



Implementing Static Routes

This module describes how to implement static routes.

Static routes are user-defined routes that cause packets moving between a source and a destination to take a specified path. Static routes can be important if the Cisco IOS XR software cannot build a route to a particular destination. They are useful for specifying a gateway of last resort to which all unroutable packets are sent.



Note

For more information about static routes on the Cisco IOS XR software and complete descriptions of the static routes commands listed in this module, see the [Related Documents](#), on page 15 section of this module. .

Feature History for Implementing Static Routes

| Release | Modification |
|---------------|--|
| Release 3.2 | This feature was introduced. |
| Release 3.3.0 | Support for configuring static routes in static router configuration mode was added. The route command was replaced with the router static command. The route maximum command was replaced with the maximum path command. VPN routing and forwarding (VRF) support was added to the command syntax. |
| Release 3.4.0 | No modification. |
| Release 3.5.0 | IPv6 Provider Edge and IPv6 VPN Provider Edge over Multiprotocol Label Switching support was added. |
| Release 4.2.1 | The Enhanced Object Tracking for IP Static feature was added. |

- [Prerequisites for Implementing Static Routes, page 2](#)
- [Restrictions for Implementing Static Routes, page 2](#)
- [Information About Implementing Static Routes, page 2](#)
- [How to Implement Static Routes, page 5](#)
- [Configuration Examples, page 13](#)
- [Where to Go Next, page 14](#)
- [Additional References, page 15](#)

Prerequisites for Implementing Static Routes

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

Restrictions for Implementing Static Routes

These restrictions apply while implementing Static Routes:

- Static routing to an indirect next hop, (any prefix learnt through the RIB and may be more specific over the AIB), that is part of a local subnet requires configuring static routes in the global table indicating the egress interfaces as next hop. To avoid forward drop, configure static routes in the global table indicating the next-hop IP address to be the next hop.
- Generally, a route is learnt from the AIB in the global table and is installed in the FIB. However, this behavior will not be replicated to leaked prefixes. Because the AIB from the global table is not present in the VRF, the leaked FIB entry takes reference from the RIB rather than the same view as the global table, which also relies on the AIB. This could lead to inconsistencies in forwarding behavior.

Information About Implementing Static Routes

To implement static routes you need to understand the following concepts:

Static Route Functional Overview

Networking devices forward packets using route information that is either manually configured or dynamically learned using a routing protocol. Static routes are manually configured and define an explicit path between two networking devices. Unlike a dynamic routing protocol, static routes are not automatically updated and must be manually reconfigured if the network topology changes. The benefits of using static routes include security and resource efficiency. Static routes use less bandwidth than dynamic routing protocols, and no CPU cycles are used to calculate and communicate routes. The main disadvantage to using static routes is the lack of automatic reconfiguration if the network topology changes.

Static routes can be redistributed into dynamic routing protocols, but routes generated by dynamic routing protocols cannot be redistributed into the static routing table. No algorithm exists to prevent the configuration of routing loops that use static routes.

Static routes are useful for smaller networks with only one path to an outside network and to provide security for a larger network for certain types of traffic or links to other networks that need more control. In general, most networks use dynamic routing protocols to communicate between networking devices but may have one or two static routes configured for special cases.

Default Administrative Distance

Static routes have a default administrative distance of 1. A low number indicates a preferred route. By default, static routes are preferred to routes learned by routing protocols. Therefore, you can configure an administrative distance with a static route if you want the static route to be overridden by dynamic routes. For example, you could have routes installed by the Open Shortest Path First (OSPF) protocol with an administrative distance of 120. To have a static route that would be overridden by an OSPF dynamic route, specify an administrative distance greater than 120.

Directly Connected Routes

The routing table considers the static routes that point to an interface as “directly connected.” Directly connected networks are advertised by IGP routing protocols if a corresponding **interface** command is contained under the router configuration stanza of that protocol.

In directly attached static routes, only the output interface is specified. The destination is assumed to be directly attached to this interface, so the packet destination is used as the next hop address. The following example shows how to specify that all destinations with address prefix 2001:0DB8::/32 are directly reachable through interface GigabitEthernet 0/5/0/0:

```
RP/0/0/CPU0:router(config)# router static
RP/0/0/CPU0:router(config-static)# address-family ipv6 unicast
RP/0/0/CPU0:router(config-static-afi)# 2001:0DB8::/32 gigabitethernet 0/5/0/0
```

Directly attached static routes are candidates for insertion in the routing table only if they refer to a valid interface; that is, an interface that is both up and has IPv4 or IPv6 enabled on it.

Recursive Static Routes

In a recursive static route, only the next hop is specified. The output interface is derived from the next hop. The following example shows how to specify that all destinations with address prefix 2001:0DB8::/32 are reachable through the host with address 2001:0DB8:3000::1:

```
RP/0/0/CPU0:router(config)# router static
RP/0/0/CPU0:router(config-static)# address-family ipv6 unicast
RP/0/0/CPU0:router(config-static-afi)# 2001:0DB8::/32 2001:0DB8:3000::1
```

A recursive static route is valid (that is, it is a candidate for insertion in the routing table) only when the specified next hop resolves, either directly or indirectly, to a valid output interface, provided the route does not self-recurse, and the recursion depth does not exceed the maximum IPv6 forwarding recursion depth.

A route self-recurses if it is itself used to resolve its own next hop. If a static route becomes self-recursive, RIB sends a notification to static routes to withdraw the recursive route.

Assuming a BGP route 2001:0DB8:3000::0/16 with next hop of 2001:0DB8::0104, the following static route would not be inserted into the IPv6 RIB because the BGP route next hop resolves through the static route and the static route resolves through the BGP route making it self-recursive:

```
RP/0/0/CPU0:router(config)# router static
RP/0/0/CPU0:router(config-static)# address-family ipv6 unicast
RP/0/0/CPU0:router(config-static-afi)# 001:0DB8::/32 2001:0DB8:3000::1
```

This static route is not inserted into the IPv6 routing table because it is self-recursive. The next hop of the static route, 2001:0DB8:3000:1, resolves through the BGP route 2001:0DB8:3000:0/16, which is itself a recursive route (that is, it only specifies a next hop). The next hop of the BGP route, 2001:0DB8::0104, resolves through the static route. Therefore, the static route would be used to resolve its own next hop.

It is not normally useful to manually configure a self-recursive static route, although it is not prohibited. However, a recursive static route that has been inserted in the routing table may become self-recursive as a result of some transient change in the network learned through a dynamic routing protocol. If this occurs, the fact that the static route has become self-recursive will be detected and it will be removed from the routing table, although not from the configuration. A subsequent network change may cause the static route to no longer be self-recursive, in which case it is re-inserted in the routing table.

Fully Specified Static Routes

In a fully specified static route, both the output interface and next hop are specified. This form of static route is used when the output interface is multiaccess and it is necessary to explicitly identify the next hop. The next hop must be directly attached to the specified output interface. The following example shows a definition of a fully specified static route:

```
RP/0/0/CPU0:router(config)# router static
RP/0/0/CPU0:router(config-static)# address-family ipv6 unicast
RP/0/0/CPU0:router(config-static-afi)# 2001:0DB8::/32 Gigetherne0/0/0/0 2001:0DB8:3000::1
```

A fully specified route is valid (that is, a candidate for insertion into the routing table) when the specified interface, IPv4 or IPv6, is enabled and up.

Floating Static Routes

Floating static routes are static routes that are used to back up dynamic routes learned through configured routing protocols. A floating static route is configured with a higher administrative distance than the dynamic routing protocol it is backing up. As a result, the dynamic route learned through the routing protocol is always preferred to the floating static route. If the dynamic route learned through the routing protocol is lost, the floating static route is used in its place. The following example shows how to define a floating static route:

```
RP/0/0/CPU0:router(config)# router static
RP/0/0/CPU0:router(config-static)# address-family ipv6 unicast
RP/0/0/CPU0:router(config-static-afi)# 2001:0DB8::/32 2001:0DB8:3000::1 210
```

Any of the three types of static routes can be used as a floating static route. A floating static route must be configured with an administrative distance that is greater than the administrative distance of the dynamic routing protocol because routes with smaller administrative distances are preferred.



Note

By default, static routes have smaller administrative distances than dynamic routes, so static routes are preferred to dynamic routes.

Default VRF

A static route is always associated with a VPN routing and forwarding (VRF) instance. The VRF can be the default VRF or a specified VRF. Specifying a VRF, using the **vrf vrf-name** command, allows you to enter VRF configuration mode for a specific VRF where you can configure a static route. If a VRF is not specified, a default VRF static route is configured.

IPv4 and IPv6 Static VRF Routes

An IPv4 or IPv6 static VRF route is the same as a static route configured for the default VRF. The IPv4 and IPv6 address families are supported in each VRF.

IPv6/IPv6 VPN Provider Edge Transport over MPLS

IPv6 Provider Edge (6PE) and IPv6 VPN Provider Edge (6VPE) leverages the existing Multiprotocol Label Switching (MPLS) IPv4 core infrastructure for IPv6 transport. 6PE and 6VPE enables IPv6 sites to communicate with each other over an MPLS IPv4 core network using MPLS label switched paths (LSPs).

Static routes can be configured under the default VRF for 6PE functionality and under IPv6 VPN routing and forwarding (VRF) instances for 6VPE functionality.

For detailed information about configuring 6PE and 6VPE over MPLS, see *Cisco IOS XR MPLS Configuration Guide for the Cisco XR 12000 Series Router*.

How to Implement Static Routes

This section contains the following procedures:

Configure Static Route

Static routes are entirely user configurable and can point to a next-hop interface, next-hop IP address, or both. In the software, if an interface was specified, then the static route is installed in the Routing Information Base (RIB) if the interface is reachable. If an interface was not specified, the route is installed if the next-hop address is reachable. The only exception to this configuration is when a static route is configured with the permanent attribute, in which case it is installed in RIB regardless of reachability.

**Note**

Currently, only default VRF is supported. VPNv4, VPNv6 and VPN routing and forwarding (VRF) address families will be supported in a future release.

This task explains how to configure a static route.

SUMMARY STEPS

1. **configure**
2. **router static**
3. **vrf** *vrf-name*
4. **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }
5. *prefix mask* [**vrf** *vrf-name*] { *ip-address* | *interface-type interface-instance* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]
6. **commit**

DETAILED STEPS

Step 1 **configure**

Step 2 **router static**

Example:

```
RP/0/0/CPU0:router(config)# router static
Enters static route configuration mode.
```

Step 3 **vrf** *vrf-name*

Example:

```
RP/0/0/CPU0:router(config-static)# vrf vrf_A
(Optional) Enters VRF configuration mode.
```

If a VRF is not specified, the static route is configured under the default VRF.

Step 4 **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }

Example:

```
RP/0/0/CPU0:router(config-static-vrf)# address family ipv4 unicast
Enters address family mode.
```

Step 5 *prefix mask* [**vrf** *vrf-name*] { *ip-address* | *interface-type interface-instance* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]

Example:

```
RP/0/0/CPU0:router(config-static-vrf-afi)# 10.0.0.0/8 172.20.16.6 110
Configures an administrative distance of 110.
```

- This example shows how to route packets for network 10.0.0.0 through to a next hop at 172.20.16.6 if dynamic information with administrative distance less than 110 is not available.

Step 6 **commit**

A default static route is often used in simple router topologies. In the following example, a route is configured with an administrative distance of 110.

```
configure
router static
address-family ipv4 unicast
0.0.0.0/0 2.6.0.1 110
end
```

Configuring a Static Route Under Multicast SAFI

This task explains how to configure a static route under multicast SAFI.

SUMMARY STEPS

1. **configure**
2. **interface** *type interface-path-id*
3. **vrf** *vrf-name*
4. **address-family** { **ipv4** | **ipv6** } **multicast**
5. **exit**
6. **router static**
7. **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** } **topology** *topology-name*
8. *prefix mask* [**vrf** *vrf-name*] [**topology** *topology-name*] { *ip-address* | *type interface-path-id* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]
9. **commit**

DETAILED STEPS

| | Command or Action | Purpose |
|---------------|--|---|
| Step 1 | configure | |
| Step 2 | interface <i>type interface-path-id</i> Example: RP/0/0/CPU0:router(config)# interface Loopback0 | Enters interface configuration mode. |
| Step 3 | vrf <i>vrf-name</i> Example: RP/0/0/CPU0:router(config-if)# vrf vrf1 | (Optional) Enters VRF configuration mode. If a VRF is not specified, the static route is configured under the default VRF. |

| | Command or Action | Purpose |
|---------------|--|---|
| Step 4 | address-family { ipv4 ipv6 } multicast Example: RP/0/0/CPU0:router(config-if)# address-family ipv4 multicast | Enters SAFI mode. |
| Step 5 | exit Example: RP/0/0/CPU0:router(config-if)# exit | Exits interface configuration mode and enters global configuration mode. |
| Step 6 | router static Example: RP/0/0/CPU0:router(config)#router static | Enters static route configuration mode. |
| Step 7 | address-family { ipv4 ipv6 } { unicast multicast } topology topology-name Example: RP/0/0/CPU0:router(config-static)# address-family ipv4 unicast topology topol | Enters address family configuration mode and configures the topology to be associated with the interface. |
| Step 8 | prefix mask [vrf vrf-name] [topology topology-name] { ip-address type interface-path-id } [distance] [description text] [tag tag] [permanent] Example: RP/0/0/CPU0:router(config-static-vrf-afi-topo)# 172.29.52.7/32 Loopback 0 110 | Configures an administrative distance of 110. |
| Step 9 | commit | |

Configure Floating Static Route

This task explains how to configure a floating static route.

SUMMARY STEPS

1. **configure**
2. **router static**
3. **vrf** *vrf-name*
4. **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }
5. *prefix mask* [**vrf** *vrf-name*] { *ip-address* | *interface-type interface-instance* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]
6. **commit**

DETAILED STEPS

Step 1 **configure**

Step 2 **router static**

Example:

```
RP/0/0/CPU0:router(config)# router static
Enters static route configuration mode.
```

Step 3 **vrf** *vrf-name*

Example:

```
RP/0/0/CPU0:router(config-static)# vrf vrf_A
(Optional) Enters VRF configuration mode.
```

If a VRF is not specified, the static route is configured under the default VRF.

Step 4 **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }

Example:

```
RP/0/0/CPU0:router(config-static-vrf)# address family ipv6 unicast
Enters address family mode.
```

Step 5 *prefix mask* [**vrf** *vrf-name*] { *ip-address* | *interface-type interface-instance* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]

Example:

```
RP/0/0/CPU0:router(config-static-vrf-afi)# 2001:0DB8::/32 2001:0DB8:3000::1 201
Configures an administrative distance of 201.
```

Step 6 **commit**

A floating static route is often used to provide a backup path if connectivity fails. In the following example, a route is configured with an administrative distance of 201.

```
configure
router static
address-family ipv6 unicast
2001:0DB8::/32 2001:0DB8:3000::1 201
end
```

Configure Static Routes Between PE-CE Routers

This task explains how to configure static routing between PE-CE routers.



Note

VRF fallback is not supported with IPv6 VPN Provider Edge (6VPE).

SUMMARY STEPS

1. **configure**
2. **router static**
3. **vrf** *vrf-name*
4. **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }
5. **prefix mask** [**vrf** *vrf-name*] { *ip-address* | *interface-type interface-path-id* } [*distance*] [**description** *text*] [**tag** *tag*] [**permanent**]
6. **commit**

DETAILED STEPS

Step 1 **configure**

Step 2 **router static**

Example:

```
RP/0/0/CPU0:router(config)# router static
Enters static route configuration mode.
```

Step 3 **vrf** *vrf-name*

Example:

```
RP/0/0/CPU0:router(config-static)# vrf vrf_A
(Optional) Enters VRF configuration mode.
```

If a VRF is not specified, the static route is configured under the default VRF.

Step 4 **address-family** { **ipv4** | **ipv6** } { **unicast** | **multicast** }

Example:

```
RP/0/0/CPU0:router(config-static-vrf)# address family ipv6 unicast
Enters address family mode.
```

Step 5

```
prefix mask [vrf vrf-name] { ip-address | interface-type interface-path-id } [ distance ] [ description text ] [ tag tag ] [ permanent ]
```

Example:

```
RP/0/0/CPU0:router(config-static-vrf-afi)# 2001:0DB8::/32 2001:0DB8:3000::1 201
Configures an administrative distance of 201.
```

Step 6

```
commit
```

In the following example, a static route between PE and CE routers is configured, and a VRF is associated with the static route:

```
configure
router static
vrf vrf_A
address-family ipv4 unicast
0.0.0.0/0 2.6.0.2 120
end
```

Change Maximum Number of Allowable Static Routes

This task explains how to change the maximum number of allowable static routes.

Before You Begin

**Note**

The number of static routes that can be configured on a router for a given address family is limited by default to 4000. The limit can be raised or lowered using the **maximum path** command. Note that if you use the **maximum path** command to reduce the configured maximum allowed number of static routes for a given address family below the number of static routes currently configured, the change is rejected. In addition, understand the following behavior: If you commit a batch of routes that would, when grouped, push the number of static routes configured above the maximum allowed, the first *n* routes in the batch are accepted. The number previously configured is accepted, and the remainder are rejected. The *n* argument is the difference between the maximum number allowed and number previously configured.

SUMMARY STEPS

1. **configure**
2. **router static**
3. **maximum path** { **ipv4** | **ipv6** } *value*
4. **commit**

DETAILED STEPS

- Step 1** **configure**
Step 2 **router static**

Example:

```
RP/0/0/CPU0:router(config)# router static
```

Enters static route configuration mode.

- Step 3** **maximum path { ipv4 | ipv6 } value**

Example:

```
RP/0/0/CPU0:router(config-static)# maximum path ipv4 10000
```

Changes the maximum number of allowable static routes.

- Specify IPv4 or IPv6 address prefixes.
- Specify the maximum number of static routes for the given address family. The range is from 1 to 140000.
- This example sets the maximum number of static IPv4 routes to 10000.

- Step 4** **commit**

Configuring a static route to point at interface null 0 may be used for discarding traffic to a particular prefix. For example, if it is required to discard all traffic to prefix 2001:0DB8:42:1/64, the following static route would be defined:

```
configure
router static
address-family ipv6 unicast
2001:0DB8:42:1::/64 null 0
end
```

Associate VRF with a Static Route

This task explains how to associate a VRF with a static route.

SUMMARY STEPS

1. **configure**
2. **router static**
3. **vrf vrf-name**
4. **address-family { ipv4 | ipv6 } { unicast | multicast }**
5. **prefix mask [vrf vrf-name] {next-hop ip-address | interface-name} {path-id} [distance] [description text] [tag tag] [permanent]**
6. **commit**

DETAILED STEPS

Step 1 **configure**

Step 2 **router static**

Example:

```
RP/0/
RP0/CPU0:router(config)# router static
Enters static route configuration mode.
```

Step 3 **vrf vrf-name**

Example:

```
RP/0/0/CPU0:router(config-static)# vrf vrf_A
Enters VRF configuration mode.
```

Step 4 **address-family { ipv4 | ipv6 } { unicast | multicast }**

Example:

```
RP/0/0/CPU0:router(config-static-vrf)# address family ipv6 unicast
Enters address family mode.
```

Step 5 **prefix mask [vrf vrf-name] {next-hop ip-address | interface-name} {path-id} [distance] [description text] [tag tag] [permanent]**

Example:

```
RP/0/0/CPU0:router(config-static-vrf-afi)# 2001:0DB8::/32 2001:0DB8:3000::1 201
Configures an administrative distance of 201.
```

Step 6 **commit**

Configuration Examples

This section provides the following configuration examples:

Configuring Traffic Discard: Example

Configuring a static route to point at interface null 0 may be used for discarding traffic to a particular prefix. For example, if it is required to discard all traffic to prefix 2001:0DB8:42:1/64, the following static route would be defined:

```
configure
router static
address-family ipv6 unicast
2001:0DB8:42:1::/64 null 0
end
```

Configuring a Fixed Default Route: Example

A default static route is often used in simple router topologies. In the following example, a route is configured with an administrative distance of 110.

```
configure
router static
address-family ipv4 unicast
0.0.0.0/0 2.6.0.1 110
end
```

Configuring a Floating Static Route: Example

A floating static route is often used to provide a backup path if connectivity fails. In the following example, a route is configured with an administrative distance of 201.

```
configure
router static
address-family ipv6 unicast
2001:0DB8::/32 2001:0DB8:3000::1 201
end
```

Configuring a Static Route Between PE-CE Routers: Example

In the following example, a static route between PE and CE routers is configured, and a VRF is associated with the static route:

```
configure
router static
vrf vrf_A
address-family ipv4 unicast
0.0.0.0/0 2.6.0.2 120
end
```

Where to Go Next

For additional information about static routes, routing protocols, and RIB, consult the following publications:

- *Implementing and Monitoring RIB on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *Implementing BGP on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *Implementing EIGRP on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *Implementing IS-IS on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *Implementing MPLS Layer 3 VPN on Cisco IOS XR Software* in *Cisco IOS XR Multiprotocol Label Switching Configuration Guide*

- *Implementing OSPF on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *Implementing OSPFv3 on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*
- *RIB Commands on Cisco IOS XR Software* in *Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router*
- *Implementing RIP on Cisco IOS XR Software* in *Cisco IOS XR Routing Configuration Guide for the Cisco XR 12000 Series Router*

Additional References

The following sections provide references related to implementing Static Routes.

Related Documents

| Related Topic | Document Title |
|---|--|
| Static routes commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples | <i>Static Routing Commands</i> in <i>Cisco IOS XR Routing Command Reference for the Cisco XR 12000 Series Router</i> |
| MPLS Layer 3 VPN configuration: configuration concepts, task, and examples | <i>Cisco IOS XR MPLS Configuration Guide for the Cisco XR 12000 Series Router</i> |

Standards

| Standards | Title |
|---|-------|
| No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature. | — |

MIBs

| MIBs | MIBs Link |
|------|---|
| — | To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml |

RFCs

| RFCs | Title |
|---|-------|
| No new or modified RFCs are supported by this feature, and support for existing RFCs has not been modified by this feature. | — |

Technical Assistance

| Description | Link |
|--|---|
| The Cisco Technical Support website contains thousands of pages of searchable technical content, including links to products, technologies, solutions, technical tips, and tools. Registered Cisco.com users can log in from this page to access more content. | http://www.cisco.com/techsupport |