Network Configuration Example

Multitopology Routing Feature Guide

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Network Configuration Example Multitopology Routing Feature Guide
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PART 1

Multitopology Routing

- Multitopology Routing Concept and Reference Materials on page 3
- Multitopology Routing Configuration on page 7
- Multitopology Routing Configuration Examples on page 11

CHAPTER 1

Multitopology Routing Concept and Reference Materials

This chapter covers these topics:

- Understanding Multitopology Routing Based on Applications on page 3
- Multitopology Routing System Requirements on page 5
- Multitopology Routing Terms and Acronyms on page 5

Understanding Multitopology Routing Based on Applications

Multitopology routing (MTR) enables you to configure class-based forwarding for different types of traffic, such as voice, video, and data. Each type of traffic is defined by a topology that is used to create a new routing table for that topology. MTR provides the ability to generate forwarding tables based on the resolved entries in the routing tables for the custom topologies you create. In this way, packets of different classes can be routed independently from one another.

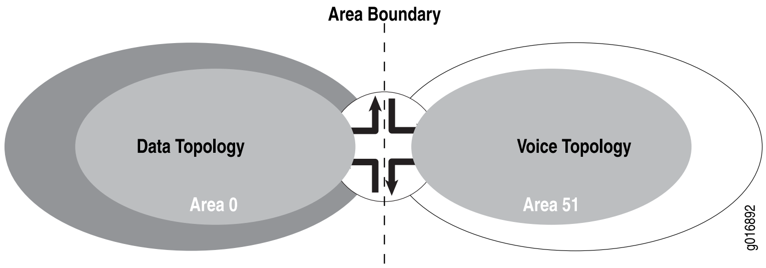
To run MTR, you must configure IP routing. MTR supports OSPFv2, static routes, and BGP. You must configure an interior gateway protocol (IGP), such as OSPFv2 or static routing, Configure BGP to add routes learned through BGP to the appropriate custom topologies. MTR also supports filter-based forwarding, which enables you to match traffic on the ingress interface with a specific type of forwarding class and then forward that traffic to the specified topology.

OSPF in MTR

OSPF in MTR uses a single instance of OSPF to carry connectivity and IP reachability information for different topologies. That information is used to calculate shortest-path-first (SPF) trees and routing tables. OSPF for MTR supports protocol extensions that include metrics that correspond to different topologies for link and prefix reachabilty information. The type-of-service (TOS) metric field is used to advertise the topology-specific metric for links and prefixes belonging to that topology. The TOS field is redefined as MT-ID in the payload of router, summary, and Type 5 and Type 7 AS-external link-state advertisements (LSAs).

Under MTR, each OSPF interface continues to belong to a single area. Therefore, by default, all topologies share the same area boundaries. As a result, attributes of an area, such as stubbiness, are independent of the topology. By default, all topologies configured for OSPF are enabled on all interfaces. However, you can disable one or more configured topologies on an interface. You can thus allocate an interface for a specific topology. In Figure 1 on page 4, Area 51 includes an interface that is uniquely allocated to voice traffic, and Area 0 includes an interface that is uniquely allocated to data traffic. Each topology thus corresponds to a different OSPF area that shares a boundary.

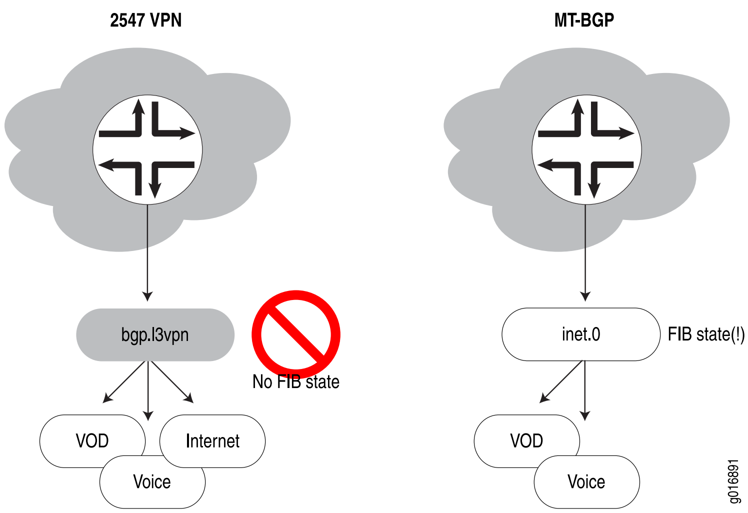
Figure 1: MTR-OSPF Area Boundary



BGP in MTR

BGP in MTR provides the ability to resolve BGP routes against configured topologies. An inbound policy is used to select routes for inclusion in the appropriate routing tables for the topologies. The default behavior for virtual private networks (VPNs) that use MPLS for forwarding packets over the backbone and that use BGP for distributing routes over the backbone is to place BGP route updates in the **bgp.l3vpn** routing table. Figure 2 on page 4 shows a BGP peer operating in an environment that conforms with the requirements in RFC 2547, *BGP/MPLS VPNs*. The figure shows how a BGP peer configured for MTR performs secondary route resolution.

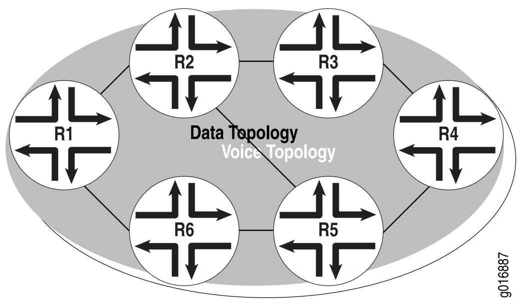
Figure 2: BGP Route Resolution



The BGP peer in a standard VPN topology places prefixes for routes it learns in the **bgp.l3vpn** routing table, which does not result in automatic updates to the forwarding table. Under BGP in MTR, when BGP receives a route from a peer, it attempts to resolve that route against a route in the **inet.0** routing table. If the route is resolved, it is placed in that table, which generates a forwarding state. If you have configured a community target identifier that matches the import policy for the topology, routing and forwarding states are added to the tables for the topology.

Because MTR provides support for BGP to perform secondary route resolution, as Figure 3 on page 5 shows, MTR is able to create two distinct network paths for each type of traffic. Each router advertises BGP routes that need to be resolved against the IGP routes for each topology. Based on the IGP metrics configured for each topology, for all routes that originate from Router 4 (R4), the upper path between R1 and R4, which traverses R2 and R3, is selected for voice traffic, whereas the lower path between R1 and R4, which traverses R5 and R6, is selected for data traffic.

Figure 3: Route Resolution for MTR



Related Documentation
- Example: Configuring Multitopology Routing Based on Applications

Multitopology Routing System Requirements

To implement MTR, your system must meet these minimum requirements:

- Junos OS Release 9.0 or later
- Two Juniper Networks M Series, MX Series, or T Series routers

Related Documentation
- Example: Configuring Multitopology Routing Based on Applications

Multitopology Routing Terms and Acronyms

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topology A subset of links in a network for which a separate set of routes is calculated. Those routes are installed in a routing table created specifically for a configured topology used to make routing and forwarding decisions.

CHAPTER 2

Multitopology Routing Configuration

To implement MTR, you must configure the following:

- Configuring Topologies on page 7
- Configuring Filter-Based Forwarding on page 7
- Configuring BGP for Multitopology Routing on page 8
- Option: Configuring OSPF for Multitopology Routing on page 9
- Option: Configuring Static Routes for Multitopology Routing on page 9
- Option: Configuring Route Resolution Policy on page 10

Configuring Topologies

You must configure one or more topologies. For each topology, you specify a string value that defines the type of traffic as well as an interface family. You can also enable a topology for IPv4 multicast traffic by including the **ipv4-multicast** statement. To configure a topology, include the **topologies** statement at the **[edit routing-options** hierarchy level:

```
[edit routing-options]
topologies {
  family inet { # inet6 is also supported, but you must use static routes as the IGP.
    topology voice; # This action creates a routing table called :voice.inet.0
      # for all routes destined for the voice topology. A default topology is also
      # automatically created. Default topology routes are added to the inet.0
      # routing table.
  }
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

Configuring Filter-Based Forwarding

Configure a firewall filter that forces a lookup against the different routing tables. Any routes that match the specified forwarding class specified and then match a specified topology are installed in the routing table for that topology. To configure a firewall filter for MTR that performs filter-based forwarding, include the following configuration at the **[edit firewall]** hierarchy level:

```
[edit firewall]
family inet { # inet6 is also supported.
  filter topology-selection {
    term ef {
      from {
        forwarding-class expedited-forwarding; # The following class types are also
          # supported: assured-forwarding, best-effort, and network-control.
      }
      then {
        topology voice; # Specify the name of a configured topology.
        accept;
      }
    }
  }
}
```

You must apply the filter to an ingress interface. Include the following statements at the **[edit interfaces]** hierarchy level to apply the filter to an interface:

```
[edit interfaces]
fe-2/2/1 {
  unit 0 {
    family inet {
      filter {
        input topology-selection; # Specify the name of the filter configured under
          # the [edit firewall] hierarchy.
      }
    }
  }
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

Configuring BGP for Multitopology Routing

Configure BGP to add routes learned through BGP into a configured topology and the default topology, which is created automatically. Routes for the default topology are installed in the **inet.0** routing table. To configure BGP for MTR, include the following statements:

```
[edit protocols bgp]
group internal {
  type internal;
  family inet {
    unicast {
      topology voice;
        community target :1:1; # Any route that has :1:1 as its target destination is
          # installed in the routing table for the voice topology. All received routes
          # are also automatically installed in the default topology.
    }
  }
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

Option: Configuring OSPF for Multitopology Routing

To implement MTR, you must configure an interior gateway protocol (IGP) to route local network traffic. MTR supports both OSPFv2 and static routes. Only static routes support IPv6 addresses because MTR does not support OSPFv3. Configure OSPF to add routes from the default topology to the routing table for the specified topology. To enable OSPF for MTR, include the **topology** statement at the **[edit protocols ospf]** hierarchy level:

```
[edit ospf protocols]
topology voice { # Specify a topology name configured under the [edit routing-options]
  # hierarchy level.
  topology-id 127; # Specify a topology identifier from 32 through 127.
}
```

Optionally, you can configure a specific metric for a topology for any interface on which OSPF has been enabled. Any topology-specific metric that you configure applies to routes advertised from that interface that belong only to that topology. To configure a topology-specific metric for an OSPF interface, include the following statements at the **[edit protocols ospf]** hierarchy level:

```
[edit protocols ospf]
area 0.0.0.0 {
  interface fe-2/2/1 {
    metric 10; # You can specify a metric for the interface that overrides the default
      # value of 1.
    }
    topology voice {
      metric 15; # Specify a topology-specific metric from 1 through 65,535.
    }
  }
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

Option: Configuring Static Routes for Multitopology Routing

To configure a static route for MTR, you must specify the name of the routing table for the topology. Static routes for MTR support IPv4 and IPv6 addresses. To configure a static route for MTR, include the **rib** statement at the **[edit routing-options]** hierarchy level:

```
[edit routing-options]
rib :voice.inet6.0 { # Specify the routing-table name for the voice topology configured
  # at the [edit routing-options topologies] hierarchy level.
  route 200::a4:0/126 next-hop 200::c0a8:1df;
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

Option: Configuring Route Resolution Policy

You can optionally configure a route resolution policy so that a routing table accepts routes from specific routing tables. For MTR, you might want to configure a policy for the voice topology for IPv4 unicast traffic, for example, **:voice.inet.0** to resolve routes through the **inet.3** routing table. You might also want to override the default policy and not have the **inet.0** routing table use the **inet.3** routing table for route resolution. To configure a route resolution policy, include the **resolution** statement at the **[edit routing-options]** hierarchy level:

```
[edit routing-options]
resolution {
  rib inet.0 { # Specify the name of the routing table you want to modify.
    resolution-ribs inet.0; # Specify use of the inet.0 table to resolve routes rather
      # than the default policy, which uses the inet.3 table.
  }
  rib :voice.inet.0 { # Specify that the routing table for the voice topology for IPv4
    # unicast traffic be modified.
    resolution-ribs [ inet.3 :voice.inet.0 ]; # Specify that routes be resolved
      # using the inet.3 routing table for the voice topology.
  }
}
```

Related Documentation

- Example: Multitopology Routing Configuration on page 11

CHAPTER 3

Multitopology Routing Configuration Examples

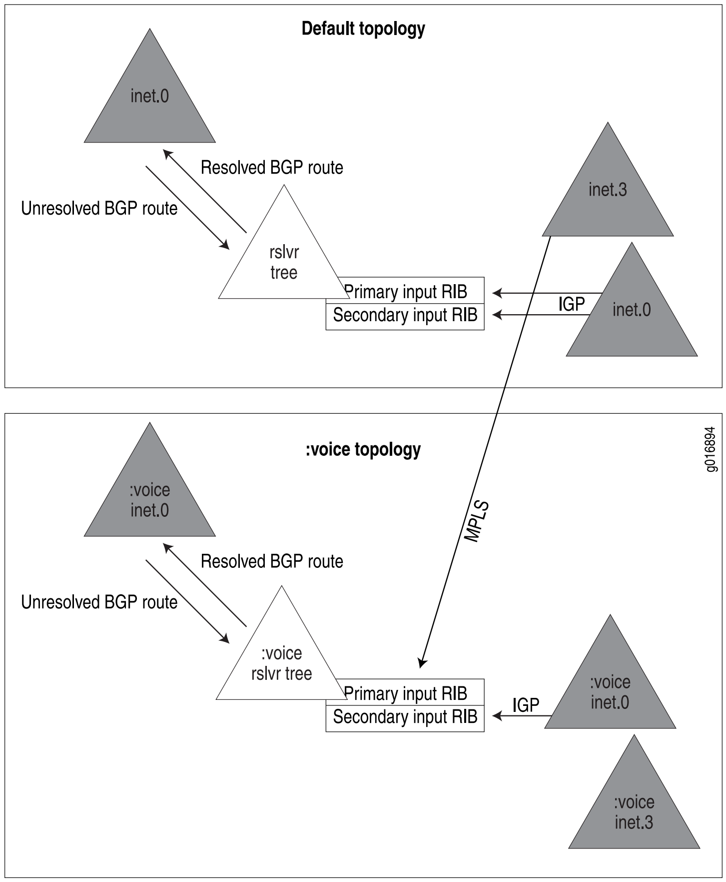
This chapter covers these topics:

- Example: Multitopology Routing Configuration on page 11
- For More Information on page 16

Example: Multitopology Routing Configuration

In this example, an MPLS network is running RSVP label-switched paths (LSPs) in the core. The network carries both best effort (BE) and expedited forwarding (EF) traffic, and the same destination prefixes are used for both types of traffic. A voice topology is created to enable the network to send EF traffic over the LSPs, but permit BE traffic to traverse the IP path. The voice, or EF traffic, is placed in the voice topology. The data, or BE traffic, is placed in the default topology. The voice and default topologies each create separate routing tables for storing routes, and each routing table creates a separate forwarding table. For each destination prefix, a different route is added to each topology-specific routing table. These routes are BGP routes. You configure filter-based forwarding so that the destination lookup is done in the two topology-specific routing tables based on the DSCP marking of the incoming packet. As Figure 4 on page 12 shows, MTR thus enables you to build two routes to the destination prefixes, one using LSP next hops for voice traffic and one using IP next hops for data traffic. The protocol next hop is resolved differently for each type of traffic. For voice EF traffic, routes from the **inet.3** routing table are taken into account, and for BE data traffic, only routes from the **inet.0** routing table are taken into account.

Figure 4: Route Resolution in Multitopology Routing



Configure the interfaces:

```
[edit]
interfaces {
   so-0/0/1 {
      unit 0 {
         family inet {
            address 1.13.1.1/24
         }
         family iso;
         family mpls;
      }
   }
   fe-2/2/0 {
      unit 0 {
         family inet {
            address 1.12.1.1/24
         }
         family iso;
         family mpls;
      }
   }
   fe/2/2/1 {
```



```
        unit 0 {
            family inet {
                filter {
                    input topo_selection; # Apply a firewall filter on the ingress interface.
                        # This filter performs filter-based forwarding for the voice topology.
                }
                family iso;
                family mpls;
            }
        }
    }
```

Configure the voice topology. Configure a route resolution policy so that IPv4 routes for data traffic are resolved through the **inet.0** routing table, which functions as the routing table for the default topology. Configure a route resolution policy so that routes for voice traffic are resolved through the routing table for the voice topology (**:voice.inet.0**) and the MPLS routing table (**inet.3**).

```
[edit]
routing-options {
    autonomous-system 65300;
    resolution {
        rib inet.0 {
            resolution-ribs inet.0; # Specify use of the inet.0 routing table to resolve
                # IPv4 data traffic. This action prevents this traffic from being resolved using
                # the MPLS routing table (inet.3).
        }
        rib :voice.inet.0 {
            resolution-ribs [ inet.3 :voice.inet.0 ]; # Specify use of the MPLS routing
                # table (inet.3) and the routing table for the voice topology (:voice.inet.0)
                # to resolve IPv4 voice traffic. This action prevents voice traffic from being
                #resolved using the inet.0 routing table.
        }
    }
    topologies {
        family inet {
            topology voice;
        }
    }
}
```

Configure MPLS using RSVP label-switched paths. Configure BGP so that routes learned through BGP are installed in the appropriate routing table. In this example, the **topology** statement is used to install BGP routes for voice traffic into the routing table for the voice topology (**:voice.inet.0**). This action overrides the default behavior to resolve BGP routes only through the **inet.0** or **inet.3** routing tables. Configure an interior gateway protocol (IGP). In this example, you configure OSPF.

```
[edit]
protocols {
    rsvp {
        interface all;
        interface fxp0.0 {
            disable;
        }
```

```
    }
    mpls {
        label-switched-path to_r3 {
            to 10.255.14.222;
            primary test;
        }
        path test {
            1.12.1.2 strict;
        }
        interface all;
    }
    bgp {
        group int {
            type internal;
            local-address 10.255.14.223;
            family inet {
                unicast {
                    topology voice {
                        community 70:1;
                    }
                }
            }
            neighbor 10.255.14.220;
            neighbor 10.255.14.218;
            neighbor 10.255.14.222;
        }
    }
    ospf {
        topology voice topology-id 32;
        traffic-engineering;
        area 0.0.0.0 {
            interface lo0.0 {
                passive;
            }
            interface all;
            interface fxp0.0 {
                disable;
            }
            interface fe-2/2/1.0 {
                metric 1;
            }
            interface fe-2/2/0.0 {
                metric 1;
            }
            interface so-0/0/1.0 {
                metric 1;
            }
        }
    }
}
```

Configure a class-of-service classifier on the ingress interface. In this example, the classifier type is **inet-precedence**, which evaluates incoming IPv4 packets and requires only the upper three bits of the DSCP field.

```
[edit]
```



```
class-of-service {
  interfaces {
    fe-2/2/1 {
      unit 0 {
        classifiers {
          inet-precedence default;
        }
      }
    }
  }
}
```

Configure filter-based forwarding. This filter is applied to the ingress interface. Traffic marked for expedited forwarding is forwarded to the routing table for the voice topology. All other traffic is forwarded to the routing table for the default topology.

```
[edit]
firewall {
  family inet {
    filter topo_selection {
      term ef {
        from {
          forwarding-class expedited-forwarding;
        }
        then {
          topology voice; # Forward expedited-forwarding traffic to the routing
            # table for the voice topology (:voice.inet.0).
          accept;
        }
      }
      term default {
        then accept; # Forward all other traffic to the routing table for the default
          # topology (inet.0).
      }
    }
  }
}
```

Verifying Your Work

To verify proper operation of Multitopology Routing, use the following commands:

- **show route summary**
- **show route table *routing-table-name***
- **show route rib-groups**

Related Documentation

- Understanding Multitopology Routing Based on Applications on page 3
- Configuring BGP for Multitopology Routing on page 8
- Configuring Filter-Based Forwarding on page 7
- Configuring Topologies on page 7
- Option: Configuring OSPF for Multitopology Routing on page 9

- Option: Configuring Route Resolution Policy on page 10
- Option: Configuring Static Routes for Multitopology Routing on page 9

For More Information

For additional information about Multitopology Routing, see the following resources:

- Junos OS Routing Protocols Configuration Guide
- RFC 4915, *Multi-Topology (MT) Routing in OSPF*

PART 2

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