FHRP - GLBP Support for IPv6

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IPv6 routing protocols ensure router-to-router resilience and failover. However, in situations in which the path between a host and the first-hop router fails, or the first-hop router itself fails, first hop redundancy protocols (FHRPs) ensure host-to-router resilience and failover. The Gateway Load Balancing Protocol (GLBP) FHRP protects data traffic from a failed router or circuit, while allowing packet load sharing between a group of redundant routers.

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 FHRP - GLBP Support for IPv6

- Before configuring GLBP, ensure that the routers can support multiple MAC addresses on the physical interfaces. An additional MAC address is used for each GLBP forwarder to be configured.
- Avoid static link-local addressing on interfaces configured with GLBP.

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Information About FHRP - GLBP Support for IPv6

GLBP for IPv6

GLBP for IPv6 Overview

The Gateway Load Balancing Protocol feature provides automatic router backup for IPv6 hosts configured with a single default gateway on an IEEE 802.3 LAN. Multiple first hop routers on the LAN combine to offer a single virtual first-hop IPv6 router while sharing the IPv6 packet forwarding load. GLBP performs a similar function for the user as HSRP. HSRP allows multiple routers to participate in a virtual router group configured with a virtual IPv6 address. One member is elected to be the active router to forward packets sent to the virtual IPv6 address for the group. The other routers in the group are redundant until the active router fails. These standby routers have unused bandwidth that the protocol is not using. Although multiple virtual router groups can be configured for the same set of routers, the hosts must be configured for different default gateways, which results in an extra administrative burden. The advantage of GLBP is that it additionally provides load balancing over multiple routers (gateways) using a single virtual IPv6 address and multiple virtual MAC addresses. The forwarding load is shared among all routers in a GLBP group rather than being handled by a single router while the other routers stand idle. Each host is configured with the same virtual IPv6 address, and all routers in the virtual router group participate in forwarding packets.

GLBP Benefits

GLBP for IPv6 provides the following benefits:

Load Sharing

You can configure GLBP in such a way that traffic from LAN clients can be shared equitably among multiple routers.

Multiple Virtual Routers

GLBP supports up to 1024 virtual routers (GLBP groups) on each physical interface of a router and up to four virtual forwarders per group.

Preemption

The redundancy scheme of GLBP enables you to preempt an active virtual gateway with a higher priority backup virtual gateway that has become available. Forwarder preemption works in a similar way, except that forwarder preemption uses weighting instead of priority and is enabled by default.

Authentication

You can also use the industry-standard Message Digest algorithm 5 (MD5) algorithm for improved reliability, security, and protection against GLBP-spoofing software. A router within a GLBP group with a different authentication string than other routers will be ignored by other group members. You can alternatively use a simple text password authentication scheme between GLBP group members to detect configuration errors.

GLBP Active Virtual Gateway

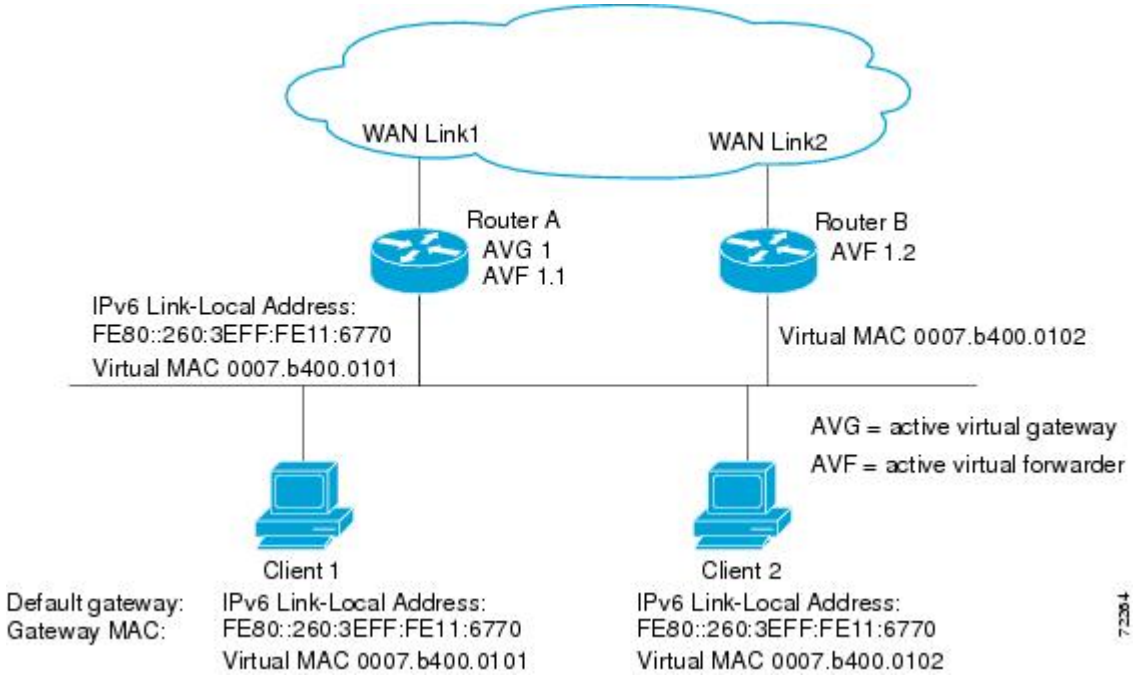
Members of a GLBP group elect one gateway to be the active virtual gateway (AVG) for that group. Other group members provide backup for the AVG in the event that the AVG becomes unavailable. The function of the AVG is that it assigns a virtual MAC address to each member of the GLBP group. Each gateway assumes responsibility for forwarding packets sent to the virtual MAC address assigned to it by the AVG. These gateways are known as active virtual forwarders (AVFs) for their virtual MAC address.

The IPv6 neighbor discovery process uses Internet Control Message Protocol (ICMP) in IPv6 messages and solicited-node multicast addresses to determine the link-layer address of a neighbor on the same network (local link), verify the reachability of a neighbor, and track neighboring routers. The IPv6 neighbor discovery process uses ICMPv6 messages and solicited-node multicast addresses to determine the link-layer address of a neighbor on the same network (local link), verify the reachability of a neighbor, and track neighboring routers. The AVG is responsible for answering ICMPv6 Neighbor Discovery requests for the virtual IPv6 address. Load sharing is achieved by the AVG replying to the ICMPv6 Neighbor Discovery requests with different virtual MAC addresses.

In the figure below, Router A is the AVG for a GLBP group, and is responsible for the IPv6 link-local address FE80::260:3EFF:FE11:6770. Router A is also an AVF for the virtual MAC address 0007.b400.0101. Router B is a member of the same GLBP group and is designated as the AVF for the virtual MAC address 0007.b400.0102. Client 1 has a default gateway IPv6 address of FE80::260:3EFF:FE11:6770 and a gateway MAC address of 0007.b400.0101. Client 2 shares the same

default gateway IP address but receives the gateway MAC address 0007.b400.0102 because Router B is sharing the traffic load with Router A.

Figure 1 GLBP Topology



If Router A becomes unavailable, Client 1 will not lose access to the WAN because Router B will assume responsibility for forwarding packets sent to the virtual MAC address of Router A, and for responding to packets sent to its own virtual MAC address. Router B will also assume the role of the AVG for the entire GLBP group. Communication for the GLBP members continues despite the failure of a router in the GLBP group.

GLBP Virtual MAC Address Assignment

A GLBP group allows up to four virtual MAC addresses per group. The AVG is responsible for assigning the virtual MAC addresses to each member of the group. Other group members request a virtual MAC address after they discover the AVG through hello messages. Gateways are assigned the next MAC address in sequence. A virtual forwarder that is assigned a virtual MAC address by the AVG is known as a primary virtual forwarder. Other members of the GLBP group learn the virtual MAC addresses from hello messages. A virtual forwarder that has learned the virtual MAC address is referred to as a secondary virtual forwarder.

GLBP Virtual Gateway Redundancy

GLBP operates virtual gateway redundancy in the same way as HSRP. One gateway is elected as the AVG, another gateway is elected as the standby virtual gateway, and the remaining gateways are placed in a listen state.

If an AVG fails, the standby virtual gateway will assume responsibility for the virtual IPv6 address. A new standby virtual gateway is then elected from the gateways in the listen state.

GLBP Virtual Forwarder Redundancy

GLBP virtual forwarder redundancy is similar to virtual gateway redundancy with an AVF. If the AVF fails, one of the secondary virtual forwarders in the listen state assumes responsibility for the virtual MAC address.

The new AVF is also a primary virtual forwarder for a different forwarder number. GLBP migrates hosts away from the old forwarder number using two timers that start as soon as the gateway changes to the active virtual forwarder state. GLBP uses the hello messages to communicate the current state of the timers.

The redirect time is the interval during which the AVG continues to redirect hosts to the old virtual forwarder MAC address. When the redirect time expires, the AVG stops using the old virtual forwarder MAC address in ICMPv6 ND replies, although the virtual forwarder will continue to forward packets that were sent to the old virtual forwarder MAC address.

The secondary hold time is the interval during which the virtual forwarder is valid. When the secondary hold time expires, the virtual forwarder is removed from all gateways in the GLBP group. The expired virtual forwarder number becomes eligible for reassignment by the AVG.

GLBP Gateway Priority

GLBP gateway priority determines the role that each GLBP gateway plays and the results if the AVG fails.

Priority also determines if a GLBP router functions as a backup virtual gateway and the order of ascendancy to becoming an AVG if the current AVG fails. You can configure the priority of each backup virtual gateway with a value of 1 through 255 using the **glbp priority** command.

In the figure above, if Router A--the AVG in a LAN topology--fails, an election process takes place to determine which backup virtual gateway should take over. In this example, Router B is the only other member in the group so it will automatically become the new AVG. If another router existed in the same GLBP group with a higher priority, then the router with the higher priority would be elected. If both routers have the same priority, the backup virtual gateway with the higher IPv6 address would be elected to become the active virtual gateway.

By default, the GLBP virtual gateway preemptive scheme is disabled. A backup virtual gateway can become the AVG only if the current AVG fails, regardless of the priorities assigned to the virtual gateways. You can enable the GLBP virtual gateway preemptive scheme using the **glbp preempt** command. Preemption allows a backup virtual gateway to become the AVG, if the backup virtual gateway is assigned a higher priority than the current AVG.

GLBP Gateway Weighting and Tracking

GLBP uses a weighting scheme to determine the forwarding capacity of each router in the GLBP group. The weighting assigned to a router in the GLBP group can be used to determine whether it will forward packets and, if so, the proportion of hosts in the LAN for which it will forward packets. Thresholds can be set to disable forwarding when the weighting falls below a certain value. When the weighting rises above another threshold, forwarding is automatically reenabled.

The GLBP group weighting can be automatically adjusted by tracking the state of an interface within the router. If a tracked interface goes down, the GLBP group weighting is reduced by a specified value. Different interfaces can be tracked to decrement the GLBP weighting by varying amounts.

By default, the GLBP virtual forwarder preemptive scheme is enabled with a delay of 30 seconds. A backup virtual forwarder can become the AVF if the current AVF weighting falls below the low weighting threshold for 30 seconds. You can disable the GLBP forwarder preemptive scheme using the **no glbp**

forwarder preempt command or change the delay using the **glbp forwarder preempt delay minimum** command.

How to Configure FHRP - GLBP Support for IPv6

Configuring and Customizing GLBP

Customizing GLBP behavior is optional. Be aware that as soon as you enable a GLBP group, that group is operating. It is possible that if you first enable a GLBP group before customizing GLBP, the router could take over control of the group and become the AVG before you have finished customizing the feature. Therefore, if you plan to customize GLBP, it is a good idea to do so before enabling GLBP.

Customizing GLBP

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ipv6 address** *ipv6-address / prefix-length | prefix-name ipv6-prefix / prefix-length* | **autoconfig** [*default-route*]}
5. **glbp** *group* **timers** [**msec**] *hellotime*[**msec**] *holdtime*
6. **glbp** *group* **timers redirect** *redirect timeout*
7. **glbp** *group* **load-balancing** [**host-dependent**| **round-robin**| **weighted**]
8. **glbp** *group* **priority** *level*
9. **glbp** *group* **preempt** [**delay minimum** *seconds*]
10. **glbp** *group* **name** *redundancy-name*
11. **exit**

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 fastethernet 0/0`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**ipv6 address** *ipv6-address* / *prefix-length* | *prefix-name* *ipv6-prefix* / *prefix-length* | **autoconfig** [*default-route*]} **Example:** `Device(config-if)# ipv6 address 2001:DB8:0:7272::72/64`	Configures an IPv6 address based on an IPv6 general prefix and enables IPv6 processing on an interface.
Step 5	**glbp** *group* **timers** [**msec**] *hellotime*[**msec**] *holdtime* **Example:** `Device(config-if)# glbp 10 timers 5 18`	Configures the interval between successive hello packets sent by the AVG in a GLBP group.
Step 6	**glbp** *group* **timers redirect** *redirect timeout* **Example:** `Device(config-if)# glbp 10 timers redirect 600 7200`	Configures the time interval during which the AVG continues to redirect clients to an AVF. • The *timeout* argument specifies the interval in seconds before a secondary virtual forwarder becomes invalid.

	Command or Action	Purpose
Step 7	**glbp** *group* **load-balancing** [**host-dependent**| **round-robin**| **weighted**] **Example:** `Device(config-if)# glbp 10 load-balancing host-dependent`	Specifies the method of load balancing used by the GLBP AVG.
Step 8	**glbp** *group* **priority** *level* **Example:** `Device(config-if)# glbp 10 priority 254`	Sets the priority level of the gateway within a GLBP group. • The default value is 100.
Step 9	**glbp** *group* **preempt** [**delay minimum** *seconds*] **Example:** `Device(config-if)# glbp 10 preempt delay minimum 60`	Configures the router to take over as AVG for a GLBP group if it has a higher priority than the current AVG. • This command is disabled by default. • Use the optional **delay** and **minimum** keywords and the *seconds* argument to specify a minimum delay interval in seconds before preemption of the AVG takes place.
Step 10	**glbp** *group* **name** *redundancy-name* **Example:** `Device(config-if)# glbp 10 name abcompany`	Enables IPv6 redundancy by assigning a name to the GLBP group. • The GLBP redundancy client must be configured with the same GLBP group name so the redundancy client and the GLBP group can be connected.
Step 11	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode, and returns the router to global configuration mode.

Configuring GLBP Authentication

The following sections describe configuration tasks for GLBP authentication. The task you perform depends on whether you want to use text authentication, a simple MD5 key string, or MD5 key chains for authentication.

GLBP MD5 authentication provides greater security than the alternative plain text authentication scheme. MD5 authentication allows each GLBP group member to use a secret key to generate a keyed MD5 hash that is part of the outgoing packet. A keyed hash of an incoming packet is generated and, if the hash within the incoming packet does not match the generated hash, the packet is ignored.

The key for the MD5 hash can either be given directly in the configuration using a key string or supplied indirectly through a key chain.

A router will ignore incoming GLBP packets from routers that do not have the same authentication configuration for a GLBP group. GLBP has three authentication schemes:

- No authentication
- Plain text authentication
- MD5 authentication

GLBP packets will be rejected in any of the following cases:

- The authentication schemes differ on the router and in the incoming packet.
- MD5 digests differ on the router and in the incoming packet.
- Text authentication strings differ on the router and in the incoming packet.

Configuring GLBP Weighting Values and Object Tracking

GLBP weighting is used to determine whether a router can act as a virtual forwarder. Initial weighting values can be set and optional thresholds specified. Interface states can be tracked and a decrement value set to reduce the weighting value if the interface goes down. When the GLBP router weighting drops below a specified value, the router will no longer be an active virtual forwarder. When the weighting rises above a specified value, the router can resume its role as an active virtual forwarder.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **track** *object-number* **interface** *type number* {**line-protocol** | **ip routing**
4. **interface** *type number*
5. **glbp** *group* **weighting** *maximum* **lower** *lower*] [**upper** *upper*
6. **glbp** *group* **weighting track** *object-number* [**decrement** *value*]
7. **glbp** *group* **forwarder preempt** [**delay minimum** *seconds*]
8. **end**
9. **show track** [*object-number*| **brief**] [**interface** [**brief**]| **ip route** [**brief**] | **resolution**| **timers**]

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 **track** *object-number* **interface** *type number* {**line-protocol** | **ip routing** **Example:** `Device(config)# track 2 interface POS 6/0 ip routing`	Configures an interface to be tracked where changes in the state of the interface affect the weighting of a GLBP gateway, and enters tracking configuration mode. • This command configures the interface and corresponding object number to be used with the **glbp weighting track** command. • The **line-protocol** keyword tracks whether the interface is up. The **ip routing** keywords also check that IPv6 routing is enabled on the interface and an IPv6 address is configured.
Step 4 **interface** *type number* **Example:** `Device(config)# interface fastethernet 0/0`	Enters interface configuration mode.
Step 5 **glbp** *group* **weighting** *maximum* **lower** *lower*] [**upper** *upper* **Example:** `Device(config-if)# glbp 10 weighting 110 lower 95 upper 105`	Specifies the initial weighting value, and the upper and lower thresholds, for a GLBP gateway.
Step 6 **glbp** *group* **weighting track** *object-number* [**decrement** *value*] **Example:** `Device(config-if)# glbp 10 weighting track 2 decrement 5`	Specifies an object to be tracked that affects the weighting of a GLBP gateway. • The *value* argument specifies a reduction in the weighting of a GLBP gateway when a tracked object fails.
Step 7 **glbp** *group* **forwarder preempt** [**delay minimum** *seconds*] **Example:** `Device(config-if)# glbp 10 forwarder preempt delay minimum 60`	Configures the router to take over as the AVF for a GLBP group if the current AVF for a GLBP group falls below its low weighting threshold. • This command is enabled by default with a delay of 30 seconds. • Use the optional **delay** and **minimum** keywords and the *seconds* argument to specify a minimum delay interval in seconds before preemption of the AVF takes place.
Step 8 **end** **Example:** `Device(config-if)# exit`	Returns to privileged EXEC mode.

	Command or Action	Purpose
Step 9	**show track** [*object-number*| **brief**] [**interface** [**brief**]| **ip route** [**brief**]	**resolution**| **timers**] **Example:** `Device# show track 2`	Displays tracking information.

Enabling and Verifying GLBP

GLBP is designed to be easy to configure. Each gateway in a GLBP group must be configured with the same group number, and at least one gateway in the GLBP group must be configured with the virtual IPv6 address to be used by the group. All other required parameters can be learned.

If VLANs are in use on an interface, the GLBP group number must be different for each VLAN.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type number*
4. **ipv6 address** *ipv6-address* / *prefix-length* | *prefix-name ipv6-prefix* / *prefix-length* | **autoconfig** [*default-route*]}
5. **glbp** *group* **ipv6** [*ipv6-address* | **autoconfig**]
6. **exit**
7. **show glbp** [*interface-type interface-number*] [*group*] [*state*] [**brief**]

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	**interface** *type number* **Example:** `Device(config)# interface fastethernet 0/0`	Specifies an interface type and number, and enters interface configuration mode.
Step 4	**ipv6 address** *ipv6-address / prefix-length | prefix-name ipv6-prefix / prefix-length* | **autoconfig** [*default-route*]} **Example:** `Device(config-if)# ipv6 address 2001:DB8:0:7262::62/64`	Configures an IPv6 address based on an IPv6 general prefix and enables IPv6 processing on an interface.
Step 5	**glbp** *group* **ipv6** [*ipv6-address* | **autoconfig**] **Example:** `Device(config-if)# glbp 1 ipv6 FE80::60:3E47:AC8:8`	Enables GLBP in IPv6.
Step 6	**exit** **Example:** `Device(config-if)# exit`	Exits interface configuration mode, and returns the router to global configuration mode.
Step 7	**show glbp** [*interface-type interface-number*] [*group*] [*state*] [**brief**] **Example:** `Device(config)# show glbp 10`	(Optional) Displays information about GLBP groups on a router. • Use the optional **brief** keyword to display a single line of information about each virtual gateway or virtual forwarder.

Troubleshooting GLBP

This task requires a router running GLBP to be attached directly to a console.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **no logging console**
4. Use Telnet to access a router port and repeat Steps 1 and 2.
5. **end**
6. **terminal monitor**
7. **debug condition glbp** *interface-type interface-number group* [*forwarder*]
8. **terminal no monitor**

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	**no logging console** **Example:** `Device(config)#` **`no logging console`**	Disables all logging to the console terminal. • To reenable logging to the console, use the **logging console** command in global configuration mode.
Step 4	Use Telnet to access a router port and repeat Steps 1 and 2.	Enters global configuration mode in a recursive Telnet session, which allows the output to be redirected away from the console port.
Step 5	**end** **Example:** `Device(config)# end`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 6	**terminal monitor** **Example:** `Device#` **terminal monitor**	Enables logging output on the virtual terminal.
Step 7	**debug condition glbp** *interface-type interface-number group* [*forwarder*] **Example:** `Device#` **debug condition glbp fastethernet 0/0 10 1**	Displays debugging messages about GLBP conditions. • Try to enter only specific **debug condition glbp**or **debug glbp**commands to isolate the output to a certain subcomponent and minimize the load on the processor. Use appropriate arguments and keywords to generate more detailed debug information on specified subcomponents. • Enter the specific **no debug condition glbp**or **no debug glbp** command when you are finished.
Step 8	**terminal no monitor** **Example:** `Device#` **terminal no monitor**	Disables logging on the virtual terminal.

Configuration Examples for FHRP - GLBP Support for IPv6

Example: Customizing GLBP Configuration

In the following example, Router A, shown in Figure 1, is configured with a number of GLBP commands:

```
interface fastethernet 0/0
 ipv6 address 2001:DB8:0001:0001:/64
 glbp 10 timers 5 18
 glbp 10 timers redirect 600 7200
 glbp 10 load-balancing host-dependent
 glbp 10 priority 254
 glbp 10 preempt delay minimum 60
```

Example: Enabling GLBP Configuration

In the following example, the router is configured to enable GLBP, and the virtual IPv6 address of 2001:DB8:0002:0002:/64 is specified for GLBP group 10:

```
interface fastethernet 0/0
```

```
ipv6 address 2001:DB8:0001:0001:/64
 glbp 10 ipv6 FE80::60:3E47:AC8:8
```

In the following example, GLBP for IPv6 is enabled for GLBP group 15:

```
interface fastethernet 0/0
 ipv6 address 2001:DB8:0001:0001:/64
 glbp 10 ipv6
```

Example: GLBP Weighting

In the following example, Router A, shown in Figure 1, is configured to track the IP routing state of the POS interfaces 5/0 and 6/0, an initial GLBP weighting with upper and lower thresholds is set, and a weighting decrement value of 10 is set. If POS interfaces 5/0 and 6/0 go down, the weighting value of the router is reduced.

```
track 1 interface POS 5/0 ip routing
track 2 interface POS 6/0 ip routing
interface fastethernet 0/0
 glbp 10 weighting 110 lower 95 upper 105
 glbp 10 weighting track 1 decrement 10
 glbp 10 weighting track 2 decrement 10
 glbp 10 forwarder preempt delay minimum 60
```

Additional References

Related Documents

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

Standards and RFCs

Standard/RFC	Title
RFCs for IPv6	*IPv6 RFCs*

MIBs

MIB	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.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for FHRP - GLBP Support 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 www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1 Feature Information for FHRP--GLBP Support for IPv6

Feature Name	Releases	Feature Information
FHRP--GLBP Support for IPv6	12.2(58)SE 12.2(33)SXI 12.4(6)T	GLBP protects data traffic from a failed router or circuit while allowing packet load sharing between a group of redundant routers. The following commands were introduced or modified: **glbp forwarder preempt**, **glbp ipv6**, **glbp load-balancing**, **glbp preempt**, **glbp priority**, **glbp name**, **glbp timers**, **glbp timers redirect**, **glbp weighting**, **glbp weighting track**, **track interface**.

Glossary

- **CPE** --Customer premises equipment
- **FHRP** --First hop redundancy protocol
- **GLBP** --Gateway load balancing protocol
- **HSRP** --Hot standby routing protocol
- **NA** --Neighbor advertisement
- **ND** --Neighbor Discovery
- **NS** --Neighbor solicitation
- **PE** --Provider equipment
- **RA** --Router advertisement
- **RS** --Router solicitation