



## VRRPv3 Protocol Support

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### VRRPv3 Protocol Support

Virtual Router Redundancy Protocol (VRRP) enables a group of devices to form a single virtual device to provide redundancy. The LAN clients can then be configured with the virtual device as their default gateway. The virtual device, representing a group of devices, is also known as a VRRP group. The VRRP version 3 (v3) Protocol Support feature provides the capability to support IPv4 and IPv6 addresses while VRRP version 2 (v2) only supports IPv4 addresses. This module explains concepts related to VRRPv3 and describes how to create and customize a VRRP group in a network. Benefits of using VRRPv3 Protocol Support include the following:

- Interoperability in multi-vendor environments.
- VRRPv3 supports usage of IPv4 and IPv6 addresses while VRRPv2 only supports IPv4 addresses
- Improved scalability through the use of VRRS Pathways.



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**Note** In this module, VRRP and VRRPv3 are used interchangeably.

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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 <http://www.cisco.com/go/cfn>. An account on Cisco.com is not required.

## Restrictions for VRRPv3 Protocol Support

- VRRPv3 is not intended as a replacement for existing dynamic protocols. VRRPv3 is designed for use over multi-access, multicast, or broadcast capable Ethernet LANs.
- VRRPv3 is supported on Ethernet, Fast Ethernet, Bridge Group Virtual Interface (BVI), and Gigabit Ethernet interfaces, and on Multiprotocol Label Switching (MPLS) Virtual Private Networks (VPNs), VRF-aware MPLS VPNs and VLANs.
- Because of the forwarding delay that is associated with the initialization of a BVI interface, you must not configure the VRRPv3 advertise timer to a value lesser than the forwarding delay on the BVI interface. If you configure the VRRPv3 advertise timer to a value equal to or greater than the forwarding delay on the BVI interface, the setting prevents a VRRP device on a recently initialized BVI interface from unconditionally taking over the primary role. Use the **bridge forward-time** command to set the forwarding delay on the BVI interface. Use the **vrrp timers advertise** command to set the VRRP advertisement timer.
- VRRPv3 does not support Stateful Switchover (SSO).
- Full network redundancy can only be achieved if VRRP operates over the same network path as the VRRS Pathway redundant interfaces. For full redundancy, the following restrictions apply:
  - VRRS pathways should not share a different physical interface as the parent VRRP group or be configured on a sub-interface having a different physical interface as the parent VRRP group.
  - VRRS pathways should not be configured on Switch Virtual Interface (SVI) interfaces as long as the associated VLAN does not share the same trunk as the VLAN on which the parent VRRP group is configured.
- Interface link-local IP address and VRRP group virtual link-local IP address should be different for VRRP features to work properly.

## Information About VRRPv3 Protocol Support

The following sections provide information about VRRPv3 protocol support.

### VRRPv3 Benefits

#### Support for IPv4 and IPv6

VRRPv3 supports IPv4 and IPv6 address families while VRRPv2 only supports IPv4 addresses.




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**Note** When VRRPv3 is in use, VRRPv2 is unavailable. For VRRPv3 to be configurable, the **fhrp version vrrp v3** command must be used in global configuration mode

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#### Redundancy

VRRP enables you to configure multiple devices as the default gateway device, which reduces the possibility of a single point of failure in a network.

### Load Sharing

You can configure VRRP in such a way that traffic to and from LAN clients can be shared by multiple devices, thereby sharing the traffic load more equitably between available devices.

### Multiple Virtual Devices

VRRP supports up to 255 virtual devices (VRRP groups) on a device physical interface, subject to restrictions in scaling. Multiple virtual device support enables you to implement redundancy and load sharing in your LAN topology. In scaled environments, VRRS Pathways should be used in combination with VRRP control groups.

### Multiple IP Addresses

The virtual device can manage multiple IP addresses, including secondary IP addresses. Therefore, if you have multiple subnets configured on an Ethernet interface, you can configure VRRP on each subnet.



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**Note** To utilize secondary IP addresses in a VRRP group, a primary address must be configured on the same group.

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### Preemption

The redundancy scheme of VRRP enables you to preempt a virtual device backup that has taken over for a failing primary virtual device with a higher priority virtual device backup that has become available.



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**Note** Preemption of a lower priority primary device is enabled with an optional delay.

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### Advertisement Protocol

VRRP uses a dedicated Internet Assigned Numbers Authority (IANA) standard multicast address for VRRP advertisements. For IPv4, the multicast address is 224.0.0.18. For IPv6, the multicast address is FF02:0:0:0:0:0:12. This addressing scheme minimizes the number of devices that must service the multicasts and allows test equipment to accurately identify VRRP packets on a segment. The IANA has assigned VRRP the IP protocol number 112.

## VRRP Device Priority and Preemption

An important aspect of the VRRP redundancy scheme is VRRP device priority. Priority determines the role that each VRRP device plays and what happens if the primary virtual device fails.

If a VRRP device owns the IP address of the virtual device and the IP address of the physical interface, this device will function as a primary virtual device.

Priority also determines if a VRRP device functions as a virtual device backup and the order of ascendancy to becoming a primary virtual device if the primary virtual device fails. You can configure the priority of each virtual device backup with a value of 1 through 254 using the **priority** command (use the **vrrp address-family** command to enter the VRRP configuration mode and access the **priority** option).

For example, if device A, the primary virtual device in a LAN topology, fails, an election process takes place to determine if virtual device backups B or C should take over. If devices B and C are configured with the priorities of 101 and 100, respectively, device B is elected to become primary virtual device because it has

the higher priority. If devices B and C are both configured with the priority of 100, the virtual device backup with the higher IP address is elected to become the primary virtual device.

By default, a preemptive scheme is enabled whereby a higher priority virtual device backup that becomes available takes over from the virtual device backup that was elected to become primary virtual device. You can disable this preemptive scheme using the **no preempt** command (use the **vrrp address-family** command to enter the VRRP configuration mode, and enter the **no preempt** command). If preemption is disabled, the virtual device backup that is elected to become primary virtual device remains the primary until the original primary virtual device recovers and becomes primary again.




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**Note** Preemption of a lower priority primary device is enabled with an optional delay.

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## VRRP Advertisements

The primary virtual device sends VRRP advertisements to other VRRP devices in the same group. The advertisements communicate the priority and state of the primary virtual device. The VRRP advertisements are encapsulated into either IPv4 or IPv6 packets (based on the VRRP group configuration) and sent to the appropriate multicast address assigned to the VRRP group. For IPv4, the multicast address is 224.0.0.18. For IPv6, the multicast address is FF02:0:0:0:0:0:12. The advertisements are sent every second by default and the interval is configurable.

Cisco devices allow you to configure millisecond timers, which is a change from VRRPv2. You need to manually configure the millisecond timer values on both the primary and the backup devices. The primary advertisement value displayed in the **show vrrp** command output on the backup devices is always 1 second because the packets on the backup devices do not accept millisecond values.

You must use millisecond timers where absolutely necessary and with careful consideration and testing. Millisecond values work only under favorable circumstances. The use of the millisecond timer values is compatible with third party vendors, as long as they also support VRRPv3. You can specify a timer value between 100 milliseconds and 40000 milliseconds.

## How to Configure VRRPv3 Protocol Support

The following sections provide configuration information about VRRPv3 protocol support.

### Creating and Customizing a VRRP Group

To create a VRRP group, perform the following task. Steps 6 to 14 denote customizing options for the group, and they are optional:

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	<b>enable</b>  <b>Example:</b>  Device> <b>enable</b>	Enables privileged EXEC mode.  Enter your password if prompted.

	Command or Action	Purpose
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b>  Device# <code>configure terminal</code>	Enters global configuration mode.
<b>Step 3</b>	<b>fhrp version vrrp v3</b> <b>Example:</b>  Device (config)# <code>fhrp version vrrp v3</code>	Enables the ability to configure VRRPv3 and VRRS.
<b>Step 4</b>	<b>interface type number</b> <b>Example:</b>  Device (config)# <code>interface</code> <code>GigabitEthernet 0/0/0</code>	Enters interface configuration mode.
<b>Step 5</b>	<b>vrrp group-id address-family {ipv4   ipv6}</b> <b>Example:</b>  Device (config-if)# <code>vrrp 3 address-family</code> <code>ipv4</code>	Creates a VRRP group and enters VRRP configuration mode.
<b>Step 6</b>	<b>address ip-address [primary   secondary]</b> <b>Example:</b>  Device (config-if-vrrp)# <code>address</code> <code>100.0.1.10 primary</code>	Specifies a primary or secondary address for the VRRP group.  <b>Note</b> VRRPv3 for IPv6 requires that a primary virtual link-local IPv6 address is configured to allow the group to operate. After the primary link-local IPv6 address is established on the group, you can add the secondary global addresses.
<b>Step 7</b>	<b>description group-description</b> <b>Example:</b>  Device (config-if-vrrp)# <code>description</code> <code>group 3</code>	(Optional) Specifies a description for the VRRP group.
<b>Step 8</b>	<b>match-address</b> <b>Example:</b>  Device (config-if-vrrp)# <code>match-address</code>	(Optional) Matches secondary address in the advertisement packet against the configured address.  <b>Note</b> Secondary address matching is enabled by default.
<b>Step 9</b>	<b>preempt delay minimum seconds</b> <b>Example:</b>	(Optional) Enables preemption of lower priority primary device with an optional delay.  <b>Note</b> Preemption is enabled by default.

	Command or Action	Purpose
	Device (config-if-vrrp) # <b>preempt delay minimum 30</b>	
<b>Step 10</b>	<b>priority</b> <i>priority-level</i> <b>Example:</b> Device (config-if-vrrp) # <b>priority 3</b>	(Optional) Specifies the priority value of the VRRP group.  The priority of a VRRP group is 100 by default.
<b>Step 11</b>	<b>timers advertise</b> <i>interval</i> <b>Example:</b> Device (config-if-vrrp) # <b>timers advertise 1000</b>	(Optional) Sets the advertisement timer in milliseconds.  The advertisement timer is set to 1000 milliseconds by default.
<b>Step 12</b>	<b>vrrpv2</b> <b>Example:</b> Device (config-if-vrrp) # <b>vrrpv2</b>	(Optional) Enables support for VRRPv2 configured devices in compatibility mode.
<b>Step 13</b>	<b>vrrs leader</b> <i>vrrs-leader-name</i> <b>Example:</b> Device (config-if-vrrp) # <b>vrrs leader leader-1</b>	(Optional) Specifies a leader's name to be registered with VRRS and to be used by followers.  <b>Note</b> A registered VRRS name is unavailable by default.
<b>Step 14</b>	<b>shutdown</b> <b>Example:</b> Device (config-if-vrrp) # <b>shutdown</b>	(Optional) Disables VRRP configuration for the VRRP group.  <b>Note</b> VRRP configuration is enabled for a VRRP group by default.
<b>Step 15</b>	<b>end</b> <b>Example:</b> Device (config) # <b>end</b>	Returns to privileged EXEC mode.

## Configuring the Delay Period Before FHRP Client Initialization

To configure the delay period before the initialization of all FHRP clients on an interface, perform the following task:

### Procedure

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

	Command or Action	Purpose
	Device> <b>enable</b>	
<b>Step 2</b>	<b>configure terminal</b> <b>Example:</b> Device# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 3</b>	<b>fhrp version vrrp v3</b> <b>Example:</b> Device(config)# <b>fhrp version vrrp v3</b>	Enables the ability to configure VRRPv3 and VRRS.
<b>Step 4</b>	<b>interface type number</b> <b>Example:</b> Device(config)# <b>interface GigabitEthernet 0/0/0</b>	Enters interface configuration mode.
<b>Step 5</b>	<b>fhrp delay {[minimum] [reload] seconds}</b> <b>Example:</b> Device(config-if)# <b>fhrp delay minimum 5</b>	Specifies the delay period for the initialization of FHRP clients after an interface comes up.  The range is 0-3600 seconds.
<b>Step 6</b>	<b>end</b> <b>Example:</b> Device(config)# <b>end</b>	Returns to privileged EXEC mode.

## Configuration Examples for VRRPv3 Protocol Support

The following sections provide configuration examples for VRRPv3 protocol support.

### Example: Enabling VRRPv3 on a Device

The following example shows how to enable VRRPv3 on a device:

```
Device> enable
Device# configure terminal
Device(config)# fhrp version vrrp v3
Device(config-if-vrrp)# end
```

### Example: Creating and Customizing a VRRP Group

The following example shows how to create and customize a VRRP group:

```
Device> enable
Device# configure terminal
```

**Example: Configuring the Delay Period Before FHRP Client Initialization**

```

Device(config)# fhrp version vrrp v3
Device(config)# interface GigabitEthernet 1/0/1
Device(config-if)# vrrp 3 address-family ipv4
Device(config-if-vrrp)# address 100.0.1.10 primary
Device(config-if-vrrp)# description group 3
Device(config-if-vrrp)# match-address
Device(config-if-vrrp)# preempt delay minimum 30
Device(config-if-vrrp)# end

```




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**Note** In the above example, the **fhrp version vrrp v3** command is used in the global configuration mode.

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**Example: Configuring the Delay Period Before FHRP Client Initialization**

The following example shows how to configure the delay period before FHRP client initialization :

```

Device> enable
Device# configure terminal
Device(config)# fhrp version vrrp v3
Device(config)# interface GigabitEthernet 1/0/1
Device(config-if)# fhrp delay minimum 5
Device(config-if-vrrp)# end

```




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**Note** In the above example, a five-second delay period is specified for the initialization of FHRP clients after the interface comes up. You can specify a delay period between 0 and 3600 seconds.

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**Example: VRRP Status, Configuration, and Statistics Details**

The following is a sample output of the status, configuration and statistics details for a VRRP group:

```

Device> enable
Device# show vrrp detail

GigabitEthernet1/0/1 - Group 3 - Address-Family IPv4
Description is "group 3"
State is MASTER
State duration 53.901 secs
Virtual IP address is 100.0.1.10
Virtual MAC address is 0000.5E00.0103
Advertisement interval is 1000 msec
Preemption enabled, delay min 30 secs (0 msec remaining)
Priority is 100
Master Router is 10.21.0.1 (local), priority is 100
Master Advertisement interval is 1000 msec (expires in 832 msec)
Master Down interval is unknown
VRRPv3 Advertisements: sent 61 (errors 0) - rcvd 0
VRRPv2 Advertisements: sent 0 (errors 0) - rcvd 0
Group Discarded Packets: 0
  VRRPv2 incompatibility: 0
  IP Address Owner conflicts: 0
  Invalid address count: 0
  IP address configuration mismatch : 0

```

```

Invalid Advert Interval: 0
Adverts received in Init state: 0
Invalid group other reason: 0
Group State transition:
  Init to master: 0
  Init to backup: 1 (Last change Sun Mar 13 19:52:56.874)
  Backup to master: 1 (Last change Sun Mar 13 19:53:00.484)
  Master to backup: 0
  Master to init: 0
  Backup to init: 0

Device# exit

```

## Additional References

### Related Documents

Related Topic	Document Title
FHRP commands	<a href="#">First Hop Redundancy Protocols Command Reference</a>
Configuring VRRPv2	<i>Configuring VRRP</i>
VRRPv3 Commands	For complete syntax and usage information for the commands used in this chapter.

### Standards and RFCs

Standard/RFC	Title
RFC5798	<i>Virtual Router Redundancy Protocol</i>

## Feature History for VRRPv3 Protocol Support

This table provides release and related information for the features explained in this module.

These features are available in all the releases subsequent to the one they were introduced in, unless noted otherwise.

Release	Feature	Feature Information
Cisco IOS XE Everest 16.5.1a	VRRPv3 Protocol Support	VRRP enables a group of devices to form a single virtual device to provide redundancy. The LAN clients can then be configured with the virtual device as their default gateway. The virtual device, representing a group of devices, is also known as a VRRP group. The VRRPv3 Protocol Support feature provides the capability to support IPv4 and IPv6 addresses.  Support for this feature was introduced only on the C9500-12Q, C9500-16X, C9500-24Q, C9500-40X models of the Cisco Catalyst 9500 Series Switches.
Cisco IOS XE Fuji 16.8.1a	VRRPv3 Protocol Support	Support for this feature was introduced only on the C9500-32C, C9500-32QC, C9500-48Y4C, and C9500-24Y4C models of the Cisco Catalyst 9500 Series Switches.

Use the Cisco Feature Navigator to find information about platform and software image support. To access Cisco Feature Navigator, go to <http://www.cisco.com/go/cfn>.

## Glossary

**Virtual IP address owner**—The VRRP device that owns the IP address of the virtual device. The owner is the device that has the virtual device address as its physical interface address.

**Virtual device**—One or more VRRP devices that form a group. The virtual device acts as the default gateway device for LAN clients. The virtual device is also known as a VRRP group.

**Virtual device backup**—One or more VRRP devices that are available to assume the role of forwarding packets if the primary virtual device fails.

**Primary Virtual device**—The VRRP device that is currently responsible for forwarding packets sent to the IP addresses of the virtual device. Usually, the primary virtual device also functions as the IP address owner.

**VRRP device**—A device that is running VRRP.