

# IPv6 Routing: Multiprotocol BGP Extensions for IPv6

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## **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 <a href="https://www.cisco.com/go/cfn">www.cisco.com/go/cfn</a>. An account on Cisco.com is not required.

# **Information About IPv6 Routing: Multiprotocol BGP Extensions for IPv6**

## **Multiprotocol BGP Extensions for IPv6**

Multiprotocol BGP is the supported Exterior Gateway Protocol (EGP) for IPv6. Multiprotocol BGP extensions for IPv6 supports many of the same features and functionality as IPv4 BGP. IPv6 enhancements to multiprotocol BGP include support for an IPv6 address family and Network Layer Reachability Information (NLRI) and next hop (the next device in the path to the destination) attributes that use IPv6 addresses.

## **How to Implement Multiprotocol BGP for IPv6**

## Configuring an IPv6 BGP Routing Process and BGP Router ID

Perform this task to configure an IPv6 BGP routing process and an optional BGP router ID for a BGP-speaking device.

BGP uses a router ID to identify BGP-speaking peers. The BGP router ID is 32-bit value that is often represented by an IPv4 address. By default, the router ID is set to the IPv4 address of a loopback interface on the device. If no loopback interface is configured on the device, then the software chooses the highest IPv4 address configured to a physical interface on the device to represent the BGP router ID.

When configuring BGP on a device that is enabled only for IPv6 (that is, the device does not have an IPv4 address), you must manually configure the BGP router ID for the device. The BGP router ID, which is represented as a 32-bit value using an IPv4 address syntax, must be unique to the BGP peers of the device.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- 3. router bgp as-number
- 4. no bgp default ipv4-unicast
- **5. bgp router-id** *ip-address*

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	• Enter your password if prompted.
	Device> enable	
Step 2	configure terminal	Enters global configuration mode.
	Example:	
	Device# configure terminal	
Step 3	router bgp as-number	Configures a BGP routing process, and enters router
	Example:	configuration mode for the specified routing process.
	Device(config)# router bgp 65000	
Step 4	no bgp default ipv4-unicast	Disables the IPv4 unicast address family for the BGP
	Example:	routing process specified in the previous step.

	Command or Action	Purpose
	Device(config-router)# no bgp default ipv4-unicast	Note Routing information for the IPv4 unicast address family is advertised by default for each BGP routing session configured with the neighbor remote-as command unless you configure the no bgp default ipv4-unicast command before configuring the neighbor remote-as command.
Step 5	bgp router-id ip-address	(Optional) Configures a fixed 32-bit router ID as the identifier of the local device running BGP.
	Example:  Device(config-router) # bgp router-id 192.168.99.70	Note Configuring a router ID using the bgp router-id

## **Configuring IPv6 Multiprotocol BGP Between Two Peers**

By default, neighbors that are defined using the **neighbor remote-as** command in router configuration mode exchange only IPv4 unicast address prefixes. To exchange other address prefix types, such as IPv6 prefixes, neighbors must also be activated using the **neighbor activate** command in address family configuration mode for the other prefix types, as shown for IPv6 prefixes.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- **3.** router bgp as-number
- **4. neighbor** {*ip-address* | *ipv6-address* [%] | *peer-group-name*} **remote-as** *autonomous-system-number* [alternate-as *autonomous-system-number* ...]
- 5. address-family ipv6 [unicast | multicast]
- **6.** neighbor {ip-address | peer-group-name | ipv6-address %} activate

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	• Enter your password if prompted.
	Device> enable	
Step 2	configure terminal	Enters global configuration mode.
	Example:	
	Device# configure terminal	
Step 3	router bgp as-number	Enters router configuration mode for the specified routing
	Example:	process.
	Device(config)# router bgp 65000	

	Command or Action	Purpose
Step 4	neighbor {ip-address   ipv6-address [%]   peer-group-name} remote-as autonomous-system-number [alternate-as autonomous-system-number]	Adds the IPv6 address of the neighbor in the specified autonomous system to the IPv6 multiprotocol BGP neighbor table of the local device.
	Example:	
	Device(config-router) # neighbor 2001:DB8:0:CC00::1 remote-as 64600	
Step 5	address-family ipv6 [unicast   multicast]  Example:	Specifies the IPv6 address family and enters address family configuration mode.
	Device(config-router)# address-family ipv6	<ul> <li>The unicast keyword specifies the IPv6 unicast address family. By default, the device is placed in configuration mode for the IPv6 unicast address family if a keyword is not specified with the address-family ipv6 command.</li> <li>The multicast keyword specifies IPv6 multicast address prefixes.</li> </ul>
Step 6	neighbor {ip-address   peer-group-name   ipv6-address %} activate	Enables the neighbor to exchange prefixes for the IPv6 address family with the local device.
	Example:	
	Device(config-router-af)# neighbor 2001:DB8:0:CC00::1 activate	

## **Advertising Routes into IPv6 Multiprotocol BGP**

By default, networks that are defined in router configuration mode using the **network** command are injected into the IPv4 unicast database. To inject a network into another database, such as the IPv6 BGP database, you must define the network using the **network** command in address family configuration mode for the other database, as shown for the IPv6 BGP database.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- **3.** router bgp as-number
- 4. address-family ipv6 [vrf vrf-name] [unicast | multicast | vpnv6]
- **5. network** {network-number [**mask** network-mask] | nsap-prefix} [**route-map** map-tag]
- 6. exit

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	Enter your password if prompted.

	Command or Action	Purpose
	Device> enable	
Step 2	configure terminal  Example:  Device# configure terminal	Enters global configuration mode.
Step 3	<pre>router bgp as-number Example: Device(config) # router bgp 65000</pre>	Enters router configuration mode for the specified BGP routing process.
Step 4	address-family ipv6 [vrf vrf-name] [unicast   multicast   vpnv6]  Example:  Device(config-router) # address-family ipv6 unicast	Specifies the IPv6 address family, and enters address family configuration mode.  • The unicast keyword specifies the IPv6 unicast address family. By default, the device is placed in configuration mode for the IPv6 unicast address family if a keyword is not specified with the address-family ipv6 command.  • The multicast keyword specifies IPv6 multicast address prefixes.
Step 5	<pre>network {network-number [mask network-mask]   nsap-prefix} [route-map map-tag] Example:  Device(config-router-af) # network 2001:DB8::/24</pre>	Advertises (injects) the specified prefix into the IPv6 BGP database (the routes must first be found in the IPv6 unicast routing table).  • The prefix is injected into the database for the address family specified in the previous step.  • Routes are tagged from the specified prefix as "local origin."  • The <i>ipv6-prefix</i> argument in the <b>network</b> command must be in the form documented in RFC 2373 where the address is specified in hexadecimal using 16-bit values between colons.  • The <i>prefix-length</i> argument is a decimal value that indicates how many of the high-order contiguous bits of the address comprise the prefix (the network portion of the address). A slash mark must precede the decimal value.
Step 6	<pre>exit Example: Device(config-router-af)# exit</pre>	Exits address family configuration mode, and returns the device to router configuration mode.  • Repeat this step to exit router configuration mode and return the device to global configuration mode.

## Configuring a Route Map for IPv6 Multiprotocol BGP Prefixes

- By default, neighbors that are defined using the **neighbor remote-as** command in router configuration mode exchange only IPv4 unicast address prefixes. To exchange other address prefix types, such as IPv6 prefixes, neighbors must also be activated using the **neighbor activate** command in address family configuration mode for the other prefix types, as shown for IPv6 prefixes.
- By default, route maps that are applied in router configuration mode using the **neighbor route-map** command are applied to only IPv4 unicast address prefixes. Route maps for other address families must be applied in address family configuration mode using the **neighbor route-map** command, as shown for the IPv6 address family. The route maps are applied either as the inbound or outbound routing policy for neighbors under the specified address family. Configuring separate route maps under each address family type simplifies managing complicated or different policies for each address family.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- 3. router bgp as-number
- **4. neighbor** {ip-address | ipv6-address[%] | peer-group-name} **remote-as** autonomous-system-number [**alternate-as** autonomous-system-number ...]
- 5. address-family ipv6 [vrf vrf-name] [unicast | multicast | vpnv6]
- **6. neighbor** {ip-address | peer-group-name | ipv6-address %} activate
- 7. neighbor {ip-address | peer-group-name | ipv6-address [%]} route-map map-name {in | out}
- 8. exit
- 9. exit
- **10.** route-map map-tag [permit | deny] [sequence-number]
- 11. match ipv6 address {prefix-list prefix-list-name | access-list-name}

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	• Enter your password if prompted.
	Device> enable	
Step 2	configure terminal	Enters global configuration mode.
	Example:	
	Device# configure terminal	
Step 3	router bgp as-number	Enters router configuration mode for the specified routing
	Example:	process.
	Device(config)# router bgp 65000	

	Command or Action	Purpose
Step 4	neighbor {ip-address   ipv6-address[%]   peer-group-name} remote-as autonomous-system-number [alternate-as autonomous-system-number]	Adds the link-local IPv6 address of the neighbor in the specified remote autonomous system to the IPv6 multiprotocol BGP neighbor table of the local device.
	Example:	
	Device(config-router)# neighbor 2001:DB8:0:cc00::1 remote-as 64600	
Step 5	address-family ipv6 [vrf vrf-name] [unicast   multicast   vpnv6]	Specifies the IPv6 address family, and enters address family configuration mode.
	Example:  Device(config-router) # address-family ipv6	<ul> <li>The unicast keyword specifies the IPv6 unicast address family. By default, the device is placed in configuration mode for the IPv6 unicast address family if the unicast keyword is not specified with the address-family ipv6 command.</li> <li>The multicast keyword specifies IPv6 multicast address prefixes.</li> </ul>
Step 6	neighbor {ip-address   peer-group-name   ipv6-address %} activate	Enables the neighbor to exchange prefixes for the IPv6 address family with the local device using the specified
	Example:	link-local addresses.
	Device(config-router-af)# neighbor 2001:DB8:0:cc00::1 activate	
Step 7	neighbor {ip-address   peer-group-name   ipv6-address [%]} route-map map-name {in   out}	Applies a route map to incoming or outgoing routes.  • Changes to the route map will not take effect for
	Example:	existing peers until the peering is reset or a soft reset
	Device(config-router-af) # neighbor 2001:DB8:0:cc00::1 route-map rtp in	is performed. Using the <b>clear bgp ipv6</b> commar with the <b>soft</b> and <b>in</b> keywords will perform a sor reset.
Step 8	exit	Exits address family configuration mode, and returns the
	Example:	device to router configuration mode.
	Device(config-router-af)# exit	
Step 9	exit	Exits router configuration mode, and returns the device to
	Example:	global configuration mode.
	Device(config-router)# exit	
Step 10	route-map map-tag [permit   deny] [sequence-number]	Defines a route map and enters route-map configuration
	Example:	mode.
	Device(config)# route-map rtp permit 10	• Follow this step with a <b>match</b> command.

	Command or Action	Purpose
Step 11	match ipv6 address {prefix-list prefix-list-name   access-list-name}  Example:	Distributes any routes that have a destination IPv6 network number address permitted by a prefix list, or performs policy routing on packets.
	Device(config-route-map)# match ipv6 address prefix-list cisco	

## **Redistributing Prefixes into IPv6 Multiprotocol BGP**

Redistribution is the process of redistributing, or injecting, prefixes from one routing protocol into another routing protocol. This task explains how to inject prefixes from a routing protocol into IPv6 multiprotocol BGP. Specifically, prefixes that are redistributed into IPv6 multiprotocol BGP using the **redistribute** router configuration command are injected into the IPv6 unicast database.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- 3. router bgp as-number
- 4. address-family ipv6 [vrf vrf-name] [unicast | multicast | vpnv6]
- **5.** redistribute bgp [process-id] [metric metric-value] [route-map map-name] [source-protocol-options]
- 6. exit

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	• Enter your password if prompted.
	Device> enable	
Step 2	configure terminal	Enters global configuration mode.
	Example:	
	Device# configure terminal	
Step 3	router bgp as-number	Enters router configuration mode for the specified BGP
Example: routing prod	routing process.	
	Device(config)# router bgp 65000	
Step 4	address-family ipv6 [vrf vrf-name] [unicast   multicast   vpnv6]	Specifies the IPv6 address family, and enters address family configuration mode.
Example:	Example:	The unicast keyword specifies the IPv6 unicast address family. By default, the device is placed in configuration
	Device(config-router)# address-family ipv6	mode for the IPv6 unicast address family if a keyword

	Command or Action	Purpose
		is not specified with the <b>address-family ipv6</b> command.  • The <b>multicast</b> keyword specifies IPv6 multicast address prefixes.
Step 5	redistribute bgp [process-id] [metric metric-value] [route-map map-name] [source-protocol-options]	Redistributes IPv6 routes from one routing domain into another routing domain.
	Example:	
	Device(config-router-af)# redistribute bgp 64500 metric 5	
Step 6	exit	Exits address family configuration mode, and returns the
	Example:	device to router configuration mode.
	Device(config-router-af)# exit	Repeat this step to exit router configuration mode and return the device to global configuration mode.

## **Clearing External BGP Peers**

#### **SUMMARY STEPS**

- 1. enable
- 2. clear bgp ipv6 {unicast | multicast} external [soft] [in | out]
- 3. clear bgp ipv6  $\{unicast \mid multicast\}$  peer-group name

	Command or Action	Purpose
Step 1	enable	Enables privileged EXEC mode.
	Example:	• Enter your password if prompted.
	Device> enable	
Step 2	clear bgp ipv6 {unicast   multicast} external [soft] [in   out]	Clears external IPv6 BGP peers.
	Example:	
	Device# clear bgp ipv6 unicast external soft in	
Step 3	clear bgp ipv6 {unicast   multicast} peer-group name	Clears all members of an IPv6 BGP peer group.
	Example:	
	Device# clear bgp ipv6 unicast peer-group marketing	

## **Advertising IPv4 Routes Between IPv6 BGP Peers**

If an IPv6 network is connecting two separate IPv4 networks, IPv6 can be used to advertise the IPv4 routes. Configure the peering using the IPv6 addresses within the IPv4 address family. Set the next hop with a static route or with an inbound route map because the advertised next hop will usually be unreachable. Advertising IPv6 routes between two IPv4 peers is also possible using the same model.

#### **SUMMARY STEPS**

- 1. enable
- 2. configure terminal
- 3. router bgp as-number
- 4. neighbor peer-group-name peer-group
- **5. neighbor** {*ip-address* | *ipv6-address*[%] | *peer-group-name*} **remote-as** *autonomous-system-number* [alternate-as *autonomous-system-number* ...]
- 6. address-family ipv4 [mdt | multicast | tunnel | unicast [vrf vrf-name] | vrf vrf-name]
- 7. **neighbor** *ipv6-address* **peer-group** *peer-group-name*
- 8. neighbor {ip-address | peer-group-name | ipv6-address [%]} route-map map-name {in | out}
- 9. exit
- 10. exit
- **11. route-map** *map-tag* [**permit** | **deny**] [*sequence-number*]
- **12. set ip next-hop** *ip-address* [... *ip-address*] [**peer-address**]

	Command or Action	Purpose	
Step 1	enable	Enables privileged EXEC mode.	
	Example:	• Enter your password if prompted.	
	Device> enable		
Step 2	configure terminal	Enters global configuration mode.	
	Example:		
	Device# configure terminal		
Step 3	router bgp as-number	Enters router configuration mode for the specified routing	
	Example:	process.	
	Device(config)# router bgp 65000		
Step 4	neighbor peer-group-name peer-group	Creates a multiprotocol BGP peer group.	
	Example:		
	Device(config-router)# neighbor 6peers peer-group		

	Command or Action	Purpose	
Step 5	neighbor {ip-address   ipv6-address[%]   peer-group-name} remote-as autonomous-system-number [alternate-as autonomous-system-number]	Adds the IPv6 address of the neighbor in the specified autonomous system to the IPv6 multiprotocol BGP neighbor table of the local device.	
	Example:		
	Device(config-router)# neighbor 6peers remote-as 65002		
Step 6	address-family ipv4 [mdt   multicast   tunnel   unicast   vrf vrf-name]   vrf vrf-name]	Enters address family configuration mode to configure a routing session using standard IPv4 address prefixes.	
	Example:		
	Device(config-router)# address-family ipv4		
Step 7	neighbor ipv6-address peer-group peer-group-name	Assigns the IPv6 address of a BGP neighbor to a peer	
	Example:	group.	
	Device(config-router-af)# neighbor 2001:DB8:1234::2 peer-group 6peers		
Step 8	neighbor {ip-address   peer-group-name   ipv6-address [%]} route-map map-name {in   out}	Applies a route map to incoming or outgoing routes.	
	Example:	<ul> <li>Changes to the route map will not take effect for existing peers until the peering is reset or a soft reset</li> </ul>	
	Device(config-router-af)# neighbor 6peers route-map rmap out	is performed. Using the <b>clear bgp ipv6</b> command with the <b>soft</b> and <b>in</b> keywords will perform a soft reset.	
Step 9	exit	Exits address family configuration mode, and returns the	
	Example:	device to router configuration mode.	
	Device(config-router-af)# exit		
Step 10	exit	Exits router configuration mode, and returns the device to	
	Example:	global configuration mode.	
	Device(config-router)# exit		
Step 11	route-map map-tag [permit   deny] [sequence-number]	Defines a route map and enters route-map configuration mode.	
	Example:	mode.	
	Device(config)# route-map rmap permit 10		
Step 12	set ip next-hop ip-address [ ip-address] [peer-address]	Overrides the next hop advertised to the peer for IPv4 packets.	
	Example:		
	Device(config-route-map)# set ip next-hop 10.21.8.10		

## **Configuration Examples for Multiprotocol BGP for IPv6**

## Example: Configuring a BGP Process, BGP Router ID, and IPv6 Multiprotocol BGP Peer

The following example enables IPv6 globally, configures a BGP process, and establishes a BGP router ID. Also, the IPv6 multiprotocol BGP peer 2001:DB8:0:CC00::1 is configured and activated.

```
ipv6 unicast-routing
!
router bgp 65000
no bgp default ipv4-unicast
bgp router-id 192.168.99.70
neighbor 2001:DB8:0:CC00::1 remote-as 64600
address-family ipv6 unicast
neighbor 2001:DB8:0:CC00::1 activate
```

## **Example: Configuring an IPv6 Multiprotocol BGP Peer Group**

The following example configures the IPv6 multiprotocol BGP peer group named group1:

```
router bgp 65000
no bgp default ipv4-unicast
neighbor group1 peer-group
neighbor 2001:DB8:0:CC00::1 remote-as 64600
address-family ipv6 unicast
neighbor group1 activate
neighbor 2001:DB8:0:CC00::1 peer-group group1
```

## **Example: Advertising Routes into IPv6 Multiprotocol BGP**

The following example injects the IPv6 network 2001:DB8::/24 into the IPv6 unicast database of the local device. (BGP checks that a route for the network exists in the IPv6 unicast database of the local device before advertising the network.)

```
router bgp 65000
no bgp default ipv4-unicast
address-family ipv6 unicast
network 2001:DB8::/24
```

## **Example: Configuring a Route Map for IPv6 Multiprotocol BGP Prefixes**

The following example configures the route map named rtp to permit IPv6 unicast routes from network 2001:DB8::/24 if they match the prefix list named cisco:

```
router bgp 64900
no bgp default ipv4-unicast
neighbor 2001:DB8:0:CC00::1 remote-as 64700
address-family ipv6 unicast
neighbor 2001:DB8:0:CC00::1 activate
```

```
neighbor 2001:DB8:0:CC00::1 route-map rtp in
ipv6 prefix-list cisco seq 10 permit 2001:DB8::/24
route-map rtp permit 10
match ipv6 address prefix-list cisco
```

## **Example: Redistributing Prefixes into IPv6 Multiprotocol BGP**

The following example redistributes RIP routes into the IPv6 unicast database of the local device:

```
router bgp 64900
no bgp default ipv4-unicast
address-family ipv6 unicast
redistribute rip
```

## **Example: Advertising IPv4 Routes Between IPv6 Peers**

The following example advertises IPv4 routes between IPv6 peers when the IPv6 network is connecting two separate IPv4 networks. Peering is configured using IPv6 addresses in the IPv4 address family configuration mode. The inbound route map named rmap sets the next hop because the advertised next hop is likely to be unreachable.

```
router bgp 65000 !
neighbor 6peers peer-group
neighbor 2001:DB8:1234::2 remote-as 65002
address-family ipv4
neighbor 6peers activate
neighbor 6peers soft-reconfiguration inbound
neighbor 2001:DB8:1234::2 peer-group 6peers
neighbor 2001:DB8:1234::2 route-map rmap in !
route-map rmap permit 10
set ip next-hop 10.21.8.10
```

## **Additional References**

#### **Related Documents**

Related Topic	Document Title
IPv6 addressing and connectivity	IPv6 Configuration Guide
Cisco IOS commands	Cisco IOS Master Command List, All Releases
IPv6 commands	Cisco IOS IPv6 Command Reference
Cisco IOS IPv6 features	Cisco IOS IPv6 Feature Mapping

#### Standards and RFCs

Standard/RFC	Title
RFCs for	IPv6
IPv6	RFCs

#### **MIBs**

MIE	MIBs Link
_	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL:
	http://www.cisco.com/go/mibs

#### **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.	

# Feature Information for IPv6 Routing: Multiprotocol BGP Extensions for IPv6

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 <a href="https://www.cisco.com/go/cfn">www.cisco.com/go/cfn</a>. An account on Cisco.com is not required.

Table 1: Feature Information for IPv6 Routing: Multiprotocol BGP Extensions for IPv6

Feature Name	Releases	Feature Information
IPv6 Routing: Multiprotocol BGP	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Multiprotocol BGP Extensions for
Extensions for IPv6		IPv6 supports the same features and functionality as IPv4 BGP.
	12.4(2)T	