/0/1.0, selected
                Label operation: Push 299808
                Label TTL action: prop-ttl
                Load balance label: Label 299808:None;
                Session Id: 0x1
                Protocol next hop: 10.255.255.1
                Label operation: Push 299872 Offset: 252
                Label TTL action: no-prop-ttl
                Load balance label: Label 299872:Flow label PUSH;
                Composite next hop: 0x9438ed8 570 INH Session ID: 0x2
                Indirect next hop: 0x9448208 262142 INH Session ID: 0x2
                State: <Active Int>
                Age: 21         Metric2: 1
                Validation State: unverified
```

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```
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 2-Common L2 VC
                AS path: I
```

show route table mpls.0 ccc ge-0/0/1.1004 detail

user@host>**show route table mpls.0 ccc ge-0/0/1.1004 detail**

```
mpls.0: 121 destinations, 121 routes (121 active, 0 holddown, 0 hidden)
ge-0/0/1.1004 (1 entry, 1 announced)
        *EVPN   Preference: 7
                Next hop type: List, Next hop index: 1048577
                Address: 0xdc14770
                Next-hop reference count: 3
                Next hop: ELNH Address 0xd011e30
                    Next hop type: Indirect, Next hop index: 0
                    Address: 0xd011e30
                    Next-hop reference count: 3
                    Protocol next hop: 100.100.100.1
                    Label operation: Push 301952
                    Composite next hop: 0xd011dc0 754 INH Session ID: 0x146
                    Indirect next hop: 0xb69a890 1048615 INH Session ID: 0x146
                        Next hop type: Router, Next hop index: 735
                        Address: 0xd00e530
                        Next-hop reference count: 23
                        Next hop: 100.46.1.2 via ge-0/0/5.0
                        Label-switched-path pe4_to_pe1
                        Label operation: Push 300320
                        Label TTL action: prop-ttl
                        Load balance label: Label 300320: None;
                        Label element ptr: 0xd00e580
                        Label parent element ptr: 0x0
                        Label element references: 18
                        Label element child references: 16
                        Label element lsp id: 5
                Next hop: ELNH Address 0xd012070
                    Next hop type: Indirect, Next hop index: 0
                    Address: 0xd012070
                    Next-hop reference count: 3
                    Protocol next hop: 100.100.100.2
                    Label operation: Push 301888
                    Composite next hop: 0xd012000 755 INH Session ID: 0x143
                    Indirect next hop: 0xb69a9a0 1048641 INH Session ID: 0x143
                        Next hop type: Router, Next hop index: 716
                        Address: 0xd00e710
                        Next-hop reference count: 23
                        Next hop: 100.46.1.2 via ge-0/0/5.0
                        Label-switched-path pe4_to_pe2
                        Label operation: Push 300304
                        Label TTL action: prop-ttl
                        Load balance label: Label 300304: None;
                        Label element ptr: 0xd00e760
                        Label parent element ptr: 0x0
                        Label element references: 15
                        Label element child references: 13
                        Label element lsp id: 6
                Next hop: ELNH Address 0xd0121f0, selected
                    Next hop type: Indirect, Next hop index: 0
                    Address: 0xd0121f0
                    Next-hop reference count: 3
```


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```
                    Protocol next hop: 100.100.100.3
                    Label operation: Push 301984
                    Composite next hop: 0xd012180 756 INH Session ID: 0x145
                    Indirect next hop: 0xb69aab0 1048642 INH Session ID: 0x145
                        Next hop type: Router, Next hop index: 801
                        Address: 0xd010ed0
                        Next-hop reference count: 32
                        Next hop: 100.46.1.2 via ge-0/0/5.0
                        Label-switched-path pe4_to_pe3
                        Label operation: Push 300336
                        Label TTL action: prop-ttl
                        Load balance label: Label 300336: None;
                        Label element ptr: 0xd0108c0
                        Label parent element ptr: 0x0
                        Label element references: 22
                        Label element child references: 20
                        Label element lsp id: 7
                State: < Active Int >
                Age: 2:06:50
                Validation State: unverified
                Task: evpn global task
                Announcement bits (1): 1-KRT
                AS path: I
```

show route table mpls.0 protocol evpn

user@host>**show route table mpls.0 protocol evpn**

```
mpls.0: 121 destinations, 121 routes (121 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

299872             *[EVPN/7] 02:30:58, routing-instance mhevpn, route-type
Ingress-IM, vlan-id 10
                      to table mhevpn.evpn-mac.0
300016             *[EVPN/7] 02:30:38, routing-instance VS-1, route-type
Ingress-IM, vlan-id 110
                      to table VS-1.evpn-mac.0
300032             *[EVPN/7] 02:30:38, routing-instance VS-1, route-type
Ingress-IM, vlan-id 120
                      to table VS-1.evpn-mac.0
300048             *[EVPN/7] 02:30:38, routing-instance VS-1, route-type
Ingress-IM, vlan-id 130
                      to table VS-1.evpn-mac.0
300064             *[EVPN/7] 02:30:38, routing-instance VS-2, route-type
Ingress-IM, vlan-id 210
                      to table VS-2.evpn-mac.0
300080             *[EVPN/7] 02:30:38, routing-instance VS-2, route-type
Ingress-IM, vlan-id 220
                      to table VS-2.evpn-mac.0
300096             *[EVPN/7] 02:30:38, routing-instance VS-2, route-type
Ingress-IM, vlan-id 230
                      to table VS-2.evpn-mac.0
300112             *[EVPN/7] 02:27:06, routing-instance mhevpn, route-type
Egress-MAC, ESI 00:44:44:44:44:44:44:44:44:44
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300128             *[EVPN/7] 02:29:22, routing-instance mhevpn, route-type
Ingress-Aliasing
                      to table mhevpn.evpn-mac.0
300144             *[EVPN/7] 02:27:06, routing-instance VS-1, route-type
Egress-MAC, ESI 00:44:44:44:44:44:44:44:44:44
```

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```
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300160             *[EVPN/7] 02:29:22, routing-instance VS-1, route-type
Ingress-Aliasing
                      to table VS-1.evpn-mac.0
300176             *[EVPN/7] 02:27:07, routing-instance VS-2, route-type
Egress-MAC, ESI 00:44:44:44:44:44:44:44:44:44
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300192             *[EVPN/7] 02:29:22, routing-instance VS-2, route-type
Ingress-Aliasing
                      to table VS-2.evpn-mac.0
300208             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-1, route-type Egress-IM, vlan-id 120
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300224             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 mhevpn, route-type Egress-IM, vlan-id 10
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300240             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-1, route-type Egress-IM, vlan-id 110
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300256             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-1, route-type Egress-IM, vlan-id 130
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300272             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-2, route-type Egress-IM, vlan-id 210
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300288             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-2, route-type Egress-IM, vlan-id 220
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300304             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-2, route-type Egress-IM, vlan-id 230
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300320             *[EVPN/7] 02:27:06, routing-instance VS-1, route-type
Egress-MAC, ESI 00:11:11:11:11:11:11:11:11:11
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300336             *[EVPN/7] 02:27:06, routing-instance VS-1, route-type
Egress-MAC, ESI 00:33:33:33:33:33:33:33:33:33
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300368             *[EVPN/7] 02:27:07, routing-instance VS-2, route-type
Egress-MAC, ESI 00:33:33:33:33:33:33:33:33:33
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300384             *[EVPN/7] 02:27:07, routing-instance VS-2, route-type
Egress-MAC, ESI 00:11:11:11:11:11:11:11:11:11
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300416             *[EVPN/7] 02:27:06, routing-instance mhevpn, route-type
Egress-MAC, ESI 00:33:33:33:33:33:33:33:33:33
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
```


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```
300432             *[EVPN/7] 02:27:06, routing-instance mhevpn, route-type
Egress-MAC, ESI 00:11:11:11:11:11:11:11:11:11
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                     to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                     to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
300480             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-1, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300496             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-2, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300560             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-1, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300592             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 VS-2, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
300608             *[EVPN/7] 02:29:23
                    > via ge-0/0/1.1001, Pop
300624             *[EVPN/7] 02:29:23
                    > via ge-0/0/1.2001, Pop
301232             *[EVPN/7] 02:29:17
                    > via ge-0/0/1.1002, Pop
301296             *[EVPN/7] 02:29:10
                    > via ge-0/0/1.1003, Pop
301312             *[EVPN/7] 02:27:06
                    > via ae10.2003, Pop
                     to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301360             *[EVPN/7] 02:29:01
                    > via ge-0/0/1.1004, Pop
301408             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 vpws1004, route-type Egress, vlan-id 2004
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
301456             *[EVPN/7] 02:27:06
                    > via ae10.1010, Pop
                     to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301552             *[EVPN/7] 02:27:07, routing-instance VS-1, route-type
Egress-MAC, ESI 00:22:22:22:22:22:22:22:22:22
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301568             *[EVPN/7] 02:27:07, routing-instance VS-2, route-type
Egress-MAC, ESI 00:22:22:22:22:22:22:22:22:22
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301648             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 vpws1010, route-type Egress, vlan-id 2010
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
301664             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 mhevpn, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
301680             *[EVPN/7] 02:27:07, remote-pe 100.100.100.2, routing-instance
 mhevpn, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
301696             *[EVPN/7] 02:27:07, routing-instance mhevpn, route-type
Egress-MAC, ESI 00:22:22:22:22:22:22:22:22:22
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301712             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-2, route-type Egress-MAC
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301728             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
```

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```
 VS-1, route-type Egress-MAC
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301744              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-2, route-type Egress-IM, vlan-id 230
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301760              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 vpws1010, route-type Egress, vlan-id 2010
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301776              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 mhevpn, route-type Egress-MAC
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301792              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-1, route-type Egress-IM, vlan-id 130
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301808              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 vpws1004, route-type Egress, vlan-id 2004
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301824              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 mhevpn, route-type Egress-IM, vlan-id 10
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301840              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 vpws1002, route-type Egress, vlan-id 2002
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301856              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 vpws1003, route-type Egress, vlan-id 2003
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301872              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 vpws1003, route-type Egress Protection, vlan-id 2003
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301888              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 vpws1010, route-type Egress Protection, vlan-id 1010
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301904              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-2, route-type Egress-IM, vlan-id 220
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301920              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-2, route-type Egress-IM, vlan-id 210
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
301936              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-IM, vlan-id 230
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301952              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-SH, vlan-id 230
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301968              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-IM, vlan-id 220
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
301984              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-SH, vlan-id 220
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302000              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-IM, vlan-id 210
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302016              *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-SH, vlan-id 210
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302032              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-2, route-type Egress-MAC
                    > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302048              *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
```


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```
 VS-2, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302064             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302080             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-2, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302096             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-1, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302112             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-1, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302128             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302144             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302160             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-1, route-type Egress-IM, vlan-id 120
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302176             *[EVPN/7] 02:27:07, remote-pe 100.100.100.1, routing-instance
 VS-1, route-type Egress-IM, vlan-id 110
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302192             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-IM, vlan-id 130
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302208             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-SH, vlan-id 130
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302224             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-IM, vlan-id 120
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302240             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-SH, vlan-id 120
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302256             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-IM, vlan-id 110
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302272             *[EVPN/7] 02:27:07, remote-pe 100.100.100.3, routing-instance
 VS-1, route-type Egress-SH, vlan-id 110
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302288             *[EVPN/7] 02:27:06, remote-pe 100.100.100.1, routing-instance
 mhevpn, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302304             *[EVPN/7] 02:27:06, remote-pe 100.100.100.1, routing-instance
 mhevpn, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302320             *[EVPN/7] 02:27:06, remote-pe 100.100.100.3, routing-instance
 mhevpn, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302336             *[EVPN/7] 02:27:06, remote-pe 100.100.100.3, routing-instance
 mhevpn, route-type Egress-MAC
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302352             *[EVPN/7] 02:27:06, remote-pe 100.100.100.3, routing-instance
 vpws1004, route-type Egress, vlan-id 2004
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302368             *[EVPN/7] 02:27:06, remote-pe 100.100.100.3, routing-instance
```

```
 mhevpn, route-type Egress-IM, vlan-id 10
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302384             *[EVPN/7] 02:27:06, remote-pe 100.100.100.3, routing-instance
 mhevpn, route-type Egress-SH, vlan-id 10
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302400             *[EVPN/7] 02:26:21
                    > via ge-0/0/1.3001, Pop
302432             *[EVPN/7] 02:26:21, remote-pe 100.100.100.3, routing-instance
 vpws3001, route-type Egress, vlan-id 40000
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302448             *[EVPN/7] 02:26:21, remote-pe 100.100.100.1, routing-instance
 vpws3001, route-type Egress, vlan-id 40000
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302464             *[EVPN/7] 02:26:20, remote-pe 100.100.100.2, routing-instance
 vpws3001, route-type Egress, vlan-id 40000
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
302480             *[EVPN/7] 02:26:14
                    > via ge-0/0/1.3016, Pop
302512             *[EVPN/7] 02:26:14, remote-pe 100.100.100.1, routing-instance
 vpws3016, route-type Egress, vlan-id 40016
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302528             *[EVPN/7] 02:26:14, remote-pe 100.100.100.2, routing-instance
 vpws3016, route-type Egress, vlan-id 40016
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
302560             *[EVPN/7] 02:26:06
                    > via ae10.3011, Pop
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302592             *[EVPN/7] 02:26:07, remote-pe 100.100.100.1, routing-instance
 vpws3011, route-type Egress, vlan-id 401100
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302608             *[EVPN/7] 02:26:07, remote-pe 100.100.100.2, routing-instance
 vpws3011, route-type Egress, vlan-id 401100
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
302624             *[EVPN/7] 02:26:07, remote-pe 100.100.100.3, routing-instance
 vpws3011, route-type Egress Protection, vlan-id 301100
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302656             *[EVPN/7] 02:25:59
                    > via ae10.3006, Pop
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302688             *[EVPN/7] 02:26:00, remote-pe 100.100.100.2, routing-instance
 vpws3006, route-type Egress, vlan-id 400600
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2
302704             *[EVPN/7] 02:26:00, remote-pe 100.100.100.1, routing-instance
 vpws3006, route-type Egress, vlan-id 400600
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
302720             *[EVPN/7] 02:25:59, remote-pe 100.100.100.3, routing-instance
 vpws3006, route-type Egress, vlan-id 400600
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
302736             *[EVPN/7] 02:25:59, remote-pe 100.100.100.3, routing-instance
 vpws3006, route-type Egress Protection, vlan-id 300600
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
ge-0/0/1.1001      *[EVPN/7] 02:29:23
                    > via ge-0/0/1.2001
ge-0/0/1.2001      *[EVPN/7] 02:29:23
                    > via ge-0/0/1.1001
ge-0/0/1.1002      *[EVPN/7] 02:27:06
                  > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
ae10.2003          *[EVPN/7] 02:29:10
                    > via ge-0/0/1.1003
ge-0/0/1.1003      *[EVPN/7] 02:27:06
```


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```
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3

                    > via ae10.2003
ge-0/0/1.1004      *[EVPN/7] 02:27:06
                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
ae10.1010          *[EVPN/7] 02:27:06
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
ge-0/0/1.3001      *[EVPN/7] 02:26:20
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
ge-0/0/1.3016      *[EVPN/7] 02:26:13
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
ae10.3011          *[EVPN/7] 02:26:06
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1
ae10.3006          *[EVPN/7] 02:25:59
                   > to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe1

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe2

                    to 100.46.1.2 via ge-0/0/5.0, label-switched-path pe4_to_pe3
```

show route table mpls.0 protocol ospf

user@host> **show route table mpls.0 protocol ospf**

```
mpls.0: 29 destinations, 29 routes (29 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

299952             *[L-OSPF/10] 23:59:42, metric 0
                    > to 10.0.10.70 via lt-1/2/0.14, Pop
                      to 10.0.6.60 via lt-1/2/0.12, Swap 800070, Push 800030(top)
299952(S=0)        *[L-OSPF/10] 23:59:42, metric 0
                    > to 10.0.10.70 via lt-1/2/0.14, Pop
                      to 10.0.6.60 via lt-1/2/0.12, Swap 800070, Push 800030(top)
299968             *[L-OSPF/10] 23:59:48, metric 0
                    > to 10.0.6.60 via lt-1/2/0.12, Pop
```

show route table mpls.0 extensive (PTX Series)

user@host> **show route table mpls.0 extensive**

```
ge-0/0/2.600 (1 entry, 1 announced)
TSI:
KRT in-kernel ge-0/0/2.600.0      /32 -> {composite(570)}
        *L2VPN  Preference: 7
                Next hop type: Indirect
                Address: 0x9438f34
                Next-hop reference count: 2
                Next hop type: Router, Next hop index: 567
                Next hop: 10.0.0.1 via ge-0/0/1.0, selected
                Label operation: Push 299808
                Label TTL action: prop-ttl
```

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```
                Load balance label: Label 299808:None;
                Session Id: 0x1
                Protocol next hop: 10.255.255.1
                Label operation: Push 299872 Offset: 252
                Label TTL action: no-prop-ttl
                Load balance label: Label 299872:Flow label PUSH;
                Composite next hop: 0x9438ed8 570 INH Session ID: 0x2
                Indirect next hop: 0x9448208 262142 INH Session ID: 0x2
                State: <Active Int>
                Age: 47         Metric2: 1
                Validation State: unverified
                Task: Common L2 VC
                Announcement bits (2): 0-KRT 2-Common L2 VC
                AS path: I
                Composite next hops: 1
                        Protocol next hop: 10.255.255.1 Metric: 1
                        Label operation: Push 299872 Offset: 252
                        Label TTL action: no-prop-ttl
                        Load balance label: Label 299872:Flow label PUSH;
                        Composite next hop: 0x9438ed8 570 INH Session ID: 0x2
                        Indirect next hop: 0x9448208 262142 INH Session ID: 0x2
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.0.0.1 via ge-0/0/1.0
                                Session Id: 0x1
                        10.255.255.1/32 Originating RIB: inet.3
                          Metric: 1                     Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.0.0.1 via ge-0/0/1.0
```

show route table mpls.0 (RSVP Route—Transit LSP)

```
user@host> show route table mpls.0

mpls.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

0                  *[MPLS/0] 00:37:31, metric 1
                      Receive
1                  *[MPLS/0] 00:37:31, metric 1
                      Receive
2                  *[MPLS/0] 00:37:31, metric 1
                      Receive
13                 *[MPLS/0] 00:37:31, metric 1
                      Receive
300352             *[RSVP/7/1] 00:08:00, metric 1
                   > to 10.64.0.106 via ge-1/0/1.0, label-switched-path lsp1_p2p
300352(S=0)        *[RSVP/7/1] 00:08:00, metric 1
                   > to 10.64.0.106 via ge-1/0/1.0, label-switched-path lsp1_p2p
300384             *[RSVP/7/2] 00:05:20, metric 1
                    > to 10.64.1.106 via ge-1/0/0.0, Pop
300384(S=0)        *[RSVP/7/2] 00:05:20, metric 1
                    > to 10.64.1.106 via ge-1/0/0.0, Pop
```

show route table vpls_1 detail

```
user@host> show route table vpls_1 detail
```


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```
vpls_1.l2vpn.0: 1 destinations, 1 routes (1 active, 0 holddown, 0 hidden)
Restart Complete

172.16.1.11:1000:1:1/96 (1 entry, 1 announced)
*L2VPN Preference: 170/-1
Receive table: vpls_1.l2vpn.0
Next-hop reference count: 2
State: <Active Int Ext>
Age: 4:29:47 Metric2: 1
Task: vpls_1-l2vpn
Announcement bits (1): 1-BGP.0.0.0.0+179
AS path: I
Communities: Layer2-info: encaps:VPLS, control flags:Site-Down
Label-base: 800000, range: 8, status-vector: 0xFF
```

show route table vpn-a

```
user@host> show route table vpn-a
vpn-a.l2vpn.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)

+ = Active Route, - = Last Active, * = Both
192.168.16.1:1:1:1/96
                   *[VPN/7] 05:48:27
                     Discard
192.168.24.1:1:2:1/96
                   *[BGP/170] 00:02:53, localpref 100, from 192.168.24.1
                      AS path: I
                    > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
192.168.24.1:1:3:1/96
                   *[BGP/170] 00:02:53, localpref 100, from 192.168.24.1
                      AS path: I
                    > to 10.0.16.2 via fe-0/0/1.0, label-switched-path am
```

show route table vpn-a.mdt.0

```
user@host> show route table vpn-a.mdt.0
vpn-a.mdt.0: 3 destinations, 3 routes (3 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:1:0:10.255.14.216:232.1.1.1/144
                   *[MVPN/70] 01:23:05, metric2 1
                      Indirect
1:1:1:10.255.14.218:232.1.1.1/144
                   *[BGP/170] 00:57:49, localpref 100, from 10.255.14.218
                      AS path: I
                    > via so-0/0/0.0, label-switched-path r0e-to-r1
1:1:2:10.255.14.217:232.1.1.1/144
                   *[BGP/170] 00:57:49, localpref 100, from 10.255.14.217
                      AS path: I
> via so-0/0/1.0, label-switched-path r0-to-r2
```

show route table VPN-A detail

```
user@host>  show route table VPN-A detail
VPN-AB.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
10.255.179.9/32 (1 entry, 1 announced)
```

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```
       *BGP    Preference: 170/-101
               Route Distinguisher: 10.255.179.13:200
               Next hop type: Indirect
               Next-hop reference count: 5
               Source: 10.255.179.13
               Next hop type: Router, Next hop index: 732
               Next hop: 10.39.1.14 via fe-0/3/0.0, selected
               Label operation: Push 299824, Push 299824(top)
               Protocol next hop: 10.255.179.13
               Push 299824
               Indirect next hop: 8f275a0 1048574
               State: (Secondary Active Int Ext)
               Local AS: 1 Peer AS: 1
               Age: 3:41:06 Metric: 1 Metric2: 1
               Task: BGP_1.10.255.179.13+64309
               Announcement bits (2): 0-KRT 1-BGP RT Background
               AS path: I
               Communities: target:1:200 rte-type:0.0.0.0:1:0
               Import Accepted
               VPN Label: 299824 TTL Action: vrf-ttl-propagate
               Localpref: 100
               Router ID: 10.255.179.13
               Primary Routing Table bgp.l3vpn.0
```

show route table VPN-AB.inet.0

```
user@host> show route table VPN-AB.inet.0
```

```
     VPN-AB.inet.0: 8 destinations, 8 routes (8 active, 0 holddown, 0 hidden)
     + = Active Route, - = Last Active, * = Both

     10.39.1.0/30       *[OSPF/10] 00:07:24, metric 1
                         > via so-7/3/1.0
     10.39.1.4/30       *[Direct/0] 00:08:42
                         > via so-5/1/0.0
     10.39.1.6/32       *[Local/0] 00:08:46
                           Local
     10.255.71.16/32    *[Static/5] 00:07:24
                         > via so-2/0/0.0
     10.255.71.17/32    *[BGP/170] 00:07:24, MED 1, localpref 100, from
     10.255.71.15
                           AS path: I
                         > via so-2/1/0.0, Push 100020, Push 100011(top)
     10.255.71.18/32    *[BGP/170] 00:07:24, MED 1, localpref 100, from
     10.255.71.15
                           AS path: I
                         > via so-2/1/0.0, Push 100021, Push 100011(top)
     10.255.245.245/32  *[BGP/170] 00:08:35, localpref 100
                           AS path: 2 I
                         > to 10.39.1.5 via so-5/1/0.0
     10.255.245.246/32  *[OSPF/10] 00:07:24, metric 1
                         > via so-7/3/1.0
```

show route table VPN_blue.mvpn-inet6.0

```
user@host> show route table VPN_blue.mvpn-inet6.0
```

```
vpn_blue.mvpn-inet6.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```


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```
1:10.255.2.202:65536:10.255.2.202/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.202
                      AS path: I
                    > via so-0/1/3.0
1:10.255.2.203:65536:10.255.2.203/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.203
                      AS path: I
                    > via so-0/1/0.0
1:10.255.2.204:65536:10.255.2.204/432
                   *[MVPN/70] 00:57:23, metric2 1
                      Indirect
5:10.255.2.202:65536:128:::192.168.90.2:128:ffff::1/432
                   *[BGP/170] 00:02:37, localpref 100, from 10.255.2.202
                      AS path: I
                    > via so-0/1/3.0
6:10.255.2.203:65536:64500:128:::10.12.53.12:128:ffff::1/432
                   *[PIM/105] 00:02:37
                      Multicast (IPv6)
7:10.255.2.202:65536:64500:128:::192.168.90.2:128:ffff::1/432
                   *[MVPN/70] 00:02:37, metric2 1
                      Indirect
```

show route table vrf1.mvpn.0 extensive

```
user@host> show route table vrf1.mvpn.0 extensive
```

```
1:10.255.50.77:1:10.255.50.77/240 (1 entry, 1 announced)
        *MVPN   Preference: 70
                PMSI: Flags 0x0: Label 0: RSVP-TE:
Session_13[10.255.50.77:0:25624:10.255.50.77]
                Next hop type: Indirect
                Address: 0xbb2c944
                Next-hop reference count: 360
                Protocol next hop: 10.255.50.77
                Indirect next hop: 0x0 - INH Session ID: 0x0
                State: <Active Int Ext>
                Age: 53:03      Metric2: 1
                Validation State: unverified
                Task: mvpn global task
                Announcement bits (3): 0-PIM.vrf1 1-mvpn global task 2-rt-export

                AS path: I
```

show route table inetflow detail

```
user@host> show route table inetflow detail
```

```
inetflow.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
10.12.44.1,*/48 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Next-hop reference count: 2
                State: <Active Ext>
                Local AS: 64502 Peer AS: 64500
                Age: 4
                Task: BGP_64500.10.12.99.5+3792
                Announcement bits (1): 0-Flow
                AS path: 64500 I
                Communities: traffic-rate:0:0
```

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```
                Validation state: Accept, Originator: 10.12.99.5
                Via: 10.12.44.0/24, Active
                Localpref: 100
                Router ID: 10.255.71.161

10.12.56.1,*/48 (1 entry, 1 announced)
        *Flow   Preference: 5
                Next-hop reference count: 2
                State: <Active>
                Local AS: 64502
                Age: 6:30
                Task: RT Flow
                Announcement bits (2): 0-Flow 1-BGP.0.0.0.0+179
                AS path: I
                Communities: 1:1
```

user@host> **show route table green.l2vpn.0** (VPLS Multihoming with FEC 129)

```
green.l2vpn.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

10.1.1.2:100:10.1.1.2/96 AD
                   *[VPLS/170] 1d 03:11:03, metric2 1
                         Indirect
10.1.1.4:100:10.1.1.4/96 AD
                   *[BGP/170] 1d 03:11:02, localpref 100, from 10.1.1.4
                      AS path: I, validation-state: unverified
                    >    via ge-1/2/1.5
10.1.1.2:100:1:0/96 MH
                   *[VPLS/170] 1d 03:11:03, metric2 1
                         Indirect
10.1.1.4:100:1:0/96 MH
                   *[BGP/170] 1d 03:11:02, localpref 100, from 10.1.1.4
                      AS path: I, validation-state: unverified
                    >    via ge-1/2/1.5
10.1.1.4:NoCtrlWord:5:100:100:10.1.1.2:10.1.1.4/176
                   *[VPLS/7] 1d 03:11:02, metric2 1
                    >    via ge-1/2/1.5
10.1.1.4:NoCtrlWord:5:100:100:10.1.1.4:10.1.1.2/176
                   *[LDP/9] 1d 03:11:02
                         Discard
```

user@host> **show route table red extensive**

```
red.inet.0: 364481 destinations, 714087 routes (364480 active, 48448 holddown, 1
 hidden)
10.0.0.0/32 (3 entries, 1 announced)
        State: <OnList CalcForwarding>
TSI:
KRT in-kernel 10.0.0.0/32 -> {composite(1048575)} Page 0 idx 1 Type 1 val 0x934342c

    Nexthop: Self
    AS path: [2] I
    Communities: target:2:1
Path 10.0.0.0 from 10.3.0.0 Vector len 4.  Val: 1
        @BGP    Preference: 170/-1
                Route Distinguisher: 2:1
                Next hop type: Indirect
                Address: 0x258059e4
```


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```
                Next-hop reference count: 2
                Source: 2.2.0.0
                Next hop type: Router
                Next hop: 10.1.1.1 via ge-1/1/9.0, selected
                Label operation: Push 707633
                Label TTL action: prop-ttl
                Session Id: 0x17d8
                Protocol next hop: 10.2.0.0
                Push 16
                Composite next hop: 0x25805988 - INH Session ID: 0x193c
                Indirect next hop: 0x23eea900 - INH Session ID: 0x193c
                State: <Secondary Active Int Ext ProtectionPath ProtectionCand>
                Local AS:     2 Peer AS:     2
                Age: 23         Metric2: 35
                Validation State: unverified
                Task: BGP_172.16.2.0.0+34549
                AS path: I
                Communities: target:2:1
                Import Accepted
                VPN Label: 16
                Localpref: 0
                Router ID: 10.2.0.0
                Primary Routing Table bgp.l3vpn.0
                Composite next hops: 1
                        Protocol next hop: 10.2.0.0 Metric: 35
                        Push 16
                        Composite next hop: 0x25805988 - INH Session ID: 0x193c
                        Indirect next hop: 0x23eea900 - INH Session ID: 0x193c
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.1.1.1 via ge-1/1/9.0
                                Session Id: 0x17d8
                        2.2.0.0/32 Originating RIB: inet.3
                          Metric: 35                      Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.1.1.1 via ge-1/1/9.0
        BGP     Preference: 170/-1
                Route Distinguisher: 2:1
                Next hop type: Indirect
                Address: 0x9347028
                Next-hop reference count: 3
                Source: 10.3.0.0
                Next hop type: Router, Next hop index: 702
                Next hop: 10.1.4.2 via ge-1/0/0.0, selected
                Label operation: Push 634278
                Label TTL action: prop-ttl
                Session Id: 0x17d9
                Protocol next hop: 10.3.0.0
                Push 16
                Composite next hop: 0x93463a0 1048575 INH Session ID: 0x17da
                Indirect next hop: 0x91e8800 1048574 INH Session ID: 0x17da
                State: <Secondary NotBest Int Ext ProtectionPath ProtectionCand>

                Inactive reason: Not Best in its group - IGP metric
                Local AS:     2 Peer AS:     2
                Age: 3:34       Metric2: 70
                Validation State: unverified
                Task: BGP_172.16.3.0.0+32805
                Announcement bits (2): 0-KRT 1-BGP_RT_Background
                AS path: I
```

```
                Communities: target:2:1
                Import Accepted
                VPN Label: 16
                Localpref: 0
                Router ID: 10.3.0.0
                Primary Routing Table bgp.l3vpn.0
                Composite next hops: 1
                        Protocol next hop: 10.3.0.0 Metric: 70
                        Push 16
                        Composite next hop: 0x93463a0 1048575 INH Session ID:
0x17da
                        Indirect next hop: 0x91e8800 1048574 INH Session ID:
0x17da
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.1.4.2 via ge-1/0/0.0
                                Session Id: 0x17d9
                        10.3.0.0/32 Originating RIB: inet.3
                          Metric: 70                      Node path count: 1
                          Forwarding nexthops: 1
                                Nexthop: 10.1.4.2 via ge-1/0/0.0
        #Multipath Preference: 255
                Next hop type: Indirect
                Address: 0x24afca30
                Next-hop reference count: 1
                Next hop type: Router
                Next hop: 10.1.1.1 via ge-1/1/9.0, selected
                Label operation: Push 707633
                Label TTL action: prop-ttl
                Session Id: 0x17d8
                Next hop type: Router, Next hop index: 702
                Next hop: 10.1.4.2 via ge-1/0/0.0
                Label operation: Push 634278
                Label TTL action: prop-ttl
                Session Id: 0x17d9
                Protocol next hop: 10.2.0.0
                Push 16
                Composite next hop: 0x25805988 - INH Session ID: 0x193c
               Indirect next hop: 0x23eea900 - INH Session ID: 0x193c Weight 0x1

                Protocol next hop: 10.3.0.0
                Push 16
                Composite next hop: 0x93463a0 1048575 INH Session ID: 0x17da
              Indirect next hop: 0x91e8800 1048574 INH Session ID: 0x17da Weight
 0x4000
                State: <ForwardingOnly Int Ext>
                Inactive reason: Forwarding use only
                Age: 23         Metric2: 35
                Validation State: unverified
                Task: RT
                AS path: I
                Communities: target:2:1
```

show route table bgp.evpn.0 extensive |no-more (EVPN)

```
show route table bgp.evpn.0 extensive | no-more
```

```
bgp.evpn.0: 6 destinations, 6 routes (6 active, 0 holddown, 0 hidden)
2:1000:10::100::00:aa:aa:aa:aa:aa/304 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
```


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```
                Route Distinguisher: 1000:10
                Next hop type: Indirect
                Address: 0x9420fd0
                Next-hop reference count: 12
                Source: 10.2.3.4
                Protocol next hop: 10.2.3.4
                Indirect next hop: 0x2 no-forward INH Session ID: 0x0
         State: Local AS: 17  Peer AS:17  Age:21:12  Metric2:1  Validation State:
 unverified
                Task: BGP_17.1.2.3.4+50756
                AS path: I
                Communities: target:1111:8388708 encapsulation0:0:0:0:3
                Import Accepted
                Route Label: 100
                ESI: 00:00:00:00:00:00:00:00:00:00
                Localpref: 100
                Router ID: 10.2.3.4
                Secondary Tables: default-switch.evpn.0
                Indirect next hops: 1
                        Protocol next hop: 10.2.3.4 Metric: 1
                        Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.10.10.1 via xe-0/0/1.0
                                Session Id: 0x2
                        1.2.3.4/32 Originating RIB: inet.0
                          Metric: 1                     Node path count: 1
                          Forwarding nexthops: 2
                                Nexthop: 10.92.78.102 via em0.0

2:1000:10::200::00:bb:bb:bb:bb:bb/304 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 1000:10
                Next hop type: Indirect
                Address: 0x9420fd0
                Next-hop reference count: 12
                Source: 10.2.3.4
                Protocol next hop: 10.2.3.4
                Indirect next hop: 0x2 no-forward INH Session ID: 0x0
          State: Local AS:17  Peer AS:17  Age:19:43  Metric2:1  Validation
State:unverified
                Task: BGP_17.1.2.3.4+50756
                AS path: I
                Communities: target:2222:22 encapsulation0:0:0:0:3
                Import Accepted
                Route Label: 200
                ESI: 00:00:00:00:00:00:00:00:00:00
                Localpref: 100
                Router ID: 10.2.3.4
                Secondary Tables: default-switch.evpn.0
                Indirect next hops: 1
                        Protocol next hop: 10.2.3.4 Metric: 1
                        Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.10.10.1 via xe-0/0/1.0
                                Session Id: 0x2
                        10.2.3.4/32 Originating RIB: inet.0
                          Metric: 1                     Node path count: 1
                          Forwarding nexthops: 2
```

```
                                Nexthop: 10.92.78.102 via em0.0

2:1000:10::300::00:cc:cc:cc:cc:cc/304 (1 entry, 0 announced)
       *BGP    Preference: 170/-101
               Route Distinguisher: 1000:10
               Next hop type: Indirect
               Address: 0x9420fd0
               Next-hop reference count: 12
               Source: 10.2.3.4
               Protocol next hop: 10.2.3.4
               Indirect next hop: 0x2 no-forward INH Session ID: 0x0
         State: Local AS:17  Peer AS:17  Age:17:21  Metric2:1  Validation State:
 unverified  Task: BGP 17,1,2,3,3,4+50756
          AS path: I
               Communities: target:3333:33 encapsulation0:0:0:0:3
               Import Accepted
               Route Label: 300
               ESI: 00:00:00:00:00:00:00:00:00:00
               Localpref: 100
               Router ID: 10.2.3.4
               Secondary Tables: default-switch.evpn.0
               Indirect next hops: 1
                       Protocol next hop: 10.2.3.4 Metric: 1
                       Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                       Indirect path forwarding next hops: 1
                               Next hop type: Router
                               Next hop: 10.10.10.1 via xe-0/0/1.0
                               Session Id: 0x2
                       10.2.3.4/32 Originating RIB: inet.0
                         Metric: 1                       Node path count: 1
                         Forwarding nexthops: 2
                               Nexthop: 10.92.78.102 via em0.0

3:1000:10::100::1.2.3.4/304 (1 entry, 0 announced)
       *BGP    Preference: 170/-101
               Route Distinguisher: 1000:10
               PMSI: Flags 0x0: Label 100: Type INGRESS-REPLICATION 1.2.3.4
               Next hop type: Indirect
               Address: 0x9420fd0
               Next-hop reference count: 12
               Source: 10.2.3.4
               Protocol next hop: 10.2.3.4
               Indirect next hop: 0x2 no-forward INH Session ID: 0x0
         State: Local AS:17  Peer AS:17 Age:37:01  Metric2:1  Validation State:
 unverified  Task: BGP 17.1.2.3.4+50756
               AS path: I
               Communities: target:1111:8388708 encapsulation0:0:0:0:3
               Import Accepted
               Localpref: 100
               Router ID: 10.2.3.4
               Secondary Tables: default-switch.evpn.0
               Indirect next hops: 1
                       Protocol next hop: 10.2.3.4 Metric: 1
                       Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                       Indirect path forwarding next hops: 1
                               Next hop type: Router
                               Next hop: 10.10.10.1 via xe-0/0/1.0
                               Session Id: 0x2
                       10.2.3.4/32 Originating RIB: inet.0
                         Metric: 1                       Node path count: 1
```


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```
                          Forwarding nexthops: 2
                                Nexthop: 10.92.78.102 via em0.0

3:1000:10::200::1.2.3.4/304 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 1000:10
                PMSI: Flags 0x0: Label 200: Type INGRESS-REPLICATION 1.2.3.4
                Next hop type: Indirect
                Address: 0x9420fd0
                Next-hop reference count: 12
                Source: 10.2.3.4
                Protocol next hop: 10.2.3.4
                Indirect next hop: 0x2 no-forward INH Session ID: 0x0
          State: Local AS: 17 Peer AS: 17   Age:35:22  Metric2:1  Validation
State:unverified  Task: BGP 17.1.2.3.4+50756
           AS path:I  Communities: target:2222:22 encapsulation):0:0:0:0:3

Import Accepted
                Localpref: 100
                Router ID: 10.2.3.4
                Secondary Tables: default-switch.evpn.0
                Indirect next hops: 1
                        Protocol next hop: 10.2.3.4 Metric: 1
                        Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.10.10.1 via xe-0/0/1.0
                                Session Id: 0x2
                        10.2.3.4/32 Originating RIB: inet.0
                          Metric: 1                       Node path count: 1
                          Forwarding nexthops: 2
                                Nexthop: 10.92.78.102 via em0.0

3:1000:10::300::1.2.3.4/304 (1 entry, 0 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 1000:10
                PMSI: Flags 0x0: Label 300: Type INGRESS-REPLICATION 1.2.3.4
                Next hop type: Indirect
                Address: 0x9420fd0
                Next-hop reference count: 12
                Source: 10.2.3.4
                Protocol next hop: 10.2.3.4
                Indirect next hop: 0x2 no-forward INH Session ID: 0x0
         State: Local AS: 17 Peer AS:  17  Age 35:22 Metric2:1  Validation State:
 unverified   Task: BGP 17.1.2.3.4+5075
          6  AS path: I   Communities: target:3333:33  encapsulation0:0:0:0:3
Import Accepted   Localpref:100
          Router ID: 10.2.3.4
                Secondary Tables: default-switch.evpn.0
                Indirect next hops: 1
                        Protocol next hop: 10.2.3.4 Metric: 1
                        Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                        Indirect path forwarding next hops: 1
                                Next hop type: Router
                                Next hop: 10.10.10.1 via xe-0/0/1.0
                                Session Id: 0x2
                        10.2.3.4/32 Originating RIB: inet.0
                          Metric: 1                       Node path count: 1
                          Forwarding nexthops: 2
                                Nexthop: 10.92.78.102 via em0.0
```

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show route table default-switch.evpn.0 extensive

The following shows the partial output listing for the EVPN VNI table.

```
user@host> show route table default-switch.evpn.0 extensive
```

```
3:1000:10::100::00:aa:aa:aa:aa:aa/304 (1 entry, 1 announced)
        *BGP    Preference: 170/-101
                Route Distinguisher: 10.255.0.1:00
                PMSI: Flags 0x0: Label 100: Type INGRESS-REPLICATION 1.2.3.4
                Next hop type: Indirect, Next hop index: 0
                Address: 0xcebfad0
                Next-hop reference count: 26
                Source: 10.255.0.1
                Protocol next hop: 10.255.0.1
                Indirect next hop: 0x2 no-forward INH Session ID: 0x0
                State: <Secondary Active Int Ext>
              Local AS:   100 Peer AS:   100
                Age: 1:35:30    Metric2: 2
                Validation State: unverified
                Task: BGP_100.10.255.0.1
                Announcement bits (1): 0-default-switch-evpn
                AS path: I
                Communities: target:100:100 encapsulation:vxlan (0x8)
evpn-mcast-flags:0x1:snooping-enabled
               . . .
```

show route table evpn1.evpn-mcsn

The following shows the output listing for the multicast information used by the rpd and mcsnoopd.

```
user@host> show route table default-switch.evpn-mcsn.1
```

```
default-switch.evpn-mcsn.1: 9 destinations, 9 routes (9 active, 0 holddown, 0
hidden)
+ = Active Route, - = Last Active, * = Both

0.14,0.0,0.0/48    *[Multicast/180] 00:01:02
                       to 1.1.1.1 via vtep.32770
                       to 1.2.2.2 via vtep.32771
                       to 1.6.6.6 via vtep.32769
                       to 1.3.3.3 via vtep.32772
0.14,0.0,0.0,224.0.0.0/52*[Multicast/180] 00:01:02
                       to 1.1.1.1 via vtep.32770
                       to 1.2.2.2 via vtep.32771
                       to 1.6.6.6 via vtep.32769
0.14,0.0,0.0,225.1.1.1/80*[Multicast/180] 00:00:06
                       to 1.1.1.1 via vtep.32770
                       to 1.2.2.2 via vtep.32771
                       to 1.6.6.6 via vtep.32769
                       to 1.3.3.3 via vtep.32772
```

show route table evpn1 (Multihomed Proxy MAC and IP Address)

The following shows a partial output listing for an EVPN instance. This indicates when Multihomed Proxy MAC and IP Address Route Advertisement is enabled.

```
user@host> show route table evpn-1
```


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```
2:666:11010003::1002::00:00:00:00:00:02::102.1.1.2/304 MAC/IP (1 entry, 1
announced)
TSI:
Page 0 idx 0, (group vteps type Internal) Type 1 val 0xb20eb10 (adv_entry)
   Advertised metrics:
     Nexthop: 103.1.1.1
     Localpref: 100
     AS path: [666] I
Communities: target:666:1002 evpn-l2-info:0x20:proxy (mtu 0)
Path 2:666:11010003::1002::00:00:00:00:00:02::102.1.1.2 Vector len 4.  Val: 0
        *EVPN   Preference: 170
                Next hop type: Indirect, Next hop index: 0
                Address: 0xc3a9cf0
                Next-hop reference count: 36
                Protocol next hop: 103.1.1.1
                Indirect next hop: 0x0 - INH Session ID: 0x0
                State: <Active Int Ext>
```

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show route terse

List of Syntax

Syntax on page 1730
Syntax (EX Series Switches) on page 1730

Syntax

```
show route terse
<logical-system (all | logical-system-name)>
```

Syntax (EX Series Switches)

```
show route terse
```

Release Information

Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description

Display a high-level summary of the routes in the routing table.

NOTE: For BGP routes, the **show route terse** command displays the local preference attribute and MED instead of the metric1 and metric2 values. This is mostly due to historical reasons.

To display the metric1 and metric2 value of a BGP route, use the show route extensive command.

Options

none—Display a high-level summary of the routes in the routing table.

logical-system (all | *logical-system-name*)—(Optional) Perform this operation on all logical systems or on a particular logical system.

Required Privilege Level

view

List of Sample Output

show route terse on page 1732

Output Fields

Table 62 on page 1730 describes the output fields for the **show route terse** command. Output fields are listed in the approximate order in which they appear.

Table 62: show route terse Output Fields

Field Name	Field Description
routing-table-name	Name of the routing table (for example, inet.0).
number destinations	Number of destinations for which there are routes in the routing table.

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Table 62: show route terse Output Fields (continued)

Field Name	Field Description
number routes	Number of routes in the routing table and total number of routes in the following states: • **active** (routes that are active) • **holddown** (routes that are in the pending state before being declared inactive) • **hidden** (routes that are not used because of a routing policy)
route key	Key for the state of the route: • **+**—A plus sign indicates the active route, which is the route installed from the routing table into the forwarding table. • **-** —A hyphen indicates the last active route. • *****—An asterisk indicates that the route is both the active and the last active route. An asterisk before a **to** line indicates the best subpath to the route.
A	Active route. An asterisk (*) indicates this is the active route.
V	Validation status of the route: • **?**—Not evaluated. Indicates that the route was not learned through BGP. • **I**—Invalid. Indicates that the prefix is found, but either the corresponding AS received from the EBGP peer is not the AS that appears in the database, or the prefix length in the BGP update message is longer than the maximum length permitted in the database. • **N**—Unknown. Indicates that the prefix is not among the prefixes or prefix ranges in the database. • **V**—Valid. Indicates that the prefix and autonomous system pair are found in the database.
Destination	Destination of the route.
P	Protocol through which the route was learned: • **A**—Aggregate • **B**—BGP • **C**—CCC • **D**—Direct • **G**—GMPLS • **I**—IS-IS • **L**—L2CKT, L2VPN, LDP, Local • **K**—Kernel • **M**—MPLS, MSDP • **O**—OSPF • **P**—PIM • **R**—RIP, RIPng • **S**—Static • **T**—Tunnel
Prf	Preference value of the route. In every routing metric except for the BGP **LocalPref** attribute, a lesser value is preferred. In order to use common comparison routines, Junos OS stores the 1's complement of the **LocalPref** value in the **Preference2** field. For example, if the **LocalPref** value for Route 1 is 100, the **Preference2** value is -101. If the **LocalPref** value for Route 2 is 155, the **Preference2** value is -156. Route 2 is preferred because it has a higher **LocalPref** value and a lower **Preference2** value.

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Table 62: show route terse Output Fields (continued)

Field Name	Field Description
Metric 1	First metric value in the route. For routes learned from BGP, this is the MED metric.
Metric 2	Second metric value in the route. For routes learned from BGP, this is the IGP metric.
Next hop	Next hop to the destination. An angle bracket (>) indicates that the route is the selected route.
AS path	AS path through which the route was learned. The letters at the end of the AS path indicate the path origin, providing an indication of the state of the route at the point at which the AS path originated: • **I**—IGP. • **E**—EGP. • **?**—Incomplete; typically, the AS path was aggregated.

Sample Output

show route terse

```
user@host> show route terse

inet.0: 10 destinations, 12 routes (10 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

A V Destination        P Prf   Metric 1   Metric 2  Next hop        AS path
* ? 172.16.1.1/32        0  10          1            >10.0.0.2
  ?                     B 170        100                          I
  unverified                                      >10.0.0.2
* ? 172.16.1.1/32        D   0                       >lo0.2
* V 2.2.0.2/32          B 170        110                          200 I
  valid                                           >10.0.0.2
* ? 10.0.0.0/30         D   0                       >lt-1/2/0.1
  ?                     B 170        100                          I
  unverified                                      >10.0.0.2
* ? 10.0.0.1/32         L   0                        Local
* ? 10.0.0.4/30         B 170        100                          I
  unverified                                      >10.0.0.2
* ? 10.0.0.8/30         B 170        100                          I
  unverified                                      >10.0.0.2
* I 172.16.1.1/32       B 170         90                          200 I
  invalid                                         >10.0.0.2
* N 192.168.2.3/32      B 170        100                          200 I
  unknown                                         >10.0.0.2
* ? 172.16.233.5/32       0  10          1            MultiRecv
```


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show security keychain

Syntax

```
show security keychain
<brief | detail>
```

Release Information

Command introduced in Junos OS Release 11.2.
Statement introduced in Junos OS Release 12.3X50 for the QFX Series.

Description

Display information about authentication keychains configured for the Border Gateway Protocol (BGP), the Label Distribution Protocol (LDP) routing protocols, the Bidirectional Forwarding Detection (BFD) protocol, and the Intermediate System-to-Intermediate System (IS-IS) protocol.

Options

none—Display information about authentication keychains.

brief | detail—(Optional) Display the specified level of output.

Required Privilege Level

view

List of Sample Output

show security keychain brief on page 1735
show security keychain detail on page 1735

Output Fields

Table 63 on page 1733 describes the output fields for the **show security keychain** command. Output fields are listed in the approximate order in which they appear.

Table 63: show security keychain Output Fields

Field Name	Field Description	Level of Output
keychain	The name of the keychain in operation.	All levels
Active-ID Send	Number of routing protocols packets sent with the active key.	All levels
Active-ID Receive	Number of routing protocols packets received with the active key.	All levels
Next-ID Send	Number of routing protocols packets sent with the next key.	All levels
Next-ID Receive	Number of routing protocols packets received with the next key.	All levels
Transition	Amount of time until the current key will be replaced with the next key in the keychain.	All levels
Tolerance	Configured clock-skew tolerance, in seconds, for accepting keys for a key chain.	All levels
Id	Identification number configured for the current key.	**detail**

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Table 63: show security keychain Output Fields (continued)

Field Name	Field Description	Level of Output
Algorithm	Authentication algorithm configured for the current key.	**detail**
State	State of the current key. The value can be: • **receive** • **send** • **send-receive** For the active key, the **State** can be **send-receive**, **send**, or **receive**. For keys that have a future start time, the **State** is **inactive**. Compare the **State** field to the **Mode** field.	**detail**
Option	For IS-IS only, the option determines how Junos OS encodes the message authentication code in routing protocol packets. The values can be: • **basic**—Based on RFC 5304. • **isis-enhanced**—Based on RFC 5310. The default value is **basic**. When you configure the **isis-enhanced** option, Junos OS sends RFC 5310-encoded routing protocol packets and accepts both RFC 5304-encoded and RFC 5310-encoded routing protocol packets that are received from other devices. When you configure **basic** (or do not include the **options** statement in the key configuration) Junos OS sends and receives RFC 5304-encoded routing protocols packets, and drops 5310-encoded routing protocol packets that are received from other devices. Because this setting is for IS-IS only, the TCP and the BFD protocol ignore the encoding option configured in the key.	**detail**
Start-time	Time that the current key became active.	**detail**
Mode	Mode of each key (Informational only.) The value can be • **receive** • **send** • **send-receive** The mode of the key is based on the configuration. Suppose you configure two keys, one with a start-time of today and the other with a start-time of next week. For both keys, the **Mode** can be **send-receive**, **send**, or **receive**, regardless of the configured start-time. Compare the **Mode** field to the **State** field.	**detail**

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Sample Output

show security keychain brief

```
user@host> show security keychain brief
keychain                Active-ID       Next-ID       Transition  Tolerance
                       Send  Receive   Send  Receive
 hakr                    3     3        1     1        1d 23:58    3600
```

show security keychain detail

```
user@host> show security keychain detail
keychain                Active-ID       Next-ID       Transition  Tolerance
                       Send  Receive   Send  Receive
 hakr                    3     3        1     1        1d 23:58    3600
  Id 3, Algorithm hmac-md5, State send-receive, Option basic
  Start-time Wed Aug 11 16:28:00 2010, Mode send-receive
  Id 1, Algorithm hmac-md5, State inactive, Option basic
  Start-time Fri Aug 20 11:30:57 2010, Mode send-receive
```

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show validation database

Syntax

```
show validation database
<brief | detail>
<instance instance-name>
<logical-system logical-system-name>
<mismatch>
<origin-autonomous-system as-number>
<record ip-prefix>
<session ip-address>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Display information about the route validation database when resource public key infrastructure (RPKI) BGP route validation is configured. You can query all route validation records that match a given prefix or origin-autonomous-system. In addition, you can filter the output by a specific RPKI cache session.

Options

none—Display all route validation database entries.

brief | detail—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display information about route validation database entries for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

mismatch—(Optional) Filter the output by mismatched origin autonomous systems.

origin-autonomous-system *as-number*—(Optional) Filter the output by mismatched origin autonomous systems. The **mismatch** qualifier is useful for finding conflicting origin-autonomous-system information between RPKI caches. Mismatches might occur during cache reconfiguration.

record *ip-prefix*—(Optional) Filter the output by route validation records that match a given prefix.

session *ip-address*—(Optional) Filter the output by a specific RPKI cache session.

Required Privilege Level view

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

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List of Sample Output show validation database on page 1737

Output Fields Table 64 on page 1737 describes the output fields for the **show validation database** command. Output fields are listed in the approximate order in which they appear.

Table 64: show validation database Output Fields

Field Name	Field Description	Level of Output
Prefix	Route validation (RV) record prefix. RV records are received from the cache server and can also be configured statically at the **[edit routing-options validation** static**]** hierarchy level .	All levels
Origin-AS	Legitimate originator autonomous system (AS).	All levels
Session	IP address of the RPKI cache server.	All levels
State	State of the route validation records. The state can be **valid**, **invalid** or **unknown**.	All levels
Mismatch	Conflicting origin-autonomous-system information between RPKI caches when nonstop active routing (NSR) is configured.	All levels
IPv4 records	Number of IPv4 route validation records.	All levels
IPv6 records	Number of IPv6 route validation records.	All levels

Sample Output

show validation database

```
user@host> show validation database
RV database for instance master

 Prefix               Origin-AS Session         State   Mismatch
 172.16.1.0/24-32             1 10.0.77.1       valid
 172.16.2.0/24-32             2 10.0.77.1       valid
 172.16.3.0/24-32             3 10.0.77.1       valid
 172.16.4.0/24-32             4 10.0.77.1       valid
 172.16.5.0/24-32             5 10.0.77.1       valid
 172.16.6.0/24-32             6 10.0.77.1       valid
 172.16.7.0/24-32             7 10.0.77.1       valid
 172.16.8.0/24-32             8 10.0.77.1       valid
 72.9.224.0/19-24         26234 192.168.1.100   valid   *
 72.9.224.0/19-24          3320 192.168.1.200   invalid *
 10.0.0.0/8-32                0 internal        valid

 IPv4 records: 14
 IPv6 records: 0
```

show validation group

Syntax

```
show validation group
<instance instance-name>
<logical-system logical-system-name>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Display information about route validation redundancy groups.

Options

none—Display information about all route validation groups.

instance *instance-name*—(Optional) Display information about route validation groups for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

Required Privilege Level view

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output show validation group on page 1739

Output Fields Table 65 on page 1738 describes the output fields for the **show validation group** command. Output fields are listed in the approximate order in which they appear.

Table 65: show validation group Output Fields

Field Name	Field Description
Group	Group name.
Maximum sessions	Number of concurrent sessions for each group. The default is 2. The number is configurable with the max-sessions statement.
Session	Resource public key infrastructure (RPKI) cache session IP address.
State	State of the connection between the routing device and the cache server. **Up** means that the connection is established. **Connect** means that the connection is not established.

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Table 65: show validation group Output Fields (continued)

Field Name	Field Description
Preference	Each cache server has a preference. Higher preferences are preferred. During a session start or restart, the routing device attempts to start a session with the cache server that has the numerically highest preference. The routing device connects to multiple cache servers in preference order. The default preference is 100. The preference is configurable with the preference statement.

Sample Output

show validation group

```
user@host> show validation group
master
    Group: test, Maximum sessions: 3
      Session 10.255.255.11, State: Up, Preference: 100
      Session 10.255.255.12, State: Up, Preference: 100
    Group: test2, Maximum sessions: 2
      Session 10.255.255.13, State: Connect, Preference: 100
```

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show validation replication database

Syntax

```
show validation replication database
<brief | detail>
<instance instance-name>
<logical-system logical-system-name>
<origin-autonomous-system as-number>
<record ip-prefix>
<session ip-address>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Display the state of the nonstop active routing (NSR) records. The output is the same as the output of the show validation database command, except for the **Mismatch** column.

Options

none—Display all route validation database entries.

brief | detail—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display information about route validation database entries for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

origin-autonomous-system *as-number*—(Optional) Filter the output by mismatched origin autonomous systems. The **mismatch** qualifier is useful for finding conflicting origin-autonomous-system information between resource public key infrastructure (RPKI) caches. Mismatches might occur during cache reconfiguration.

record *ip-prefix*—(Optional) Filter the output by route validation records that match a given prefix.

session *ip-address*—(Optional) Filter the output by a specific RPKI cache session.

Required Privilege Level view

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output show validation replication database on page 1741

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Output Fields Table 66 on page 1741 describes the output fields for the **show validation replication database** command. Output fields are listed in the approximate order in which they appear.

Table 66: show validation replication database Output Fields

Field Name	Field Description	Level of Output
Prefix	Route validation (RV) record prefix. RV records are received from the cache server and can also be configured statically at the **[edit routing-options validation** static**]** hierarchy level.	All levels
Origin-AS	Legitimate originator autonomous system (AS).	All levels
Session	IP address of the RPKI cache server.	All levels
State	State of the route validation records. The state can be **valid** or **invalid**.	All levels
IPv4 records	Number of IPv4 route validation records.	All levels
IPv6 records	Number of IPv6 route validation records.	All levels

Sample Output

show validation replication database

```
user@host> show validation replication database
RV database for instance master

  Prefix               Origin-AS Session         State
  172.16.1.0/24-32                1 10.0.77.1       valid
  172.16.2.0/24-32                2 10.0.77.1       valid
  172.16.3.0/24-32                3 10.0.77.1       valid
  172.16.4.0/24-32                4 10.0.77.1       valid
  172.16.5.0/24-32                5 10.0.77.1       valid
  172.16.6.0/24-32                6 10.0.77.1       valid
  172.16.7.0/24-32                7 10.0.77.1       valid
  172.16.8.0/24-32                8 10.0.77.1       valid
  72.9.224.0/19-24            26234 192.168.1.100   valid
  72.9.224.0/19-24             3320 192.168.1.200   invalid
  10.0.0.0/8-32                   0 internal        valid

  IPv4 records: 14
  IPv6 records: 0
```

show validation session

Syntax

```
show validation session
<brief | detail>
<destination>
<instance instance-name>
<logical-system logical-system-name>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Display information about all sessions or a specific session with a resource public key infrastructure (RPKI) cache server.

Options

none—Display information about all sessions.

destination—(Optional) Display information about a specific session.

brief | detail—(Optional) Display the specified level of output.

instance *instance-name*—(Optional) Display information about sessions for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

Required Privilege Level view

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output

show validation session brief on page 1744
show validation session detail on page 1744

Output Fields Table 67 on page 1742 describes the output fields for the **show validation session** command. Output fields are listed in the approximate order in which they appear.

Table 67: show validation session Output Fields

Field Name	Field Description	Level of Output
Session	IP address of the RPKI cache server.	All levels

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Table 67: show validation session Output Fields (continued)

Field Name	Field Description	Level of Output
State	State of the connection between the routing device and the cache server. **Up** means that the connection is established. **Connect** means that the connection is not established.	All levels
Flaps	Number of attempts to establish a session.	None and **brief**
Uptime	Length of time that the session has remained establshed.	None and **brief**
#IPv4/IPv6 records	Number of IPv4 and IPv6 route validation records.	None and **brief**
Session index	Every session has an index number.	**detail**
Group	Name of the group to which the session belongs	**detail**
Preference	Each cache server has a preference. Higher preferences are preferred. During a session start or restart, the routing device attempts to start a session with the cache server that has the numerically highest preference. The routing device connects to multiple cache servers in preference order. The default preference is 100. The preference is configurable with the preference statement.	**detail**
Port	TCP port number for the outgoing connection with the cache server. The well-known RPKI port is TCP port 2222. For a given deployment, an RPKI cache server might listen on some other TCP port number. If so, you can configure the alternative port number with the port statement.	**detail**
Refresh time	Liveliness check interval for an RPKI cache server. Everyrefresh-time (seconds), a serial query protocol data unit (PDU) with the last known serial number is transmitted. The hold-time must be at least 2 x the **refresh-time**.	**detail**
Hold time	Length of time in seconds that the session between the routing device and the cache server is considered operational without any activity. After the hold time expires, the session is dropped. Reception of any PDU from the cache server resets the hold timer. The hold-time is 600 seconds, by default, and must be least 2 x the refresh-time. If the hold time expires, the session is considered to be down. This, in turn, triggers a session restart event. During a session restart, the routing device attempts to start a session with the cache server that has the numerically highest preference.	**detail**

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Table 67: show validation session Output Fields (continued)

Field Name	Field Description	Level of Output
Record Life time	Amount of time that route validation (RV) records learned from a cache server are valid. RV records expire if the session to the cache server goes down and remains down for the record-lifetime (seconds).	**detail**
Serial (Full Update)	Number of full serial updates.	**detail**
Serial (Incremental Update)	Number of incremental serial updates.	**detail**
Session flaps	Number of attempts to establish a session.	**detail**
Session uptime	Length of time that the session has remained establshed.	**detail**
Last PDU received	Time when the most recent PDU was received.	**detail**
IPv4 prefix count	Number of IPv4 sessions.	**detail**
IPv6 prefix count	Number of IPv6 sessions.	**detail**

Sample Output

show validation session brief

```
user@host> show validation session brief
 Session                                State   Flaps     Uptime #IPv4/IPv6
records
  1.3.0.2                               up          2   00:01:37 13/0
  10.255.255.11                         up          3   00:00:01 1/0
  10.255.255.12                         connect     2            64/68
```

show validation session detail

```
user@host> show validation session detail
Session 10.0.77.1, State: up
    Group: test, Preference: 100
    Local IPv4 address: 10.0.77.2, Port: 2222
    Refresh time: 300s
    Session flaps: 14, Last Session flap: 5h13m18s ago
    Hold time: 900s
    Record Life time: 3600s
    Serial (Full Update): 0
    Serial (Incremental Update): 0
      Session flaps 2
      Session uptime: 00:48:35
      Last PDU received: 00:03:35
      IPv4 prefix count: 71234
      IPv6 prefix count: 345
```


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show validation statistics

Syntax

```
show validation statistics
<instance instance-name>
<logical-system logical-system-name>
```

Release Information Command introduced in Junos OS Release 12.2.

Description Display route validation statistics.

Options

none—Display statistics for all routing instances.

instance *instance-name*—(Optional) Display information for the specified routing instance. The instance name can be master for the main instance, or any valid configured instance name or its prefix.

logical-system *logical-system-name*—(Optional) Perform this operation on a particular logical system.

Required Privilege Level view

Related Documentation

- Use Case and Benefit of Origin Validation on page 803
- Understanding Origin Validation for BGP on page 804
- Example: Configuring Origin Validation for BGP on page 810

List of Sample Output show validation statistics on page 1746

Output Fields Table 68 on page 1745 describes the output fields for the **show validation statistics** command. Output fields are listed in the approximate order in which they appear.

Table 68: show validation statistics Output Fields

Field Name	Field Description
Total RV records	Group name.
Total Replication RV records	Number of concurrent sessions for each group. The default is 2. The number is configurable with the max-sessions statement.
Prefix entries	Resource public key infrastructure (RPKI) cache session IP address.
Origin-AS entries	State of the connection between the routing device and the cache server. **Up** means that the connection is up. **Connect** means that the connection is not up.

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Table 68: show validation statistics Output Fields (continued)

Field Name	Field Description
Memory utilization	Each cache server has a preference. Higher preferences are preferred. During a session start or restart, the routing device attempts to start a session with the cache server that has the numerically highest preference. The routing device connects to multiple cache servers in preference order. The default preference is 100. The preference is configurable with the preference statement.
Policy origin-validation requests	Number of queries for validation state of a given instance and prefix.
Valid	Number of valid prefixes reported by the validation query.
Invalid	Number of invalid prefixes reported by the validation query.
Unknown	Number of unknown prefixes reported by the validation query. This means that the prefix is not found in the database.
BGP import policy reevaluation notifications	A change, addition, or deletion of a route validation record triggers a BGP import reevaluation for all exact matching and more specific prefixes.
inet.0	Number of IPv4 route validation records that have been added, deleted, or changed.
inet6.0	Number of IPv6 route validation records that have been added, deleted, or changed.

Sample Output

show validation statistics

```
user@host> show validation statistics
Total RV records:        453455
  Total Replication RV records: 453455
    Prefix entries:         35432
    Origin-AS entries:     124400
  Memory utilization: 16.31MB
  Policy origin-validation requests: 234995
    valid:                  23445
    invalid:                14666
    unknown:                34567
  BGP import policy reevaluation notifications: 460268
    inet.0:                435345
    inet6.0:                 3454
```


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show v4ov6-tunnels

Syntax

```
show v4ov6-tunnels information
<anchor-pfe>
<anti-spoof-ip>
<fabric>
<logical-system>
<tcnh-index>
<v6-dest>
<v6-source>
```

Release Information Command introduced in 17.3R1 on the MX Series.

Description Display all configured V4oV6 tunnels in the routing protocol process (rpd). If the tunnel composite **NHINDEX** is **0**, then the route is not yet installed in the forwarding information base (FIB) also known as the forwarding table.

Options

none—Display dynamic tunnel localization information for the Packet Forwarding Engine tunnel.

anchor-pfe— Filter the V4oV6 tunnels in the routing protocol process based on the anchor-pfe.

anti-spoof-ip—(Optional) Filter the IPv4-over-IPv6 tunnels in the routing protocol process based on the anti-spoof IP address.

fabric—(Optional) Internal fabric state.

logical-system (all | *logical-system-name*—(Optional) Perform this operation on all logical systems or on a particular logical system.

tcnh-index—(Optional) Filter the V4oV6 tunnels in the routing protocol process based on the tcnh-index.

v6-dest—(Optional) Filter the V4oV6 tunnels in the routing protocol process based on the IPv6 destination address.

v6-source—Filter the V4oV6 tunnels in the routing protocol process based on the IPv6 source address.

Required Privilege Level view

Related Documentation

- *dynamic-tunnels*
- extended-nexthop on page 1164
- tunnel-attributes on page 1386
- show dynamic-tunnels pfe-tunnel-localization on page 1496

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- Understanding Redistribution of IPv4 Routes with IPv6 Next Hop into BGP on page 676

List of Sample Output show v4ov6-tunnels information on page 1748

Output Fields Table 69 on page 1748 lists the output fields for the **show v4ov6-tunnels** command. Output fields are listed in the approximate order in which they appear.

Table 69: show v4ov6-tunnels

Field Name	Field Description
Destination	Destination IPv6 address of the dynamic tunnel.
Source	Source IPv6 address of the dynamic tunnel.
Antispoof	Anti-spoof address of the dynamic tunnel.
Antispoof Status	Status of the anti-spoof ability.
Mtu	Maximum transmission unit configured for the dynamic tunnel.
Anchor pfe	Anchor PFE of the dynamic tunnel.
tcnh	Tunnel composite next hop address.
tcnh-index	Index value of tunnel composite next hop address.
tcnh-refcount	Reference count of the tunnel composite next hop address.

Sample Output

show v4ov6-tunnels information

```
user@host> show v4ov6-tunnels information
Destination         Source          Antispoof      Antispoof Status     Mtu
     Anchor pfe    tcnh       tcnh-index    tcnh-refcount
5555::5555          9999::9999      4.4.4.4              DISABLED       1400
     pfe-0/0/0    0x9dc0f7c    559            2
3333::3333          7777::7777      2.2.2.2              DISABLED       1400
     pfe-0/0/0    0x9dc1858    561          2
4444::4444          8888::8888      3.3.3.3              DISABLED       1400
     pfe-0/0/0    0x9dc11c8    560          2
2222::2222          6666::6666      1.1.1.1              DISABLED       1400
     pfe-0/0/0    0x9dc1fe4    622            2
```


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test policy

Syntax test policy *policy-name prefix*

Release Information Command introduced before Junos OS Release 7.4.
Command introduced in Junos OS Release 9.0 for EX Series switches.

Description Test a policy configuration to determine which prefixes match routes in the routing table.

NOTE: If you are using the **test policy** command on a logical system, you must first set the CLI to the logical system context. For example, if you want to test a routing policy that is configured on logical system R2, first run the **set cli logical-system R2** command.

Options ***policy-name***—Name of a policy.

prefix—Destination prefix to match.

Additional Information All prefixes in the default unicast routing table (inet.0) that match prefixes that are the same as or longer than the specific prefix are processed by the **from** clause in the specified policy. All prefixes accepted by the policy are displayed. The **test policy** command evaluates a policy differently from the BGP import process. When testing a policy that contains an **interface** match condition in the **from** clause, the **test policy** command uses the match condition. In contrast, BGP does not use the **interface** match condition when evaluating the policy against routes learned from internal BGP (IBGP) or external BGP (EGBP) multihop peers.

When testing a policy, you can see the length of time (in microseconds) required to evaluate the policy and the number of times it has been executed by running the show policy ***policy-name*** **statistics** command.

Required Privilege Level view

Related Documentation

- *Understanding Routing Policy Tests*
- *Example: Testing a Routing Policy with Complex Regular Expressions*
- show policy on page 1507

List of Sample Output test policy on page 1750

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Output Fields For information about output fields, see the output field tables for the show route command, the show route detail command, the show route extensive command, or the show route terse command.

Sample Output

test policy

```
user@host> test policy test-statics 172.16.0.1/8
inet.0: 44 destinations, 44 routes (44 active, 0 holddown, 0 hidden)
Prefixes passing policy:

172.16.3.0/8          *[BGP/170] 16:22:46, localpref 100, from 10.255.255.41
                    AS Path: 50888 I
                     > to 10.11.4.32 via en0.2, label-switched-path l2
172.16.3.1/32         *[IS-IS/18] 2d 00:21:46, metric 0, tag 2
                     > to 10.0.4.7 via fxp0.0
172.16.3.2/32         *[IS-IS/18] 2d 00:21:46, metric 0, tag 2
                     > to 10.0.4.7 via fxp0.0
172.16.3.3/32         *[IS-IS/18] 2d 00:21:46, metric 0, tag 2
                     > to 10.0.4.7 via fxp0.0
172.16.3.4/32         *[IS-IS/18] 2d 00:21:46, metric 0, tag 2
                     > to 10.0.4.7 via fxp0.0
Policy test-statics: 5 prefixes accepted, 0 prefixes rejected
```


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