

Network Configuration Example

Advertising Multiple Paths in BGP

Release
13.1



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Network Configuration Example Advertising Multiple Paths in BGP

Release 13.1

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Introduction

This document describes how you can configure BGP to advertise multiple paths to a destination network for redundancy and load balancing.

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 router 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 router 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**)
- Internal BGP (IBGP) peers only. No support on external BGP (EBGP) peers.
- Master instance only. No support for routing instances.
- Graceful restart supported, but not nonstop active routing (NSR).
- 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. However, prefix policies can only match routes. Prefix policies cannot change the attributes of routes.

- Related Documentation**
- [Understanding BGP Path Selection](#)
 - [Example: Advertising Multiple Paths in BGP on page 2](#)

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 Internet draft [draft-ietf-idr-add-paths-04.txt](#), *Advertisement of Multiple Paths in BGP*.

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Requirements

This example uses the following hardware and software components:

- Eight BGP-speaking 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 3D Universal Edge Routers, 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.

With the **add-path send path-count 6** configuration, Router R4 is also configured to send up to six paths to Router R8.

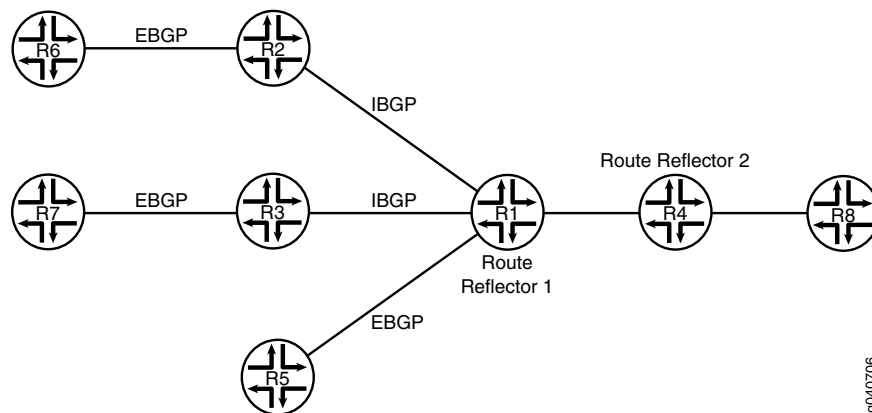
With the **add-path receive** configuration, Router R8 is configured to receive multiple paths from Router R4.

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 199.1.1.1/32 route.

Topology Diagram

Figure 1 on page 3 shows the topology used in this example.

Figure 1: Advertisement of Multiple Paths in BGP



Configuration

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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.

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

```

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 routing-options autonomous-system 1
set policy-options policy-statement allow_199 from route-filter 199.1.1.1/32 exact
set policy-options policy-statement allow_199 then accept
```

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 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 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 199.1.1.1/32 reject
set routing-options static route 198.1.1.1/32 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
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 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 routing-options autonomous-system 2
set routing-options static route 199.1.1.1/32 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
```

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**, 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;
    }
  }
}
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;  
            }  
          }  
        }  
      }  
    }  
  }  
}  
  
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
```

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 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 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 policy-options
policy-statement set_nh_self {
  then {
    next-hop self;
  }
}

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;
    }
  }
}
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 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
```

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 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-1/0/1 {
  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 policy-options  
policy-statement set_nh_self {  
  then {  
    next-hop self;  
  }  
}  
  
user@R3# show protocols  
bgp {  
  group rr {  
    type internal;  
    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 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
```

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]
```

```
user@R4# set group rr family inet unicast add-path receive
```

5. Configure OSPF on the interfaces.

```
[edit protocols ospf]
```

```
user@R4# set area 0.0.0.0 interface fe-1/2/0.41
```

```
user@R4# set area 0.0.0.0 interface lo0.40 passive
```

```
user@R4# set area 0.0.0.0 interface fe-1/2/1.48
```

6. Configure a policy that allows Router R4 to send Router R8 multiple paths to the 199.1.1.1/32 route.

Router R4 receives multiple paths for the 198.1.1.1/32 route and the 199.1.1.1/32 route. However, because of this policy, Router R4 only sends multiple paths for the 199.1.1.1/32 route.

```
[edit]
```

```
user@R4# set protocols bgp group rr_client neighbor 10.0.0.80 family inet unicast
add-path send prefix-policy allow_199
user@R4# set policy-options policy-statement allow_199 from route-filter 199.1.1.1/32
exact
user@R4# set policy-options policy-statement allow_199 then accept
```

7. Configure the autonomous system number.

```
[edit routing-options]
user@R4# set autonomous-system 1
```

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**, **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 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 policy-options
policy-statement allow_199 {
  from {
    route-filter 199.1.1.1/32 exact;
  }
  then accept;
}

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 {
            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 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]

```
user@R5# set bgp group e1 type external
```

```
user@R5# set bgp group e1 neighbor 10.0.15.1 peer-as 1
```

3. Create static routes for redistribution into BGP.

```
[edit]
user@R5# set routing-options static route 199.1.1.1/32 reject
user@R5# set routing-options static route 198.1.1.1/32 reject
```

4. Redistribute static and direct routes into BGP.

```
[edit]
user@R5# set protocols bgp group e1 neighbor 10.0.15.1 export s2b
user@R5# set policy-options policy-statement s2b from protocol static
user@R5# set policy-options policy-statement s2b from protocol direct
user@R5# set policy-options policy-statement s2b then as-path-expand 2
user@R5# set policy-options policy-statement s2b then accept
```

5. Configure the autonomous system number.

```
[edit]
user@R5# set routing-options 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 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@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;
    }
  }
}

user@R5# show policy-options
policy-statement s2b {
  from protocol [ static direct ];
  then {
    as-path-expand 2;
    accept;
  }
}

user@R5# show protocols
bgp {
  group e1 {
```

```

    type external;
    neighbor 10.0.15.1 {
        export s2b;
        peer-as 1;
    }
}
}

user@R5# show routing-options
static {
    route 198.1.1.1/32 reject;
    route 199.1.1.1/32 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 199.1.1.1/32 reject
user@R6# set routing-options static route 198.1.1.1/32 reject

```
4. Redistribute static and direct routes from Router R6's routing table into BGP.


```

[edit]
user@R6# set protocols bgp group e1 neighbor 10.0.26.1 export s2b
user@R6# set policy-options policy-statement s2b from protocol static
user@R6# set policy-options policy-statement s2b from protocol direct
user@R6# set policy-options policy-statement s2b then accept

```
5. Configure the autonomous system number.


```

[edit]
user@R6# set routing-options 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 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@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 policy-options
policy-statement s2b {
  from protocol [ static direct ];
  then accept;
}

user@R6# show protocols
bgp {
  group e1 {
    type external;
    neighbor 10.0.26.1 {
      export s2b;
      peer-as 1;
    }
  }
}

user@R6# show routing-options
static {
  route 198.1.1.1/32 reject;
  route 199.1.1.1/32 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]
```

-
- ```
user@R7# set bgp group e1 type external
user@R7# set bgp group e1 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 199.1.1.1/32 reject
```
  4. Redistribute static and direct routes from Router R7's routing table into BGP.

```
[edit]
user@R7# set protocols bgp group e1 neighbor 10.0.37.1 export s2b
user@R7# set policy-options policy-statement s2b from protocol static
user@R7# set policy-options policy-statement s2b from protocol direct
user@R7# set policy-options policy-statement s2b then accept
```
  5. Configure the autonomous system number.

```
[edit]
user@R7# set routing-options 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 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@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 policy-options
policy-statement s2b {
 from protocol [static direct];
 then accept;
}

user@R7# show protocols
bgp {
 group e1 {
 type external;
 neighbor 10.0.37.1 {
 export s2b;
 }
 }
}
```

```

 peer-as 1;
 }
}

user@R7# show routing-options
static {
 route 199.1.1.1/32 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**, 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@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 22](#)
- [Verifying That Router R1 Is Advertising Multiple Paths on page 22](#)
- [Verifying That Router R4 Is Receiving and Advertising Multiple Paths on page 23](#)
- [Verifying That Router R8 Is Receiving Multiple Paths on page 24](#)
- [Checking the Path ID on page 24](#)

### 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+65237 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+65237 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 198.1.1.1/32 destination and multiple paths to the 199.1.1.1/32 destination are advertised to Router R4.

**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     |
| * 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   |
| * 200.1.1.0/30 | 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 199.1.1.1/32 destination are received from Router R1 and advertised to Router R8. Make sure that multiple paths to the 198.1.1.1/32 destination are received from Router R1, but only one path to this destination is advertised to Router R8.

**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     |
| * 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   |
| * 200.1.1.0/30 | 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     |
| * 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     |
|                | 10.0.15.2 |     | 100     | 2 2 I   |
| * 200.1.1.0/30 | 10.0.0.20 |     | 100     | 2 I     |

**Meaning** The **show route receive-protocol** command shows that Router R4 receives two paths to the 198.1.1.1/32 destination and three paths to the 199.1.1.1/32 destination. The **show route advertising-protocol** command shows that Router R4 advertises only one path to the 198.1.1.1/32 destination and advertises all three paths to the 199.1.1.1/32 destination.

Because of the prefix policy that is applied to Router R4, Router R4 does not advertise multiple paths to the 198.1.1.1/32 destination. Router R4 advertises only one path to the 198.1.1.1/32 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 199.1.1.1/32 destination through Router R4. Make sure that Router R8 receives only one path to the 198.1.1.1/32 destination through Router R4.

**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 Lc1pref 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  
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.

Action user@R4> show route 199.1.1.1/32 detail

```
inet.0: 18 destinations, 20 routes (18 active, 0 holddown, 0 hidden)
199.1.1.1/32 (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+65237
 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+65237
 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+65237
 Announcement bits (1): 3-BGP RT Background
 AS path: 2 2 I
 Accepted
 Localpref: 100
```

Router ID: 10.0.0.10  
Addpath Path ID: 3

user@R8> show route 199.1.1.1/32 detail

```
inet.0: 17 destinations, 19 routes (17 active, 0 holddown, 0 hidden)
199.1.1.1/32 (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
 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
```

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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 1](#)

