Implementing VRRP

The Virtual Router Redundancy Protocol (VRRP) feature allows for transparent failover at the first-hop IP router, enabling a group of routers to form a single virtual router.

Note For a complete description of the VRRP commands listed in this module, refer to the *Cisco ASR 9000 Series Aggregation Services Router IP Addresses and Services Command Reference* publication.

Feature History for Implementing VRRP

Release	Modification
Release 3.7.2	This feature was introduced.
Release 3.9.0	• BFD for VRRP feature was added. • MIB support for VRRP feature was added.
Release 4.1.0	VRRP over IPv6 feature was added.

Prerequisites for Implementing VRRP on Cisco IOS XR Software

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 VRRP on Cisco IOS XR Software

VRRP is supported on Ethernet interfaces, Ethernet sub-interfaces and Ethernet link bundles.

The following are restrictions for implementing VRRP:

- ICMP redirects are not supported.

- Upto 4000 sessions are permitted on Ethernet sub-interfaces.

- On bundle interfaces, the number of sessions per member vary depending on the number of bundle members and their location on network processor (NP) as listed here:

    - One member on one NP: 3999 VRRP sessions

    - Two members on same NP: 1999 VRRP sessions

    - Four members on same NP: 999 VRRP sessions

    - Two members, one on each NP: 3999 VRRP sessions

    - Four members, two on each NP: 1999 VRRP sessions

- Protocol Independent Multicast (PIM) is not supported with VRRP.

Information About Implementing VRRP

To implement VRRP , you need to understand the following concepts:

VRRP Overview

A LAN client can use a dynamic process or static configuration to determine which router should be the first hop to a particular remote destination. The client examples of dynamic router discovery are as follows:

- Proxy ARP—The client uses Address Resolution Protocol (ARP) to get the destination it wants to reach, and a router responds to the ARP request with its own MAC address.

- Routing protocol—The client listens to dynamic routing protocol updates (for example, from Routing Information Protocol [RIP]) and forms its own routing table.

- IRDP (ICMP Router Discovery Protocol) client—The client runs an Internet Control Message Protocol (ICMP) router discovery client.

The drawback to dynamic discovery protocols is that they incur some configuration and processing overhead on the LAN client. Also, in the event of a router failure, the process of switching to another router can be slow.

An alternative to dynamic discovery protocols is to statically configure a default router on the client. This approach simplifies client configuration and processing, but creates a single point of failure. If the default gateway fails, the LAN client is limited to communicating only on the local IP network segment and is cut off from the rest of the network.

The Virtual Router Redundancy Protocol (VRRP) feature can solve the static configuration problem. VRRP is an IP routing redundancy protocol designed to allow for transparent failover at the first-hop IP router. VRRP enables a group of routers to form a single *virtual router* . The LAN clients can then be configured with the virtual router as their default gateway. The virtual router, representing a group of routers, is also known as a *VRRP group*.

For example, Figure 1: Basic VRRP Topology, on page 3 shows a LAN topology in which VRRP is configured. In this example, Routers A, B, and C are *VRRP routers* (routers running VRRP) that compose a virtual router. The IP address of the virtual router is the same as that configured for the interface of Router A (10.0.0.1).

Figure 1: Basic VRRP Topology
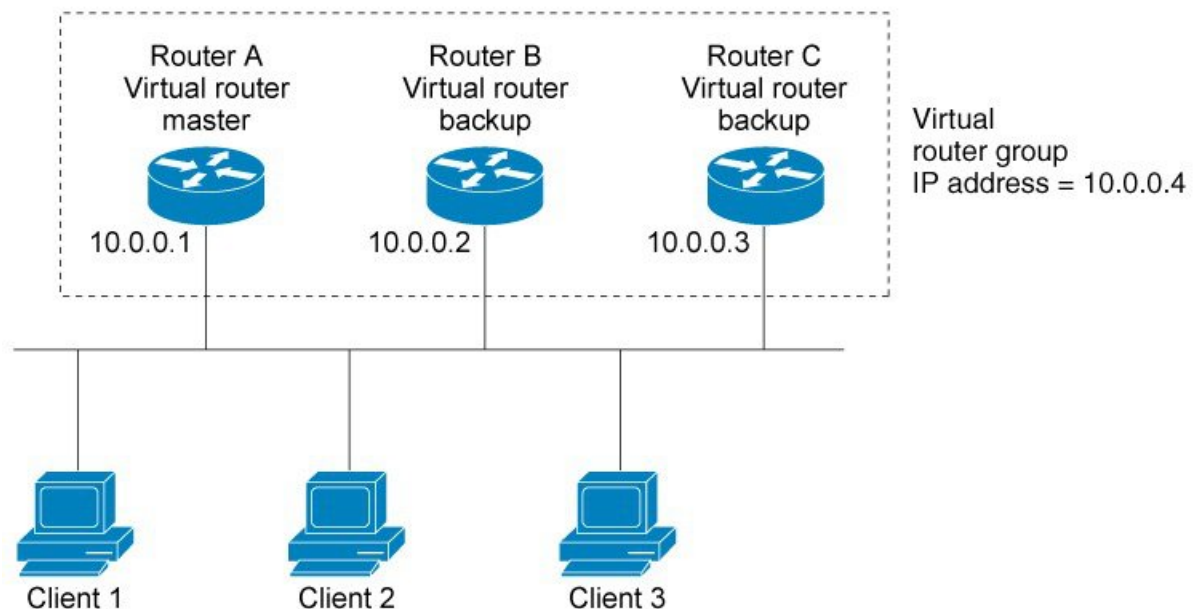
Because the virtual router uses the IP address of the physical interface of Router A, Router A assumes the role of the *IP address owner*. As the IP address owner router, Router A controls the IP address of the virtual router and is responsible for forwarding packets sent to this IP address. Clients 1 through 3 are configured with the default gateway IP address of 10.0.0.1.

Routers B and C function as *backup virtual routers*. If the IP address owner router fails, the router configured with the higher priority becomes the IP address owner virtual router and provides uninterrupted service for the LAN hosts. When Router A recovers, it becomes the IP address owner virtual router again.

✎

| Note | We recommend that you disable Spanning Tree Protocol (STP) on switch ports to which the virtual routers are connected. Enable RSTP or rapid-PVST on the switch interfaces if the switch supports these protocols. |

Multiple Virtual Router Support

You can configure up to 100 virtual routers on a router interface. The actual number of virtual routers that a router interface can support depends on the following factors:

- Router processing capability

- Router memory capability

- Router interface support of multiple MAC addresses

In a topology where multiple virtual routers are configured on a router interface, the interface can act as a IP address owner for one or more virtual routers and as a backup for one or more virtual routers.

VRRP Router Priority

An important aspect of the VRRP redundancy scheme is VRRP router priority. Priority determines the role that each VRRP router plays and what happens if the IP address owner virtual router fails.

If a VRRP router owns the IP address of the virtual router and the IP address of the physical interface, this router functions as a IP address owner virtual router.

If no VRRP router owns the IP address, the priority of a VRRP router, combined with the preempt settings, determines if a VRRP router functions as a IP address owner or a backup virtual router. By default, the highest priority VRRP router functions as IP address owner router, and all the others function as backups. Priority also determines the order of ascendancy to becoming a IP address owner virtual router if the IP address owner virtual router fails. You can configure the priority of each backup virtual router with a value of 1 through 254, using the **vrrp priority** command.

For example, if Router A, the IP address owner virtual router in a LAN topology, fails, an election process takes place to determine if backup virtual Routers B or C should take over. If Routers B and C are configured with the priorities of 101 and 100, respectively, Router B is elected to become IP address owner virtual router because it has the higher priority. If Routers B and C are both configured with the priority of 100, the backup virtual router with the higher IP address is elected to become the IP address owner virtual router.

By default, a preemptive scheme is enabled whereby a higher-priority backup virtual router that becomes available takes over from the current IP address owner virtual router. You can disable this preemptive scheme using the **vrrp preempt disable** command. If preemption is disabled, the backup virtual router that is elected to become IP address owner router upon the failure of the original higher priority IP address owner router, remains the IP address owner router even if the original IP address owner virtual router recovers and becomes available again.

VRRP Advertisements

The IP address owner virtual router sends VRRP advertisements to other VRRP routers in the same group. The advertisements communicate the priority and state of the IP address owner virtual router. The VRRP

advertisements are encapsulated in IP packets and sent to the IP Version 4 multicast address assigned to the VRRP group. The advertisements are sent every second by default; the interval is configurable.

Benefits of VRRP

The benefits of VRRP are as follows:

- Redundancy— VRRP enables you to configure multiple routers as the default gateway router, 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 routers, thereby sharing the traffic load more equitably among available routers.

- Multiple Virtual Routers—VRRP supports up to 100 virtual routers (VRRP groups) on a router interface, subject to the platform supporting multiple MAC addresses. Cisco ASR 9000 Series Routers support up to a limit of 100 per system with default timers. Multiple virtual router support enables you to implement redundancy and load sharing in your LAN topology.

- Multiple IP Addresses—The virtual router 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.

- Preemption—The redundancy scheme of VRRP enables you to preempt a backup virtual router that has taken over for a failing IP address owner virtual router with a higher-priority backup virtual router that has become available.

- Text Authentication—You can ensure that VRRP messages received from VRRP routers that comprise a virtual router are authenticated by configuring a simple text password.

- Advertisement Protocol—VRRP uses a dedicated Internet Assigned Numbers Authority (IANA) standard multicast address (224.0.0.18) for VRRP advertisements. This addressing scheme minimizes the number of routers that must service the multicasts and allows test equipment to accurately identify VRRP packets on a segment. The IANA assigns VRRP the IP protocol number 112.

Unicast VRRP

Table 1: Feature History Table

Feature Name	Release Name	Description
Unicast VRRP	Release 7.11.1	We have now enabled Layer 3 unicast transport mode in VRRP, allowing it to enhance its capacity to send data to other networks, including cloud networks. Pairwise router redundancy enables high availability in cloud network scenarios. However, a virtual IP (VIP) address is required by the default route of the cloud native function because there is no pre-designated active member in paired routers. HSRP can provide a VIP, but cloud networks do not support Layer 2 multicast or broadcast transports. You can configure VRRP to support Layer 3 unicast transport to overcome the limitation of Layer 2 multicast and broadcast transports.
		The feature introduces these changes:
		New Command:
		CLI:
		• **unicast-peer**
		Modified Commands:
		• **show vrrp** command is modified to support new fields: **Mcast packet in Ucast mode**, **IPv4 Unicast Peer**, and **IPv4 Unicast Peer**.
		YANG Data Model:
		New Xpaths for:
		• `Cisco-IOS-XR-ipv4-vrrp-cfg.yang`
		• `Cisco-IOS-XR-ipv4-vrrp-oper.yang`
		(see GitHub, YANG Data Models Navigator)

You can now configure VRRP to support Layer 3 unicast transport, allowing it to enhance its capacity to send data to cloud networks. Pairwise router redundancy enables high availability in cloud network scenarios. The default route of the cloud native function needs a virtual IP (VIP) address because the paired routers do not have a pre-designated active member. Though HSRP provides a VIP, the cloud networks do not support Layer 2 multicast or broadcast transports. To overcome the limitations of Layer 2 multicast and broadcast transports, configure VRRP in Layer 3 unicast mode to support Layer 3 unicast transport.

This feature also enables VRRP to communicate state transition notifications using event-driven telemetry.

Restrictions for Unicast VRRP

- When you configure the unicast-peer command, the router neither sends nor receives multicast packets.

- You can configure the unicast-peer command only once, allowing for the participation of only two physical routers in a unicast VRRP session.

Configure Unicast VRRP

Configuration Example

The following example shows how to enable unicast transport through VRRP.

```
Router(config)# router vrrp
Router(config-vrrp)# interface GigabitEthernet0/0/0/0
Router(config-vrrp-if)# address-family ipv4
Router(config-vrrp-address-family)# vrrp 1
/* Configure the virtual IP address on the interface. */
Router(config-vrrp-virtual-router)# address 10.0.1.100
/* Configure the unicast-peer command to enable IPv4 unicast transport. */
Router(config-vrrp-virtual-router)# unicast-peer 10.0.1.1
Router(config-vrrp-virtual-router)# exit
Router(config-vrrp-address-family)# exit
Router(config-vrrp-if)# address-family ipv6
Router(config-vrrp-address-family)# vrrp 2
/* Configure the unicast-peer command to enable IPv6 unicast transport.  */
Router(config-vrrp-virtual-router)# unicast-peer FE80::260:3EFF:FE11:6770
Router(config-vrrp-virtual-router)# exit
Router(config-vrrp-address-family)# exit
```

Running Configuration

```
router vrrp
 interface GigabitEthernet0/0/0/0
  address-family ipv4
   vrrp 1
    address 10.0.0.100
    unicast-peer 10.0.1.1
   !
  !
  address-family ipv6
   vrrp 2
    unicast-peer  FE80::260:3EFF:FE11:6770
   !
  !
 !
!
```

Verification

Use the following command to verify if the unicast transport enabled in VRRP. The output shows that both IPv4 and IPv6 unicast peers have been configured, and the respective IP addresses are displayed.

```
Router# show vrrp detail
Fri Sep  8 15:02:35.268 IST
GigabitEthernet0/0/0/0 - IPv4 vrID 1
  State is Master
    2 state changes, last state change 04:00:02
    State change history:
    Sep  8 11:02:29.518 IST  Init    -> Backup   Virtual IP configured
    Sep  8 11:02:33.127 IST  Backup  -> Master   Master down timer expired
  Last resign sent:    Never
  Last resign received: Never
  Virtual IP address is 10.0.0.100
  Virtual MAC address is 0000.5E00.0101, state is active
  Master router is local
  Version is 2
  Advertise time 1 secs
    Master Down Timer 3.609 (3 x 1 + (156 x 1/256))
  Minimum delay 1 sec, reload delay 5 sec
  Current priority 100
    Configured priority 100, may preempt
      minimum delay 0 secs
  IPv4 Unicast Peer: 10.0.1.1 --> IPv4 unicast transport is enabled on VRRP.

GigabitEthernet0/0/0/0 - IPv6 vrID 2
  State is Init
    0 state changes, last state change never
    State change history:
  Last resign sent:    Never
  Last resign received: Never
  Virtual IP address is ::
  Virtual MAC address is 0000.5E00.0202, state is stored
  Master router is unknown
  Version is 3
  Advertise time 1 secs
    Master Down Timer 3.609 (3 x 1 + (156 x 1/256))
  Minimum delay 1 sec, reload delay 5 sec
  Current priority 100
    Configured priority 100, may preempt
      minimum delay 0 secs
  IPv6 Unicast Peer: FE80::260:3EFF:FE11:6770 --> IPv6 unicast transport is enabled on VRRP.
```

Use the following command to verify detailed statistics about the Virtual Router VRRP configuration. Note that the number of multicast packets received in the VRRP instance when it's configured to function in unicast mode is zero.

```
Router# show vrrp statistics
Fri Sep  8 15:03:03.521 IST
Invalid packets:
  Invalid checksum:                  0
  Unknown/unsupported versions:      0
  Invalid vrID:                      0
  Too short:                         0
Protocol:
  Transitions to Master              1
Packets:
  Total received:                    0
  Adverts sent:                  14476
  Bad TTL:                           0
```

```
 Short Packets:                          0
 Failed authentication:                  0
 Unknown authentication:                 0
 Conflicting authentication:             0
 Unknown Type field:                     0
 Conflicting Advertise time:             0
 Conflicting Addresses:                  0
 Received with zero priority:            0
 Sent with zero priority:               0
 Mcast packet in Ucast mode:             0 --> Multicast packet being received in unicast
mode.
```

Configuring VRRP

This section contains instructions for configuring VRRP for IPv4 and IPv6 networks.

Note   The VRRP virtual router id (vrid) has to be different for different sub-interfaces, for a given physical interface.

Configuring VRRP for IPv4 Networks

This section describes the procedure for configuring and verifying VRRP for IPv4 networks.

Configuration

Use the following configuration for configuring VRRP for IPv4 networks.

Note   Certain customizations (as mentioned) are recommended to control the behavior of the VRRP group on committing the VRRP configuration on the Router. If the following customizations are not configured, then the Router seizes control of the VRRP group, and immediately assumes the role of the IP address owner virtual Router.

```
/* Enter the interface configuration mode and configure an IPv4 address for the interface.
 */
Router(config)# interface gigabitEthernet 0/0/0/1
Router(config-if)# ipv4 address 10.10.10.1 255.255.255.0
Router(config-if)# no shut
Router(config-if)# commit
Fri Dec  8 13:49:24.142 IST
Router:Dec  8 13:49:24.285 : ifmgr[402]: %PKT_INFRA-LINK-3-UPDOWN : Interface
GigabitEthernet0/0/0/1, changed state to Down
Router:Dec  8 13:49:24.711 : ifmgr[402]: %PKT_INFRA-LINK-3-UPDOWN : Interface
GigabitEthernet0/0/0/1, changed state to Up

Router(config-if)# exit
Router(config)# do show ip int brief
Fri Dec  8 13:50:05.505 IST

Interface                      IP-Address      Status          Protocol      Vrf-Name
GigabitEthernet0/0/0/0          unassigned      Shutdown        Down          default

GigabitEthernet0/0/0/1          10.10.10.1      Up              Up            default
```

GigabitEthernet0/0/0/2	unassigned	Shutdown	Down	default
GigabitEthernet0/0/0/3	unassigned	Shutdown	Down	default
GigabitEthernet0/0/0/4	unassigned	Shutdown	Down	default

```
/* Enter the VRRP configuration mode and add the configured interface. */
Router(config)# router vrrp
Router(config-vrrp)# interface GigabitEthernet 0/0/0/1

/* CUSTOMIZATION: Configure a delay for the startup of the state machine when the interface
 comes up. */
Router(config-vrrp)# delay minimum 2 reload 10 */

/* Configure VRRP version 3 for IPv4 */
Router(config-vrrp-if)# address-family ipv4 vrrp 100 version 3
Router(config-vrrp-virtual-router)# address 10.10.10.1

/* CUSTOMIZATION: Disable the installation of routes for the VRRP virtual addresses. */
Router(config-vrrp-virtual-Router)# accept-mode disable

/* CUSTOMIZATION: Set a priority for the virtual Router. */
Router(config-vrrp-virtual-Router)# priority 254

/* CUSTOMIZATION: Configure a preempt delay value that controls the selection of the IP
address owner virtual Router. */
Router(config-vrrp-virtual-Router)# preempt delay 15

/* CUSTOMIZATION: Configure the interval between successive advertisements by the IP address
 owner virtual Router. */
Router(config-vrrp-virtual-Router)#timer 4

/* CUSTOMIZATION: Configure VRRP to track an interface. */
Router(config-vrrp-virtual-Router)# track interface GigabitEthernet0/0/0/1 30

 /* Commit the configuration */
Router(config-vrrp-virtual-Router)# commit
```

You have successfully configured VRRP for IPv4 networks.

Validation

Use the following commands to validate the configuration.

```
/* Validate the configuration */
Router(config-vrrp-virtual-router)# do show run interface GigabitEthernet 0/0/0/1
Fri Dec  8 15:04:38.140 IST
interface GigabitEthernet0/0/0/1
 ipv4 address 10.10.10.1 255.255.255.0
!
```

```
Router(config)# show running-config router vrrp
Fri Dec  8 13:50:18.959 IST
router vrrp
 interface GigabitEthernet0/0/0/1
   delay minimum 2 reload 10
  address-family ipv4
   vrrp 100 version 3
    priority 254
```

```
    preempt delay 15
    timer 4
    track interface GigabitEthernet0/0/0/2 30
    address 10.10.10.1
    accept-mode disable
   !
  !
 !
_____
Router(config-vrrp-virtual-router)# do show vrrp ipv4 interface gigabitEthernet 0/0/0/1
Fri Dec  8 15:02:56.952 IST
IPv4 Virtual Routers:
                    A indicates IP address owner
                    | P indicates configured to preempt
                    | |
Interface   vrID Prio A P State    Master addr    VRouter addr
Gi0/0/0/1    100  255 A P Master   local          10.10.10.1

_____
Router(config-vrrp-virtual-router)# end
Router# show vrrp detail
Fri Dec  8 15:08:36.469 IST
GigabitEthernet0/0/0/1 - IPv4 vrID 100
  State is Master, IP address owner
    1 state changes, last state change 01:19:06
    State change history:
    Dec  8 13:49:30.147 IST  Init    -> Master   Delay timer expired
  Last resign sent:     Never
  Last resign received: Never
  Virtual IP address is 10.10.10.1
  Virtual MAC address is 0000.5E00.0164, state is active
  Master router is local
  Version is 3
  Advertise time 1 secs
    Master Down Timer 3.003 (3 x 1 + (1 x 1/256))
  Minimum delay 1 sec, reload delay 5 sec
  Current priority 255
    Configured priority 100, may preempt
      minimum delay 0 secs
```

You have successfully validated VRRP for IPv4 networks.

Configuring VRRP for IPv6 Networks

This section describes the procedure for configuring and verifying VRRP for IPv6 networks.

Configuration

The following sample includes the configuration and customization of VRRP for IPv6 networks.

Note Certain customizations (as mentioned) are recommended to control the behavior of the VRRP group on committing the VRRP configuration on the Router. If the following customizations are not configured, then the Router seizes control of the VRRP group, and immediately assumes the role of the IP address owner virtual Router.

```
/* Enter the interface configuration mode and configure an IPv6 address */
```

```
Router# interface GigabitEthernet 0/0/0/2
Router(config-if)# ipv6 address 10::1/64
Router(config-if)# no shut

/* Exit the interface configuration mode and enter the vrrp configuration mode */
Router(config-if)# exit
Router(config)# Router vrrp

/* Add the configured interface for VRRP */
Router(config-vrrp)# interface GigabitEthernet 0/0/0/2

/* CUSTOMIZATION: Configure a delay for the startup of the state machine when the interface
 comes up. */
Router(config-vrrp)# delay minimum 2 reload 10 */

/* Enable the IPv6 global and link local address family on the interface  */
Router(config-vrrp-if)# address-family ipv6 vrrp 50
Router(config-vrrp-virtual-Router)# address linklocal autoconfig

/* CUSTOMIZATION: Disable the installation of routes for the VRRP virtual addresses. */
Router(config-vrrp-virtual-Router)# accept-mode disable

/* CUSTOMIZATION: Set a priority for the virtual Router. */
Router(config-vrrp-virtual-Router)# priority 254

/* CUSTOMIZATION: Configure a preempt delay value that controls the selection of the IP
address owner virtual Router. */
Router(config-vrrp-virtual-Router)# preempt delay 15

/* CUSTOMIZATION: Configure the interval between successive advertisements by the IP address
 owner virtual Router. */
Router(config-vrrp-virtual-Router)#timer 4

/* CUSTOMIZATION: Configure VRRP to track an interface. */
Router(config-vrrp-virtual-Router)# track interface GigabitEthernet0/0/0/2 30

/* Commit the configuration */
Router(config-vrrp-virtual-Router)# commit
```

You have successfully configured VRRP for IPv6 networks.

Validation

Use the following commands to validate the configuration.

```
/* Validate the configuration */
Router(config-vrrp-virtual-router)# do show run interface GigabitEthernet 0/0/0/2
Fri Dec  8 14:55:48.378 IST
interface GigabitEthernet0/0/0/2
 ipv6 address 10::1/64
!
-------------------------------------------------------------------------------------------------
Router(config-vrrp-virtual-router)# do show running-config router vrrp
...
router vrrp
 interface GigabitEthernet0/0/0/2
  delay minimum 2 reload 10
  address-family ipv6
   vrrp 50
    priority 254
    preempt delay 15
    timer 4
```

```
     track interface GigabitEthernet0/0/0/2 30
     address linklocal autoconfig
     accept-mode disable
    !
   !
  !
!
```
_____

```
Router(config-vrrp-virtual-router)# do show vrrp ipv6 interface gigabitEthernet 0/0/0/2
Fri Dec  8 14:59:25.547 IST
IPv6 Virtual Routers:
                    A indicates IP address owner
                    | P indicates configured to preempt
                    | |
Interface    vrID Prio A P State    Master addr     VRouter addr
Gi0/0/0/2      50  254   P Master   local
                                              fe80::200:5eff:fe00:203
```

_____

```
Router(config-vrrp-virtual-router)# end
Router# show vrrp detail
Fri Dec  8 15:08:36.469 IST
GigabitEthernet0/0/0/2 - IPv6 vrID 50
  State is Master
    2 state changes, last state change 00:18:01
    State change history:
    Dec  8 14:50:23.326 IST  Init     -> Backup   Virtual IP configured
    Dec  8 14:50:35.365 IST  Backup   -> Master   Master down timer expired
  Last resign sent:     Never
  Last resign received: Never
  Virtual IP address is fe80::200:5eff:fe00:203
  Virtual MAC address is 0000.5E00.0203, state is active
  Master router is local

  Advertise time 4 secs
    Master Down Timer 12.031 (3 x 4 + (2 x 4/256))
  Minimum delay 2 sec, reload delay 10 sec
  Current priority 254
    Configured priority 254, may preempt
      minimum delay 15 secs
    Tracked items: 1/1 up: 0 decrement
      Object name               State     Decrement
      GigabitEthernet0/0/0/2     Up          30
```

You have successfully validated VRRP for IPv6 networks.

Clearing VRRP Statistics

Use the **clear vrrp statistics** command to clear all the software counters for the specified virtual router.

SUMMARY STEPS

1. **clear vrrp statistics** [**ipv4** | **ipv6**] [**interface***type interface-path-id* [*vrid*]]

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**clear vrrp statistics** [**ipv4** | **ipv6**] [**interface***type interface-path-id* [*vrid*]] **Example:** `RP/0/RSP0/CPU0:router# clear vrrp statistics`	Clears all software counters for the specified virtual router. • If no interface is specified, statistics of all virtual routers are removed.

Disabling State Change Logging

Perform this task to disable the task of logging the VRRP state change events via syslog.

SUMMARY STEPS

1. **configure**
2. **router vrrp**
3. **message state disable**
4. **commit**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure**	
Step 2	**router vrrp** **Example:** `RP/0/RSP0/CPU0:router(config)# router vrrp`	Enables the VRRP configuration mode.

Step 3	**message state disable**
	
	Example:
	
	`RP/0/RSP0/CPU0:router(config-vrrp)# message state disable`
	`RP/0/RSP0/CPU0:router(config-vrrp)#`
		Disables the task of logging the VRRP state change events via syslog.

Step 4	**commit**	

Multiple Group Optimization for Virtual Router Redundancy Protocol

Multiple Group Optimization for Virtual Router Redundancy Protocol (VRRP) provides a solution for reducing control traffic in a deployment consisting of many subinterfaces. By running the VRRP control traffic for just one session, the control traffic is reduced for the subinterfaces with identical redundancy requirements. All other sessions are subordinates of this primary session, and inherit their states from it.

Configuring a VRRP Session Name

Perform this task to configure a VRRP session name.

SUMMARY STEPS

1. **configure**
2. **router vrrp**
3. **interface** *type interface-path-id*
4. **address-family ipv4**
5. **vrrp** *group-no*
6. **name** *name*
7. **commit**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**configure**	
Step 2	**router vrrp** **Example:** `RP/0/RSP0/CPU0:router(config)# router vrrp`	EnablesVRRP configuration mode.
Step 3	**interface** *type interface-path-id* **Example:** `RP/0/RSP0/CPU0:router(config-vrrp)# interface TenGigE 0/2/0/1`	Enables RP interface configuration mode on a specific interface.
Step 4	**address-family ipv4** **Example:** `RP/0/RSP0/CPU0:router(config-vrrp-if)# address-family ipv4`	Enables VRRP address-family configuration mode on a specific interface.
Step 5	**vrrp** *group-no* **Example:**	Enables VRRP group configuration mode on a specific interface.

	Command or Action	Purpose
	`RP/0/RSP0/CPU0:router(config-vrrp-address-family)# vrrp 1`	
Step 6	**name** *name* **Example:** `RP/0/RSP0/CPU0:router(config-vrrp-vritual-router)# name s1`	Configures a VRRP session name.
Step 7	**commit**	

Configuring the Subordinate Group to Inherit its State from a Specified Group (VRRP)

Perform this task to instruct the subordinate group to inherit its state from a specified group.

SUMMARY STEPS

1. **configure**
2. **router vrrp**
3. **interface** *type interface-path-id*
4. **address-family ipv4**
5. **vrrp** *group-no* **slave**
6. **follow** *mgo-session-name*
7. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure**	
Step 2	**router vrrp** **Example:** `Router(config)# router vrrp`	Enables VRRP configuration mode.
Step 3	**interface** *type interface-path-id* **Example:** `Router(config-vrrp)# interface TenGigE 0/2/0/1`	Enables VRRP interface configuration mode on a specific interface.
Step 4	**address-family ipv4** **Example:** `Router(config-vrrp-if)# address-family ipv4`	Enables VRRP address-family configuration mode on a specific interface.

	Command or Action	Purpose
Step 5	**vrrp** *group-no* **slave** **Example:** `Router(config-vrrp-address-family)# vrrp 2 slave`	Enables VRRP slave configuration mode on a specific interface.
Step 6	**follow** *mgo-session-name* **Example:** `Router(config-vrrp-slave)# follow m1`	Instructs the subordinate group to inherit its state from a specified group.
Step 7	**commit**	

Configuring a Primary Virtual IPv4 Address for a Subordinate Group(VRRP)

Perform this task to configure the primary virtual IPv4 address for the subordinate group.

SUMMARY STEPS

1. **configure**
2. **router vrrp**
3. **interface** *type interface-path-id*
4. **address-family ipv4**
5. **vrrp** *group-no* **slave**
6. **address** *ip-address*
7. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure**	
Step 2	**router vrrp** **Example:** `Router(config)# router vrrp`	Enables VRRP configuration mode.
Step 3	**interface** *type interface-path-id* **Example:** `Router(config-vrrp)# interface TenGigE 0/2/0/1`	Enables VRRP interface configuration mode on a specific interface.
Step 4	**address-family ipv4** **Example:** `Router(config-vrrp-if)# address-family ipv4`	Enables VRRP address-family configuration mode on a specific interface.

	Command or Action	Purpose
Step 5	**vrrp** *group-no* **slave** **Example:** `Router(config-vrrp-address-family)# vrrp 2 slave`	Enables VRRP slave configuration mode on a specific interface.
Step 6	**address** *ip-address* **Example:** `Router(config-vrrp-slave)# address 10.2.3.2`	Configures the primary virtual IPv4 address for the subordinate group.
Step 7	**commit**	

Configuring a Secondary Virtual IPv4 address for the Subordinate Group

Perform this task to configure the secondary virtual IPv4 address for the subordinate group.

SUMMARY STEPS

1. **configure**
2. **router vrrp**
3. **interface** *type interface-path-id*
4. **address-family ipv4**
5. **vrrp** *group-no* **slave**
6. **address** *address* **secondary**
7. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure**	
Step 2	**router vrrp** **Example:** `Router(config)# router vrrp`	Enables VRRP configuration mode.
Step 3	**interface** *type interface-path-id* **Example:** `Router(config-vrrp)# interface TenGigE 0/2/0/1`	Enables VRRP interface configuration mode on a specific interface.
Step 4	**address-family ipv4** **Example:** `Router(config-vrrp-if)# address-family ipv4`	Enables VRRP address-family configuration mode on a specific interface.

	Command or Action	Purpose
Step 5	**vrrp** *group-no* **slave** **Example:** `Router(config-vrrp-address-family)# vrrp 2 slave`	Enables VRRP slave configuration mode on a specific interface.
Step 6	**address** *address* **secondary** **Example:** `Router(config-vrrp-slave)# address 10.20.30.1 secondary`	Configures the secondary virtual IPv4 address for a router.
Step 7	**commit**	

MIB support for VRRP

VRRP enables one or more IP addresses to be assumed by a router when a failure occurs. For example, when IP traffic from a host reaches a failed router because the failed router is the default gateway, the traffic is transparently forwarded by the VRRP router that has assumed control. VRRP does not require configuration of dynamic routing or router discovery protocols on every end host. The VRRP router controlling the IP address(es) associated with a virtual router is called the IP address owner router, and forwards packets sent to these IP addresses. The election process provides dynamic fail over(standby) in the forwarding responsibility should the IP address owner router become unavailable. This allows any of the virtual router IP addresses on the LAN to be used as the default first hop router by end-hosts.The advantage gained from using VRRP is a higher availability default path without requiring configuration of dynamic routing or router discovery protocols on every end-host. SNMP traps provide information of the state changes, when the virtual routers(in standby) are moved to IP address owner router's state or if the standby router is made IP address owner router.

Configuring SNMP server notifications for VRRP events

The **snmp-server traps vrrp events** command enables the Simple Network Management Protocol (SNMP) server notifications (traps) for VRRP.

SUMMARY STEPS

1. **configure**
2. **snmp-server traps vrrp events**
3. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure**	
Step 2	**snmp-server traps vrrp events** **Example:**	Enables the SNMP server notifications for VRRP.

	Command or Action	Purpose
	`RP/0/RSP0/CPU0:router(config)snmp-server traps vrrp events`	
Step 3	**commit**	

VRRP Support on PWHE Interfaces

Pseudowire Headend (PWHE) is a technology that allows termination of access pseudowires (PWs) into a Layer 3 (VRF or global) domain or into a Layer 2 domain. This feature enables you to configure VRRP on PWHE interfaces to provide redundancy between two routers that are connected through PWHE interfaces .

For more information about PWHE interfaces, see the chapter *Implementing Multipoint Layer 2 Services* of the *L2VPN and Ethernet Services Configuration Guide for Cisco ASR 9000 Series Routers*.

Configuration Example

To configure VRRP on PWHE interfaces, use the following steps:

1. Enter the VRRP configuration mode.

2. Configure a PWHE interface.

3. Configure the VRRP address family for IPv4 and IPv6.

Configuration

```
/* Enter the VRRP configuration mode. */
Router# configure
Router(config)# router vrrp

/* Configure a PWHE interface. */
Router# (config-vrrp)# interface pw-Ether 1000

/* Configure the VRRP address family for IPv4 and IPv6. */
Router(config-vrrp-if)# address-family ipv4 vrrp
Router(config-vrrp-virtual-router)# address 172.16.0.0
Router(config-vrrp-virtual-router)# vrrp 1
Router(config-vrrp-virtual-router)# commit
Router(config-vrrp-address-family)# exit
Router(config-vrrp-if)# exit
Router(config-vrrp-if)# address-family ipv6 vrrp 1
Router(config-vrrp-virtual-router)# address global 2001:DB8::1
Router(config-vrrp-virtual-router)# address linklocal autoconfig
Router(config-vrrp-virtual-router)# commit
```

Running Configuration

```
router vrrp
 interface PW-Ether1000
  address-family ipv4
   vrrp 1
    address 172.16.0.0
    !
```

```
 !
address-family ipv6
 vrrp 1
  address global 2001:db8::1
  address linklocal autoconfig
 !
```

Verification

Use the following command to verify the configuration of VRRP on PWHE interfaces:

```
Router# show run interface pw-ether 1000
interface PW-Ether1000
ipv4 address 172.16.0.0 255.255.255.0
ipv6 address 2001:DB8::1/125
attach generic-interface-list pwhe_vrrp
!
```

Use the following command to verify the details of VRRP configuration on PWHE interfaces:

```
Router# show vrrp  interface pw-Ether 1000 detail
PW-Ether1000 - IPv4 vrID 1
  State is Backup
    1 state changes, last state change 2d08h
    State change history:
    Nov 24 11:47:16.585 IST  Init
  Last resign sent:     Never
  Last resign received: Never
  Virtual IP address is 172.16.0.0
  Virtual MAC address is 0000.5E00.0101, state is reserved
  Master router is 172.16.0.1, priority 100
  Version is 2
  Advertise time 1 secs
    Master Down Timer 3.609 (3 x 1 + (156 x 1/256))
  Minimum delay 1 sec, reload delay 5 sec
  Current priority 100
    Configured priority 100, may preempt
      minimum delay 0 secs

PW-Ether1000 - IPv6 vrID 1
  State is Backup
    1 state changes, last state change 2d08h
    State change history:
    Nov 24 11:47:19.600 IST  Init
  Last resign sent:     Never
  Last resign received: Never
  Virtual IP address is 2001:DB8::1/125
    Secondary Virtual IP address is 2001:DB8:FFFF:FFFF:FFFF:FFFE:FFFF:FFFF
  Virtual MAC address is 0000.5E00.0201, state is reserved
  Master router is 2001:DB8::2
  Version is 3
  Advertise time 1 secs
    Master Down Timer 3.609 (3 x 1 + (156 x 1/256))
  Minimum delay 1 sec, reload delay 5 sec
  Current priority 100
    Configured priority 100, may preempt
      minimum delay 0 secs
```

Use the following command to verify VRRP state and priority of the current router:

```
Router# show vrrp  interface pw-Ether 1000
IPv4 Virtual Routers:
                      A indicates IP address owner
                      | P indicates configured to preempt
                      | |
```

```
Interface   vrID Prio A P State    Master addr      VRouter addr
PE1000         1  100   P Backup   172.16.0.1       172.16.0.0
IPv6 Virtual Routers:
                     A indicates IP address owner
                     | P indicates configured to preempt
                     | |
Interface   vrID Prio A P State    Master addr              VRouter addr
PE1000         1  100   P Backup   2001:DB8::2    fe80::200:5eff:fe00:201
```

Hot Restartability for VRRP

In the event of failure of a VRRP process in one group, forced failovers in peer VRRP IP address owner router groups should be prevented. Hot restartability supports warm RP failover without incurring forced failovers to peer VRRP routers.

Configuration Examples for VRRP Implementation on Cisco IOS XR Software

This section provides the following VRRP configuration examples:

Configuring a VRRP Group: Example

This section provides the following configuration example of Router A and Router B, each belonging to three VRRP groups:

Router A:

```
config
interface tenGigE 0/4/0/4
ipv4 address 10.1.0.1/24
exit
router vrrp
interface tenGigE 0/4/0/4
address-family ipv4
vrrp 1 version 2
priority 120
text-authentication cisco
timer 3
address 10.1.0.10
vrrp 5 version 2
timer 30
address 10.1.0.50
vrrp 100 version 2
preempt disable
address 10.1.0.100
commit
```

Router B:

```
config
```

```
interface tenGigE 0/4/0/4
ipv4 address 10.1.0.2/24
exit
router vrrp
interface tenGigE 0/4/0/4
address-family ipv4
vrrp 1 version 2
priority 100
text-authentication cisco
timer 3
address 10.1.0.10
vrrp 5 version 2
priority 200
timer 30
address 10.1.0.50
vrrp 100 version 2
preempt disable
address 10.1.0.100
commit
```

In the configuration example, each group has the following properties:

- Group 1:

    - Virtual IP address is 10.1 .0.10 .

    - Router A will become the IP address owner router for this group with priority 120.

    - Advertising interval is 3 seconds.

    - Advertising interval is 3 seconds .

    - Preemption is enabled.

- Group 5:

    - Router B will become IP address owner router for this group with priority 200.

    - Advertising interval is 30 seconds .

    - Preemption is enabled .

- Group 100:

    - Router configured first becomes IP Address owner router for this group first, because preempt is disabled.

    - Advertising interval is the default 1 second.

    - Preemption is disabled .

    - Preemption is disabled.

Clearing VRRP Statistics: Example

The **clear vrrp statistics** command produces no output of its own. The command modifies the statistics given by **show vrrp statistics** command so that all the statistics are reset to zero.

The following section provides examples of the output of the **show vrrp statistics** command followed by the **clear vrrp statistics** command:

```
RP/0/RSP0/CPU0:router# show vrrp statistics
show vrrp statistics
Invalid packets:
 Invalid checksum:             0
 Unknown/unsupported versions: 0
 Invalid vrID:                 10
 Too short:                    0
Protocol:
 Transitions to Master         6
Packets:
 Total received:               155
 Bad TTL:                      0
 Failed authentication:        0
 Unknown authentication:       0
 Conflicting authentication:   0
 Unknown Type field:           0
 Conflicting Advertise time:   0
 Conflicting Addresses:        0
 Received with zero priority:  3
 Sent with zero priority:      3


RP/0/RSP0/CPU0:router# clear vrrp statistics
RP/0/RSP0/CPU0:router# show vrrp statistics
Invalid packets:
 Invalid checksum:             0
 Unknown/unsupported versions: 0
 Invalid vrID:                 0
 Too short:                    0
Protocol:
 Transitions to Master         0
Packets:
 Total received:               0
 Bad TTL:                      0
 Failed authentication:        0
 Unknown authentication:       0
 Conflicting authentication:   0
 Unknown Type field:           0
 Conflicting Advertise time:   0
 Conflicting Addresses:        0
 Received with zero priority:  0
 Sent with zero priority:      0
```

Additional References

The following sections provide references related to VRRP.

Related Documents

Related Topic	Document Title
QoS commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples	*Quality of Service Commands on Modular Quality of Service Command Reference for Cisco ASR 9000 Series Routers*
Class-based traffic shaping, traffic policing, low-latency queuing, and Modified Deficit Round Robin (MDRR)	*Configuring Modular Quality of Service Congestion Management on Modular QoS Configuration Guide for Cisco ASR 9000 Series Routers*
WRED, RED, and tail drop	*Configuring Modular QoS Congestion Avoidance on Modular QoS Configuration Guide for Cisco ASR 9000 Series Routers*
VRRP commands	*VRRP Commands on IP Addresses and Services Command Reference for Cisco ASR 9000 Series Routers*
getting started material	*Cisco ASR 9000 Series Aggregation Services Router Getting Started Guide*
Information about user groups and task IDs	*Configuring AAA Services on System Security Configuration Guide for Cisco ASR 9000 Series Routers*

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, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: https://mibs.cloudapps.cisco.com/ITDIT/MIBS/servlet/index

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 even more content.	http://www.cisco.com/techsupport