Multitopology Routing Configuration Guide, Cisco IOS Release 15S

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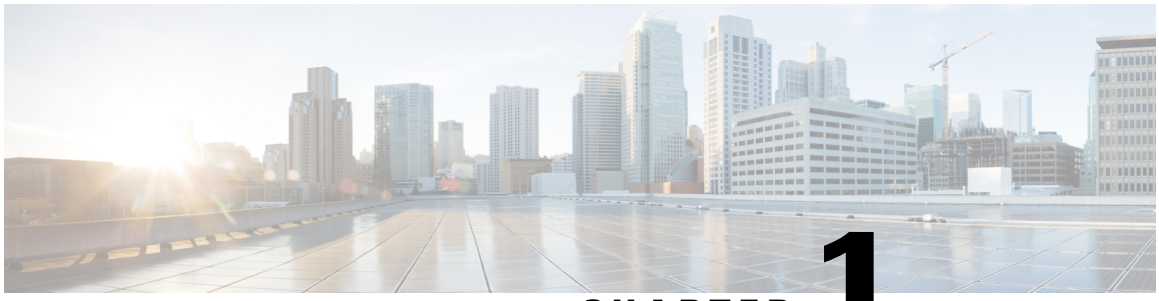


CHAPTER 1

Multitopology Routing

Multitopology Routing (MTR) enables you to configure service differentiation through class-based forwarding. MTR provides multiple logical topologies over a single physical network. Service differentiation can be achieved by forwarding different traffic types over different logical topologies that could take different paths to the same destination. MTR can be used, for example, to define separate topologies for voice, video, and data traffic classes

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Multitopology Routing

- You should have a clear understanding of the physical topology and traffic classification in your network before deploying Multitopology Routing (MTR).
- MTR should be deployed consistently throughout the network. Cisco Express Forwarding or distributed Cisco Express Forwarding and IP routing must be enabled on all networking devices.
- We recommend that you deconfigure custom route configurations such as route summarization and default routes before enabling a topology and that you reapply custom route configuration only after the topology is fully enabled. This recommendation is designed to prevent traffic interruption because some destinations might be obscured during the transition. Custom route configuration is most useful when all of the more-specific routes are available in the routing table of the topology.

Restrictions for Multitopology Routing

- Only the IPv4 (unicast and multicast) address family is supported.
- Multiple unicast topologies cannot be configured within a virtual routing and forwarding (VRF) instance. However, multiple unicast topologies and a separate multicast topology can be configured under the global address space, and a separate multicast topology can be configured within a VRF.
- All topologies share a common address space. Multitopology Routing (MTR) is not intended to enable address reuse. Configuring address reuse in separate topologies is not supported.
- IP Differentiated Services or IP Precedence can be independently configured in a network where MTR is also deployed. However, MTR requires exclusive use of some subset of the differentiated services code point (DSCP) bits in the IP packet header for specific topology traffic. For this reason, simultaneous configuration must be carefully coordinated. Re-marking DSCP bits in the IP packet header is not recommended or supported on devices that contain class-specific topologies.
- Distance Vector Multicast Routing Protocol (DVMRP) CLI and functionality are not provided in Cisco software images that provide MTR support.

Information About Multitopology Routing

MTR Overview

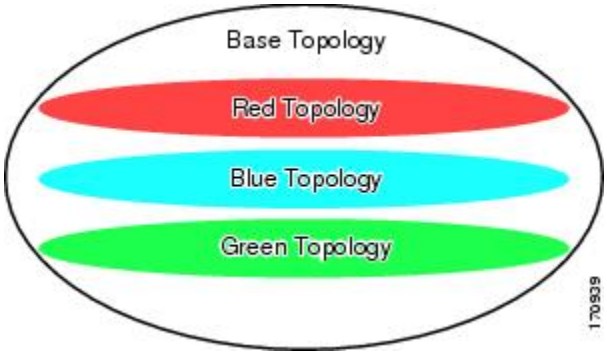
Use Multitopology Routing (MTR) to configure service differentiation through class-based forwarding. Two primary components comprise MTR configuration: independent topology configuration and traffic classification configuration.

A topology is defined as a subset of devices and links in a network for which a separate set of routes is calculated. The entire network itself, for which the usual set of routes is calculated, is known as the base topology. The base topology (or underlying network) is characterized by the Network Layer Reachability Information (NLRI) that a device uses to calculate the global routing table to make routing and forwarding decisions. The base topology is the default routing environment that exists prior to enabling MTR.

Any additional topologies are known as class-specific topologies and are a subset of the base topology. Each class-specific topology carries a class of traffic and is characterized by an independent set of NLRI that is used to maintain a separate Routing Information Base (RIB) and Forwarding Information Base (FIB). This design allows the device to perform independent route calculation and forwarding for each topology.

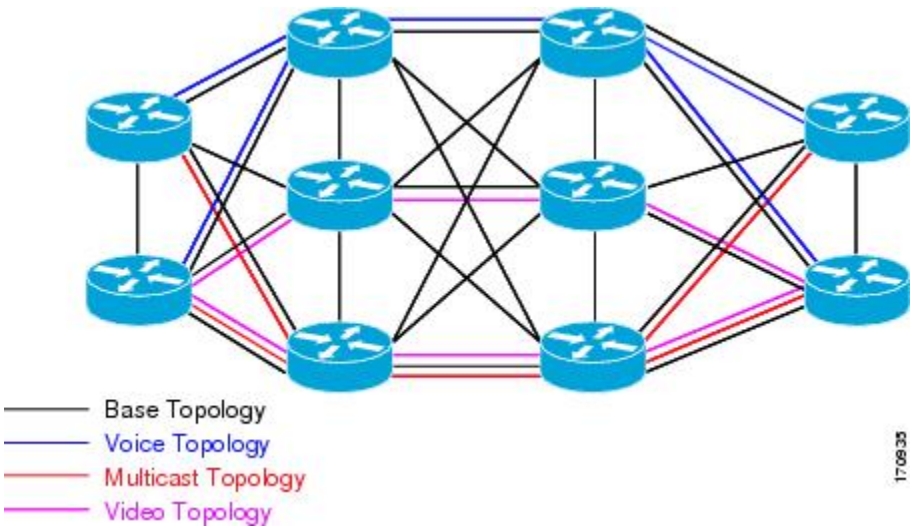
MTR creates a selection of routes within a given device upon which to forward to a given destination. The specific choice of route is based on the class of the packet being forwarded, a class that is an attribute of the packet itself. This design allows packets of different classes to be routed independently from one another. The path that the packet follows is determined by classifiers configured on the devices and interfaces in the network. The figure below shows a base topology, which is a superset of the red, blue, and green topologies.

Figure 1: MTR Base Topology



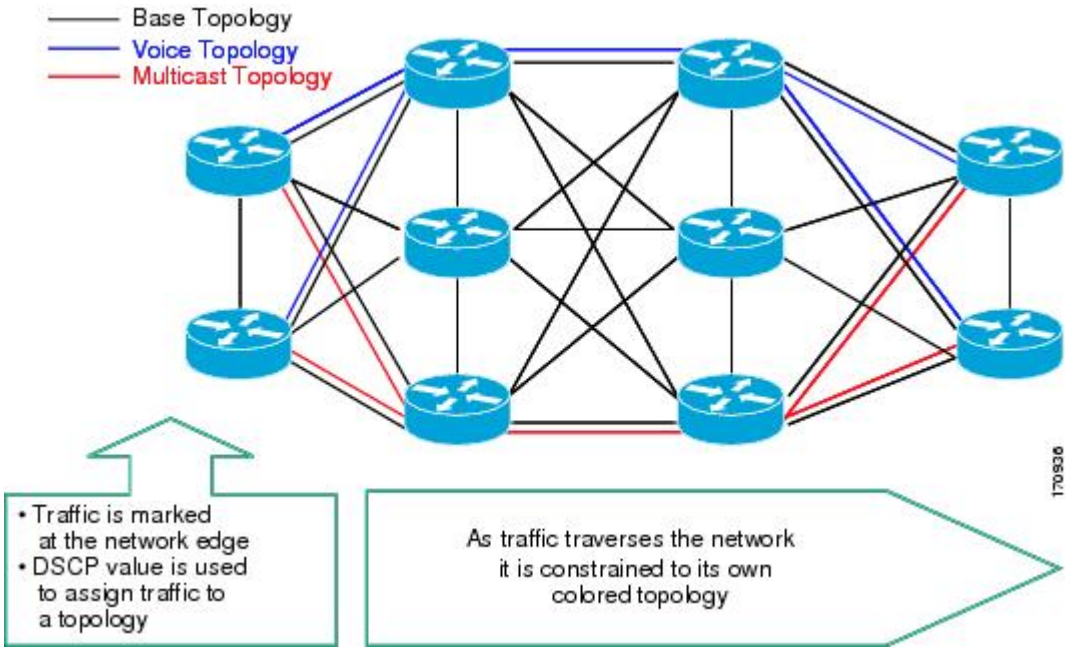
The figure below shows an MTR-enabled network that is configured using the service separation model. The base topology (shown in black) uses NLRI from all reachable devices in the network. The blue, red, and purple paths each represent a different class-specific topology. Each class-specific topology calculates a separate set of paths through the network. Routing and forwarding are independently calculated based on individual sets of NLRI that are carried for each topology.

Figure 2: Defining MTR Topologies



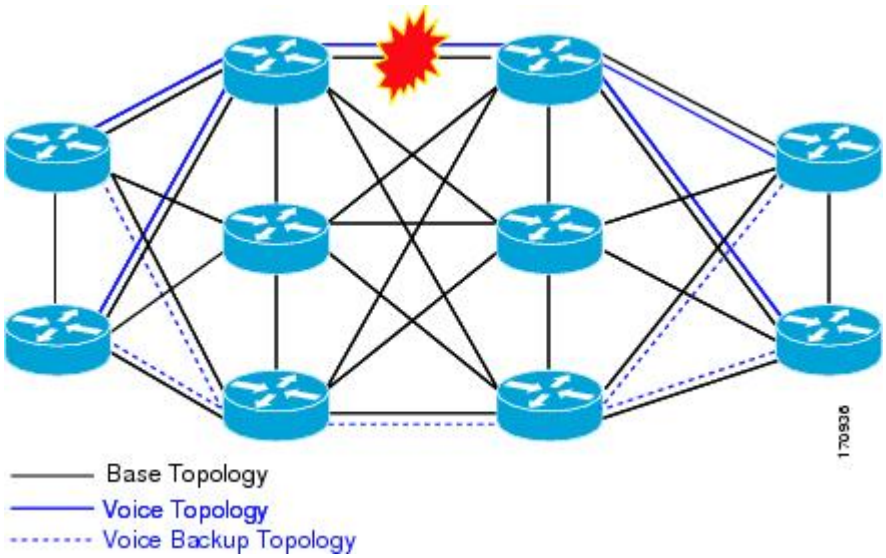
The figure below shows that the traffic is marked at the network edge. As the traffic traverses the network, the marking is used during classification and forwarding to constrain the traffic to its own colored topology.

Figure 3: Traffic Follows Class-Specific Forwarding Paths



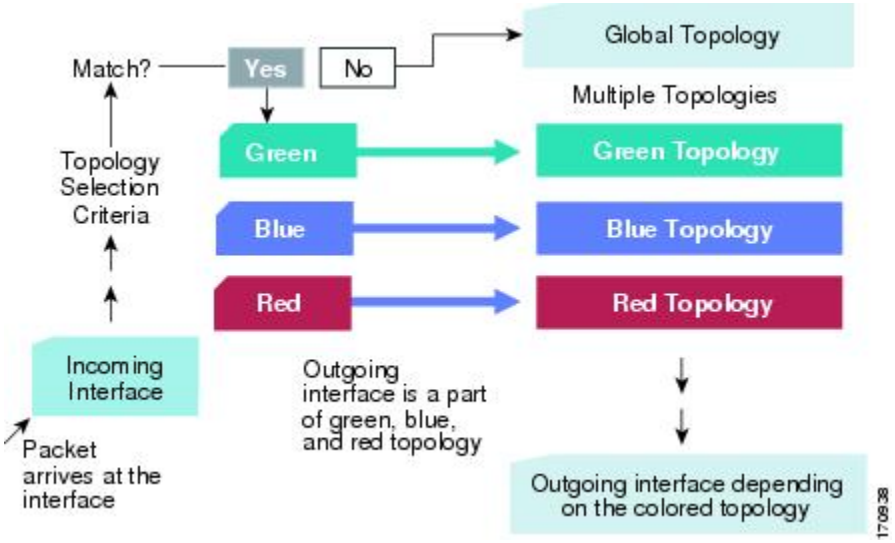
The same topology can have configured backup paths. In the figure below, the preferential path for the voice topology is represented by the solid blue line. In case this path becomes unavailable, you can configure MTR to choose the voice backup path represented by the dotted blue line. Both of these paths represent the same topology and none overlap.

Figure 4: MTR Backup Contingencies Within a Topology



The figure below shows the MTR forwarding model at the system level. When a packet arrives at the incoming interface, the marking is examined. If the packet marking matches a topology, the associated topology is consulted, the next hop for that topology is determined, and the packet is forwarded. If there is no forwarding entry within a topology, the packet is dropped. If the packet does not match any classifier, it is forwarded to the base topology. The outgoing interface is a function of the colored route table in which the lookup is done.

Figure 5: MTR Forwarding at the System Level



MTR is implemented in Cisco software according to a address family and subaddress family basis. MTR supports up to 32 unicast topologies (including the base topology) and a separate multicast topology. A topology can overlap with another or share any subset of the underlying network. You configure each topology with a unique topology ID. You configure the topology ID under the routing protocol, and the ID is used to identify and group NLRI for each topology in updates for a given protocol.

Unicast Topology Support for MTR

You can configure up to 32 unicast topologies on each device. You first define the topology by entering the **global-address-family** command in global configuration mode. The address family and optionally the subaddress family are specified in this step. You then enter the **topology** command in global address family configuration mode. This command places the device in address family topology configuration mode, and the global topology configuration parameters are applied in this mode.

For each new topology that you configure on a device, you increase the total number of routes from the global routing table by the number of routes that are in each new topology [base + topology(*n*)]. If the device carries a large global routing table, and you plan to add a significant number of routes through the Multitopology Routing (MTR) topology configuration, you can configure the **maximum routes** command in address family topology configuration mode to limit the number of routes that the device accepts for a given topology and installs into the corresponding Routing Information Base (RIB).

Note Per-interface topology configuration parameters override configurations applied in global address family topology configuration mode and router address family topology configuration mode.

Interface Configuration Support for MTR

The configuration of a Multitopology Routing (MTR) topology in interface configuration mode allows you to enable or disable MTR on a per-interface basis. By default, a class-specific topology does not include any interfaces.

You can include or exclude individual interfaces by configuring the **topology** interface configuration command. You specify the address family and the topology (base or class-specific) when entering this command. The subaddress family can be specified. If no subaddress family is specified, the unicast subaddress family is used by default.

You can include globally all interfaces on a device in a topology by entering the **all-interfaces** command in routing topology configuration mode. Per-interface topology configuration applied with the **topology** command overrides global interface configuration.

The interface configuration support for MTR has these characteristics:

- Per-interface routing configuration: Interior Gateway Protocol (IGP) routing and metric configurations can be applied in interface topology configuration mode. Per-interface metrics and routing behaviors can be configured for each IGP.
- Open Shortest Path First (OSPF) interface topology configuration: Interface mode OSPF configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable OSPF routing without removing the interface from the global topology configuration.
- Enhanced Interior Gateway Routing Protocol (EIGRP) interface topology configuration: Interface mode EIGRP configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure various EIGRP features.
- Intermediate System-to-Intermediate System (IS-IS) interface topology configuration: Interface mode IS-IS configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable IS-IS routing without removing the interface from the global topology configuration.

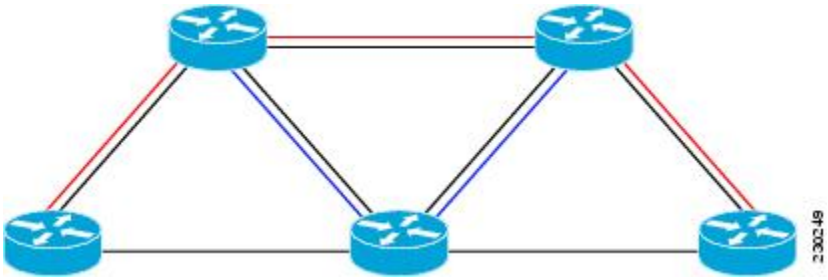
MTR Deployment Models

The base topology is the superset of all topologies in the network. It is defined by Network Layer Reachability Information (NLRI) for all reachable devices regardless of the deployment model that is used. Multitopology Routing (MTR) can be deployed using the service separation MTR model, or it can deployed using the overlapping MTR model. Each model represents a different approach to deploying MTR. However, these models are not mutually exclusive. Any level of variation of a combined model can be deployed.

Service Separation MTR Model

The figure below shows the service separation model where no topologies except for the base topology (shown in black) overlap with each other. In the service separation model, each class of traffic is constrained to its own exclusive topology. This model restricts the given class of traffic to a subset of the network. This model is less configuration intensive than the overlapping MTR model because no topology-specific metrics need to be configured.

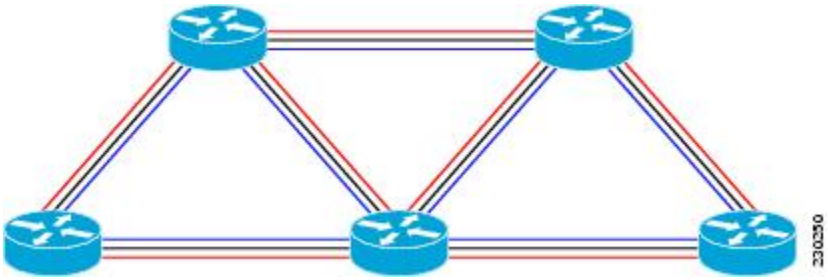
Figure 6: Service-Separation MTR Model



Overlapping MTR Model

In the overlapping Multitopology Routing (MTR) model, all topologies are configured to run over all devices in the network. This model provides the highest level of redundancy. All classes of traffic can use all links. Per-topology metrics are then configured to bias different classes of traffic to use different parts of the network. The redundancy that this model provides, however, makes it more configuration intensive than the service separation MTR model. In the figure below, all topologies are configured to run over all network devices. In this model, per-topology metrics are configured to bias the preferred routes for each topology.

Figure 7: Overlapping MTR Model



MTR Deployment Configuration

Multitopology Routing (MTR) supports both full and incremental deployment configurations. To support these options, MTR provides two different, configurable forwarding rules: strict forwarding mode for full deployment and incremental forwarding mode for an incremental deployment.

Strict Forwarding Mode for Full Deployment of MTR

Strict forwarding mode is the default forwarding mode in Multitopology Routing (MTR). In this mode, the device looks for a forwarding route only in the class-specific Forwarding Information Base (FIB). If no forwarding route is found, the device drops the received packet. In this mode, the device performs a longest match lookup for the topology FIB entry. This mode is designed for full deployment, where MTR is enabled on every device in the network or every device in the topology. Strict forwarding mode should be enabled after an incremental deployment transition has been completed or when all devices in the network or topology are MTR enabled. You can enable strict forwarding mode after incremental forwarding mode by entering the **no forward-base** command in address family topology configuration mode.

Incremental Forwarding Mode for Incremental Deployment of MTR

Incremental forwarding mode is designed to support transitional or incremental deployment of Multitopology Routing (MTR), where devices in the network are not MTR enabled. In this mode, the device looks for a forwarding entry first in the class-specific Forwarding Information Base (FIB). If an entry is not found, the device looks for the longest match in the base topology FIB. If an entry is found in the base topology FIB, the device forwards the packet on the base topology. If a forwarding entry is not found in the base topology FIB, the device drops the packet.

This mode is designed to preserve connectivity during an incremental deployment of MTR and is recommended for use only during migration (the transition from a non-MTR to an MTR-enabled network). Class-specific traffic for a given destination is forwarded over contiguous segments of the class-specific topology containing that destination; otherwise, it is forwarded over the base topology.

This forwarding mode can be enabled to support mixed networks where some devices are not configured to run MTR. You enable incremental forwarding mode by entering the **forward-base** command in address family topology configuration mode.

Guidelines for Enabling and Disabling MTR

The section provides guidelines and procedures for enabling or disabling Multitopology Routing (MTR) in a production network. These guidelines assume that all participating networking devices are running a software image that supports MTR. The guidelines are designed to prevent major traffic interruptions due to misconfiguration and to minimize temporary transitional effects that can occur when you introduce or remove a topology from a network. The following guidelines must be implemented in the order that they are described:

First, create a class-specific topology on all networking devices and enable incremental forwarding mode by entering the **forward-base** command in address family topology configuration mode. Configure incremental forwarding whenever a topology is introduced or removed from the network. The topology is defined as a global container at this stage. No routing or forwarding can occur within the topology. Routing protocol support should not be configured.

Second, configure classification rules for the class-specific topology. You must consistently apply classification on all devices in the topology; each device has identical classifier configuration. You activate the topology when you attach a valid classification configuration to the global topology configuration. You can use **ping** and **traceroute** commands to verify reachability for interfaces and networking devices that are in the same topology and configured with identical classification.

Third, configure routing protocol support and static routing. Configure the devices in the topology one at a time. This configuration should include an interface, router process, and routing protocol-specific metrics and filters.

Enable routing in the topology by using a physical pattern in a contiguous manner relative to a single starting point. For example, configure all interfaces on a single device, and then all interfaces on each adjacent device. Follow this pattern until the task is complete. The starting point can be on the edge or core of the network. This recommendation is designed to increase the likelihood that class-specific traffic is forwarded on the same paths in the incremental topology as it is on the full topology when MTR is completely deployed.

If your network design requires strict forwarding mode, you should disable incremental forwarding only after you configure routing on all devices in a given topology. At this stage, MTR is fully operational. Class-specific traffic is forwarded only over devices within the topology. Traffic that is not classified or destined for the topology is dropped.

When disabling a topology, reenable incremental forwarding mode. Remove custom route configuration, such as route summarization and default routes before disabling a topology, and reapply custom route configuration only after the topology is reenabled. This recommendation is designed to prevent traffic interruption because some destinations might be obscured during the transition. Custom route configuration is most useful when all of the more-specific routes are available in the routing table of the topology.

Note These guideliens apply only when a given classifier is enabled or disabled for a given topology. All other MTR configuration, including interface and routing protocol-specific configuration (other than the topology ID) can be modified dynamically as necessary.

How to Configure Multitopology Routing

Configuring a Unicast Topology for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **global-address-family ipv4** [**multicast** | **unicast**]
4. **topology** {**base** | *topology-name*}
5. **all-interfaces**
6. **forward-base**
7. **maximum routes** *number* [**threshold** [**reinstall** *threshold*] | **warning-only**]
8. **shutdown**
9. **end**
10. **show topology** [**cache** [*topology-id*] | **ha** [[**detail** | **interface** | **lock** | **router**] [**all** | **ipv4** | **ipv6** | **vrf** *vpn-instance*]]]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**global-address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config)# global-address-family ipv4`	Enters global address family topology configuration mode to configure the global topology. • The address family for the class-specific topology is specified in this step. The subaddress family can be specified. Unicast is the default if no subaddress family is entered.
Step 4	**topology** {**base** | *topology-name*} **Example:** `Device(config-af)# topology VOICE`	Configures the global topology instance and enters address family topology configuration mode. • The **base** keyword is used to configure the base topology or a multicast topology. • The *topology-name* argument is entered to label a class-specific topology. Topology names are case-sensitive. For example, VOICE and voice identify two different topologies. • Multitopology Routing (MTR) supports 32 unicast topologies including the base topology.
Step 5	**all-interfaces** **Example:** `Device(config-af-topology)# all-interfaces`	(Optional) Configures the topology instance to use all interfaces on a device. • By default, no interfaces are used. **Note** The configuration of this command does not override the topology configuration applied in interface configuration mode.
Step 6	**forward-base** **Example:** `Device(config-af-topology)# forward-base`	(Optional) Configures the forwarding mode under a topology instance. • Strict mode (default) configures the device to look for forwarding entries only in the topology-specific Forwarding Information Base (FIB). If an entry is not found, the packet is dropped. • Incremental mode (enable form) configures the device to look first in the class-specific topology FIB. If a forwarding route is not found, then the device looks in the base topology FIB.

	Command or Action	Purpose
Step 7	**maximum routes** *number* [**threshold** [**reinstall** *threshold*] | **warning-only**] **Example:** `Device(config-af-topology)# maximum routes 1000 warning-only`	(Optional) Configures the maximum number of routes that a topology instance accepts and installs into the RIB. • Use the **warning-only** keyword to generate only a warning, to set an upper limit, and to set a lower limit (low-water mark) for reinstalling routes after the maximum limit has been exceeded.
Step 8	**shutdown** **Example:** `Device(config-af-topology)# shutdown`	(Optional) Temporarily disables a topology instance without removing the topology configuration (while other topology parameters are configured and other devices are configured with MTR).
Step 9	**end** **Example:** `Device(config-af-topology)# end`	(Optional) Exits address family topology configuration mode and enters privileged EXEC mode.
Step 10	**show topology** [**cache** [*topology-id*] | **ha** [[**detail** | **interface** | **lock** | **router**] [**all** | **ipv4** | **ipv6** | **vrf** *vpn-instance*]]] **Example:** `Device# show topology`	(Optional) Displays information about class-specific and base topologies.

Configuring an MTR Topology in Interface Configuration Mode

Before You Begin

Define a topology globally before configuring the per-interface topology configuration.

Note Interfaces cannot be excluded from the base topology by design. However, an Interior Gateway Protocol (IGP) can be excluded from an interface in a base topology configuration.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable**] | **base**}
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0/0`	Specifies the interface type and number, and enters interface configuration mode.
Step 4	**topology ipv4** [**multicast**	**unicast**] {*topology-name* [**disable**]	**base**} **Example:** `Device(config-if)# topology ipv4 VOICE`	Enters interface topology configuration mode to configure a Multitopology Routing (MTR) topology name on an interface. • Use the **disable** keyword to disable the topology instance on the interface. This form is used to exclude a topology configuration from an interface. • If the **no** form of this command is used, the topology interface configuration is removed. • If the **no** form of this command is used with the **disable** keyword, the topology instance is enabled on the interface.
Step 5	**end** **Example:** `Device(config-if-topology)# end`	Exits interface topology configuration mode and returns to privileged EXEC mode.

Enabling Topology Statistics Accounting for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **global-address-family ipv4** [**multicast** | **unicast**]
4. **topology accounting**
5. **exit**
6. **interface** *type number*
7. **ip topology-accounting**
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**global-address-family ipv4** [**multicast**	**unicast**] **Example:** `Device(config)# global-address-family ipv4`	Enters global address family configuration mode.
Step 4	**topology accounting** **Example:** `Device(config-af)# topology accounting`	Enables topology accounting on all interfaces in the global address family for all IPv4 unicast topologies in the default virtual routing and forwarding (VRF) instance.
Step 5	**exit** **Example:** `Device(config-af)# exit`	Exits global address family configuration mode.

	Command or Action	Purpose
Step 6	**interface** *type number* **Example:** `Device(config)# interface FastEthernet 1/10`	Specifies the interface type and number, and enters interface configuration mode.
Step 7	**ip topology-accounting** **Example:** `Device(config-if)# ip topology-accounting`	Enables topology accounting for all IPv4 unicast topologies in the VPN VRF associated with the specified interface. • This topology accounting is supported only for the default VRF.
Step 8	**end** **Example:** `Device(config-if)# end`	Exits interface configuration mode and returns to privileged EXEC mode.

Monitoring Interface and Topology IP Traffic Statistics for MTR

Use any of the following commands in any order to monitor interface and topology IP traffic statistics for Multitopology Routing (MTR).

SUMMARY STEPS

1. **enable**
2. **show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**]
3. **show ip traffic** [**topology** {*name* | **all** | **base**}]
4. **clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**]
5. **clear ip traffic** [**topology** {*name* | **all** | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip interface** [*type number*] [**topology** {*name*	**all**	**base**}] [**stats**]	(Optional) Displays IP traffic statistics for all interfaces or statistics related to the specified interface.

	Command or Action	Purpose
	Example: `Device# show ip interface FastEthernet 1/10 stats`	• If you specify an interface type and number, information for that specific interface is displayed. If you specify no optional arguments, information for all the interfaces is displayed. • If the **topology** *name* keyword and argument are used, statistics are limited to the IP traffic for that specific topology. • The **base** keyword displays the IPv4 unicast base topology.
Step 3	**show ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# show ip traffic topology VOICE`	(Optional) Displays global IP traffic statistics (an aggregation of all the topologies when MTR is enabled) or statistics related to a particular topology. • The **base** keyword is reserved for the IPv4 unicast base topology.
Step 4	**clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# clear ip interface FastEthernet 1/10 topology all`	(Optional) Resets interface-level IP traffic statistics. • If the **topology** keyword and a related keyword are not used, only the interface-level aggregate statistics are reset. • If all topologies need to be reset, use the **all** keyword as the topology name.
Step 5	**clear ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# clear ip traffic topology all`	(Optional) Resets IP traffic statistics. • If no topology name is specified, global statistics are cleared.

Testing Network Connectivity for MTR

SUMMARY STEPS

1. **enable**
2. **ping** [**vrf** *vrf-name* | **topology** *topology-name*] *protocol* [*target-address*] [*source-address*]
3. **traceroute** [**vrf** *vrf-name* | **topology** *topology-name*] [*protocol*] *destination*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**ping** [**vrf** *vrf-name* | **topology** *topology-name*] *protocol* [*target-address*] [*source-address*] **Example:** `Device# ping topology VOICE ip`	Configures the device to transmit ping messages to the target host in a topology. • An extended ping is configured by entering this command with only the topology name.
Step 3	**traceroute** [**vrf** *vrf-name* | **topology** *topology-name*] [*protocol*] *destination* **Example:** `Device# traceroute VOICE`	Configures the device to trace the specified host in a topology. • An extended trace is configured by entering this command with only the topology name. • If the **vrf** *vrf-name* keyword and argument are used, the **topology** option is not displayed because only the default virtual routing and forwarding (VRF) instance is supported. The **topology** *topology-name* keyword and argument and the differentiated services code point (DSCP) option in the extended traceroute system dialog are displayed only if there is a topology configured on the device.

Configuration Examples for Multitopology Routing

Example: Global Interface Configuration

The following example shows how to create a topology instance named VOICE. This topology is configured to use all operational interfaces on the device. Per the default forwarding rule (strict), only packets destined for routes in the VOICE topology Routing Information Base (RIB) are forwarded. Packets that do not have a topology-specific forwarding entry are dropped.

```
global-address-family ipv4
 topology VOICE
  all-interfaces
  end
```

Example: Incremental Forwarding Configuration

The following example shows how to create a topology instance named VIDEO. This topology is configured to accept and install a maximum of 1000 routes in the VIDEO topology Routing Information Base (RIB).

Incremental forwarding mode is configured so that the device forwards packets over the base topology if no forwarding entry is found in the class-specific RIB.

```
global-address-family ipv4
 topology VIDEO
  forward-base
  maximum routes 1000
  end
```

Example: Unicast Topology Verification

The output of the **show topology detail** command displays information about class-specific and base topologies. This information includes the address family, associated interfaces, interface and topology status, topology name, and associated virtual routing and forwarding (VRF) instance.

```
Device# show topology detail

Topology: base
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP
Topology: VIDEO
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology fallback is enabled
  Topology maximum route limit 1000, warning limit 90% (900)
  Associated interfaces:
Topology: VOICE
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology is enabled on all interfaces
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP
Topology: base
  Address-family: ipv4 multicast
  Associated VPN VRF is default
  Topology state is DOWN
  Route Replication Enabled:
    from unicast all
  Associated interfaces:
```

Example: MTR Topology in Interface Configuration Mode

The following example shows how to disable the VOICE topology on Ethernet interface 0/0:

```
interface Ethernet 0/0
 topology ipv4 VOICE disable
```

Examples: Monitoring Interface and Topology IP Traffic Statistics for MTR

In the following example, the **show ip interface** command displays IP traffic statistics for Fast Ethernet interface 1/10:

```
Device# show ip interface FastEthernet 1/10 stats

FastEthernet1/10
 5 minutes input rate 0 bits/sec, 0 packet/sec,
 5 minutes output rate 0 bits/sec, 0 packet/sec,
 201 packets input, 16038 bytes
 588 packets output, 25976 bytes
```

In this example, the **show ip traffic** command displays statistics related to a particular topology:

```
Device# show ip traffic topology VOICE

  Topology: VOICE
  5 minute input rate 0 bits/sec, 0 packet/sec,
  5 minute output rate 0 bits/sec, 0 packet/sec,
  100 packets input, 6038 bytes,
  88 packets output, 5976 bytes.
```

Examples: Testing Network Connectivity for MTR

The following example shows how to send a ping to the 10.1.1.2 neighbor in the VOICE topology:

```
Device# ping topology VOICE ip 10.1.1.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/4 ms
```

The following example shows how to trace the 10.1.1.4 host in the VOICE topology:

```
Device# traceroute VOICE ip 10.1.1.4
Type escape sequence to abort.
Tracing the route to 10.1.1.4
  1 10.1.1.2 4 msec *  0 msec
  2 10.1.1.3 4 msec *  2 msec
  3 10.1.1.4 4 msec *  4 msec
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Multitopology Routing

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for Multitopology Routing

Feature Name	Releases	Feature Information
Multitopology Routing	12.2(33)SRB 15.0(1)S	Multitopology Routing (MTR) enables you to configure service differentiation through class-based forwarding. MTR provides multiple logical topologies over a single physical network. Service differentiation can be achieved by forwarding different traffic types over different logical topologies that could take different paths to the same destination. MTR can be used, for example, to define separate topologies for voice, video, and data traffic classes. The following commands were introduced or modified: **all-interfaces**, **clear ip interface**, **clear ip route topology**, **clear ip traffic**, **debug topology**, **exit-global-af**, **exit-if-topology**, **exit-topo**, **forward-base**, **global-address-family ipv4**, **ip route topology**, **ip topology accounting**, **maximum routes**, **ping**, **route replicate**, **show ip interface**, **show ip protocols topology**, **show ip route topology**, **show ip static route**, **show ip static route summary**, **show ip traffic**, **show topology**, **shutdown**, **topology**, **topology accounting**, **traceroute**.

Glossary

base topology—The entire network for which the usual set of routes are calculated. This topology is the same as the default global routing table that exists without Multitopology Routing (MTR) being used.

class-specific topology—New topologies that are defined over and above the existing base topology; each class-specific topology is represented by its own Routing Information Base (RIB) and Forwarding Information Base (FIB).

classification—Selection and matching of traffic that needs to be provided with a different treatment based on its mark. Classification is a read-only operation.

DSCP—differentiated services code point. Six bits in the Type of Service (ToS) field. Two bits are used for Explicit Congestion Notification, which are used to mark the packet.

incremental forwarding mode—Incremental forwarding mode is designed to support transitional or incremental deployment of MTR, where devices are in the network that are not MTR enabled. In this mode, the device looks for a forwarding entry first in the class-specific FIB. If an entry is not found, the device then looks for the longest match in the base topology FIB. If an entry is found in the base topology FIB, the packet is forwarded on the base topology. If a forwarding entry is not found in the base topology FIB, the packet is dropped.

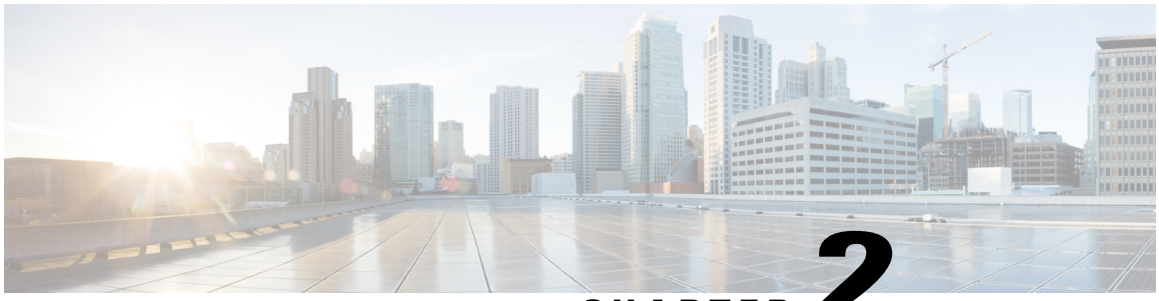
marking—Setting a value in the packet or frame. Marking is a read and write operation.

multitopology—Multitopology means that each topology routes and forward a subset of the traffic as defined by the classification criteria.

NLRI—Network Layer Reachability Information.

strict forwarding mode—Strict forwarding mode is the default forwarding mode for MTR. Only routes in the topology-specific routing table are considered. Among these, the longest match for the destination address is used. If no route containing the destination address can be found in the topology specific table, the packet is dropped.

TID—Topology Identifier. Each topology is configured with a unique topology ID. The topology ID is configured under the routing protocol and is used to identify and group NLRI for each topology in updates for a given protocol.



CHAPTER 2

BGP Support for MTR

The BGP Support for MTR feature provides Border Gateway Protocol (BGP) support for multiple logical topologies over a single physical network. This module describes how to configure BGP for Multitopology Routing (MTR).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for BGP Support for MTR

- Be familiar with all the concepts in the “Information About BGP Support for MTR” section.
- Configure and activate a global Multitopology Routing (MTR) topology configuration.

Restrictions for BGP Support for MTR

- Redistribution within a topology is permitted. Redistribution from one topology to another is not permitted. This restriction is designed to prevent routing loops. You can use topology translation or topology import functionality to move routes from one topology to another.
- Only a single multicast topology can be configured, and only the base topology can be specified if a multicast topology is created.

Information About BGP Support for MTR

Routing Protocol Support for MTR

You must enable IP routing on the device for Multitopology Routing (MTR) to operate. MTR supports static and dynamic routing in Cisco software. You can enable dynamic routing per topology to support interdomain and intradomain routing. Route calculation and forwarding are independent for each topology. MTR support is integrated into Cisco software for the following protocols:

- Border Gateway Protocol (BGP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Integrated Intermediate System-to-Intermediate System (IS-IS)
- Open Shortest Path First (OSPF)

You apply the per-topology configuration in router address family configuration mode of the global routing process (router configuration mode). The address family and subaddress family are specified when the device enters address family configuration mode. You specify the topology name and topology ID by entering the **topology** command in address family configuration mode.

You configure each topology with a unique topology ID under the routing protocol. The topology ID is used to identify and group Network Layer Reachability Information (NLRI) for each topology in updates for a given protocol. In OSPF, EIGRP, and IS-IS, you enter the topology ID during the first configuration of the **topology** command for a class-specific topology. In BGP, you configure the topology ID by entering the **bgp tid** command under the topology configuration.

You can configure class-specific topologies with different metrics than the base topology. Interface metrics configured on the base topology can be inherited by the class-specific topology. Inheritance occurs if no explicit inheritance metric is configured in the class-specific topology.

You configure BGP support only in router configuration mode. You configure Interior Gateway Protocol (IGP) support in router configuration mode and in interface configuration mode.

By default, interfaces are not included in nonbase topologies. For routing protocol support for EIGRP, IS-IS, and OSPF, you must explicitly configure a nonbase topology on an interface. You can override the default behavior by using the **all-interfaces** command in address family topology configuration mode. The **all-interfaces** command causes the nonbase topology to be configured on all interfaces of the device that are part of the default address space or the virtual routing and forwarding (VRF) instance in which the topology is configured.

BGP Network Scope

To implement Border Gateway Protocol (BGP) support for Multitopology Routing (MTR), the scope hierarchy is required, but the scope hierarchy is not limited to MTR use. The scope hierarchy introduces new configuration modes such as router scope configuration mode. The device enters router scope configuration mode when you configure the **scope** command in router configuration mode. When this command is entered, a collection of routing tables is created.

You configure BGP commands under the scope hierarchy for a single network (globally), or on a per-virtual routing and forwarding (VRF) basis; these configurations are referred to as scoped commands. The scope hierarchy can contain one or more address families.

MTR CLI Hierarchy Under BGP

The Border Gateway Protocol (BGP) CLI provides backward compatibility for pre-Multitopology Routing (MTR) BGP configuration and provides a hierarchical implementation of MTR. Router configuration mode is backward compatible with the pre-address family and pre-MTR configuration CLI. Global commands that affect all networks are configured in this configuration mode. For address family and topology configuration, you configure general session commands and peer templates to be used in address family configuration mode or in topology configuration mode.

After configuring any global commands, you define the scope either globally or for a specific virtual routing and forwarding (VRF) instance. The device enters address family configuration mode when you configure the **address-family** command in router scope configuration mode or in router configuration mode. Unicast is the default address family if no subaddress family identifier (SAFI) is specified. MTR supports only the IPv4 address family with a SAFI of unicast or multicast.

When the device enters address family configuration mode from router configuration mode, the software configures BGP to use pre-MTR-based CLI. This configuration mode is backward compatible with pre-existing address family configurations. Entering address family configuration mode from router scope configuration mode configures the device to use the hierarchical CLI that supports MTR. Address family configuration parameters that are not specific to a topology are entered in this address family configuration mode.

The device enters BGP topology configuration mode when you configure the **topology** command in address family configuration mode. You can configure up to 32 topologies (including the base topology) on a device. You configure the topology ID by entering the **bgp tid** command. All address family and subaddress family configuration parameters for the topology are configured here.

Note Configuring a scope for a BGP routing process removes CLI support for pre-MTR-based configuration.

The following example shows the hierarchy levels that are used when you configure BGP for MTR implementation:

```
router bgp <autonomous-system-number>
 ! Global commands

 scope {global | vrf <vrf-name>}
  ! Scoped commands

  address-family {<afi>} [<safi>]
   ! Address family specific commands
```

```
topology {<topology-name> | base}
 ! topology specific commands
```

BGP Sessions for Class-Specific Topologies

Multitopology Routing (MTR) is configured under the Border Gateway Protocol (BGP) on a per-session basis. The base unicast and multicast topologies are carried in the global (default) session. A separate session is created for each class-specific topology that is configured under a BGP routing process. Each session is identified by its topology ID. BGP performs a best-path calculation individually for each class-specific topology. A separate Routing Information Base (RIB) and Forwarding Information Base (FIB) are maintained for each session.

Topology Translation Using BGP

Depending on the design and policy requirements for your network, you might need to install routes from a class-specific topology on one device in a class-specific topology on a neighboring device. Topology translation functionality using the Border Gateway Protocol (BGP) provides support for this operation. Topology translation is BGP neighbor-session based. You configure the **neighbor translate-topology** command by using the IP address and topology ID from the neighbor.

The topology ID identifies the class-specific topology of the neighbor. The routes in the class-specific topology of the neighbor are installed in the local class-specific Routing Information Base (RIB). BGP performs a best-path calculation on all installed routes and installs these routes into the local class-specific RIB. If a duplicate route is translated, BGP selects and installs only one instance of the route per standard BGP best-path calculation behavior.

Topology Import Using BGP

Importing topologies using the Border Gateway Protocol (BGP) is similar to topology translation. The difference is that routes are moved between class-specific topologies on the same device. You configure this function by entering the **import topology** command and specify the name of the class-specific topology or base topology. Best-path calculations are run on the imported routes before they are installed into the topology Routing Information Base (RIB). This **import topology** command also includes a **route-map** keyword to allow you to filter routes that are moved between class-specific topologies.

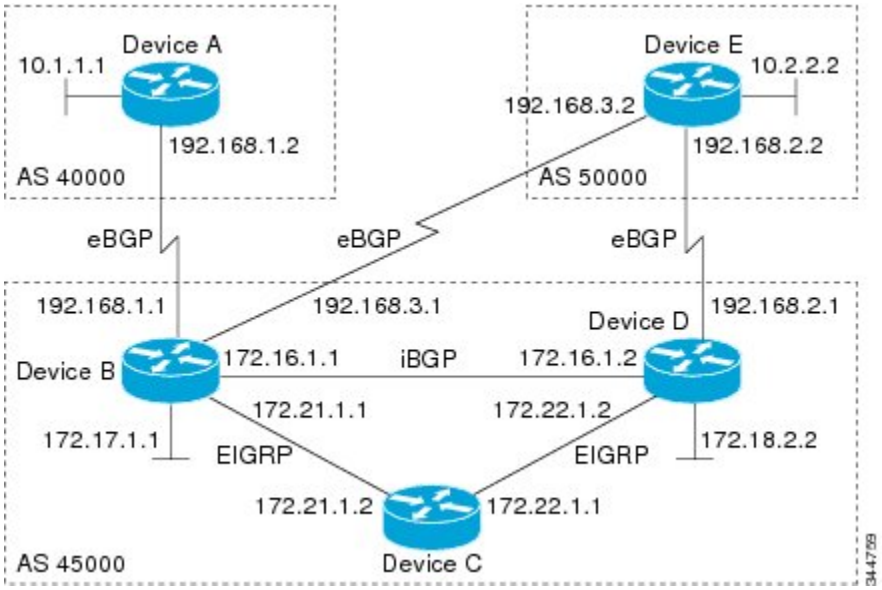
How to Configure BGP Support for MTR

Activating an MTR Topology by Using BGP

Perform this task to activate a Multitopology Routing (MTR) topology inside an address family by using the Border Gateway Protocol (BGP). This task is configured on Device B in the figure below and must also be configured on Device D and Device E. In this task, a scope hierarchy is configured to apply globally, and a neighbor is configured in router scope configuration mode. Under the IPv4 unicast address family, an MTR

topology that applies to video traffic is activated for the specified neighbor. There is no interface configuration mode for BGP topologies.

Figure 8: BGP Network Diagram



SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router bgp** *autonomous-system-number*
4. **scope** {**global** | **vrf** *vrf-name*}
5. **neighbor** {*ip-address* | *peer-group-name*} **remote-as** *autonomous-system-number*
6. **neighbor** {*ip-address* | *peer-group-name*} **transport** {**connection-mode** {**active** | **passive**} | **path-mtu-discovery** | **multi-session** | **single-session**}
7. **address-family ipv4** [**mdt** | **multicast** | **unicast**]
8. **topology** {**base** | *topology-name*}
9. **bgp tid** *number*
10. **neighbor** *ip-address* **activate**
11. **neighbor** {*ip-address* | *peer-group-name*} **translate-topology** *number*
12. **end**
13. **clear ip bgp topology** {* | *topology-name*} {*as-number* | **dampening** [*network-address* [*network-mask*]] | **flap-statistics** [*network-address* [*network-mask*]] | **peer-group** *peer-group-name* | **table-map** | **update-group** [*number* | *ip-address*]} [**in** [**prefix-filter**] | **out** | **soft** [**in** [**prefix-filter**] | **out**]]
14. **show ip bgp topology** {* | *topology*} **summary**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router bgp** *autonomous-system-number* **Example:** `Device(config)# router bgp 45000`	Enters router configuration mode to create or configure a BGP routing process.
Step 4	**scope** {**global** | **vrf** *vrf-name*} **Example:** `Device(config-router)# scope global`	Defines the scope for the BGP routing process and enters router scope configuration mode. • BGP general session commands that apply to a single network, or a specified virtual and routing forwarding (VRF) instance, are entered in this configuration mode. • Use the **global** keyword to specify that BGP uses the global routing table. • Use the **vrf** *vrf-name* keyword and argument to specify that BGP uses a specific VRF routing table. The VRF must already exist.
Step 5	**neighbor** {*ip-address* | *peer-group-name*} **remote-as** *autonomous-system-number* **Example:** `Device(config-router-scope)# neighbor 172.16.1.2 remote-as 45000`	Adds the IP address of the neighbor in the specified autonomous system to the multiprotocol BGP neighbor table of the local device.
Step 6	**neighbor** {*ip-address* | *peer-group-name*} **transport** {**connection-mode** {**active** | **passive**} | **path-mtu-discovery** | **multi-session** | **single-session**} **Example:** `Device(config-router-scope)# neighbor 172.16.1.2 transport multi-session`	Enables a TCP transport session option for a BGP session. • Use the **connection-mode** keyword to specify the type of connection, either active or passive. • Use the **path-mtu-discovery** keyword to enable the TCP transport path maximum transmission unit (MTU) discovery. • Use the **multi-session** keyword to specify a separate TCP transport session for each address family.

	Command or Action	Purpose
		• Use the **single-session** keyword to specify that all address families use a single TCP transport session.
Step 7	**address-family ipv4** [**mdt** | **multicast** | **unicast**] **Example:** `Device(config-router-scope)# address-family ipv4`	Specifies the IPv4 address family and enters router scope address family configuration mode. • Use the **mdt** keyword to specify IPv4 multicast distribution tree (MDT) address prefixes. • Use the **multicast** keyword to specify IPv4 multicast address prefixes. • Use the **unicast** keyword to specify the IPv4 unicast address family. By default, the device is placed in address family configuration mode for the IPv4 unicast address family if the **unicast** keyword is not specified with the **address-family ipv4** command. • Nontopology-specific configuration parameters are configured in this configuration mode.
Step 8	**topology** {**base** | *topology-name*} **Example:** `Device(config-router-scope-af)# topology VIDEO`	Configures the topology instance in which BGP routes class-specific or base topology traffic, and enters router scope address family topology configuration mode.
Step 9	**bgp tid** *number* **Example:** `Device(config-router-scope-af-topo)# bgp tid 100`	Associates a BGP routing process with the specified topology ID. • Each topology must be configured with a unique topology ID.
Step 10	**neighbor** *ip-address* **activate** **Example:** `Device(config-router-scope-af-topo)# neighbor 172.16.1.2 activate`	Enables the BGP neighbor to exchange prefixes for the network service access point (NSAP) address family with the local device. **Note** If you have configured a peer group as a BGP neighbor, do not use this command because peer groups are automatically activated when any peer group parameter is configured.
Step 11	**neighbor** {*ip-address* | *peer-group-name*} **translate-topology** *number* **Example:** `Device(config-router-scope-af-topo)# neighbor 172.16.1.2 translate-topology 200`	(Optional) Configures BGP to install routes from a topology on another device to a topology on the local device. • The topology ID is entered for the *number* argument to identify the topology on the device.

	Command or Action	Purpose
Step 12	**end** **Example:** `Device(config-router-scope-af-topo)# end`	(Optional) Exits router scope address family topology configuration mode and returns to privileged EXEC mode.
Step 13	**clear ip bgp topology** {***** | *topology-name*} {*as-number* | **dampening** [*network-address* [*network-mask*]] | **flap-statistics** [*network-address* [*network-mask*]] | **peer-group** *peer-group-name* | **table-map** | **update-group** [*number* | *ip-address*]} [**in** [**prefix-filter**] | **out** | **soft** [**in** [**prefix-filter**] | **out**]] **Example:** `Device# clear ip bgp topology VIDEO 45000`	Resets BGP neighbor sessions under a specified topology or all topologies.
Step 14	**show ip bgp topology** {***** | *topology*} **summary** **Example:** `Device# show ip bgp topology VIDEO summary`	(Optional) Displays BGP information about a topology. • Most standard BGP keywords and arguments can be entered following the **topology** keyword. **Note** Only the syntax required for this task is shown. For more details, see the *Cisco IOS IP Routing: BGP Command Reference*.

What to Do Next

Repeat this task for every topology that you want to enable, and repeat this configuration on all neighbor devices that are to use the topologies.

If you want to import routes from one Multitopology Routing (MTR) topology to another on the same device, see the “Importing Routes from an MTR Topology by Using BGP” section.

Importing Routes from an MTR Topology by Using BGP

Perform this task to import routes from one Multitopology Routing (MTR) topology to another on the same device, when multiple topologies are configured on the same device. In this task, a prefix list is defined to permit prefixes from the 10.2.2.0 network, and this prefix list is used with a route map to filter routes moved from the imported topology. A global scope is configured, address family IPv4 is entered, the VIDEO topology is specified, the VOICE topology is imported, and the routes are filtered using the route map named 10NET.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip prefix-list** *list-name* [**seq** *number*] {**deny** | **permit**} *network/length* [**ge** *ge-length*] [**le** *le-length*]
4. **route-map** *map-name* [**permit** | **deny**] [*sequence-number*]
5. **match ip address** {*access-list-number* [*access-list-number ...* | *access-list-name...*] | *access-list-name* [*access-list-number ...* | *access-list-name*] | **prefix-list** *prefix-list-name* [*prefix-list-name...*]}
6. **exit**
7. **router bgp** *autonomous-system-number*
8. **scope** {**global** | **vrf** *vrf-name*}
9. **address-family ipv4** [**mdt** | **multicast** | **unicast**]
10. **topology** {**base** | *topology-name*}
11. **import topology** {**base** | *topology-name*} [**route-map** *map-name*]
12. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip prefix-list** *list-name* [**seq** *number*] {**deny** | **permit**} *network/length* [**ge** *ge-length*] [**le** *le-length*] **Example:** `Device(config)# ip prefix-list TEN permit 10.2.2.0/24`	Configures an IP prefix list. • In this example, prefix list TEN permits advertising of the 10.2.2.0/24 prefix depending on a match set by the **match ip address** command.
Step 4	**route-map** *map-name* [**permit** | **deny**] [*sequence-number*] **Example:** `Device(config)# route-map 10NET`	Creates a route map and enters route-map configuration mode. • In this example, the route map named 10NET is created.
Step 5	**match ip address** {*access-list-number* [*access-list-number ...* | *access-list-name...*] |	Configures the route map to match a prefix that is permitted by a standard access list, an extended access list, or a prefix list.

	Command or Action	Purpose
	access-list-name [*access-list-number ...* | *access-list-name*] | **prefix-list** *prefix-list-name* [*prefix-list-name...*]} **Example:** `Device(config-route-map)# match ip address prefix-list TEN`	• In this example, the route map is configured to match prefixes permitted by prefix list TEN.
Step 6	**exit** **Example:** `Device(config-route-map)# exit`	Exits route-map configuration mode and returns to global configuration mode.
Step 7	**router bgp** *autonomous-system-number* **Example:** `Device(config)# router bgp 50000`	Enters router configuration mode to create or configure a Border Gateway Protocol (BGP) routing process.
Step 8	**scope** {**global** | **vrf** *vrf-name*} **Example:** `Device(config-router)# scope global`	Defines the scope to the BGP routing process and enters router scope configuration mode. • BGP general session commands that apply to a single network, or a specified virtual routing and forwarding (VRF) instance, are entered in this configuration mode. • Use the **global** keyword to specify that BGP uses the global routing table. • Use the **vrf** *vrf-name* keyword and argument to specify that BGP uses a specific VRF routing table. The VRF must already exist.
Step 9	**address-family ipv4** [**mdt** | **multicast** | **unicast**] **Example:** `Device(config-router-scope)# address-family ipv4`	Enters router scope address family configuration mode to configure an address family session under BGP. • Nontopology-specific configuration parameters are configured in this configuration mode.
Step 10	**topology** {**base** | *topology-name*} **Example:** `Device(config-router-scope-af)# topology VIDEO`	Configures the topology instance in which BGP routes class-specific or base topology traffic, and enters router scope address family topology configuration mode.
Step 11	**import topology** {**base** | *topology-name*} [**route-map** *map-name*]	(Optional) Configures BGP to move routes from one topology to another on the same device.

	Command or Action	Purpose
	Example: `Device(config-router-scope-af-topo)# import topology VOICE route-map 10NET`	• The **route-map** keyword can be used to filter routes that moved between topologies.
Step 12	**end** **Example:** `Device(config-router-scope-af-topo)# end`	(Optional) Exits router scope address family topology configuration mode and returns to privileged EXEC mode.

Configuration Examples for BGP Support for MTR

Example: BGP Topology Translation Configuration

The following example shows how to configure the Border Gateway Protocol (BGP) in the VIDEO topology and how to configure topology translation with the 192.168.2.2 neighbor:

```
router bgp 45000
 scope global
  neighbor 172.16.1.1 remote-as 50000
  neighbor 192.168.2.2 remote-as 55000
  neighbor 172.16.1.1 transport multi-session
  neighbor 192.168.2.2 transport multi-session
   address-family ipv4
    topology VIDEO
     bgp tid 100
     neighbor 172.16.1.1 activate
     neighbor 192.168.2.2 activate
     neighbor 192.168.2.2 translate-topology 200
     end
clear ip bgp topology VIDEO 50000
```

Example: BGP Global Scope and VRF Configuration

The following example shows how to configure a global scope for a unicast topology and also for a multicast topology. After the device exits the router scope configuration mode, a scope is configured for the virtual routing and forwarding (VRF) instance named DATA.

```
router bgp 45000
 scope global
  bgp default ipv4-unicast
  neighbor 172.16.1.2 remote-as 45000
  neighbor 192.168.3.2 remote-as 50000
  address-family ipv4 unicast
   topology VOICE
   bgp tid 100
   neighbor 172.16.1.2 activate
   exit
```

```
 address-family ipv4 multicast
  topology base
   neighbor 192.168.3.2 activate
   exit
  exit
 exit
scope vrf DATA
 neighbor 192.168.1.2 remote-as 40000
 address-family ipv4
  neighbor 192.168.1.2 activate
  end
```

Examples: BGP Topology Verification

The following example shows summary output for the **show ip bgp topology** command. Information is displayed about Border Gateway Protocol (BGP) neighbors configured to use the Multitopology Routing (MTR) topology named VIDEO.

```
Device# show ip bgp topology VIDEO summary

BGP router identifier 192.168.3.1, local AS number 45000
BGP table version is 1, main routing table version 1
Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
172.16.1.2      4 45000     289     289        1    0    0 04:48:44        0
192.168.3.2     4 50000       3       3        1    0    0 00:00:27        0
```

The following partial output displays BGP neighbor information under the VIDEO topology:

```
Device# show ip bgp topology VIDEO neighbors 172.16.1.2

BGP neighbor is 172.16.1.2,  remote AS 45000, internal link
  BGP version 4, remote router ID 192.168.2.1
  BGP state = Established, up for 04:56:30
  Last read 00:00:23, last write 00:00:21, hold time is 180, keepalive interval is 60
seconds
  Neighbor sessions:
    1 active, is multisession capable
  Neighbor capabilities:
    Route refresh: advertised and received(new)
  Message statistics, state Established:
    InQ depth is 0
    OutQ depth is 0
                         Sent       Rcvd
    Opens:                  1          1
    Notifications:          0          0
    Updates:                0          0
    Keepalives:           296        296
    Route Refresh:          0          0
    Total:                297        297
  Default minimum time between advertisement runs is 0 seconds
 For address family: IPv4 Unicast topology VIDEO
  Session: 172.16.1.2 session 1
  BGP table version 1, neighbor version 1/0
  Output queue size : 0
  Index 1, Offset 0, Mask 0x2
1 update-group member
  Topology identifier: 100
.
.
.
  Address tracking is enabled, the RIB does have a route to 172.16.1.2
  Address tracking requires at least a /24 route to the peer
  Connections established 1; dropped 0
  Last reset never
  Transport(tcp) path-mtu-discovery is enabled
Connection state is ESTAB, I/O status: 1, unread input bytes: 0
Minimum incoming TTL 0, Outgoing TTL 255
Local host: 172.16.1.1, Local port: 11113
```

```
Foreign host: 172.16.1.2, Foreign port: 179
.
.
.
```

Example: Importing Routes from an MTR Topology by Using BGP

The following example shows how to configure an access list to be used by a route map named VOICE to filter routes imported from the Multitopology Routing (MTR) topology named VOICE. Only routes with the prefix 192.168.1.0 are imported.

```
access-list 1 permit 192.168.1.0 0.0.0.255
route-map BLUE
 match ip address 1
 exit
router bgp 50000
 scope global
  neighbor 10.1.1.2 remote-as 50000
  neighbor 172.16.1.1 remote-as 60000
   address-family ipv4
    topology VIDEO
     bgp tid 100
     neighbor 10.1.1.2 activate
     neighbor 172.16.1.1 activate
     import topology VOICE route-map VOICE
     end
clear ip bgp topology VIDEO 50000
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
Border Gateway Protocol (BGP) commands	Cisco IOS IP Routing: BGP Command Reference
BGP concepts and tasks	*IP Routing: BGP Configuration Guide*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

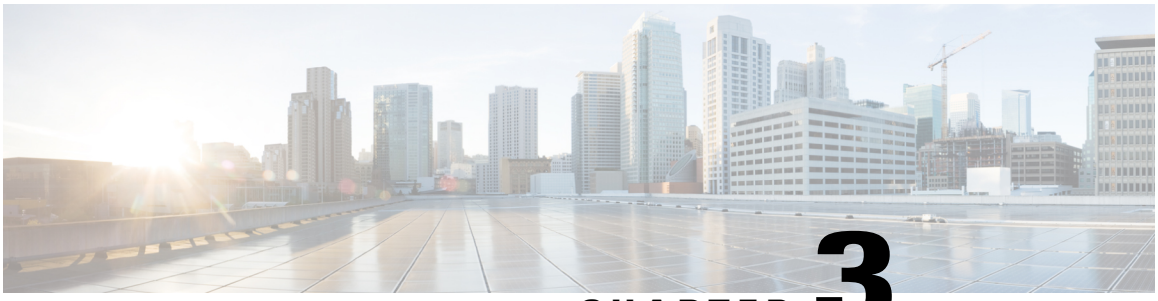
Feature Information for BGP Support for MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 2: Feature Information for BGP Support for MTR

Feature Name	Releases	Feature Information
BGP Support for MTR	12.2(33)SRB 15.0(1)S	This feature provides Border Gateway Protocol (BGP) support for multiple logical topologies over a single physical network. In Cisco IOS XE Release 2.5, support was added for the Cisco ASR 1000 Series Routers. The following commands were introduced or modified: **address-family ipv4**, **bgp tid**, **clear ip bgp topology**, **import topology**, **neighbor translate-topology**, **neighbor transport**, **scope**, **show ip bgp topology**, **topology**.



CHAPTER 3

EIGRP Support for MTR

The EIGRP Support for MTR feature provides Enhanced Interior Gateway Routing Protocol (EIGRP) support for multiple logical topologies over a single physical network. This module describes how to configure EIGRP for Multitopology Routing (MTR).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for EIGRP Support for MTR

- Be familiar with the concepts in the “Routing Protocol Support for MTR” section.
- Configure and activate a global topology configuration.

Restrictions for EIGRP Support for MTR

Graceful restart in the Enhanced Interior Gateway Routing Protocol (EIGRP) works only for base topologies. All other service topologies reset with new adjacencies.

Information About EIGRP Support for MTR

Routing Protocol Support for MTR

You must enable IP routing on the device for Multitopology Routing (MTR) to operate. MTR supports static and dynamic routing in Cisco software. You can enable dynamic routing per topology to support interdomain and intradomain routing. Route calculation and forwarding are independent for each topology. MTR support is integrated into Cisco software for the following protocols:

- Border Gateway Protocol (BGP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Integrated Intermediate System-to-Intermediate System (IS-IS)
- Open Shortest Path First (OSPF)

You apply the per-topology configuration in router address family configuration mode of the global routing process (router configuration mode). The address family and subaddress family are specified when the device enters address family configuration mode. You specify the topology name and topology ID by entering the **topology** command in address family configuration mode.

You configure each topology with a unique topology ID under the routing protocol. The topology ID is used to identify and group Network Layer Reachability Information (NLRI) for each topology in updates for a given protocol. In OSPF, EIGRP, and IS-IS, you enter the topology ID during the first configuration of the **topology** command for a class-specific topology. In BGP, you configure the topology ID by entering the **bgp tid** command under the topology configuration.

You can configure class-specific topologies with different metrics than the base topology. Interface metrics configured on the base topology can be inherited by the class-specific topology. Inheritance occurs if no explicit inheritance metric is configured in the class-specific topology.

You configure BGP support only in router configuration mode. You configure Interior Gateway Protocol (IGP) support in router configuration mode and in interface configuration mode.

By default, interfaces are not included in nonbase topologies. For routing protocol support for EIGRP, IS-IS, and OSPF, you must explicitly configure a nonbase topology on an interface. You can override the default behavior by using the **all-interfaces** command in address family topology configuration mode. The **all-interfaces** command causes the nonbase topology to be configured on all interfaces of the device that are part of the default address space or the virtual routing and forwarding (VRF) instance in which the topology is configured.

Interface Configuration Support for MTR

The configuration of a Multitopology Routing (MTR) topology in interface configuration mode allows you to enable or disable MTR on a per-interface basis. By default, a class-specific topology does not include any interfaces.

You can include or exclude individual interfaces by configuring the **topology** interface configuration command. You specify the address family and the topology (base or class-specific) when entering this command. The subaddress family can be specified. If no subaddress family is specified, the unicast subaddress family is used by default.

You can include globally all interfaces on a device in a topology by entering the **all-interfaces** command in routing topology configuration mode. Per-interface topology configuration applied with the **topology** command overrides global interface configuration.

The interface configuration support for MTR has these characteristics:

- Per-interface routing configuration: Interior Gateway Protocol (IGP) routing and metric configurations can be applied in interface topology configuration mode. Per-interface metrics and routing behaviors can be configured for each IGP.
- Open Shortest Path First (OSPF) interface topology configuration: Interface mode OSPF configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable OSPF routing without removing the interface from the global topology configuration.
- Enhanced Interior Gateway Routing Protocol (EIGRP) interface topology configuration: Interface mode EIGRP configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure various EIGRP features.
- Intermediate System-to-Intermediate System (IS-IS) interface topology configuration: Interface mode IS-IS configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable IS-IS routing without removing the interface from the global topology configuration.

How to Configure EIGRP Support for MTR

Activating an MTR Topology by Using EIGRP

Only Multitopology Routing (MTR) commands are shown in this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router eigrp** *name*
4. **address-family ipv4** [**unicast** | **multicast** | **vrf** *vrf-name*] **autonomous-system** *as-number*
5. **topology** {**base** | *topology-name* **tid** *number*}
6. **end**
7. **show ip protocols topology** *name* [**summary**]
8. **show ip eigrp topology** *name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router eigrp** *name* **Example:** `Device(config)# router eigrp MTR`	Configures an Enhanced Interior Gateway Routing Protocol (EIGRP) process for MTR, and enters router configuration mode. • You can use the command without configuring MTR, but the topology defaults to the base topology.
Step 4	**address-family ipv4** [**unicast** | **multicast** | **vrf** *vrf-name*] **autonomous-system** *as-number* **Example:** `Device(config-router)# address-family ipv4 autonomous-system 1`	Enters router address family configuration mode to configure EIGRP for MTR.
Step 5	**topology** {**base** | *topology-name* **tid** *number*} **Example:** `Device(config-router-af)# topology VIDEO tid 100`	Configures an EIGRP process to route IP traffic under the specified topology instance and enters router address family topology configuration mode. • Each topology must be configured with a unique topology ID. The topology ID must be entered each time this command is entered.

	Command or Action	Purpose
Step 6	**end** **Example:** `Device(config-router-af-topology)# end`	Exits router address family configuration mode and returns to privileged EXEC mode.
Step 7	**show ip protocols topology** *name* [**summary**] **Example:** `Device# show ip protocols topology VIDEO`	Displays the status of routing protocols configured in a topology. **Tip** This command can be entered to display the status, under a topology, of any configured routing protocol.
Step 8	**show ip eigrp topology** *name* **Example:** `Device# show ip eigrp topology VIDEO`	Displays the routing table of an EIGRP process configured under a topology.

What to Do Next

If an Intermediate System-to-Intermediate System (IS-IS) topology configuration is required, see the "IS-IS Support for MTR" feature module.

If a Border Gateway Protocol (BGP) topology configuration is required, see the "BGP Support for MTR" feature module.

Activating an MTR Topology in Interface Configuration Mode by Using EIGRP

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable**] | **base**}
5. **eigrp** *as-number* **delay** *value*
6. **eigrp** *as-number* **next-hop-self**
7. **eigrp** *as-number* **shutdown**
8. **eigrp** *as-number* **split-horizon**
9. **eigrp** *as-number* **summary-address** *ip-address wildcard-mask* [**distance**]
10. **end**
11. **show ip eigrp topology** *name* **interfaces**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0/0`	Specifies the interface type and number, and enters interface configuration mode.
Step 4	**topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable**] | **base**} **Example:** `Device(config-if)# topology ipv4 VOICE`	Configures a Multitopology Routing (MTR) topology instance on an interface and enters interface topology configuration mode. **Note** Entering this command with the **disable** keyword disables the topology instance on the interface. This form is used to exclude a topology configuration from an interface.
Step 5	**eigrp** *as-number* **delay** *value* **Example:** `Device(config-if-topology)# eigrp 1 delay 100000`	Configures the delay value that the Enhanced Interior Gateway Routing Protocol (EIGRP) uses for interface metric calculation. • The *value* argument is entered in tens of microseconds. The example configures an interface delay metric of 100 milliseconds.
Step 6	**eigrp** *as-number* **next-hop-self** **Example:** `Device(config-if-topology)# eigrp 1 next-hop-self`	Configures an EIGRP process to advertise itself as the next hop. • This command is enabled by default.
Step 7	**eigrp** *as-number* **shutdown** **Example:** `Device(config-if-topology)# eigrp 1 shutdown`	Disables an EIGRP process on the interface without disabling the global topology configuration on the interface.
Step 8	**eigrp** *as-number* **split-horizon**	Configures an EIGRP process to use split horizon.

	Command or Action	Purpose
	Example: `Device(config-if-topology)# eigrp 1 split-horizon`	• This command is enabled by default.
Step 9	**eigrp** *as-number* **summary-address** *ip-address wildcard-mask* [**distance**] **Example:** `Device(config-if-topology)# eigrp 1 summary-address 10.1.1.0 0.0.0.255`	Configures an EIGRP summary address. • An administrative distance of 5 is applied to EIGRP summary routes if the distance is not specified.
Step 10	**end** **Example:** `Device(config-if-topology)# end`	Exits interface topology configuration mode and returns to privileged EXEC mode.
Step 11	**show ip eigrp topology** *name* **interfaces** **Example:** `Device# show ip eigrp topology VOICE interfaces`	Displays information about interfaces, on which EIGRP is configured, in a topology.

Monitoring Interface and Topology IP Traffic Statistics for MTR

Use any of the following commands in any order to monitor interface and topology IP traffic statistics for Multitopology Routing (MTR).

SUMMARY STEPS

1. **enable**
2. **show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**]
3. **show ip traffic** [**topology** {*name* | **all** | **base**}]
4. **clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**]
5. **clear ip traffic** [**topology** {*name* | **all** | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# show ip interface FastEthernet 1/10 stats`	(Optional) Displays IP traffic statistics for all interfaces or statistics related to the specified interface. • If you specify an interface type and number, information for that specific interface is displayed. If you specify no optional arguments, information for all the interfaces is displayed. • If the **topology** *name* keyword and argument are used, statistics are limited to the IP traffic for that specific topology. • The **base** keyword displays the IPv4 unicast base topology.
Step 3	**show ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# show ip traffic topology VOICE`	(Optional) Displays global IP traffic statistics (an aggregation of all the topologies when MTR is enabled) or statistics related to a particular topology. • The **base** keyword is reserved for the IPv4 unicast base topology.
Step 4	**clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# clear ip interface FastEthernet 1/10 topology all`	(Optional) Resets interface-level IP traffic statistics. • If the **topology** keyword and a related keyword are not used, only the interface-level aggregate statistics are reset. • If all topologies need to be reset, use the **all** keyword as the topology name.
Step 5	**clear ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# clear ip traffic topology all`	(Optional) Resets IP traffic statistics. • If no topology name is specified, global statistics are cleared.

Configuration Examples for EIGRP Support for MTR

Examples: Activating an MTR Topology by Using EIGRP

The following example shows how to activate the VIDEO topology using the Enhanced Interior Gateway Routing Protocol (EIGRP):

```
router eigrp MTR
 address-family ipv4 autonomous-system 1
  network 10.0.0.0 0.0.0.255
```

```
  topology VIDEO tid 10
   redistribute connected
   end
```

The following example shows how to display the status of routing protocols configured in the VIDEO topology. EIGRP information is shown in the output.

```
Device# show ip protocols topology VIDEO

*** IP Routing is NSF aware ***
Routing Protocol is "eigrp 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Default networks flagged in outgoing updates
  Default networks accepted from incoming updates
  EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
  EIGRP maximum hopcount 100
  EIGRP maximum metric variance 1
  Redistributing: eigrp 1
  EIGRP graceful-restart disabled
  EIGRP NSF-aware route hold timer is 240s
  Topologies : 100(VOICE) 0(base)
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
  Routing Information Sources:
    Gateway         Distance      Last Update
  Distance: internal 90 external 170
```

The following example shows the EIGRP routing table configured under the VIDEO topology:

```
Device# show ip eigrp topology VIDEO

EIGRP-IPv4 Topology Table for AS(1)/ID(10.1.1.2) Routing Table: VOICE
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
       r - reply Status, s - sia Status
P 10.1.1.0/24, 1 successors, FD is 281600
        via Connected, Ethernet0/0
```

Examples: MTR EIGRP Topology in Interface Configuration Mode

The following example shows how to set the Enhanced Interior Gateway Routing Protocol (EIGRP) delay calculation on interface Ethernet 0/0 to 100 milliseconds:

```
interface Ethernet 0/0
 topology ipv4 VOICE
  eigrp 1 delay 100000
  eigrp 1 next-hop-self
  eigrp 1 shutdown
  eigrp 1 split-horizon
  eigrp 1 summary-address 10.1.1.0 0.0.0.255
  end
```

The following example shows how to display EIGRP information about interfaces in the VOICE topology:

```
Device# show ip eigrp topology VOICE interfaces

EIGRP-IPv4 interfaces for process 1
                      Xmit Queue   Mean   Pacing Time   Multicast    Pending
Interface        Peers  Un/Reliable  SRTT   Un/Reliable   Flow Timer   Routes
Et0/0              1        0/0        20       0/2            0           0
```

The following example shows how to display EIGRP information about links in the VOICE topology:

```
Device# show ip eigrp topology VOICE detail-links

EIGRP-IPv4 Topology Table for AS(1)/ID(10.1.1.1) Routing Table: VOICE
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
```

```
       r - reply Status, s - sia Status
P 10.1.1.0/24, 1 successors, FD is 25856000, serno 5
        via Connected, Ethernet0/0
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
Enhanced Interior Gateway Routing Protocol (EIGRP) commands	Cisco IOS IP Routing: EIGRP Command Reference
EIGRP concepts and tasks	*IP Routing: EIGRP Configuration Guide*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

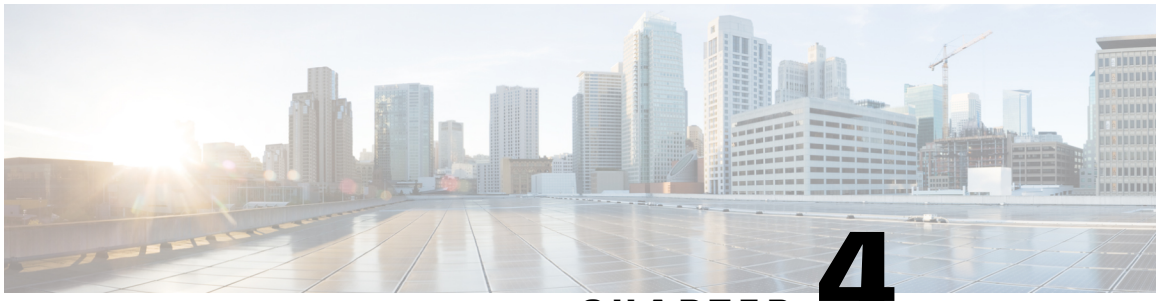
Feature Information for EIGRP Support for MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 3: Feature Information for EIGRP Support for MTR

Feature Name	Releases	Feature Information
EIGRP Support for MTR	12.2(33)SRB 15.0(1)S	This feature provides Enhanced Interior Gateway Routing Protocol (EIGRP) support for multiple logical topologies over a single physical network. The following commands were introduced or modified: **address-family ipv4**, **clear ip eigrp neighbor**, **eigrp delay**, **eigrp next-hop-self**, **eigrp shutdown**, **eigrp split-horizon**, **eigrp summary-address**, **router eigrp**, **show ip eigrp topology**, **topology**.



CHAPTER 4

IS-IS Support for MTR

The IS-IS Support for MTR feature provides Intermediate System-to-Intermediate System (IS-IS) support for multiple logical topologies over a single physical network. This module describes how to configure IS-IS for Multitopology Routing (MTR) for both unicast and multicast topologies.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for IS-IS Support for MTR

- Be familiar with the concepts in the “Routing Protocol Support for MTR” section.
- Configure and activate a global topology configuration.

- You must configure a multicast topology before activating the Intermediate System-to-Intermediate System (IS-IS) protocol in the multicast topology. For details, see the "MTR support for Multicast" feature module.
- Activate a Multitopology Routing (MTR) topology on an IS-IS device.
- Configure the MTR topology to globally configure all interfaces by using the **all-interfaces** address family topology configuration command, or configure the IS-IS topology in interface configuration mode to configure only IS-IS interfaces. The order in which you perform the two tasks does not matter.

Restrictions for IS-IS Support for MTR

Only the IPv4 address family (multicast and unicast) and IPv6 address family unicast are supported. For information about configuring Multitopology IS-IS for IPv6, see the *IS-IS Configuration Guide.*

Information About IS-IS Support for MTR

Routing Protocol Support for MTR

You must enable IP routing on the device for Multitopology Routing (MTR) to operate. MTR supports static and dynamic routing in Cisco software. You can enable dynamic routing per topology to support interdomain and intradomain routing. Route calculation and forwarding are independent for each topology. MTR support is integrated into Cisco software for the following protocols:

- Border Gateway Protocol (BGP)
- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Integrated Intermediate System-to-Intermediate System (IS-IS)
- Open Shortest Path First (OSPF)

You apply the per-topology configuration in router address family configuration mode of the global routing process (router configuration mode). The address family and subaddress family are specified when the device enters address family configuration mode. You specify the topology name and topology ID by entering the **topology** command in address family configuration mode.

You configure each topology with a unique topology ID under the routing protocol. The topology ID is used to identify and group Network Layer Reachability Information (NLRI) for each topology in updates for a given protocol. In OSPF, EIGRP, and IS-IS, you enter the topology ID during the first configuration of the **topology** command for a class-specific topology. In BGP, you configure the topology ID by entering the **bgp tid** command under the topology configuration.

You can configure class-specific topologies with different metrics than the base topology. Interface metrics configured on the base topology can be inherited by the class-specific topology. Inheritance occurs if no explicit inheritance metric is configured in the class-specific topology.

You configure BGP support only in router configuration mode. You configure Interior Gateway Protocol (IGP) support in router configuration mode and in interface configuration mode.

By default, interfaces are not included in nonbase topologies. For routing protocol support for EIGRP, IS-IS, and OSPF, you must explicitly configure a nonbase topology on an interface. You can override the default

behavior by using the **all-interfaces** command in address family topology configuration mode. The **all-interfaces** command causes the nonbase topology to be configured on all interfaces of the device that are part of the default address space or the virtual routing and forwarding (VRF) instance in which the topology is configured.

Interface Configuration Support for MTR

The configuration of a Multitopology Routing (MTR) topology in interface configuration mode allows you to enable or disable MTR on a per-interface basis. By default, a class-specific topology does not include any interfaces.

You can include or exclude individual interfaces by configuring the **topology** interface configuration command. You specify the address family and the topology (base or class-specific) when entering this command. The subaddress family can be specified. If no subaddress family is specified, the unicast subaddress family is used by default.

You can include globally all interfaces on a device in a topology by entering the **all-interfaces** command in routing topology configuration mode. Per-interface topology configuration applied with the **topology** command overrides global interface configuration.

The interface configuration support for MTR has these characteristics:

- Per-interface routing configuration: Interior Gateway Protocol (IGP) routing and metric configurations can be applied in interface topology configuration mode. Per-interface metrics and routing behaviors can be configured for each IGP.
- Open Shortest Path First (OSPF) interface topology configuration: Interface mode OSPF configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable OSPF routing without removing the interface from the global topology configuration.
- Enhanced Interior Gateway Routing Protocol (EIGRP) interface topology configuration: Interface mode EIGRP configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure various EIGRP features.
- Intermediate System-to-Intermediate System (IS-IS) interface topology configuration: Interface mode IS-IS configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable IS-IS routing without removing the interface from the global topology configuration.

How to Configure IS-IS Support for MTR

Activating an MTR Topology by Using IS-IS

Note Only Multitopology Routing (MTR) commands are shown in this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router isis** [*area-tag*]
4. **net** *network-entity-title*
5. **metric-style wide** [**transition**] [**level-1** | **level-2** | **level-1-2**]
6. **address-family ipv4** [**multicast** | **unicast**]
7. **topology** *topology-name* **tid** *number*
8. **end**
9. **show isis neighbors detail**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router isis** [*area-tag*] **Example:** `Device(config)# router isis`	Enables the Intermediate System-to-Intermediate System (IS-IS) routing protocol and optionally specifies an IS-IS process. • Enters router configuration mode.
Step 4	**net** *network-entity-title* **Example:** `Device(config-router)# net 31.3131.3131.3131.00`	Configures an IS-IS network entity title (NET) for a Connectionless Network Service (CLNS) routing process.
Step 5	**metric-style wide** [**transition**] [**level-1**	**level-2**	**level-1-2**] **Example:** `Device(config-router)# metric-style wide`	Globally changes the metric value for all IS-IS interfaces. **Note** Wide style metrics are required for prefix tagging.

	Command or Action	Purpose
Step 6	**address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config-router)# address-family ipv4`	Enters router address family configuration mode.
Step 7	**topology** *topology-name* **tid** *number* **Example:** `Device(config-router-af)# topology DATA tid 100`	Configures IS-IS support for the topology and assigns a Topology Identifier (TID) number for each topology. • In this example, IS-IS support for the DATA topology is configured.
Step 8	**end** **Example:** `Device(config-router-af)# end`	Exits router address family configuration mode and returns to privileged EXEC mode.
Step 9	**show isis neighbors detail** **Example:** `Device# show isis neighbors detail`	(Optional) Displays information about IS-IS neighbors, including MTR information for the TID values for the device and its IS-IS neighbors.

What to Do Next

If a Border Gateway Protocol (BGP) topology configuration is required, see the "BGP Support for MTR" feature module.

Activating an MTR Topology in Interface Configuration Mode by Using IS-IS

Before You Begin

Define a topology globally before performing the per-interface topology configuration.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ip address** *ip-address mask* [**secondary**]
5. **ip router isis** [*area-tag*]
6. **topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable** | **base**]}
7. **isis topology disable**
8. **topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable** | **base**]}
9. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 2/0`	Specifies the interface type and number, and enters interface configuration mode.
Step 4	**ip address** *ip-address mask* [**secondary**] **Example:** `Device(config-if)# ip address 192.168.7.17 255.255.255.0`	Sets a primary or secondary IP address for an interface.
Step 5	**ip router isis** [*area-tag*] **Example:** `Device(config-if)# ip router isis`	Configures an Intermediate System-to-Intermediate System (IS-IS) routing process for IP on an interface and attaches an area designator to the routing process. **Note** If a tag is not specified, a null tag is assumed and the process is referenced with a null tag.
Step 6	**topology ipv4** [**multicast**	**unicast**] {*topology-name* [**disable**	**base**]}	Configures a Multitopology Routing (MTR) topology instance on an interface and enters interface topology configuration mode.

	Command or Action	Purpose
	Example: `Device(config-if)# topology ipv4 DATA`	**Note** In this example, the topology instance DATA is configured for an MTR network that has a global topology named DATA.
Step 7	**isis topology disable** **Example:** `Device(config-if-topology)# isis topology disable`	(Optional) Prevents an IS-IS process from advertising the interface as part of the topology. **Note** In this example, the topology instance DATA will not advertise the interface as part of the topology.
Step 8	**topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable** | **base**]} **Example:** `Device(config-if-topology)# topology ipv4 VOICE`	Configures an MTR topology instance on an interface. **Note** In this example, the topology instance VOICE is configured for an MTR network that has a global topology named VOICE.
Step 9	**end** **Example:** `Device(config-if-topology)# end`	Exits interface topology configuration mode and returns to privileged EXEC mode.

Monitoring Interface and Topology IP Traffic Statistics for MTR

Use any of the following commands in any order to monitor interface and topology IP traffic statistics for Multitopology Routing (MTR).

SUMMARY STEPS

1. **enable**
2. **show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**]
3. **show ip traffic** [**topology** {*name* | **all** | **base**}]
4. **clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**]
5. **clear ip traffic** [**topology** {*name* | **all** | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# show ip interface FastEthernet 1/10 stats`	(Optional) Displays IP traffic statistics for all interfaces or statistics related to the specified interface. • If you specify an interface type and number, information for that specific interface is displayed. If you specify no optional arguments, information for all the interfaces is displayed. • If the **topology** *name* keyword and argument are used, statistics are limited to the IP traffic for that specific topology. • The **base** keyword displays the IPv4 unicast base topology.
Step 3	**show ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# show ip traffic topology VOICE`	(Optional) Displays global IP traffic statistics (an aggregation of all the topologies when MTR is enabled) or statistics related to a particular topology. • The **base** keyword is reserved for the IPv4 unicast base topology.
Step 4	**clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# clear ip interface FastEthernet 1/10 topology all`	(Optional) Resets interface-level IP traffic statistics. • If the **topology** keyword and a related keyword are not used, only the interface-level aggregate statistics are reset. • If all topologies need to be reset, use the **all** keyword as the topology name.
Step 5	**clear ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# clear ip traffic topology all`	(Optional) Resets IP traffic statistics. • If no topology name is specified, global statistics are cleared.

Configuration Examples for IS-IS Support for MTR

Example: Activating an MTR Topology by Using IS-IS

The following example shows how to configure both the Multitopology Routing (MTR) topologies DATA and VIDEO and Intermediate System-to-Intermediate System (IS-IS) support for MTR. The DATA and VIDEO topologies are enabled on three IS-IS neighbors in a network.

Device 1

```
global-address-family ipv4
 topology DATA
 topology VOICE
 end
interface Ethernet 0/0
 ip address 192.168.128.2 255.255.255.0
 ip router isis
 topology ipv4 DATA
 isis topology disable
 topology ipv4 VOICE
 end
router isis
 net 33.3333.3333.3333.00
 metric-style wide
 address-family ipv4
  topology DATA tid 100
  topology VOICE tid 200
  end
```

Device 2

```
global-address-family ipv4
 topology DATA
 topology VOICE
 all-interfaces
  forward-base
  maximum routes 1000 warning-only
  shutdown
  end
interface Ethernet 0/0
 ip address 192.168.128.1 255.255.255.0
 ip router isis
 topology ipv4 DATA
  isis topology disable
  topology ipv4 VOICE
  end
interface Ethernet 1/0
 ip address 192.168.130.1 255.255.255.0
 ip router isis
 topology ipv4 DATA
  isis topology disable
  topology ipv4 VOICE
  end
router isis
 net 32.3232.3232.3232.00
 metric-style wide
 address-family ipv4
  topology DATA tid 100
  topology VOICE tid 200
  end
```

Device 3

```
global-address-family ipv4
 topology DATA
  topology VOICE
  all-interfaces
  forward-base
  maximum routes 1000 warning-only
  shutdown
  end
interface Ethernet 1/0
 ip address 192.168.131.1 255.255.255.0
 ip router isis
 topology ipv4 DATA
  isis topology disable
```

```
  topology ipv4 VOICE
  end
router isis
 net 31.3131.3131.3131.00
 metric-style wide
 address-family ipv4
  topology DATA tid 100
  topology VOICE tid 200
  end
```

Entering the **show isis neighbors detail** command verifies topology translation with the IS-IS neighbor Device 1:

```
Device# show isis neighbors detail

System Id      Type Interface IP Address      State Holdtime Circuit Id
R1             L2   Et0/0     192.168.128.2   UP    28       R5.01
  Area Address(es): 33
  SNPA: aabb.cc00.1f00
  State Changed: 00:07:05
  LAN Priority: 64
  Format: Phase V
  Remote TID:  100, 200
  Local TID:   100, 200
```

Example: MTR IS-IS Topology in Interface Configuration Mode

The following example shows how to prevent the Intermediate System-to-Intermediate System (IS-IS) process from advertising interface Ethernet 1/0 as part of the DATA topology:

```
interface Ethernet 1/0
 ip address 192.168.130.1 255.255.255.0
 ip router isis
 topology ipv4 DATA
  isis topology disable
  topology ipv4 VOICE
  end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
Intermediate System-to-Intermediate System (IS-IS) commands	Cisco IOS IP Routing: IS-IS Command Reference
IS-IS concepts and tasks	*IP Routing: IS-IS Configuration Guide*

Related Topic	Document Title
Configuring a multicast topology	"MTR Support for Multicast" feature module in the *Multitopology Routing Configuration Guide*
Configure Multitopology IS-IS for IPv6	*IP Routing: IS-IS Configuration Guide*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

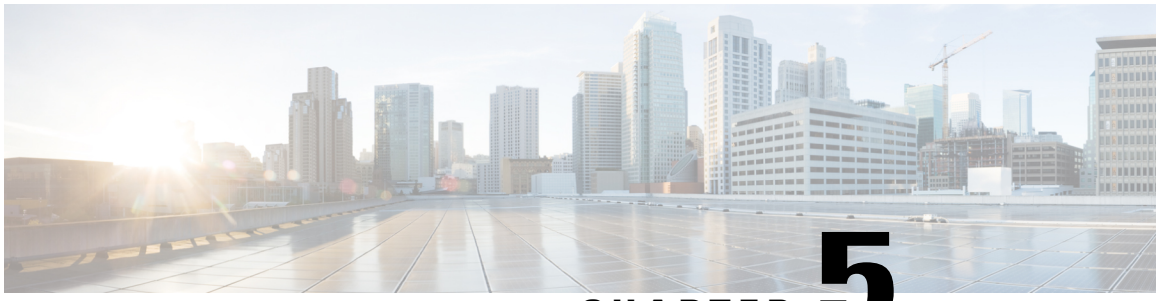
Feature Information for IS-IS Support for MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 4: Feature Information for IS-IS Support for MTR

Feature Name	Releases	Feature Information
IS-IS Support for MTR	12.2(33)SRB Cisco IOS XE Release 2.5	This feature provides Intermediate System-to-Intermediate System (IS-IS) support for multiple logical topologies over a single physical network. In Cisco IOS XE Release 2.5, support was added for the Cisco ASR 1000 Series Routers. The following commands were introduced or modified: **address-family ipv4**, **isis topology disable**, **show isis neighbors**, **topology**.



CHAPTER 5

ISSU-MTR

The ISSU-MTR feature extends In Service Software Upgrade (ISSU) support to include the Multitopology Routing (MTR) functionality and all protocols and applications that support MTR. This module describes the benefits of using ISSU-MTR.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About ISSU-MTR

Benefits of ISSU-MTR

All protocols and applications that support Multitopology Routing (MTR) and that also support In Service Software Upgrade (ISSU) have extended their ISSU support to include the MTR functionality.

ISSU allows a high-availability (HA) system to run in stateful switchover (SSO) mode even when different versions of Cisco software are running on the active and standby Route Processors (RPs). This feature allows the system to switch over to a secondary RP that is running upgraded (or downgraded) software and to continue forwarding packets without session loss and with minimal or no packet loss.

The ISSU-MTR feature is enabled by default.

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
Cisco In Service Software Upgrade Process	*High Availability Configuration Guide*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

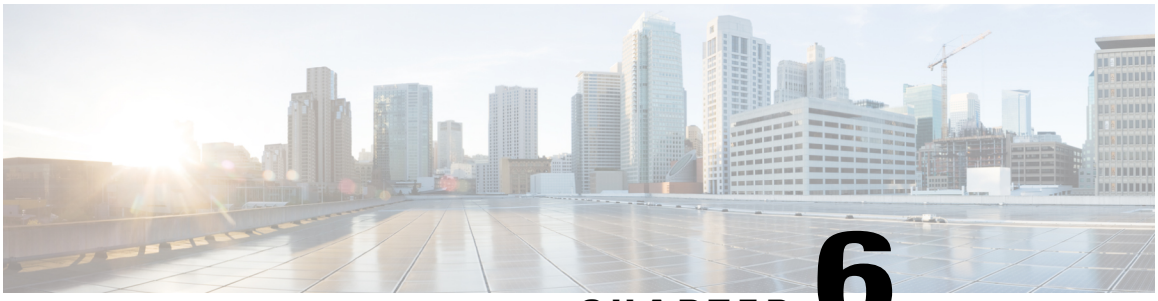
Feature Information for ISSU-MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 5: Feature Information for ISSU-MTR

Feature Name	Releases	Feature Information
ISSU-MTR	12.2(33)SRB1	All protocols and applications that support Multitopology Routing (MTR) and also support In Service Software Upgrade (ISSU) have extended their ISSU support to include the MTR functionality. No commands were introduced or modified in this feature.



CHAPTER 6

MTR Support for Multicast

The MTR Support for Multicast feature provides Multitopology Routing (MTR) support for multicast and allows you to control the path of multicast traffic in the network. This module describes how to configure MTR support for multicast.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for MTR Support for Multicast

Only a single multicast topology can be configured, and only the **topology base** command can be entered when the multicast topology is created.

Information About MTR Support for Multicast

Overview of Multicast MTR in VRF

Cisco software supports legacy (pre-Multitopology Routing (MTR) IP multicast behavior by default. MTR support for IP multicast must be explicitly enabled. Legacy IP multicast uses reverse path forwarding (RPF) on routes in the unicast Routing Information Base (RIB) to build multicast distribution trees (MDTs).

MTR introduces a multicast topology that is completely independent from the unicast topology. MTR integration with multicast allows you to control the path of multicast traffic in the network.

The multicast topology maintains separate routing and forwarding tables. The following list summarizes MTR multicast support that is integrated into Cisco software:

- Conventional longest match support for multicast routes.
- RPF support for Protocol Independent Multicast (PIM).
- Border Gateway Protocol (BGP) MDT subaddress family identifier (SAFI) support for Inter-AS VPNs (SAFI number 66).
- Support for static multicast routes integrated into the **ip route topology** command (modifying the **ip mroute** command).

As in pre-MTR software, you enable multicast support by configuring the **ip multicast-routing** command in global configuration mode. You enable MTR support for multicast by configuring the **ip multicast rpf multitopology** command. After the device enters global address family configuration mode, you then enter the **topology** command with the **base** keyword; global topology configuration parameters are applied in this mode.

How to Configure MTR Support for Multicast

Configuring a Multicast Topology for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip multicast-routing** [**vrf** *name*]
4. **ip multicast rpf multitopology**
5. **global-address-family ipv4** [**multicast** | **unicast**]
6. **topology** {**base** | *topology-name*}
7. **route-replicate from** {**multicast** | **unicast**} [**topology** {**base** | *name*}] *protocol* [**route-map** *name* | **vrf** *name*]
8. **use-topology unicast** {**base** | *topology-name*}
9. **shutdown**
10. **end**
11. **show topology** [**cache** [*topology-id*] | **ha** [**detail** | **interface** | **lock** | **router**] [**all** | **ipv4** | **ipv6** | **vrf** *vpn-instance*]]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip multicast-routing** [**vrf** *name*] **Example:** `Device(config)# ip multicast-routing`	Enables IP multicast routing.

	Command or Action	Purpose
Step 4	**ip multicast rpf multitopology** **Example:** `Device(config)# ip multicast rpf multitopology`	Enables Multitopology Routing (MTR) support for IP multicast routing.
Step 5	**global-address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config)# global-address-family ipv4 multicast`	Enters global address family configuration mode to configure the global topology. • The address family for the class-specific topology is specified in this step. The subaddress family can be specified. Unicast is the default if no subaddress family is entered.
Step 6	**topology** {**base** | *topology-name*} **Example:** `Device(config-af)# topology base`	Configures the global topology instance and enters address family topology configuration mode. • Only the **base** keyword can be accepted for a multicast topology.
Step 7	**route-replicate from** {**multicast** | **unicast**} [**topology** {**base** | *name*}] *protocol* [**route-map** *name* | **vrf** *name*] **Example:** `Device(config-af-topology)# route-replicate from unicast topology VOICE ospf route-map map1`	(Optional) Replicates (copies) routes from another multicast topology Routing Information Base (RIB). • The *protocol* argument is configured to specify the protocol that is the source of the route. Routes can be replicated from the unicast base topology or a class-specific topology. **Note** However, route replication cannot be configured from a class-specific topology that is configured to forward the base topology (incremental forwarding). You can replicate routes from a multicast RIB to a multicast RIB or replicate routes from a unicast RIB to a multicast RIB, but you cannot replicate routes from a multicast RIB to a unicast RIB. • Replicated routes can be filtered through a route map before they are installed into the multicast RIB.
Step 8	**use-topology unicast** {**base** | *topology-name*} **Example:** `Device(config-af-topology)# use-topology unicast VIDEO`	(Optional) Configures a multicast topology to perform reverse path forwarding (RPF) computations using a unicast topology RIB. • The base or a class-specific unicast topology can be configured. When this command is configured, the multicast topology uses routes in the specified unicast topology table to build multicast distribution trees. **Note** This multicast RIB is not used when this command is enabled, even if the multicast RIB is populated and supported by a routing protocol.

	Command or Action	Purpose
Step 9	**shutdown** **Example:** `Device(config-af-topology)# shutdown`	(Optional) Temporarily disables a topology instance without removing the topology configuration (while other topology parameters are configured and other devices are configured with MTR).
Step 10	**end** **Example:** `Device(config-af-topology)# end`	(Optional) Exits address family topology configuration mode and enters privileged EXEC mode.
Step 11	**show topology** [**cache** [*topology-id*] | **ha** [**detail** | **interface** | **lock** | **router**] [**all** | **ipv4** | **ipv6** | **vrf** *vpn-instance*]] **Example:** `Device# show topology detail`	(Optional) Displays information about class-specific and base topologies.

What to Do Next

The topology is not activated until classification is configured. See the "QoS-MQC Support for MTR" feature module to configure classification for a class-specific topology.

Configuration Examples for MTR Support for Multicast

Examples: Route Replication Configuration

The following example shows how to enable multicast support for Multitopology Routing (MTR) and to configure a separate multicast topology:

```
ip multicast-routing
ip multicast rpf multitopology
!
global-address-family ipv4 multicast
 topology base
 end
```

The following example shows how to configure the multicast topology to replicate Open Shortest Path First (OSPF) routes from the VOICE topology. The routes are filtered through the VOICE route map before they are installed in the multicast routing table.

```
ip multicast-routing
ip multicast rpf multitopology
!
access-list 1 permit 192.168.1.0 0.0.0.255
!
```

```
route-map VOICE
 match ip address 1
 exit
!
global-address-family ipv4 multicast
 topology base
 route-replicate from unicast topology VOICE ospf route-map VOICE
```

Example: Using a Unicast RIB for Multicast RPF Configuration

The following example shows how to configure the multicast topology to perform reverse path forwarding (RPF) calculations on routes in the VIDEO topology Routing Information Base (RIB) to build multicast distribution trees:

```
ip multicast-routing
ip multicast rpf multitopology
!
global-address-family ipv4 multicast
 topology base
 use-topology unicast VIDEO
 end
```

Example: Multicast Verification

The following example shows that the multicast topology is configured to replicate routes from the Routing Information Base (RIB) of the VOICE topology:

```
Device# show topology detail

Topology: base
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP

Topology: VIDEO
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology fallback is enabled
  Topology maximum route limit 1000, warning limit 90% (900)
  Associated interfaces:
Topology: VOICE
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology is enabled on all interfaces
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP
Topology: base
  Address-family: ipv4 multicast
  Associated VPN VRF is default
  Topology state is DOWN
  Multicast multi-topology mode is enabled.
  Route Replication Enabled:
```

```
  from unicast topology VOICE all route-map VOICE
Associated interfaces:
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
IP multicast commands	Cisco IOS Multicast Command Reference
IP multicast concepts and tasks	*IP Multicast Configuration Guide Library*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

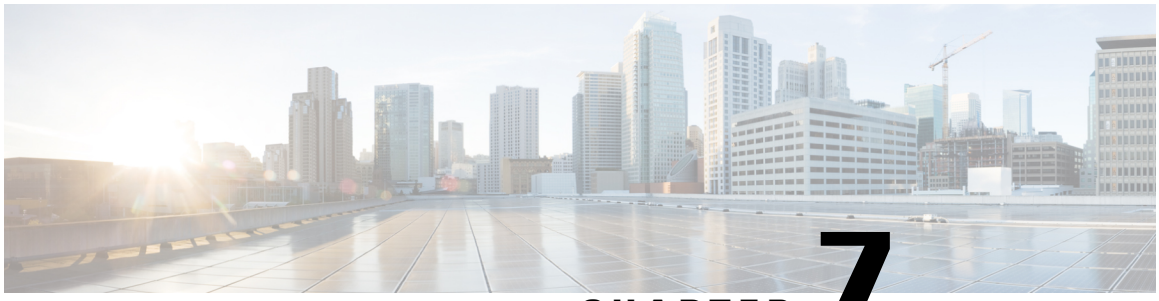
Feature Information for MTR Support for Multicast

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 6: Feature Information for MTR Support for Multicast

Feature Name	Releases	Feature Information
MTR Support for Multicast	12.2(33)SRB 15.0(1)M 15.0(1)SY 15.1(1)SY	This feature provides Multitopology Routing (MTR) support for multicast and allows you to control the path of multicast traffic in the network. The following commands were introduced or modified: **clear ip route multicast**, **ip multicast rpf multitopology**, **show ip route multicast**, **use-topology**.



CHAPTER 7

OSPF Support for MTR

The OSPF Support for MTR feature provides Open Shortest Path First (OSPF) support for multiple logical topologies over a single physical network. This module describes how to configure OSPF for Multitopology Routing (MTR).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for OSPF Support for MTR

- Be familiar with the concepts documented in the“ Routing Protocol Support for MTR” section.
- Configure and activate a global topology configuration.
- Check your Open Shortest Path First (OSPF) device configuration and enter the topology-aware device configuration commands in router address family configuration mode.

- Several OSPF configuration commands need to be topology-aware. Before you configure OSPF Multitopology Routing (MTR), you need to enter the following commands in router address family configuration mode if they are used in your original OSPF device configuration.
  - **area** *area-id* **default-cost** *cost*
  - **area** *area-id* **filter-list prefix** *prefix-list-name* {**in** | **out**}
  - **area nssa** *area-id* [**no-redistribution**] [**default-information-originate** [**metric**] [*metric-type*] [**no-summary**] [**nssa-only**]
  - **area** *area-id* **range** *ip-address mask* [**advertise** | **not-advertise**] [**cost** *cost*]
  - **area** *area-id* **stub** [**no-summary**]
  - **area** *transit-area-id* **virtual-link** *transit-router-id* **topology disable**
  - **default-information originate** [**always**] [**metric** *metric-value*] [**metric-type** *type-value*] [**route-map** *map-name*]
  - **default-metric** *metric-value*
  - **discard-route** [**external** | **internal**]
  - **distance ospf** {**external** *dist1* | **inter-area** *dist2* | **intra-area** *dist3*}
  - **distribute-list in**
  - **distribute-list out**
  - **max-metric router-lsa** [**on-startup** {*seconds* | **wait-for-bgp**}]
  - **maximum-paths** *number-of-paths*
  - **neighbor** *ip-address* [**cost** *number*]
  - **redistribute** *protocol* [*process-id*] {**level-1** | **level-1-2** | **level-2**} [*as-number*] [**metric** {*metric-value* | **transparent**}] [*metric-type type-value*] [**match** {**external** | **internal** | **nssa-external**}] [**tag** *tag-value*] [**route-map** *map-tag*] [**subnets**]
  - **summary-address** {**ip-address** *mask* | **prefix** *mask*} [**not-advertise**] [**tag** *tag*]
  - **timers throttle spf** *spf-start spf-hold spf-max-wait*
  - **traffic-share min across-interfaces**

Information About OSPF Support for MTR

Routing Protocol Support for MTR

You must enable IP routing on the device for Multitopology Routing (MTR) to operate. MTR supports static and dynamic routing in Cisco software. You can enable dynamic routing per topology to support interdomain and intradomain routing. Route calculation and forwarding are independent for each topology. MTR support is integrated into Cisco software for the following protocols:

- Border Gateway Protocol (BGP)

- Enhanced Interior Gateway Routing Protocol (EIGRP)
- Integrated Intermediate System-to-Intermediate System (IS-IS)
- Open Shortest Path First (OSPF)

You apply the per-topology configuration in router address family configuration mode of the global routing process (router configuration mode). The address family and subaddress family are specified when the device enters address family configuration mode. You specify the topology name and topology ID by entering the **topology** command in address family configuration mode.

You configure each topology with a unique topology ID under the routing protocol. The topology ID is used to identify and group Network Layer Reachability Information (NLRI) for each topology in updates for a given protocol. In OSPF, EIGRP, and IS-IS, you enter the topology ID during the first configuration of the **topology** command for a class-specific topology. In BGP, you configure the topology ID by entering the **bgp tid** command under the topology configuration.

You can configure class-specific topologies with different metrics than the base topology. Interface metrics configured on the base topology can be inherited by the class-specific topology. Inheritance occurs if no explicit inheritance metric is configured in the class-specific topology.

You configure BGP support only in router configuration mode. You configure Interior Gateway Protocol (IGP) support in router configuration mode and in interface configuration mode.

By default, interfaces are not included in nonbase topologies. For routing protocol support for EIGRP, IS-IS, and OSPF, you must explicitly configure a nonbase topology on an interface. You can override the default behavior by using the **all-interfaces** command in address family topology configuration mode. The **all-interfaces** command causes the nonbase topology to be configured on all interfaces of the device that are part of the default address space or the virtual routing and forwarding (VRF) instance in which the topology is configured.

Interface Configuration Support for MTR

The configuration of a Multitopology Routing (MTR) topology in interface configuration mode allows you to enable or disable MTR on a per-interface basis. By default, a class-specific topology does not include any interfaces.

You can include or exclude individual interfaces by configuring the **topology** interface configuration command. You specify the address family and the topology (base or class-specific) when entering this command. The subaddress family can be specified. If no subaddress family is specified, the unicast subaddress family is used by default.

You can include globally all interfaces on a device in a topology by entering the **all-interfaces** command in routing topology configuration mode. Per-interface topology configuration applied with the **topology** command overrides global interface configuration.

The interface configuration support for MTR has these characteristics:

- Per-interface routing configuration: Interior Gateway Protocol (IGP) routing and metric configurations can be applied in interface topology configuration mode. Per-interface metrics and routing behaviors can be configured for each IGP.
- Open Shortest Path First (OSPF) interface topology configuration: Interface mode OSPF configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable OSPF routing without removing the interface from the global topology configuration.

- Enhanced Interior Gateway Routing Protocol (EIGRP) interface topology configuration: Interface mode EIGRP configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure various EIGRP features.
- Intermediate System-to-Intermediate System (IS-IS) interface topology configuration: Interface mode IS-IS configurations for a class-specific topology are applied in interface topology configuration mode. In this mode, you can configure an interface cost or disable IS-IS routing without removing the interface from the global topology configuration.

How to Configure OSPF Support for MTR

Activating an MTR Topology by Using OSPF

Note Only Multitopology Routing (MTR) commands are shown in this task.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router ospf** *process-id* [**vrf** *vrf-name*]
4. **address-family ipv4** [**multicast** | **unicast**]
5. **topology** {**base** | *topology-name* **tid** *number*}
6. **end**
7. **show ip ospf** [*process-id*] **topology-info** [**multicast**] [**topology** {*topology-name* | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**router ospf** *process-id* [**vrf** *vrf-name*] **Example:** `Device(config)# router ospf 1`	Enables an Open Shortest Path First (OSPF) routing process and enters router configuration mode.
Step 4	**address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config-router)# address-family ipv4`	Enters router address family configuration mode to configure an OSPF address family session. • Only the base topology can be configured under the multicast subaddress family.
Step 5	**topology** {**base** | *topology-name* **tid** *number*} **Example:** `Device(config-router-af)# topology VOICE tid 10`	Configures OSPF support for the topology and assigns a Topology Identifier (TID) number for each topology. • Enters router address family topology configuration mode. • Use the **tid** *number* keyword and argument to configure a topology ID. The topology ID must be configured in the first configuration of the specified topology. It is optional for subsequent configuration. **Note** The **base** keyword is accepted only for IPv4 multicast. The **tid** keyword is accepted only for IPv4 or IPv6 unicast.
Step 6	**end** **Example:** `Device(config-router-af-topology)# end`	Exits router address family topology configuration mode and returns to privileged EXEC mode.
Step 7	**show ip ospf** [*process-id*] **topology-info** [**multicast**] [**topology** {*topology-name* | **base**}] **Example:** `Device# show ip ospf topology-info topology VOICE`	(Optional) Displays OSPF information about the specified topology.

What to Do Next

If an Enhanced Interior Gateway Routing Protocol (EIGRP) topology configuration is required, see the "EIGRP Support for MTR" feature module.

If an Intermediate System-to-Intermediate System (IS-IS) topology configuration is required, see the "IS-IS Support for MTR" feature module.

Activating an MTR Topology in Interface Configuration Mode by Using OSPF

Before You Begin

Define a topology globally before performing the per-interface topology configuration.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **topology ipv4** [**multicast** | **unicast**] {*topology-name* [**disable**] | **base**}
5. **ip ospf cost** *number*
6. **ip ospf topology disable**
7. **end**
8. **show ip ospf** [*process-id*] **interface** [*type number*] [**brief**] [**multicast**] [**topology** {*topology-name* | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**interface** *type number* **Example:** `Device(config)# interface Ethernet 0/0`	Specifies the interface type and number, and enters interface configuration mode.
Step 4	**topology ipv4** [**multicast**	**unicast**] {*topology-name* [**disable**]	**base**} **Example:** `Device(config-if)# topology ipv4 VOICE`	Enters interface topology configuration mode to configure Multitopology Routing (MTR). **Note** Entering this command with the **disable** keyword disables the topology instance on the interface. This form is used to exclude a topology configuration from an interface.
Step 5	**ip ospf cost** *number*	Applies a cost to the interface in a topology instance.

	Command or Action	Purpose
	Example: `Device(config-if-topology)# ip ospf cost 100`	• The lowest cost number has the highest preference.
Step 6	**ip ospf topology disable** **Example:** `Device(config-if-topology)# ip ospf topology disable`	Prevents Open Shortest Path First (OSPF) from advertising the interface as part of the topology without disabling the OSPF process or the topology on the interface.
Step 7	**end** **Example:** `Device(config-if-topology)# end`	Exits interface topology configuration mode and returns to privileged EXEC mode.
Step 8	**show ip ospf** [*process-id*] **interface** [*type number*] [**brief**] [**multicast**] [**topology** {*topology-name* | **base**}] **Example:** `Device# show ip ospf 1 interface topology VOICE`	(Optional) Displays OSPF-related interface information. • Displays OSPF and interface information about the specified topology when the **topology** keyword is entered.

Monitoring Interface and Topology IP Traffic Statistics for MTR

Use any of the following commands in any order to monitor interface and topology IP traffic statistics for Multitopology Routing (MTR).

SUMMARY STEPS

1. **enable**
2. **show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**]
3. **show ip traffic** [**topology** {*name* | **all** | **base**}]
4. **clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**]
5. **clear ip traffic** [**topology** {*name* | **all** | **base**}]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip interface** [*type number*] [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# show ip interface FastEthernet 1/10 stats`	(Optional) Displays IP traffic statistics for all interfaces or statistics related to the specified interface. • If you specify an interface type and number, information for that specific interface is displayed. If you specify no optional arguments, information for all the interfaces is displayed. • If the **topology** *name* keyword and argument are used, statistics are limited to the IP traffic for that specific topology. • The **base** keyword displays the IPv4 unicast base topology.
Step 3	**show ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# show ip traffic topology VOICE`	(Optional) Displays global IP traffic statistics (an aggregation of all the topologies when MTR is enabled) or statistics related to a particular topology. • The **base** keyword is reserved for the IPv4 unicast base topology.
Step 4	**clear ip interface** *type number* [**topology** {*name* | **all** | **base**}] [**stats**] **Example:** `Device# clear ip interface FastEthernet 1/10 topology all`	(Optional) Resets interface-level IP traffic statistics. • If the **topology** keyword and a related keyword are not used, only the interface-level aggregate statistics are reset. • If all topologies need to be reset, use the **all** keyword as the topology name.
Step 5	**clear ip traffic** [**topology** {*name* | **all** | **base**}] **Example:** `Device# clear ip traffic topology all`	(Optional) Resets IP traffic statistics. • If no topology name is specified, global statistics are cleared.

Configuration Examples for OSPF Support for MTR

Examples: Activating an MTR Topology by Using OSPF

The following example shows how to configure the VOICE topology in an Open Shortest Path First (OSPF) routing process and set the priority of the VOICE topology to the highest priority:

```
router ospf 1
 address-family ipv4
  topology VOICE tid 10
  priority 127
  end
```

In the following example, the **show ip ospf** command is used with the **topology-info** and **topology** keywords to display OSPF information about the topology named VOICE:

```
Device# show ip ospf 1 topology-info topology VOICE

OSPF Router with ID (10.0.0.1) (Process ID 1)
VOICE Topology (MTID 66)
Topology priority is 64
Redistributing External Routes from,
isis
Number of areas transit capable is 0
Initial SPF schedule delay 5000 msecs
Minimum hold time between two consecutive SPFs 10000 msecs
Maximum wait time between two consecutive SPFs 10000 msecs
Area BACKBONE(0) (Inactive)
SPF algorithm last executed 16:45:18.984 ago
SPF algorithm executed 3 times
Area ranges are
Area 1
SPF algorithm last executed 00:00:21.584 ago
SPF algorithm executed 1 times
Area ranges are
```

Examples: MTR OSPF Topology in Interface Configuration Mode

The following example shows how to disable Open Shortest Path First (OSPF) routing on Ethernet interface 0/0 without removing the interface from the global topology configuration:

```
interface Ethernet 0/0
 topology ipv4 VOICE
  ip ospf cost 100
  ip ospf topology disable
  end
```

In the following example, the **show ip ospf interface** command is used with the **topology** keyword to display information about the topologies configured for OSPF in interface configuration mode:

```
Device# show ip ospf 1 interface topology VOICE

VOICE Topology (MTID 66)
Serial3/0 is up, line protocol is up
   Internet Address 10.0.0.5/30, Area 1
   Process ID 1, Router ID 44.44.44.44, Network Type POINT_TO_POINT
   Topology-MTID    Cost    Disabled    Shutdown      Topology Name
         4           77        no          no            grc
   Transmit Delay is 1 sec, State POINT_TO_POINT
   Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
     oob-resync timeout 40
```

```
    Hello due in 00:00:05
  Supports Link-local Signaling (LLS)
  Cisco NSF helper support enabled
  IETF NSF helper support enabled
  Index 1/4, flood queue length 0
  Next 0x0(0)/0x0(0)
  Last flood scan length is 1, maximum is 1
  Last flood scan time is 0 msec, maximum is 0 msec
  Neighbor Count is 1, Adjacent neighbor count is 1
    Adjacent with neighbor 10.2.2.2
  Suppress hello for 0 neighbor(s)
```

In the following example, the **show ip ospf interface** command is used with the **brief** and **topology** keywords to display information about the topologies configured for OSPF in interface configuration mode:

```
Device# show ip ospf 1 interface brief topology VOICE

VOICE Topology (MTID 66)
Interface    PID   Area    IP Address/Mask    Cost    State    Nbrs F/C
Se3/0        1     1       10.0.0.5/30        1       UP       0/0
Se2/0        1     1       10.0.0.1/30        1       UP       0/0
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
Open Shortest Path First (OSPF) commands	Cisco IOS IP Routing: OSPF Command Reference
OSPF concepts and tasks	*IP Routing: OSPF Configuration Guide*

Technical Assistance

Description	Link
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Feature Information for OSPF Support for MTR

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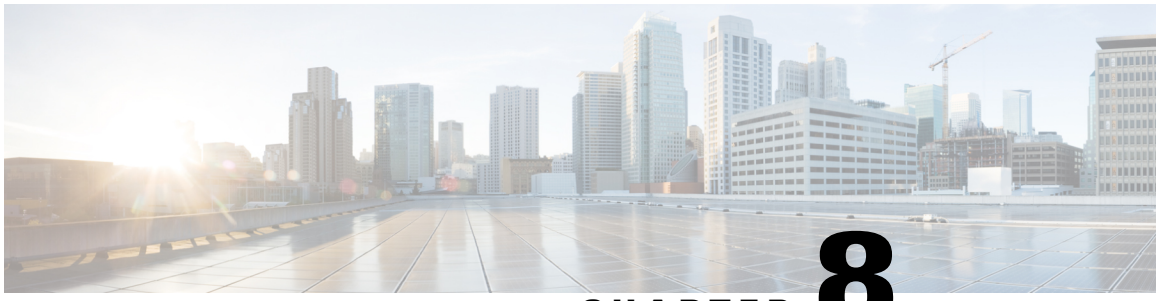
Table 7: Feature Information for OSPF Support for MTR

Feature Name	Releases	Feature Information
OSPF Support for MTR	12.2(33)SRB	This feature provides Open Shortest Path First (OSPF) support for multiple logical topologies over a single physical network. The following commands were introduced or modified: **address-family ipv4**, **area capability default-exclusion**, **ip ospf cost**, **ip ospf topology disable**, **priority**, **router ospf**, **show ip ospf interface**, **show ip ospf topology-info**, **topology**.



CHAPTER 8

QoS-MQC Support for MTR

The QoS-MQC Support for MTR feature enables Multitopology Routing (MTR) traffic classification. Traffic classification is used to associate different classes of traffic with different topologies when multiple topologies are configured on the same device. This module describes how to configure quality of service (QoS) with modular QoS CLI (MQC) support for MTR.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

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Prerequisites for QoS-MQC Support for MTR

- Be familiar with the concepts documented in the “MTR Traffic Classification” section.

- Define a topology globally rather than at the interface level as in quality of service (QoS) before configuring traffic classification
- Ensure that all devices throughout the network have the same definition of classifiers and the same sequencing of classifiers.
- Carefully coordinate simultaneous configuration in a network where Multitopology Routing (MTR) and QoS traffic classification are configured.

Restrictions for QoS-MQC Support for MTR

- Multitopology Routing (MTR) classification values must be unique for each topology. An error message is generated if you attempt to configure overlapping values.
- A topology cannot be placed in the shutdown state if it is referenced by any active policy map.
- A subset of differentiated services code point (DSCP) bits is used to encode classification values in the IP packet header. Certain DSCP values are reserved. These DSCP values are commonly used by routing software components for purposes unrelated to MTR (for example, Open Shortest Path First [OSPF], Bidirection Forwarding Detection [BFD], and Simple Network Management Protocol [SNMP]). If you use these values for MTR classification, they are likely to interfere with correct operation of the device and is strongly discouraged. These DSCP values are:
  - DSCP 16 (cs2)
  - DSCP 48 (cs6)

Information About QoS-MQC Support for MTR

MTR Traffic Classification

Multitopology Routing (MTR) cannot be enabled on a device until traffic classification is configured, even if only one class-specific topology is configured. Traffic classification is used to configure topology-specific forwarding behaviors when multiple topologies are configured on the same device. Traffic classification must be applied consistently throughout the network. Class-specific packets are associated with the corresponding topology table forwarding entries.

Traffic classification is configured when you use the modular quality of service (QoS) CLI (MQC). MTR traffic classification is similar to QoS traffic classification. However, there is an important distinction. MTR traffic classification is defined globally for each topology, rather than at the interface level as in QoS.

A subset of differentiated services code point (DSCP) bits is used to encode classification values in the IP packet header. You configure a class map to define the traffic class by entering the **class-map** *class-map-name* command in global configuration mode. Only the **match-any** keyword is supported for MTR. You associate the traffic class with a policy by configuring the **policy-map type class-routing ipv4 unicast** command in global configuration mode. You activate the policy for the topology by configuring the **service-policy type class-routing** command in global address family configuration mode. Then you associate the service policy with all interfaces on the device.

You can configure MTR traffic classification and IP Differentiated Services or IP Precedence-based traffic classification in the same network. However, MTR requires exclusive use of some subset of the DSCP bits in the IP packet header for specific topology traffic. In a network where MTR and QoS traffic classification are configured, you must carefully coordinate simultaneous configuration.

How to Configure QoS-MQC Support for MTR

Configuring MTR Traffic Classification

Before You Begin

Note Following the correct order of the commands in this task is very important. Ensure that all configuration that affects traffic classification is complete before entering the **service-policy type class-routing** command.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **class-map match-any** *class-map-name*
4. **match** [**ip**] **dscp** *dscp-value* [*dscp-value dscp-value dscp-value dscp-value dscp-value dscp-value dscp-value*]
5. **exit**
6. **policy-map type class-routing ipv4 unicast** *policy-map-name*
7. **class** {*class-name* | **class-default**}
8. **select-topology** *topology-name*
9. **exit**
10. **exit**
11. **global-address-family ipv4** [**multicast** | **unicast**]
12. **service-policy type class-routing** *policy-map-name*
13. **end**
14. **show topology detail**
15. **show policy-map type class-routing ipv4 unicast** [**interface** [*type number*]]
16. **show mtm table**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable**	Enables privileged EXEC mode.

	Command or Action	Purpose
	Example: `Device> enable`	• Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**class-map match-any** *class-map-name* **Example:** `Device(config)# class-map match-any VOICE-CLASS`	Creates a class map to be used for matching packets to a specified class and enters quality of service (QoS) class-map configuration mode. • The Multitopology Routing (MTR) traffic class is defined using this command. **Note** The **match-any** keyword must be entered when configuring classification for MTR.
Step 4	**match** [**ip**] **dscp** *dscp-value* [*dscp-value dscp-value dscp-value dscp-value dscp-value dscp-value dscp-value*] **Example:** `Device(config-cmap)# match ip dscp 9`	Identifies a differentiated services code point (DSCP) value as a match criterion. • Use the *dcsp-value* argument to define a specific metric value. • Do not use the DSCP values 48 and 16. See the "Restrictions for QoS-MQC Support for MTR" section for more information.
Step 5	**exit** **Example:** `Device(config-cmap)# exit`	Exits QoS class-map configuration mode.
Step 6	**policy-map type class-routing ipv4 unicast** *policy-map-name* **Example:** `Device(config)# policy-map type class-routing ipv4 unicast VOICE-CLASS-POLICY`	Creates or modifies a policy map that can be attached to one or more interfaces to specify a service policy and enters QoS policy-map configuration mode.
Step 7	**class** {*class-name* | **class-default**} **Example:** `Device(config-pmap)# class VOICE-CLASS`	Specifies the name of the class whose policy you want to create or change or specifies the default class and enters policy-map class configuration mode. • The class map is referenced.

	Command or Action	Purpose
		• For a class map to be referenced in a class-routing policy map, you must first define it by using the **class-map** command as shown in Step 3.
Step 8	**select-topology** *topology-name* **Example:** `Device(config-pmap-c)# select-topology VOICE`	Attaches the policy map to the topology.
Step 9	**exit** **Example:** `Device(config-pmap-c)# exit`	Exits QoS policy-map class configuration mode.
Step 10	**exit** **Example:** `Device(config-pmap)# exit`	Exits QoS policy-map configuration mode.
Step 11	**global-address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config)# global-address-family ipv4`	Enters global address family configuration mode to configure MTR.
Step 12	**service-policy type class-routing** *policy-map-name* **Example:** `Device(config-af)# service-policy type class-routing VOICE-CLASS-POLICY`	Attaches the service policy to the policy map for MTR traffic classification and activates MTR. • The *policy-map-name* argument must match the value configured in step 6. **Note** Traffic classification is enabled after this command is entered. Ensure that all configuration that affects traffic classification is complete before entering this command.
Step 13	**end** **Example:** `Device(config-af)# end`	Exits global address family configuration mode and returns to privileged EXEC mode.
Step 14	**show topology detail** **Example:** `Device# show topology detail`	(Optional) Displays detailed information about class-specific and base topologies.

	Command or Action	Purpose
Step 15	**show policy-map type class-routing ipv4 unicast** [**interface** [*type number*]] **Example:** `Device# show policy-map type class-routing ipv4 unicast`	(Optional) Displays the class-routing policy map configuration. • If you specify the **interface** keyword without the argument, statistics for all interfaces are displayed.
Step 16	**show mtm table** **Example:** `Device# show mtm table`	(Optional) Displays information about the DSCP values assigned to each topology.

Configuration Examples for QoS-MQC Support for MTR

Examples: MTR Traffic Classification

The following example shows how to configure classification and activate Multitopology Routing (MTR) for two topologies:

```
global-address-family ipv4
 topology VOICE
  all-interfaces
  exit
 topology VIDEO
  forward-base
  maximum routes 1000 90
  exit
 exit
class-map match-any VOICE-CLASS
 match ip dscp 9
 exit
class-map match-any VIDEO-CLASS
 match ip dscp af11
 exit
policy-map type class-routing ipv4 unicast MTR
 class VOICE-CLASS
  select-topology VOICE
  exit
 class VIDEO-CLASS
  select-topology VIDEO
  exit
 exit
global-address-family ipv4
 service-policy type class-routing MTR
end
```

The following example shows how to display detailed information about the VOICE and VIDEO topologies:

```
Device# show topology detail

Topology: base
  Address-family: ipv4
```

```
  Associated VPN VRF is default
  Topology state is UP
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP

Topology: VIDEO
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology fallback is enabled
  Topology maximum route limit 1000, warning limit 90% (900)
  Associated interfaces:
Topology: VOICE
  Address-family: ipv4
  Associated VPN VRF is default
  Topology state is UP
  Topology is enabled on all interfaces
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP
Topology: base
  Address-family: ipv4 multicast
  Associated VPN VRF is default
  Topology state is DOWN
  Multicast multi-topology mode is enabled.
  Route Replication Enabled:
    from unicast topology VOICE all route-map BLUE
  Associated interfaces:
    Ethernet0/0, operation state: UP
    Ethernet0/1, operation state: DOWN
    Ethernet0/2, operation state: DOWN
    Ethernet0/3, operation state: DOWN
    Loopback0, operation state: UP
```

The following example shows how to display the classification values for the VOICE and VIDEO topologies:

```
Device# show mtm table

MTM Table for VRF: default, ID:0
Topology                Address Family   Associated VRF         Topo-ID
base                    ipv4              default                 0
VOICE                    ipv4             default                 2051
Classifier: ClassID:3
DSCP: cs1
DSCP: 9
VIDEO                    ipv4             default                 2054
Classifier: ClassID:4
DSCP: af11
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases

Related Topic	Document Title
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
QoS commands	Cisco IOS Quality of Service Solutions Command Reference
QoS concepts and tasks	*Quality of Service Solutions Configuration Guide Library*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for QoS-MQC Support for MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 8: Feature Information for QoS-MQC Support for MTR

Feature Name	Releases	Feature Information
QoS-MQC Support for MTR	12.2(33)SRB 15.0(1)S	This feature enables Multitopology Routing (MTR) traffic classification. Traffic classification is used to associate different classes of traffic with different topologies when multiple topologies are configured on the same device. A subset of differentiated services code point (DSCP) bits is used to encode classification values in the IP packet header and mark the packet for classification. When MTR traffic classification is enabled, MTR is activated and ready for the routing protocols to start contributing to the topologies. The following commands were introduced or modified: **policy-map type class-routing ipv4 unicast**, **select topology**, **service-policy type class-routing**, **show mtm table**, **show policy-map type class-routing ipv4 unicast**.

Glossary

base topology—The entire network for which the usual set of routes are calculated. This topology is the same as the default global routing table that exists without Multitopology Routing (MTR) being used.

class-specific topology—New topologies that are defined over and above the existing base topology; each class-specific topology is represented by its own Routing Information Base (RIB) and Forwarding Information Base (FIB).

classification—Selection and matching of traffic that needs to be provided with a different treatment based on its mark. Classification is a read-only operation.

DSCP—differentiated services code point. Six bits in the Type of Service (ToS) field. Two bits are used for Explicit Congestion Notification, which are used to mark the packet.

incremental forwarding mode—Incremental forwarding mode is designed to support transitional or incremental deployment of MTR, where devices are in the network that are not MTR enabled. In this mode, the device looks for a forwarding entry first in the class-specific FIB. If an entry is not found, the device then looks for the longest match in the base topology FIB. If an entry is found in the base topology FIB, the packet is forwarded on the base topology. If a forwarding entry is not found in the base topology FIB, the packet is dropped.

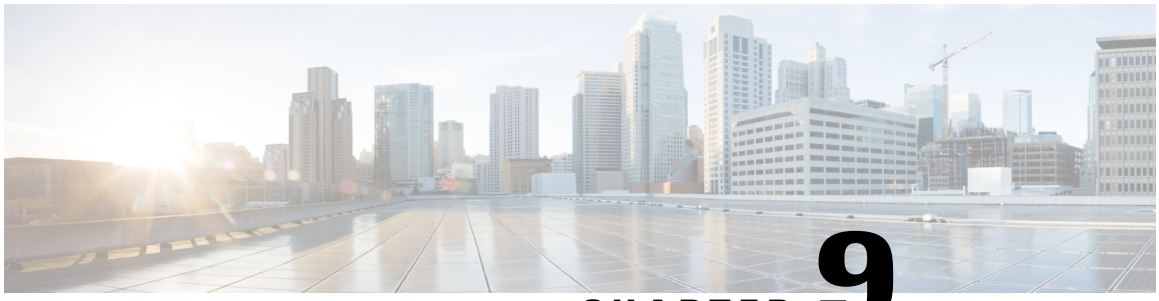
marking—Setting a value in the packet or frame. Marking is a read and write operation.

multitopology—Multitopology means that each topology routes and forward a subset of the traffic as defined by the classification criteria.

NLRI—Network Layer Reachability Information.

strict forwarding mode—Strict forwarding mode is the default forwarding mode for MTR. Only routes in the topology-specific routing table are considered. Among these, the longest match for the destination address is used. If no route containing the destination address can be found in the topology specific table, the packet is dropped.

TID—Topology Identifier. Each topology is configured with a unique topology ID. The topology ID is configured under the routing protocol and is used to identify and group NLRI for each topology in updates for a given protocol.



CHAPTER 9

SNMP Support for MTR

The SNMP Support for MTR feature uses context-based the Simple Network Management Protocol (SNMP) to extend support for existing MIBs from representing the management information for just the base topology to representing the same information for multiple topologies. This module describes how to configure SNMP support for Multitopology Routing (MTR).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for SNMP Support for MTR

Enable Simple Network Management Protocol (SNMP).

Information About SNMP Support for MTR

Network Management Support for MTR

Context-based Simple Network Management Protocol (SNMP) support is integrated into Cisco software. SNMP support for Multitopology Routing (MTR) uses context-based SNMP to extend support for existing MIBs from representing the management information for just the base topology to representing the same information for multiple topologies.

You can configure the SNMP agent software component on the device to pass a context string to existing MIB access functions. Network management applications can provide these context strings in SNMP transactions to direct those transactions to a specific VPN routing and forwarding (VRF) instance, a specific topology, or a routing protocol instance. The SNMP infrastructure on the receiving device verifies that a context string is defined for the device, and that the accompanying internal identifier is defined for that context string, before passing the context string and the internal identifier to the MIB access function.

Standard network management utilities, such as ping and traceroute, are enhanced to support MTR. You can configure a standard or extended ping using the topology name in place of a hostname or IP address. Traceroute is similarly enhanced.

How to Configure SNMP Support for MTR

Associating an SNMP Context with a VRF for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip vrf** *vrf-name*
4. **snmp context** *context-name*
5. **end**
6. **show snmp context mapping**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**ip vrf** *vrf-name* **Example:** `Device(config)# ip vrf vrfA`	Defines a virtual routing and forwarding (VRF) instance and enters VRF configuration mode.
Step 4	**snmp context** *context-name* **Example:** `Device(config-vrf)# snmp context context-vrfA`	Creates a Simple Network Management Protocol (SNMP) context for Multitopology Routing (MTR) for a specific VRF and enters VRF address family configuration mode.
Step 5	**end** **Example:** `Device(config-af-topology)# end`	Exits VRF address family configuration mode and returns to privileged EXEC mode.
Step 6	**show snmp context mapping** **Example:** `Device# show snmp context mapping`	(Optional) Displays information about SNMP contexts for MTR.

Associating an SNMP Context with a Data Topology for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **global-address-family ipv4** [**multicast** | **unicast**]
4. **topology** {**base** | *topology-name*}
5. **snmp context** *context-name*
6. **end**
7. **show snmp context mapping**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**global-address-family ipv4** [**multicast** | **unicast**] **Example:** `Device(config)# global-address-family ipv4`	Enters global address family configuration mode to configure the global topology. • The address family for the class-specific topology is specified in this step. The subaddress family can be specified. Unicast is the default if no subaddress family is entered.
Step 4	**topology** {**base** | *topology-name*} **Example:** `Device(config-af)# topology VOICE`	Configures the global topology instance and enters address family topology configuration mode.
Step 5	**snmp context** *context-name* **Example:** `Device(config-af-topology)# snmp context comp-topol`	Creates a Simple Network Management Protocol (SNMP) context for Multiopology Routing (MTR) for a specific topology.
Step 6	**end** **Example:** `Device(config-af-topology)# end`	Exits address family topology configuration mode and returns to privileged EXEC mode.
Step 7	**show snmp context mapping** **Example:** `Device# show snmp context mapping`	(Optional) Displays information about SNMP contexts for MTR.

Associating an SNMP Context with a Routing Protocol for MTR

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **router ospf** *process-id* [**vrf** *vrf-name*]
4. **snmp context** *context-name*
5. **address-family ipv4** [**multicast** | **unicast**]
6. **topology** {**base** | *topology-name* **tid** *number*}
7. **snmp context** *context-name*
8. **end**
9. **show snmp context mapping**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**router ospf** *process-id* [**vrf** *vrf-name*] **Example:** `Device(config)# router ospf 1`	Enables an Open Shortest Path First (OSPF) routing process and enters router configuration mode. • You can configure support for multiple routing protocols.
Step 4	**snmp context** *context-name* **Example:** `Device(config-router)# snmp context comp-prot`	Creates a Simple Network Management Protocol (SNMP) context for Multitopology Routing (MTR) for a specific topology under a routing protocol.
Step 5	**address-family ipv4** [**multicast**	**unicast**] **Example:** `Device(config-router)# address-family ipv4`	Enters router address family configuration mode to configure an OSPF address family session.

	Command or Action	Purpose
Step 6	**topology** {**base** | *topology-name* **tid** *number*} **Example:** `Device(config-router-af)# topology VOICE tid 10`	Configures the global topology instance and enters router address family topology configuration mode.
Step 7	**snmp context** *context-name* **Example:** `Device(config-router-af-topology)# snmp context comp-protocol`	Creates an SNMP context for MTR for a specific topology under a routing protocol.
Step 8	**end** **Example:** `Device(config-router-af-topology)# end`	Exits router address family topology configuration mode and returns to privileged EXEC mode.
Step 9	**show snmp context mapping** **Example:** `Device# show snmp context mapping`	(Optional) Displays information about SNMP contexts for MTR.

Configuration Examples for SNMP Support for MTR

Examples: SNMP Support for MTR

In the following example, the context string context-vrfA is configured to be associated with vrfA and will be passed on to the MIB access function during Simple Network Management Protocol (SNMP) transactions:

```
snmp-server community public
ip vrf vrfA
 snmp context context-vrfA
 end
```

In the following example, the context string context-voice is configured to be associated with the data topology named voice and will be passed on to the MIB access function during SNMP transactions:

```
global-address-family ipv4
 topology voice
  snmp context context-voice
  end
```

In the following example, the context strings context-ospf and context-voice are configured to be associated with the Open Shortest Path First (OSPF) process and topology named voice and will be passed on to the MIB access function during SNMP transactions:

```
router ospf 3
 snmp context context-ospf
 address-family ipv4
 topology voice tid 10
  snmp context ospf-voice
  end
```

The following example shows how the context strings are mapped to the specified virtual routing and forwarding (VRF), address family, topology, or protocol instance:

```
Device# show snmp context mapping

Context: ospf-voice
  VRF Name:
  Address Family Name: ipv4
  Topology Name: voice
  Protocol Instance: OSPF-3 Router
Context: context-ospf
  VRF Name:
  Address Family Name:
  Topology Name:
  Protocol Instance: OSPF-3 Router
Context: context-vrfA
  VRF Name: vrfA
  Address Family Name:
  Topology Name:
  Protocol Instance:
Context: context-voice
  VRF Name:
  Address Family Name: ipv4
  Topology Name: voice
  Protocol Instance:
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

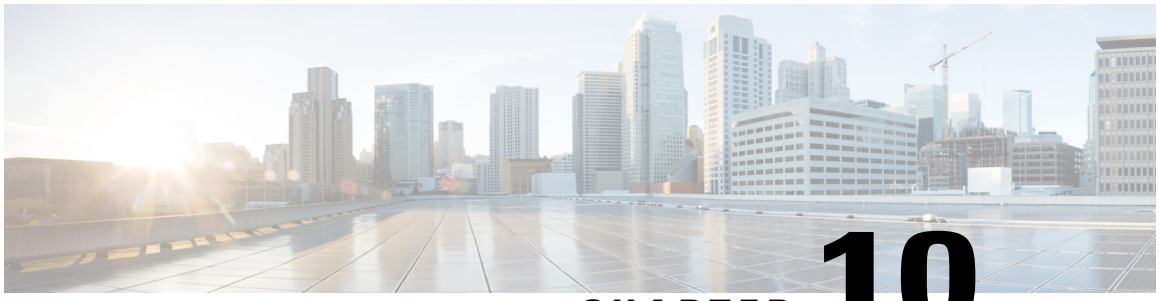
Feature Information for SNMP Support for MTR

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 9: Feature Information for SNMP Support for MTR

Feature Name	Releases	Feature Information
SNMP Support for MTR	12.2(33)SB 12.2(33)SRB 15.0(1)S	Context-based SNMP functionality is integrated into Cisco software and can be used to support Multitopology Routing (MTR). SNMP support for MTR uses context-based Simple Network Management Protocol (SNMP) to extend support for existing MIBs from representing the management information for just the base topology to representing the same information for multiple topologies. The following commands were introduced or modified: **show snmp context mapping**, **snmp context**.



CHAPTER 10

MTR in VRF

The MTR in VRF feature extends to IPv4 VRF contexts the Cisco IOS software's capability that allows users to configure one or more non-congruent multicast topologies in global IPv4 routing context. These contexts can be used to forward unicast and multicast traffic over different links in the network, or in the case of non-base topologies to provide a Live-Live multicast service using multiple non-congruent multicast topologies mapped to different (S,G) groups.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest caveats and feature information, see Bug Search Tool and the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the feature information table at the end of this module.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Information About MTR in VRF

MTR in VRF Overview

The MTR in VRF feature extends to IPv4 VRF contexts, Cisco IOS software's capability that allows users to configure one or more non-congruent multicast topologies in global IPv4 routing context. These contexts can

be used to forward unicast and multicast traffic over different links in the network, or in the case of non-base topologies to provide a Live-Live multicast service using multiple non-congruent multicast topologies mapped to different (S,G) groups.

The Cisco IOS Software allows a set of attributes, primarily used by BGP/MPLS L3VPNs, to be configured on a per-address family basis within a VRF. The MTR in VRF feature allows these attributes to be independently configured for the multicast sub-address families within a VRF address family.

How to Configure VRF in MTR

Configuring MTR in VRF

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **vrf definition** *vrf-name*
4. **rd** *route-distinguisher*
5. **ipv4 multicast multitoplogy**
6. **address-family ipv4**
7. **exit-address-family**
8. **address-family ipv4 multicast**
9. **topology** *topology-instance-name*
10. **all-interfaces**
11. **exit**
12. **exit-address-family**
13. **exit**
14. **interface** *type number*
15. **interface** *type number*
16. **vrf forwarding** *vrf-name*
17. **ip address** *ip-address mask*
18. **ip pim sparse-dense-modeip**
19. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Device> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 3	**vrf definition** *vrf-name* **Example:** `Device(config)# vrf definition vd1`	Configures a VRF routing table and enters VRF configuration mode.
Step 4	**rd** *route-distinguisher* **Example:** `Device(config-vrf)# rd 10:1`	Creates routing and forwarding tables for a VRF.
Step 5	**ipv4 multicast multitoplogy** **Example:** `Device(config-vrf)# ipv4 multicast multitoplogy`	Enables IPv4 multicast support for multi-topology routing (MTR) in a VRF instance.
Step 6	**address-family ipv4** **Example:** `Device(config-vrf)# address-family ipv4`	Specifies the IPv4 address family type and enters address family configuration mode.
Step 7	**exit-address-family** **Example:** `Device(config-vrf-af)# exit-address-family`	Exits address family configuration mode and removes the IPv4 address family.
Step 8	**address-family ipv4 multicast** **Example:** `Device(config-vrf)# address-family ipv4 multicast`	Specifies the IPv4 address family multicast type and enters VRF address family configuration mode.
Step 9	**topology** *topology-instance-name* **Example:** `Device(config-vrf-af)# topology red`	Specifies a topology instance and a name to it and enters VRF address family topology configuration mode.
Step 10	**all-interfaces** **Example:** `Device(config-vrf-af-topology)# all-interfaces`	Configure the topology instance to use all interfaces on the device.

	Command or Action	Purpose
Step 11	**exit** **Example:** `Device(config-vrf-af-topology)# exit`	Exits VRF address-family topology configuration mode and enters VRF address-family configuration mode.
Step 12	**exit-address-family** **Example:** `Device(config-vrf-af)# exit-address-family`	Exits address family configuration mode and removes the IPv4 address family.
Step 13	**exit** **Example:** `Device(config-vrf)# exit`	Exits VRF configuration mode and enters global configuration mode.
Step 14	**interface** *type number* **Example:** `Device(config)# interface ethernet 0/1`	Selects the Ethernet interface and enters the interface configuration mode.
Step 15	**interface** *type number* **Example:** `Device(config)# interface ethernet 0/1`	Selects the Ethernet interface and enters the interface configuration mode.
Step 16	**vrf forwarding** *vrf-name* **Example:** `Device(config-if)# vrf forwwarding vrf1`	Associates a VRF instance with the interface.
Step 17	**ip address** *ip-address mask* **Example:** `Device(config-if)# ip address 10.1.10.1 255.255.255.0`	Sets a primary or secondary IP address for an interface.
Step 18	**ip pim sparse-dense-modeip** **Example:** `Device(config-if)# ip pim sparse-dense-mode`	Enables Protocol Independent Multicast (PIM) on an interface.
Step 19	**end** **Example:** `Device(config-if)# end`	Exits the interface configuration mode and enters privileged EXEC mode.

Configuring Examples for MTR in VRF

Example for MTR in VRF

```
Device> enable
Device# configuration terminal
Device(config)# vrf definition vd1
Device(config-vrf)# rd 10:1
Device(config-vrf)# ipv4 multicast multitoplogy
Device(config-vrf)# address-family ipv4
Device(config-vrf)# exit-address-family
Device(config-vrf)# address-family ipv4 multicast
Device(config-vrf-af)# topology red
Device(config-vrf-af-topology)# all-interfaces
Device(config-vrf-af-topology)# exit
Device(config-vrf-af)# exit-address-family
Device(config-vrf)# exit
Device(config)# vrf forwarding vrf1
Device(config)# ip address 10.1.10.1 255.255.255.0
Device(config)# ip pim sparse-dense-mode
Device(config)# end
```

Additional References for MTR in VRF

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Command List, All Releases
Multitopology Routing (MTR) commands	Cisco IOS Multitopology Routing Command Reference
IP multicast commands	Cisco IOS Multicast Command Reference
IP multicast concepts and tasks	*IP Multicast Configuration Guide Library*

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/support

Feature Information for MTR in VRF

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 10: Feature Information for MTR in VRF

Feature Name	Releases	Feature Information
MTR in VRF	Cisco IOS Release 15.4(1)S	The MTR in VRF feature extends to IPv4 VRF contexts the Cisco IOS software's capability that allows users to configure one or more non-congruent multicast topologies in global IPv4 routing context. These contexts can be used to forward unicast and multicast traffic over different links in the network, or in the case of non-base topologies to provide a Live-Live multicast service using multiple non-congruent multicast topologies mapped to different (S,G) groups.