JUNIPER NETWORKS

Technology Overview

Ingress Replication for MVPN and for IP Multicast Using Next Gen MVPN

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Introduction

This document describes features and commands supported in Junos OS Release 10.4 and later that allow you to configure ingress replication provider tunnels for MVPN and for IP multicast using Next Gen MVPN (MBGP MVPN). This document provides configuration examples that you can copy and paste to create a sample configuration for your own system. There are also step-by-step configuration and verification examples provided.

Example: Configuring Ingress Replication for IP Multicast Using MBGP MVPNs

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Requirements

The routers used in this example are Juniper Networks M Series Multiservice Edge Routers, T Series Core Routers, or MX Series 3D Universal Edge Routers running Junos OS Release 10.4 or later. When using ingress replication for IP multicast, each participating router must be configured with BGP for control plane procedures and with ingress replication for the data provider tunnel, which forms a full mesh of MPLS point-to-point LSPs. The ingress replication tunnel can be selective or inclusive, depending on the configuration of the provider tunnel in the routing instance.

Overview

The **ingress-replication** provider tunnel type uses unicast tunnels between routers to create a multicast distribution tree.

The **mpls-internet-multicast** routing instance type uses ingress replication provider tunnels to carry IP multicast data between routers through an MPLS cloud, using MBGP (or Next Gen) MVPN. Ingress replication can also be configured when using MVPN to carry multicast data between PE routers.

The **mpls-internet-multicast** routing instance is a non-forwarding instance used only for control plane procedures. It does not support any interface configurations. Only one **mpls-internet-multicast** routing instance can be defined for a logical system. All multicast and unicast routes used for IP multicast are associated only with the default routing instance (**inet.0**), not with a configured routing instance. The **mpls-internet-multicast** routing instance type is configured for the default master instance on each router, and is also included at the **[edit protocols pim]** hierarchy level in the default instance.

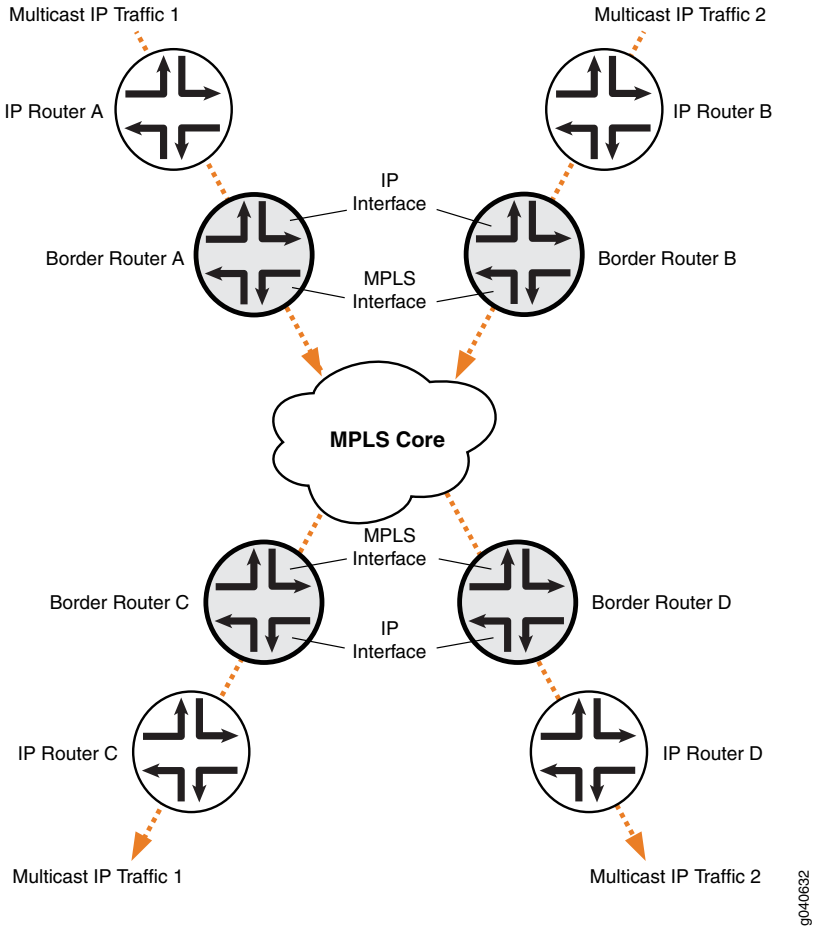
For each **mpls-internet-multicast** routing instance, the **ingress-replication** statement is required under the **provider-tunnel** statement and also under the **[edit routing-instances routing-instance-name provider-tunnel selective group source]** hierarchy level.

When a new destination needs to be added to the ingress replication provider tunnel, the resulting behavior differs depending on how the ingress replication provider tunnel is configured:

- **create-new-ucast-tunnel**—When this statement is configured, a new unicast tunnel to the destination is created, and is deleted when the destination is no longer needed. Use this mode for RSVP LSPs using ingress replication.
- **label-switched-path-template**—When this statement is configured, an LSP template is used for the for the point-to-multipoint LSP for ingress replication.

The IP topology consists of routers on the edge of the IP multicast domain. Each router has a set of IP interfaces configured toward the MPLS cloud and a set of interfaces configured toward the IP routers. See Figure 1 on page 2. Internet multicast traffic is carried between the IP routers, through the MPLS cloud, using ingress replication tunnels for the data plane and a full-mesh IBGP session for the control plane.

Figure 1: Internet Multicast 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.

Border Router C

```
set protocols mpls ipv6-tunneling
set protocols mpls interface all
set protocols bgp group ibgp type internal
set protocols bgp group ibgp local-address 10.255.10.61
set protocols bgp group ibgp family inet unicast
set protocols bgp group ibgp family inet-vpn any
set protocols bgp group ibgp family inet6 unicast
set protocols bgp group ibgp family inet6-vpn any
set protocols bgp group ibgp family inet-mvpn signaling
set protocols bgp group ibgp family inet6-mvpn signaling
set protocols bgp group ibgp export to-bgp
set protocols bgp group ibgp neighbor 10.255.10.97
set protocols bgp group ibgp neighbor 10.255.10.55
set protocols bgp group ibgp neighbor 10.255.10.57
set protocols bgp group ibgp neighbor 10.255.10.59
set protocols ospf traffic-engineering
set protocols ospf area 0.0.0.0 interface fxp0.0 disable
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface so-1/3/1.0
set protocols ospf area 0.0.0.0 interface so-0/3/0.0
set protocols ospf3 area 0.0.0.0 interface lo0.0
set protocols ospf3 area 0.0.0.0 interface so-1/3/1.0
set protocols ospf3 area 0.0.0.0 interface so-0/3/0.0
set protocols ldp interface all
set protocols pim rp static address 15.10.10.2
set protocols pim rp static address 2::15:10:10:2
set protocols pim interface fe-0/1/0.0
set protocols pim mpls-internet-multicast
set routing-instances test instance-type mpls-internet-multicast
set routing-instances test provider-tunnel ingress-replication label-switched-path
set routing-instances test protocols mvpn
```

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.

The following example shows how to configure ingress replication on an IP multicast instance with the routing instance type **mpls-internet-multicast**. Additionally, this example shows how to configure a selective provider tunnel that selects a new unicast tunnel each time a new destination needs to be added to the multicast distribution tree.

This example shows the configuration of the link between Border Router C and edge IP Router C, from which Border Router C receives PIM join messages.

1. Enable MPLS.

   ```
   [edit protocols mpls]
   ```

```
user@Border_Router_C# set ipv6-tunneling
user@Border_Router_C# set interface all
```

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

```
[edit protocols ldp]
user@Border_Router_C# set interface all
```

3. Configure a full-mesh of IBGP peering sessions.

```
[edit protocols bgp group ibgp]
user@Border_Router_C# set type internal
user@Border_Router_C# set local-address 10.255.10.61
user@Border_Router_C# set neighbor 10.255.10.97
user@Border_Router_C# set neighbor 10.255.10.55
user@Border_Router_C# set neighbor 10.255.10.57
user@Border_Router_C# set neighbor 10.255.10.59
user@Border_Router_C# set export to-bgp
```

4. Configure the multiprotocol BGP-related settings so that the BGP sessions carry the necessary NLRI.

```
[edit protocols bgp group ibgp]
user@Border_Router_C# set family inet unicast
user@Border_Router_C# set family inet-vpn any
user@Border_Router_C# set family inet6 unicast
user@Border_Router_C# set family inet6-vpn any
user@Border_Router_C# set family inet-mvpn signaling
user@Border_Router_C# set family inet6-mvpn signaling
```

5. Configure an interior gateway protocol (IGP).

   This example shows a dual stacking configuration with OSPF and OSPF version 3 configured on the interfaces.

```
[edit protocols ospf3]
user@Border_Router_C# set area 0.0.0.0 interface lo0.0
user@Border_Router_C# set area 0.0.0.0 interface so-1/3/1.0
user@Border_Router_C# set area 0.0.0.0 interface so-0/3/0.0


[edit protocols ospf]
user@Border_Router_C# set traffic-engineering
user@Border_Router_C# set area 0.0.0.0 interface fxp0.0 disable
user@Border_Router_C# set area 0.0.0.0 interface lo0.0
user@Border_Router_C# set area 0.0.0.0 interface so-1/3/1.0
user@Border_Router_C# set area 0.0.0.0 interface so-0/3/0.0
```

6. Configure a global PIM instance on the interface facing the edge device.

   PIM is not configured in the core.

```
[edit protocols pim]
user@Border_Router_C# set rp static address 15.10.10.2
user@Border_Router_C# set rp static address 2::15:10:10:2
user@Border_Router_C# set interface fe-0/1/0.0
user@Border_Router_C# set mpls-internet-multicast
```

7. Configure the ingress replication provider tunnel to create a new unicast tunnel each time a destination needs to be added to the multicast distribution tree.


```
[edit routing-instances test]
user@Border_Router_C# set instance-type mpls-internet-multicast
user@Border_Router_C# set provider-tunnel ingress-replication label-switched-path
user@Border_Router_C# set protocols mvpn
```

NOTE: Alternatively, use the **label-switched-path-template** statement to configure a point-to-point LSP for the ingress tunnel.

Configure the point-to-point LSP to use the default template settings (this is needed only when using RSVP tunnels). For example:

```
[edit routing-instances test provider-tunnel]
user@Border_Router_C# set ingress-replication label-switched-path
  label-switched-path-template default-template
user@Border_Router_C# set selective group 232.1.1.1/32 source
  192.168.195.145/32 ingress-replication label-switched-path
```

8. Commit the configuration.

```
user@Border_Router_C# commit
```

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

```
user@Border_Router_C# show protocols
mpls {
  ipv6-tunneling;
  interface all;
}
bgp {
  group ibgp {
    type internal;
    local-address 10.255.10.61;
    family inet {
      unicast;
    }
    family inet-vpn {
      any;
    }
    family inet6 {
      unicast;
    }
    family inet6-vpn {
      any;
    }
    family inet-mvpn {
      signaling;
    }
    family inet6-mvpn {
      signaling;
    }
    export to-bgp; ## 'to-bgp' is not defined
```

```
      neighbor 10.255.10.97;
      neighbor 10.255.10.55;
      neighbor 10.255.10.57;
      neighbor 10.255.10.59;
    }
  }
  ospf {
    traffic-engineering;
    area 0.0.0.0 {
      interface fxp0.0 {
        disable;
      }
      interface lo0.0;
      interface so-1/3/1.0;
      interface so-0/3/0.0;
    }
  }
  ospf3 {
    area 0.0.0.0 {
      interface lo0.0;
      interface so-1/3/1.0;
      interface so-0/3/0.0;
    }
  }
  ldp {
    interface all;
  }
  pim {
    rp {
      static {
        address 15.10.10.2;
        address 2::15:10:10:2;
      }
    }
    interface fe-0/1/0.0;
    mpls-internet-multicast;
  }
```

```
user@Border_Router_C# show routing-instances
test {
  instance-type mpls-internet-multicast;
  provider-tunnel {
    ingress-replication {
      label-switched-path;
    }
  }
  protocols {
    mvpn;
  }
}
```

Verification

Confirm that the configuration is working properly. The following operational output is for LDP ingress replication SPT-only mode. The multicast source behind IP Router B. The multicast receiver is behind IP Router C.

- Checking the Ingress Replication Status on Border Router C on page 7
- Checking the Routing Table for the MVPN Routing Instance on Border Router C on page 7
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- Checking the Multicast Route Status on Border Router B on page 13

Checking the Ingress Replication Status on Border Router C

Purpose Use the **show ingress-replication mvpn** command to check the ingress replication status.

Action

```
user@Border_Router_C> show ingress-replication mvpn

Ingress Tunnel: mvpn:1
  Application: MVPN
  Unicast tunnels
    Leaf Address       Tunnel-type      Mode         State
    10.255.10.61       P2P LSP          Existing     Up
```

Meaning The ingress replication is using a point-to-point LSP, and is in the Up state.

Checking the Routing Table for the MVPN Routing Instance on Border Router C

Purpose Use the **show route table** command to check the route status.

Action

```
user@Border_Router_C> show route table test.mvpn

test.mvpn.0: 5 destinations, 7 routes (5 active, 1 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:0:0:10.255.10.61/240
                   *[BGP/170] 00:45:55, localpref 100, from 10.255.10.61
                      AS path: I, validation-state: unverified
                    > via so-2/0/1.0
1:0:0:10.255.10.97/240
                   *[MVPN/70] 00:47:19, metric2 1
                      Indirect
5:0:0:32:192.168.195.106:32:224.1.1.1/240
                   *[PIM/105] 00:06:35
                      Multicast (IPv4) Composite
                    [BGP/170] 00:06:35, localpref 100, from 10.255.10.61
                      AS path: I, validation-state: unverified
                    > via so-2/0/1.0
6:0:0:1000:32:15.10.10.2:32:224.1.1.1/240
                   *[PIM/105] 00:07:03
                      Multicast (IPv4) Composite
7:0:0:1000:32:192.168.195.106:32:224.1.1.1/240
                   *[MVPN/70] 00:06:35, metric2 1
                      Multicast (IPv4) Composite
                    [PIM/105] 00:05:35
                      Multicast (IPv4) Composite

test.mvpn-inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:0:0:10.255.10.61/432
                   *[BGP/170] 00:45:55, localpref 100, from 10.255.10.61
                      AS path: I, validation-state: unverified
                    > via so-2/0/1.0
1:0:0:10.255.10.97/432
                   *[MVPN/70] 00:47:19, metric2 1
                      Indirect
```

Meaning The expected routes are populating the test.mvpn routing table.

Checking the MVPN Neighbors on Border Router C

Purpose Use the **show mvpn neighbor** command to check the neighbor status.

Action

```
user@Border_Router_C> show mvpn neighbor

MVPN instance:
Legend for provider tunnel
S-    Selective provider tunnel

Legend for c-multicast routes properties (Pr)
DS -- derived from (*, c-g)          RM -- remote VPN route
Family : INET

Instance : test
  MVPN Mode : SPT-ONLY
  Neighbor                              Inclusive Provider Tunnel
  10.255.10.61                          INGRESS-REPLICATION:MPLS Label
16:10.255.10.61

MVPN instance:
Legend for provider tunnel
S-    Selective provider tunnel

Legend for c-multicast routes properties (Pr)
DS -- derived from (*, c-g)          RM -- remote VPN route
Family : INET6

Instance : test
  MVPN Mode : SPT-ONLY
  Neighbor                              Inclusive Provider Tunnel
  10.255.10.61                          INGRESS-REPLICATION:MPLS Label
16:10.255.10.61
```

Checking the PIM Join Status on Border Router C

Purpose Use the **show pim join extensive** command to check the PIM join status.

Action

```
user@Border_Router_C> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 224.1.1.1
    Source: *
    RP: 15.10.10.2
    Flags: sparse,rptree,wildcard
    Upstream interface: Local
    Upstream neighbor: Local
    Upstream state: Local RP
    Uptime: 00:07:49
    Downstream neighbors:
        Interface: ge-3/0/6.0
            15.10.10.2 State: Join Flags: SRW  Timeout: Infinity
            Uptime: 00:07:49 Time since last Join: 00:07:49
    Number of downstream interfaces: 1

Group: 224.1.1.1
    Source: 192.168.195.106
    Flags: sparse
    Upstream protocol: BGP
    Upstream interface: Through BGP
    Upstream neighbor: Through MVPN
    Upstream state: Local RP, Join to Source, No Prune to RP
    Keepalive timeout: 69
    Uptime: 00:06:21
    Number of downstream interfaces: 0

Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

Checking the Multicast Route Status on Border Router C

Purpose Use the **show multicast route extensive** command to check the multicast route status.

Action

```
user@Border_Router_C> show multicast route extensive
Instance: master Family: INET

Group: 224.1.1.1
    Source: 192.168.195.106/32
    Upstream interface: lsi.0
    Downstream interface list:
        ge-3/0/6.0
    Number of outgoing interfaces: 1
    Session description: NOB Cross media facilities
    Statistics: 18 kBps, 200 pps, 88907 packets
    Next-hop ID: 1048577
    Upstream protocol: MVPN
    Route state: Active
    Forwarding state: Forwarding
    Cache lifetime/timeout: forever
    Wrong incoming interface notifications: 0
    Uptime: 00:07:25

Instance: master Family: INET6
```

Checking the Ingress Replication Status on Border Router B

Purpose Use the **show ingress-replication mvpn** command to check the ingress replication status.

Action

```
user@Border_Router_B> show ingress-replication mvpn

Ingress Tunnel: mvpn:1
  Application: MVPN
  Unicast tunnels
    Leaf Address       Tunnel-type      Mode         State
    10.255.10.97       P2P LSP          Existing     Up
```

Meaning The ingress replication is using a point-to-point LSP, and is in the Up state.

Checking the Routing Table for the MVPN Routing Instance on Border Router B

Purpose Use the **show route table** command to check the route status.

Action

```
user@Border_Router_B> show route table test.mvpn

test.mvpn.0: 5 destinations, 7 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:0:0:10.255.10.61/240
                   *[MVPN/70] 00:49:26, metric2 1
                      Indirect
1:0:0:10.255.10.97/240
                   *[BGP/170] 00:48:22, localpref 100, from 10.255.10.97
                      AS path: I, validation-state: unverified
                    > via so-1/3/1.0
5:0:0:32:192.168.195.106:32:224.1.1.1/240
                   *[PIM/105] 00:09:02
                      Multicast (IPv4) Composite
                    [BGP/170] 00:09:02, localpref 100, from 10.255.10.97
                      AS path: I, validation-state: unverified
                    > via so-1/3/1.0
7:0:0:1000:32:192.168.195.106:32:224.1.1.1/240
                   *[PIM/105] 00:09:02
                      Multicast (IPv4) Composite
                    [BGP/170] 00:09:02, localpref 100, from 10.255.10.97
                      AS path: I, validation-state: unverified
                    > via so-1/3/1.0

test.mvpn-inet6.0: 2 destinations, 2 routes (2 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1:0:0:10.255.10.61/432
                   *[MVPN/70] 00:49:26, metric2 1
                      Indirect
1:0:0:10.255.10.97/432
                   *[BGP/170] 00:48:22, localpref 100, from 10.255.10.97
                      AS path: I, validation-state: unverified
                    > via so-1/3/1.0
```

Meaning The expected routes are populating the test.mvpn routing table.

Checking the MVPN Neighbors on Border Router B

Purpose Use the **show mvpn neighbor** command to check the neighbor status.

Action

```
user@Border_Router_B> show mvpn neighbor

MVPN instance:
Legend for provider tunnel
S-    Selective provider tunnel

Legend for c-multicast routes properties (Pr)
DS -- derived from (*, c-g)          RM -- remote VPN route
Family : INET

Instance : test
  MVPN Mode : SPT-ONLY
  Neighbor                              Inclusive Provider Tunnel
  10.255.10.97                          INGRESS-REPLICATION:MPLS Label
16:10.255.10.97

MVPN instance:
Legend for provider tunnel
S-    Selective provider tunnel

Legend for c-multicast routes properties (Pr)
DS -- derived from (*, c-g)          RM -- remote VPN route
Family : INET6

Instance : test
  MVPN Mode : SPT-ONLY
  Neighbor                              Inclusive Provider Tunnel
  10.255.10.97                          INGRESS-REPLICATION:MPLS Label
16:10.255.10.97
```

Checking the PIM Join Status on Border Router B

Purpose Use the **show pim join extensive** command to check the PIM join status.

Action

```
user@Border_Router_B> show pim join extensive
Instance: PIM.master Family: INET
R = Rendezvous Point Tree, S = Sparse, W = Wildcard

Group: 224.1.1.1
    Source: 192.168.195.106
    Flags: sparse,spt
    Upstream interface: fe-0/1/0.0
    Upstream neighbor: Direct
    Upstream state: Local Source
    Keepalive timeout: 0
    Uptime: 00:09:39
    Downstream neighbors:
        Interface: Pseudo-MVPN
            Uptime: 00:09:39 Time since last Join: 00:09:39
    Number of downstream interfaces: 1


Instance: PIM.master Family: INET6
R = Rendezvous Point Tree, S = Sparse, W = Wildcard
```

Checking the Multicast Route Status on Border Router B

Purpose Use the **show multicast route extensive** command to check the multicast route status.

Action

```
user@Border_Router_B> show multicast route extensive
Instance: master Family: INET

Group: 224.1.1.1
    Source: 192.168.195.106/32
    Upstream interface: fe-0/1/0.0
    Downstream interface list:
        so-1/3/1.0
    Number of outgoing interfaces: 1
    Session description: NOB Cross media facilities
    Statistics: 18 kBps, 200 pps, 116531 packets
    Next-hop ID: 1048580
    Upstream protocol: MVPN
    Route state: Active
    Forwarding state: Forwarding
    Cache lifetime/timeout: forever
    Wrong incoming interface notifications: 0
    Uptime: 00:09:43
```

Related Documentation

- Configuring Routing Instances for an MBGP MVPN
- mpls-internet-multicast
- ingress-replication
- create-new-ucast-tunnel
- label-switched-path-template
- show ingress-replication mvpn