Virtual Router Redundancy Protocol (VRRP)

Contents

Overview

In many networks, edge devices are often configured to send packets to a statically configured default router. If this router becomes unavailable, the devices that use it as their first-hop router become isolated from the network. VRRP uses dynamic failover to ensure the availability of an end node's default router. This is done by assigning the IP address used as the default route to a "virtual router", or VR. The VR includes:

■ an Owner router assigned to forward traffic designated for the virtual router (If the Owner is forwarding traffic for the VR, it is the *Master* router for that VR.)

■ one or more prioritized Backup routers (If a Backup is forwarding traffic for the VR, it has replaced the Owner as the Master router for that VR.)

License Requirements   In the 3500yl and 5400zl switches, VRRP is included with the Premium License. In the 6200yl and 8200zl switches, this feature is included with the base feature set.

This redundancy provides a backup for gateway IP addresses (first- hop routers) so that if a VR's Master router becomes unavailable, the traffic it supports will be transferred to a Backup router without major delays or operator intervention. This operation can eliminate single-point-of-failure problems and provide dynamic failover (and failback) support. As long as one physical router in a VR configuration is available, the IP addresses assigned to the VR are always available, and the edge devices can send packets to these IP addresses without interruption.

Advantages to using VRRP include:

■ minimizing failover time and bandwidth overhead if a primary router becomes unavailable

■ minimizing service disruptions during a failover

■ providing backup for a load-balanced routing solution

■ addressing failover problems at the router level instead of on the network edge

■ avoiding the need to make configuration changes in the end nodes if a gateway router fails

■ eliminating the need for router discovery protocols to support failover operation.

Terminology

Backup: A router configured in a VR as a Backup to the Owner configured for the same VR. There must be a minimum of one Backup in a VR to support VRRP operation if the Owner fails. Every backup is created with a configurable priority (default: 100) that determines the precedence for becoming the Master of the VR if the Owner or another Backup operating as the Master becomes unavailable.

Master: The Owner or Backup router that is currently the physical forwarding agent for routed traffic using the VR as a gateway. There can be only one router operating as the Master for a network or (in the case of a multinetted VLAN) a subnet. If the router configured as the Owner for a VR is available to the network, it will also be the Master. If the Owner fails or loses availability to the network, the highest-priority Backup becomes the Master.

Owner: The router configured in a VR to "own" the "virtual" IP address associated with the VR.(The virtual IP address for the VR must be configured as a real IP address on the VLAN on which the VR is configured. The Owner is automatically configured with the highest VRRP router priority in the VR (255) and operates as the Master router for the VR unless it becomes unavailable to the network.

VR (Virtual Router): Consists of one Owner router and one or more Backup routers, all of which belong to the same network or (in the case of a multinetted VLAN, the same subnet). The Owner is the router that owns the IP address(es) associated with the VR. The VR has one virtual IP address (or, in the case of a multinetted VLAN, multiple, virtual IP addresses) that corresponds to a real IP address on the Owner, and is assigned an identification number termed the VRID.

VRID: The identifier for a specific VR configured on a specific VLAN interface. On a given router, a VRID can be used for only one VR in a given VLAN, but can be used again for a different VR in a different VLAN.

General Operation

VRRP supports router redundancy through a prioritized election process among routers configured as members of the same virtual router (VR).

On a given VLAN, a VR includes two or more member routers configured with a virtual IP address that is also configured as a real IP address on one of the routers, plus a virtual router MAC address. The router that owns the IP address is configured to operate as the Owner of the VR for traffic-forwarding purposes, and by default has the highest VRRP priority in the VR. The other router(s) in the VR have a lower priority and are configured to operate as Backups in case the Owner router becomes unavailable.

The Owner normally operates as the Master for a VR. But if it becomes unavailable, then a failover to a Backup router belonging to the same VR occurs, and this Backup becomes the current Master. If the Owner recovers, a failback occurs, and "Master" status reverts to the Owner. (Note that using more than one Backup provides additional redundancy, meaning that if both the Owner and the highest-priority Backup fail, then another, lower-priority Backup can take over as Master.)

N o t e   ■   The virtual IP address used by all VRRP routers in a VR instance is a real IP address that is also configured on the applicable VLAN interface on the VR's Owner router.

■   The same MAC and virtual IP addresses are included in the VRRP configuration for the Owner and all Backup routers belonging to the same VR, and are used as the source addresses for all traffic forwarded by the VR.

Figure 6-1, below, illustrates a virtual router on VLAN 100 supported by Router 1 (R1) and Router 2 (R2).
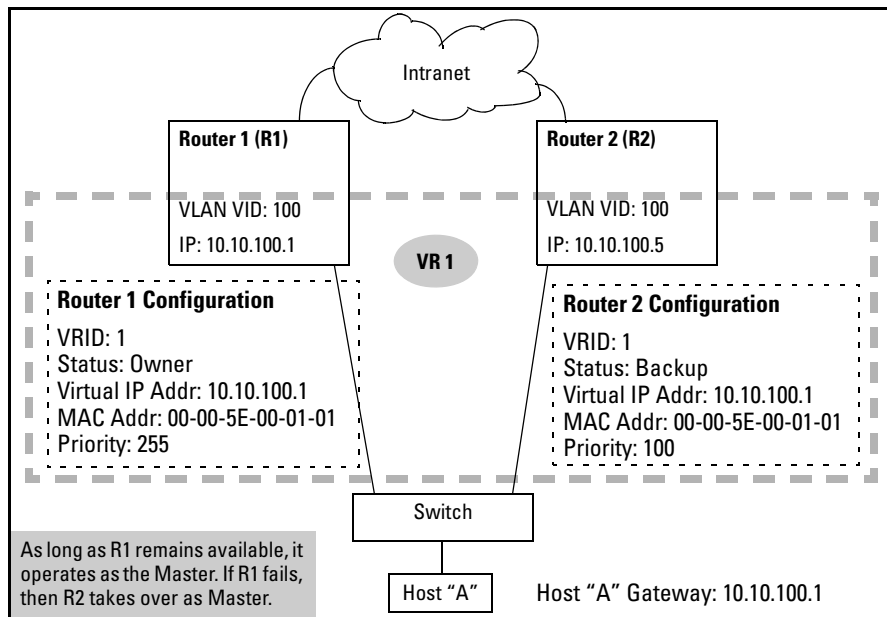
Figure 6-1. Example of Using VRRP To Provide Redundant Network Access

VR Parameter	Router 1 VR Configuration	Router 2 VR Configuration	Operation
VRID (Virtual Router ID)	1	1	All routers in the same VR have the same VRID.
Status	Owner	Backup	One Owner and one or more Backups are allowed in a given VR.
Virtual IP Address	10.10.100.1	10.10.100.1	The IP address configured for VLAN 100 in R1 (the Owner) is also configured as the Virtual IP Address for VRRP in both R1 and R2.
VR Source MAC Address	00-00-5E-00-01-01		For any VR in any VLAN, this is always defined as 00-00-5E-00-01-< *VRID* >, and is not configurable.
Priority	255 (Default)	100 (Default)	The router configured as Owner in any VR is automatically assigned the highest priority (255). Backup routers are assigned a default priority of 100, which can be reconfigured.

In figure 6-1:

1. Host "A" uses 10.10.100.1 as its next-hop gateway out of the subnet, as represented by the virtual router (VR 1).

   • Router 1 (the configured Owner) advertises itself as the Master in the VR supporting the gateway and:
     – "owns" the VR's (virtual) IP address
     – transmits ARP responses that associate the VR's virtual IP address with the (shared) source MAC address for VR 1.

   • During normal operation, Router 1 forwards the routed traffic for host "A".

2. If Router 1 fails or otherwise becomes unavailable:

   a. Router 1 advertisements of its Master status for VR 1 fail to reach Router 2 (which is the only configured backup).

   b. After the time-out period for receiving Master advertisements expires on Router 2, the VR initiates a failover to Router 2 and it becomes the new Master of the VR.

   c. Router 2 advertises itself as the Master of the VR supporting the gateway and:
     – takes control of the VR's (virtual) IP address
     – begins transmitting ARP responses that associate the VR's virtual IP address with the (shared) source MAC address for VR 1

   d. Host "A" routed traffic then moves through Router 2.

3. If Router 1 again becomes available:

   a. Router 1 resumes advertising itself as the Master for the VR and sends ARP responses that associate the VR's virtual IP address with the (shared) source MAC address for VR 1.

   b. Router 2 receives the advertisement from Router 1 and ceases to operate as the VR's Master, and halts further transmission of its own VRRP advertisements and ARP responses related to VR 1.

   c. The VR executes a failback to Router 1 as Master, and Host "A" traffic again moves through Router 1.

Virtual Router (VR)

A Virtual Router (VR) instance consists of one Owner router and one or more Backup routers belonging to the same network. Any VR instance exists within a specific VLAN, and all members of a given VR must belong to the same subnet. In a multinetted VLAN, multiple VRs can be configured. The Owner operates as the VR's Master unless it becomes unavailable, in which case the highest-priority backup becomes the VR's Master.

A VR includes the following:

■ a virtual router identification (*VRID*) configured on all VRRP routers in the same network or, in the case of a multinetted VLAN, on all routers in the same subnet

■ the same virtual IP address configured on each instance of the same VR

■ a status of either Owner or Backup configured on each instance of the same VR (On a given VR there can be one Owner and One or more Backups.)

■ a priority level configured on each instance of the VR (On the Owner router the highest priority setting, 255, is automatically fixed. On Backups, the default priority setting is 100 and is configurable.)

■ a VR MAC address (not configurable)

Where a VLAN is configured with only one network (IP address), one VR is allowed in that VLAN. In a multinetted VLAN, there can be one VR per subnet, with a maximum of 32 VRs in any combination of Masters and Backups.

Note　　All routers in a given VR must belong to the same network (or subnet, in the case of a multinetted VLAN).

Virtual IP Address

The virtual IP address associated with a VR must be a real IP address already configured in the associated VLAN interface on the Owner router in the VR. Also, the Owner and all other (Backup) routers belonging to the VR have this IP address configured in their VRID contexts as the *virtual IP address*. In figure 6-1 on page 6-6, 10.10.100.1 is a real IP address configured on VLAN 100 in Router 1, and is the virtual IP address associated with VR 1.

Note that if the configured Owner in a VR becomes unavailable, then it is no longer the Master for the VR and a Backup router in the VR is elected to assume the role of Master, as described under "Backup Router" on page 6-10.

A subnetted VLAN allows multiple, virtual IP addresses. However, if there are 32 or fewer IP addresses in a VLAN interface and you want VRRP support on multiple subnets, then the recommended approach is to configure a separate VR instance for each IP address in the VLAN. In cases where VRRP support is needed for more than 32 IP addresses in the same VLAN, refer to "Associating More Than One Virtual IP Address With a VR" on page 6-17.

Master Router

The current Master router in a VR operates as the "real", or physical gateway router for the network or subnet for which a virtual IP address is configured .

Control of Master Selection. Selection of the Master is controlled by the VRRP priority value configured in the VRID context of each router in the VR. The router configured as the Owner in the VR is automatically assigned the highest VRRP priority (255) and, as long as it remains available, operates as the Master router for the VR. (The other routers belonging to the VR as Backups are assigned the default priority value (100) and can be reconfigured to any priority value between 1 and 254, inclusive.) If the current Master becomes unavailable, the protocol uses the priority values configured on the other, available routers in the VR to select another router in the VR to take over the Master function.

Function of the VRRP Advertisement. The current Master router sends periodic advertisements to inform the other router(s) in the VR of its operational status. If the backup VR(s) fail to receive a Master advertisement within the timeout interval, the current Master is assumed to be unavailable and a new Master is elected from the existing Backups. The timeout interval for a VR is three times the advertisement interval configured on the VR(s) in the network or subnet. In the default VRRP configuration, the advertisement interval is one second and the resulting timeout interval is three seconds.

Note   All VRRP routers belonging to the same VR must be configured with the same advertisement interval. As required in RFC 3768, if a locally configured advertisement interval does not match the interval received in an inbound VRRP packet, then the VR drops that packet.

Owner Router

An Owner router for a VR is the default Master router for the VR, and operates as the Owner for all subnets included in the VR. As mentioned earlier, the VRRP priority on an Owner router is always 255 (the highest).

Note   On a multinetted VLAN where multiple subnets are configured in the same VR, the router must be either the Owner for all subnets in the VR or a Backup for all subnets in the VR.

Backup Router

There must be at least one Backup router. A given VR instance on a Backup router must be configured with the same *virtual IP address* as the Owner for that VR (and both routers must belong to the same network or subnet). Router 2 in figure 6-1 on page 6-6 illustrates this point.

VR Priority Operation.   In a Backup router's VR configuration, the virtual router priority defaults to 100. (The priority for the configured Owner is automatically set to the highest value; 255.) In a VR where there are two or more Backup routers, the priority settings can be reconfigured to define the order in which Backups will be reassigned as Master in the event of a failover from the Owner.

Preempt Mode.   Where multiple Backup routers exist in a VR, if the current Master fails and the highest-priority Backup is not available, then VRRP selects the next-highest priority Backup to operate as Master. If the highest-priority Backup later becomes available, it pre-empts the lower-priority Backup and takes over the Master function. If you don't want a Backup router to have this preemptive ability on a particular VR, you can disable this operation with the **no preempt-mode** command. (Note that Preempt Mode applies only to VRRP routers configured as Backups.) Refer to "Preempt Mode on VRRP Backup Routers" on page 6-24.

Virtual Router MAC Address

When a VR instance is configured, the protocol automatically assigns a MAC address based on the standard MAC prefix for VRRP packets, plus the VRID number (as described in RFC 3768). The first five octets form the standard MAC prefix for VRRP, and the last octet is the configured VRID. That is:

00-00-5E-00-01-< *VRid* >

For example, the virtual router MAC address for the VR in figure 6-1 on page 6-6 is 00-00-5E-00-01-01.

VRRP and ARP

The Master for a given VR responds to ARP requests for the virtual IP addresses with the VR's assigned MAC address. The virtual MAC address is also used as the source MAC address for the periodic advertisements sent by the current Master.

The VRRP router responds to ARP requests for non-virtual IP addresses (IP addresses on a VLAN interface that are not configured as virtual IP addresses for any VR on that VLAN) with the system MAC address.

General Operating Rules

■   IP routing must be enabled on the router before enabling VRRP.

■   IP must be enabled on a VLAN before creating a VR instance on the VLAN.

■   virtual IP address:
  •   On an Owner: The virtual IP address configured in a VR instance must match one of the IP addresses configured in the VLAN interface on which the VR is configured.
  •   On a Backup: The virtual IP address configured in a VR instance cannot be a "real" IP address configured in a VLAN interface on that router.

Note   The virtual IP address configured for one VR cannot be configured on another VR.

■   Before changing a router from Owner to Backup, or the reverse, the virtual IP address must be removed from the configuration.

■   The priority configuration on an Owner can only be 255. The priority configuration on a Backup must be 254 or lower; the default being 100.

■   advertisement intervals:
  •   A VRRP router must be configured as an Owner or Backup before configuring the advertisement interval.
  •   If a VRRP router has a different advertisement interval than a VRRP packet it receives, the router drops the packet. For this reason, the advertisement interval must be the same for the Owner and all Backups in the same VR.

■ When a VR is active you cannot change any of the following on that VR:

- priority
- advertisement interval
- preempt mode
- virtual IP address

■A VR exists within a single VLAN interface. If the VLAN is multinetted, then a separate VR can be configured within the VLAN for each subnet. A VLAN allows up to 32 VRs and the switch allows up to 2048 VRs.

■ All routers in the same VR must belong to the same network or subnet.

■ The router supports the following maximums:

- 32 VRs per VLAN in any combination of Masters and Backups
- 2048 VRs per router
- 32 IP addresses per VR

■ Each VR uses one MAC address as described under "Virtual Router MAC Address" on page 6-10.

■ If an IP address is deleted on a VLAN interface, one of the following occurs:

- VR Owner: If the VR uses the same IP address as a virtual IP address, then that IP address is deleted from the VR.
- VR Backup: If the VR has a virtual IP address in the same subnet as that of the deleted IP address, then that virtual IP address will be deleted from the VR.

If the deleted virtual IP address was the last virtual IP address of an active VR, then the VR will be deactivated. (For more on multiple, virtual IP addresses on a VR, refer to "Associating More Than One Virtual IP Address With a VR" on page 6-17.

Steps for Provisioning VRRP Operation

Basic Configuration Process

This process assumes the following for VRRP operation:

- VLANs on the selected routers are already configured and IP-enabled.

- IP routing is enabled

- The network topology allows multiple paths for routed traffic between edge devices.

1. Configure the Owner for VRRP operation and a VR instance.

   a. On the router intended as the Owner for a particular network or subnet, enter the global configuration context and enable VRRP.

      router vrrp

   b. Enter the desired VLAN context and configure a VR instance.

      vlan < *vid* >

      vrrp vrid < 1 - 255 >

      Note that this step places the CLI in the context of the specified VR.

   c. Configure the router as the Owner of the VR instance.

      owner

      Note that this step automatically fixes the router's priority as 255 (the highest) for this VR instance. (The Owner priority cannot change.)

   d. Configure the router's real IP address and subnet mask for the current VLAN interface as the virtual IP address for the VR instance. You can use either of the following methods:

      virtual-ip-address < *ip-mask* >
      virtual-ip-address/*mask-bits*

   e. Activate the Owner VR instance.

      enable

   f. Inspect the configuration for the Owner VR.

      show vrrp vlan < *vid* > vrid < *vrid-#* > config

Leave the Owner's advertisement interval at its default (1 second). (For more on this topic, refer to "Changing VR Advertisement Interval and Source IP Address" on page 6-22.)

2. Configure a Backup for the same VR instance as for the Owner in step 1.

   a. On another router with an interface in the same network or subnet as is the Owner (configured in step 1), enter the global configuration context and enable VRRP.

      router vrrp

   b. Configure (and enter) the same VR instance as was configured for the Owner in step 1.

      vlan < *vid* >

      vrrp vrid < 1 - 255 >

   c. Configure the router as a Backup for the VR instance.

      backup

      Note that this step sets the Backup router's priority as 100 for this VR instance.

   d. Optional: If there is only one Backup router, or if you want the priority among backups to be determined by the lowest IP address among the Backups, leave the VR instance priority for the current backup router at the default of 100. If you want to control Backup router priority by creating a numeric hierarchy among the Backup routers in the VR, then set the priority on each accordingly.

      priority < 1 - 254 >

   e. Configure the virtual IP address for the current VR. Use the same address as you used for the Owner router's instance of the VR. As mentioned earlier, you can use either of the following methods:

      virtual-ip-address < *ip-mask* >
      virtual-ip-address/*mask-bits*

   f. Activate the Backup VR instance.

      enable

   g. Inspect the configuration for the Owner VR.

      show vrrp vlan < *vid* > vrid < *vrid-#* > config

   Leave the advertisement interval for Backup routers at the default (1 second). (For more on this topic, refer to "Changing VR Advertisement Interval and Source IP Address" on page 6-22.)

3. Repeat step 2 for each Backup router on the same VR.

Example Configuration

In VR 1, below, R1 is the Owner and the current Master router, and R2 is the (only) Backup in the VR. If R1 becomes unavailable, VR 1 fails over to R2.

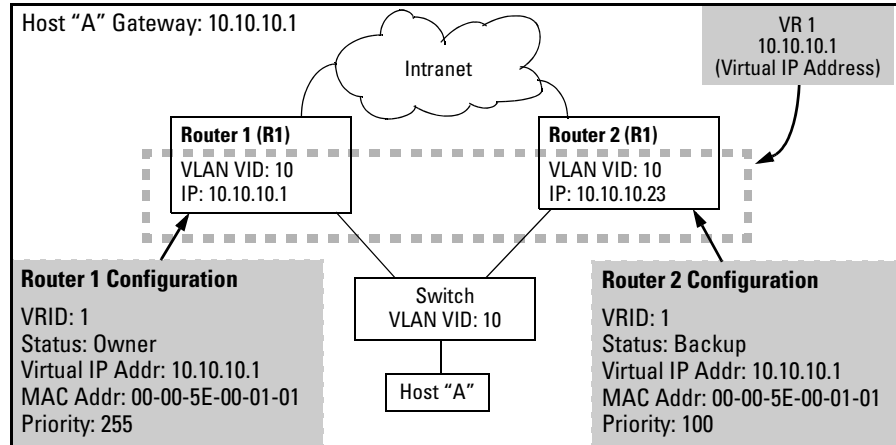**Figure 6-2. Example of a Basic VRRP Configuration**

	VLAN 10 IP	**VR 1 IP**	**Status**
Router 1	10.10.10.1	10.10.10.1	Owner
Router 2	10.10.10.23	10.10.10.1	Backup

```
ProCurve(config)# router vrrp
ProCurve(config)# vlan 10
ProCurve(vlan-10)# vrrp vrid 1
ProCurve(vlan-10-vrid-1)# owner
ProCurve(vlan-10-vrid-1)# virtual-ip-address 10.10.10.1 255.255.255.0
ProCurve(vlan-10-vrid-1)# enable
ProCurve(vlan-10-vrid-1)# show vrrp vlan 10 vrid 1 config
 VRRP Virtual Router Configuration Information
  Vlan ID : 10
  Virtual Router ID : 1

  Administrative Status [Disabled] : Enabled
  Mode [Uninitialized] : Owner
  Priority [100] : 255
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.10.1      255.255.255.0
```

This router is the Owner for VR 1 in VLAN 10.

Because this router is the Owner, the priority is fixed at 255 and cannot be changed.

For the same reason, the Preempt mode cannot be changed.

Because there is only one virtual IP address configured on the VR, the source address included with advertisements from this VR is the same as the virtual IP address for the VR.

Figure 6-3. VRRP Configuration for Router 1 (R1) in Figure 6-2, Above

```
ProCurve(config)# router vrrp
ProCurve(config)# vlan 10
ProCurve(vlan-10)# vrrp vrid 1
ProCurve(vlan-10-vrid-1)# backup
ProCurve(vlan-10-vrid-1)# virtual-ip-address 10.10.10.1/24
ProCurve(vlan-10-vrid-1)# enable
ProCurve(vlan-10-vrid-1)# show vrrp vlan 10 vrid 1 config
 VRRP Virtual Router Configuration Information
  Vlan ID : 10
  Virtual Router ID : 1

  Administrative Status [Disabled] : Enabled
  Mode [Uninitialized] : Backup
  Priority [100] : 100
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.10.1      255.255.255.0
```

This router is a Backup in VR 1 for VLAN 10.

Because this router is a Backup, the priority is set by default to 100 and can be changed to manipulate the precedence for Backup routers in the VR.

On a Backup router, the Preempt mode can be changed. However, in a VR having only one backup, Preempt mode has no effect.

Figure 6-4. VRRP Configuration for Router 2 (R2) in Figure 6-2 on Page 6-15

Associating More Than One Virtual IP Address With a VR

This need arises if a VLAN is configured with more than 32 subnets *and* it is necessary to apply VRRP to all of these subnets.

Because a VLAN on the routers covered by this Guide supports up to 32 VRs, applying VRRP to a higher number of subnets in the VLAN requires multiple virtual IP addresses in one or more VRs.

If the Owner of a VR is associated with multiple virtual IP addresses, then the Backup router(s) belonging to the same VR must also be associated with the same set of virtual IP addresses. If the virtual IP addresses on the Owner are not also on the Backup(s), a misconfiguration exists. VRRP advertisement packets sent by the VR Master will be dropped by the VR Backup(s) on account of a mismatch among virtual IP addresses.

Configuring VRRP

Enabling VRRP in the Global Configuration Context

VRRP can be configured regardless of the global VRRP configuration status. However, enabling a VR and running VRRP requires enabling it in the global configuration context.

Syntax: [no] router vrrp

Enables or disables VRRP operation in the global configuration context. IP routing must be enabled before enabling VRRP on the router. Disabling global VRRP halts VRRP operation on the router, but does not affect the current VRRP configuration. Enabling or disabling VRRP generates an Event Log message. To display the current global VRRP configuration, use **show vrrp config global**.

(Default: Disabled)

Syntax: [no] router vrrp traps]

Enables or disables SNMP trap generation for the following events:

New Master *— Indicates that the sending router has transitioned to 'Master' state.*

Authentication Failure *- Indicates that a VRRP packet has been received from a router whose authentication key or authentication type conflicts with this router's authentication key or authentication type.*

Notes: *This feature assumes the* **snmp-server host** *command has been used to configure a a trap receiver. If a VRRP packet is received with an authentication type other than 0 (zero; that is, no authentication), then the packet is dropped. (Refer to "Operating Notes" on page 6-34.)*

(Default: Enabled)

For example, the following commands enable VRRP at the global configuration level and then display the current global VRRP configuration:

```
ProCurve(config)# router vrrp
ProCurve(config)# show vrrp config global

 VRRP Global Configuration Information

  VRRP Enabled   : Yes
  Traps Enabled  : Yes
```

Figure 6-5. Example of Enabling and Displaying the Global VRRP Configuration

Creating a VR and Entering the VR Context

This command is used to create (or delete) a VR instance and to enter a VR context to do further configuration steps.

Syntax: [no] vrrp vrid < 1 - 255 >

> *Used in the VLAN interface context to create a virtual router (VR) instance and to enter the context of the new VR. It is also used to enter the context of an existing VR, and is the method used for accessing a VR for configuration purposes. You can configure up to 32 VRs on a multinetted VLAN.*

> *The VLAN interface must be IP enabled.*

For example, to create VR 1 in VLAN 10 and enter the VR context, you would execute the following command:

```
ProCurve(vlan-10)# vrrp vrid 1
ProCurve(vlan-10-vrid-1)#
```

Configuring a VR Instance on a VLAN Interface

The preceeding section describes the command for creating and entering a VR context. This section describes the configuration and activation commands available in the VR context.

Assigning Owner and Backup Status. Each VRRP router must be configured as either the Owner of the VR instance or a Backup for the instance.

Syntax: < owner | backup >

> *Used in a VR context of a VLAN to set the router as either the Owner of the VR on that interface or as a Backup. There can be one Owner per network or subnet for a given VR. If the VLAN is multinetted and multiple subnets are configured in the same VR, the router must be either the Owner for all subnets in the VR or a Backup for all subnets in the VR. The VR instance must be disabled (the default VR state) when using this command.*

> *(Default: None)*

These commands configure and display the Owner status in VR 1 on VLAN 10:

```
ProCurve(vlan-10-vrid-1)# owner          ←   Executing the owner or
ProCurve(vlan-10-vrid-1)# show vrrp config   backup command must be
                                             done in the VR context of the
                                             VLAN in which the VR exists.
 VRRP Global Configuration Information
  VRRP Enabled   : Yes
  Traps Enabled  : Yes

 VRRP Virtual Router Configuration Information
  Vlan ID : 10
  Virtual Router ID : 10

  Administrative Status [Disabled] : Disabled
  Mode [Uninitialized] : Owner       ←   Mode and Priority settings for
  Priority [100] : 255                   the configured Owner on a VR.
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.10.1      255.255.255.0
```

Figure 6-6. Example of Owner Configuration on a VR

Configuring a Virtual IP address in a VR. The virtual IP address must be the same for the Owner and all Backups on the same network or subnet in a VR.

Syntax: virtual-ip-address < owner-ip-addr >/*mask-length* >
virtual-ip-address < owner-ip-addr > < *mask* >

> *Used in a VR context of a VLAN to assign an IP address/mask combination to a VR instance.*
>
> *For an Owner: The virtual IP address must be one of the IP addresses configured on the VLAN interface for that VR.*
>
> *For a Backup: The virtual IP address must match the virtual IP address for the Owner.*
>
> *The Owner and the Backup(s) using a given virtual IP address must all belong to the same network or subnet. Also, the VR instance must be disabled (the default VR state) when using this command.*
>
> *(Default: None)*

Fox example, if VLAN 10 on router "A" is configured with an IP address of 10.10.10.1/24 and VR 1, and you want router "A" to operate as the Owner for this VR, then the virtual IP address of the Owner in VR 1 on router "A" is also 10.10.10.1/24. On router "B", which will operate as a Backup for VR 1, VLAN 10 is configured (in the same network) with an IP address of 10.10.10.15/24. However, because the Backup must use the same virtual IP address as the Owner, the virtual IP address for the Backup configured on router "B" for VR 1 is also 10.10.10.1/24.
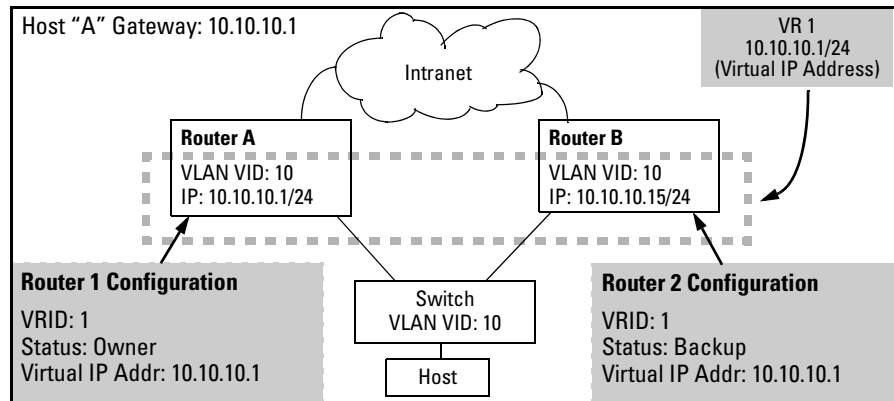

Figure 6-7. Example of Virtual IP Address Assignment for Owner and Backup

Reconfiguring the Priority for a Backup. When you configure a Backup in a VR, it is given a default priority of 100. This command is intended for use where it is necessary to establish a precedence among the Backup routers on the same network or subnet in a given VR.

Syntax: priority < 1 - 254 >

Used in a VR context of a VLAN where the router is configured as a Backup. This command changes the Backup's priority and is used to establish the precedence of a Backup where there are multiple Backups belonging to the same network or subnet. Also, the VR instance must be disabled (the default VR state) when using this command.

Note: An Owner is automatically assigned the highest priority, 255, which cannot be changed unless the Owner status is reconfigured to Backup.

(Range: 1 - 254, where 1 is the lowest precedence; Default: 100)

Changing VR Advertisement Interval and Source IP Address

The advertisement interval is used in one of two ways, depending on whether a VRRP router is operating as a Master or a Backup.

Syntax: advertise-interval < 1 - 255 >

■ *When a VRRP router is operating as Master, this value specifies the interval at which the router sends an advertisement notifying the other VRRP routers on the network or subnet that a Master is active.*

■ *When a VRRP router is operating as a Backup, it uses this value to calculate a timeout interval (3 x advt-interval).*

The VR instance must be disabled (the default VR state) when using this command.

(Range: 1 - 255 seconds; Default: 1 second)

For information on advertisements and advertisement intervals, see "Function of the VRRP Advertisement" on page 6-9

Note: All VRRP routers belonging to the same VR must be configured with the same advertisement interval. As required in RFC 3768, if a locally configured advertisement interval does not match the interval received in an inbound VRRP packet, then the VR drops that packet.

Syntax: primary-ip-address < *ip-address* | lowest >

> *Specifies the virtual IP address to designate as the source for VRRP advertisements from the VR. If there is only one virtual IP address configured on the VR, the default setting (**lowest**) is sufficient. Where there are multiple virtual IP addresses in the same VR and you want to designate an advertisement source other than the lowest IP Address, use this command.*

> *For an Owner VR, the primary IP address must be one of the virtual IP addresses configured on the VR. For a Backup VR, the primary IP address must be in the same subnet as one of the virtual IP addresses configured on the VR. In addition, the primary IP address for a Backup VR must be one of the IP addresses configured on the VLAN on which the VR is configured.*

> *The VR instance must be disabled (the default VR state) when using this command.*

> *(Default: lowest)*

> *Note: It is common in VRRP applications to have only one virtual IP address per VR. In such cases, the protocol uses that address as the source IP address for VRRP advertisements, and it is not necessary to specify an address.*

Preempt Mode on VRRP Backup Routers

This command applies to VRRP Backup routers only, and is used to minimize network disruption due to unnecessary preemption of the Master operation among Backup routers.

Syntax: [no] preempt-mode

> *Disables or re-enables Preempt mode. In the default mode, a Backup router coming up with a higher priority than another Backup that is currently operating as Master will take over the Master function. Using the **no** form of the command disables this operation, thus preventing the higher-priority Backup from taking over the Master operation from a lower-priority Backup. This command does not prevent an Owner router from resuming the Master function after recovering from being unavailable. Also, the VR instance must be disabled (the default VR state) when using this command. For more on Preempt mode, refer to "Preempt Mode" on page 6-10.*

> *(Default: Enabled)*

Enabling or Disabling VRRP Operation on a VR

After configuring a new VR or changing the configuration on an existing VR, you must use this command to enable the VR to operate.

Syntax: [no] enable

> *Enabling or disabling a VR enables or disables dynamic VRRP operation on that VR. Also, it is necessary to disable a VR before changing its configuration. Note that VRRP must be enabled (using the **router vrrp** command) in the global config-uration context before enabling a VR. (Disabling a VR can be done regardless of the current, global VRRP configuration.)*

> *(Default: Disabled)*

Displaying VRRP Configuration and Statistics Data

VRRP Configuration Data

Displaying the VRRP Global Configuration

Syntax: show vrrp config global

> *This command displays the configuration state for the global VRRP configuration and VRRP trap generation.*

For example:

```
ProCurve(config)# show vrrp config global

VRRP Global Configuration Information

  VRRP Enabled   : No

  Traps Enabled  : Yes
```

Figure 6-8. Example Output Showing the Default Global VRRP Configuration

Displaying All VR Configurations on the Router

Syntax: show vrrp config

> *This command displays the configuration for the global VRRP configuration and all VRs configured on the router.*

For example, the following figures lists output indicating two Owner VRs configured on the router:

```
ProCurve(config)# show vrrp config

 VRRP Global Configuration Information

  VRRP Enabled   : Yes
  Traps Enabled  : Yes


 VRRP Virtual Router Configuration Information

  Vlan ID : 10
  Virtual Router ID : 10

  Administrative Status [Disabled] : Disabled
  Mode [Uninitialized] : Owner
  Priority [100] : 255
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.10.1      255.255.255.0

 VRRP Virtual Router Configuration Information

  Vlan ID : 20
  Virtual Router ID : 20

  Administrative Status [Disabled] : Enabled
  Mode [Uninitialized] : Owner
  Priority [100] : 255
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.20.1      255.255.255.0
```

This data shows the virtual IP address(es) configured on VR 10.

This data shows the virtual IP address(es) configured on VR 20.

Figure 6-9. Example VRRP Configuration Listing with Two Owner VRs Configured

Displaying a Specific VR Configuration

Syntax: show vrrp vlan 23 vrid 10 config

> *Displays the configuration for a specific VR in a specific
> VLAN.*

For example, the following command displays the configuration of a VR
identified as VR 10 in VLAN 23:

```
ProCurve(config)# show vrrp vlan 23 vrid 10 config

 VRRP Virtual Router Configuration Information

  Vlan ID : 23
  Virtual Router ID : 10

  Administrative Status [Disabled] : Disabled
  Mode [Uninitialized] : Owner
  Priority [100] : 255
  Advertisement Interval [1] : 1
  Preempt Mode [True] : True
  Primary IP Address : Lowest

  IP Address      Subnet Mask
  --------------- ---------------
  10.10.10.1      255.255.255.0
```

Figure 6-10. Example of Displaying the Configuration for a Specific VR

VRRP Statistics Data

All command outputs shown in this section assume that VRRP is enabled at the global configuration level. If global VRRP is disabled, these commands produce the following output:

```
VRRP Global Statistics Information

  VRRP Enabled         : No
```

Figure 6-11. Statistics Command Output If Global VRRP Is Disabled

Displaying Global VRRP Statistics Only

Syntax: show vrrp statistics global

> *Displays the global VRRP statistics for the router.*

> ■   *VRRP Enabled*

> ■   *Protocol Version: 2*

> ■   *Invalid VRID Pkts Rx: VRRP packets received for a VRID that is not configured on the specific VLAN of the VRRP router.*

> ■   *Checksum Error Pkts Rx: VRRP packets received with a bad checksum*

> ■   *Bad Version Pkts Rx: VRRP advertisement packets received with a version number other than 2.*

```
ProCurve(config)# show vrrp statistics global

 VRRP Global Statistics Information

  VRRP Enabled         : Yes
  Protocol Version     : 2
  Invalid VRID Pkts Rx   : 0
  Checksum Error Pkts Rx : 0
  Bad Version Pkts Rx    : 0
```

Figure 6-12. Example of a Global VRRP Statistics Output

Displaying Statistics for All VRRP Instances on the Router

Syntax: show vrrp [statistics]

Displays the following VRRP statistics:

■ *global VRRP statistics for the router*

■ *VRRP statistics for all VRs configured on the router:*

- **State:** *Indicates whether the router is a Backup or the current Master of the VR.*

- **Uptime:** *The amount of time the router has been up since the last reboot.*

- **Virtual MAC Address:** *The virtual MAC address for the VR instance.*

- **Master's IP Address:** *The IP address used as the source IP address in the last advertisement packet received from the VR Master. If this VR is the Master, then this is the primary IP address of the VR. If the VR is disabled, this value appears as* **0.0.0.0**.

- **Associated IP Address Count:** *Number of virtual IP addresses.*

- **Advertise Packets Rx:** *The number of VRRP Master advertisements the VR has received from other VRRP routers since the last reboot.*

- **Zero Priority Tx:** *The number of VRRP advertisement packets received with the priority field set to* **0** *(zero).*

- **Bad Length Pkts:** *The number of VRRp packets received with missing fields of information.*

- **Mismatched Interval Pkts:** *The number of VRRP packets received from other routers (since the last reboot) with an advertisement interval that is different from the interval configured on the current VR. (Note that VRRP packets received with an interval mismatch are dropped.*

- **Mismatched IP TTL Pkts:** *The number of VRRP packets received with the IP TTL field not set to 255. Such packets are dropped.*

- **Become Master:** *The number of times the VR has become the Master since the last reboot.*

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- ***Zero Priority Tx:*** *The number of VRRP advertise-ment packets sent with the priority field set to* **0** *(zero).*

- ***Bad Type Pkts:*** *The number of VRRP packets received with packet type not equal to 1 (that is, not an advertisement packet.)*

- ***Mismatched Addr List Pkts:*** *The number of VRRP packets received wherein the list of virtual IP addresses doesn't match the locally configured virtual IP addresses for a VR.*

- ***Mismatched Auth Type Pkts:*** *The number of VRRP packets received with the authentication type not equal to 0 (zero, which is no authentication).*

Note that **show vrrp** *and* **show vrrp statistics** *give the same output.*

For example, the following output shows the VRRP statistics on a router having one VR (VR 1 in VLAN 10) configured.

```
ProCurve(config)# show vrrp

 VRRP Global Statistics Information

 VRRP Enabled          : Yes
 Protocol Version      : 2
 Invalid VRID Pkts Rx  : 0
 Checksum Error Pkts Rx : 0
 Bad Version Pkts Rx    : 0

 VRRP Virtual Router Statistics Information

 Vlan ID                 : 10
 Virtual Router ID       : 1
 State                   : Master
 Up Time                 : 31 mins
 Virtual MAC Address     : 00005e-000101
 Master's IP Address     : 10.10.10.2
 Associated IP Addr Count : 1
 Advertise Pkts Rx       : 1213      Become Master              : 2
 Zero Priority Rx        : 0         Zero Priority Tx           : 0
 Bad Length Pkts         : 0         Bad Type Pkts              : 0
 Mismatched Interval Pkts : 0        Mismatched Addr List Pkts : 0
 Mismatched IP TTL Pkts  : 0         Mismatched Auth Type Pkts : 0
```

Figure 6-13. Output for Show VRRP Command Includes Global and VR Statistics

Displaying Statistics for All VRRP Instances in a VLAN

Syntax: show vrrp vlan < *vid* > [statistics]

This command displays the VRRP statistics for all VRs configured on the specified VLAN.

The actual statistics data per VR is the same as for the **show vrrp [statistics]** *command (pages 6-29 and 6-31).*

Note that **show vrrp vlan <** *vid* **>** *and* **show vrrp vlan <** *vid* **> statistics** *produce the same output.*

In the following example, there is one VR configured in VLAN 10.

```
ProCurve(config)# show vrrp vlan 10

 VRRP Virtual Router Statistics Information

 Vlan ID                  : 10
 Virtual Router ID        : 10
 State                    : Master
 Up Time                  : 6 mins
 Virtual MAC Address      : 00005e-00010a
 Master's IP Address      : 10.10.10.1
 Associated IP Addr Count : 1
 Advertise Pkts Rx        : 1          Become Master            : 1
 Zero Priority Rx         : 0          Zero Priority Tx         : 0
 Bad Length Pkts          : 0          Bad Type Pkts            : 0
 Mismatched Interval Pkts : 0          Mismatched Addr List Pkts : 0
 Mismatched IP TTL Pkts   : 0          Mismatched Auth Type Pkts : 0
```

Figure 6-14. Example of Displaying Statistics for All VRs in a VLAN

Displaying Statistics for a Specific VRRP Instance

Syntax: show vrrp vlan < *vid* > vrid < 1 - 255 > [statistics]

> *This command displays the VRRP statistics for a specific VR configured on a specific VLAN.*
>
> *The actual statistics data per VR is the same as for the* **show vrrp [statistics]** *command (pages 6-29 and 6-31).*
>
> *Note that* **show vrrp vlan < *vid* > vrid < 1 - 255 >** *and* **show vrrp vlan < *vid* > vrid < 1 - 255 > statistics** *produce the same output.*

Standards Compliance

VRRP on the switches supported by this Guide includes the following:

■   Complies with RFC 3768 Virtual Router Redundancy Protocol (VRRP), except for maximum number of VRs per VLAN, which is 32 on the routers covered by this Guide.

■   Compatible with ProCurve Series 9300m routers, the ProCurve 9408sl router, and the ProCurve Series 8100fl switches. (VRRP on these devices is based on RFC 2338.)

■   Complies with RFC 2787-- Definitions of Managed Objects for VRRP, except for support for authentication-related values.

■   Applies to use on IPv4 routers.

Operating Notes

■ **VRRP Advertisements Not Reaching the Backup(s):** If a Master is forwarding traffic properly, but its Backup(s) are prevented from receiving the Master's VRRP advertisements, then both routers will operate in the Master mode for the VR. If this occurs, traffic for the applicable gateway will continuously alternate between routers (sometimes termed "flapping").

■ **Deleting an IP Address Used To Support a VR:** Refer to "General Operating Rules" on page 6-11.

■ **VR Limits:** A VLAN allows up to 32 VRs, and a VR allows up to 32 IP addresses. This means that one VR can support up to 32 subnets. This capacity enables use of VRRP on all subnets in a VLAN that has more than 32 subnets.

■ **IPv4:** The routers covered by this Guide support IPv4 IP addressing for VRRP applications.

■ **Authentication Type:** As per RFC 3768, the authentication type for VRRP packets inbound on the router is 0 (zero; that is, "no authenti-cation"). Packets with other authentication types are dropped, and authentication type is not supported in the VRRP MIB. If you are coordinating the use of VRRP on the routers covered by this manual with another vendor's implementation based on an older RFC, then you must set the authentication type to 0 (zero) on the other vendor's device.

■ **Proxy-ARP requests and MAC addresses:** The following table shows which MAC address is returned in response to a proxy-ARP request.

Configured as:	Administratively:	Returns:
Owner	Enabled	VRRP MAC address
Owner	Disabled	Default VLAN MAC address
Backup	Enabled, in Master state	VRRP MAC address
Backup	Enabled, not in Master state	VRRP router does not respond to proxy-ARP request.
Backup	Disabled	Default VLAN MAC address

Event Log Messages

Message	Meaning
`Failure to send out pkt for vrid` < *vrid-#* >, `vid` < *vid-#* >	A VRRP packet could not be sent out for the indicated VR on the specific VLAN due to any system-dependent problem. If packets could not be sent out, the expected protocol operation may be hampered.
`No VR with vrid` < *vrid-#* > `found on vid` < *vid-#* >	Indicates a VRRP packet received for a VR that does not exist on the VLAN. This can indicate asymmetric configuration of VRs across VRRP routers.
`Pkt recd on a non-VRRP Vlan with vid` < *vid-#* >	A VRRP packet was received on a VLAN that does not have any VRs. This could possibly be a result of misconfiguration of VRs on VLANs.
`Pkt recd with version number` < *ver-#* >, `expected` < *ver-#* >	A VRRP packet was received with a wrong version number.
`Vrid` < *vrid-#* > `on Vid` < *vid-#* > `has taken backup IP ctrl`	The Owner of a VR is not available and a Backup has taken Master control of the VR.
`Vrid` < *vrid-#* > `on Vid` < *vid-#* > `has taken owner IP ctrl`	The Owner of a VR has taken Master control of the VR, either following a reboot or a failback from a Backup serving as Master.
`Vrid` < *vrid-#* > `on Vid` < *vid-#* > `lost backup IP ctrl`	The indicated VR has been preempted by either the Owner or a higher-priority Master.
`Vrid` < *vrid-#* >, `Vid` < *vid-#* > `IP addr is duplicated on the network`	The virtual IP address owned by the indicated VR on the indicated VLAN is duplicated on the network.
`Vrid` < *vrid-#* >, `Vid` < *vid-#* > `recd pkt from a duplicate master`	A VRRP packet was received from a duplicate master VR by the indicated VR on the indicated VLAN.
`Vrid` < *vrid-#* >, `Vid` < *vid-#* > `recd pkt with advt int mismatch`	The indicated VR on the indicated VLAN has received a VRRP Master message carrying a different advertisement interval than is configured on the receiving VR and has dropped the packet.
`Vrid` < *vrid-#* >, `Vid` < *vid-#* > `recd pkt with auth type mismatch`	Indicates the VR has received a packet with the authentication type set to 1 or 2. These are generally valid authentication types, but are not required by RFC 3768. Thus, the software supports only an authentication type of 0 (zero), and VRRP packets with 1 or 2 for authentication type are dropped. Refer to "Authentication Type" under "Operating Notes" on page 6-34.

— Continued —

Message	Meaning
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`Vrid <`*`vrid-#`*`>, Vid <`*`vid-#`*`> recd pkt with bad IP-TTL`	A VRRP packet was received by the indicated VR on the indicated VLAN with an IP TTL value not equal to 255.
`Vrid <`*`vrid-#`*`>, Vid <`*`vid-#`*`> recd pkt with checksum error`	The indicated VR on the indicated VLAN has received a VRRP advertisement packet with a checksum error. The VR has therefore dropped that packet.
`Vrid <`*`vrid-#`*`>, Vid <`*`vid-#`*`> recd pkt with invalid auth type`	Indicates the VR has received a VRRP packet with an authentication type set to a value other than the 0, 1, or 2 (allowed by RFC 3768) and has dropped the packet.
`Vrid <`*`vrid-#`*`>, Vid <`*`vid-#`*`> recd pkt with IP address mismatch`	A VRRP packet was received by the indicated VR on the indicated VLAN with virtual IP address(es) that did not match the virtual IP addresses configured on the receiver VR.
`Vrid <`*`vrid-#`*`>, Vid <`*`vid-#`*`> recd pkt with invalid type`	A VRRP packet was received by the indicated VR on the indicated VLAN with the packet type not equal to 1.
`VRRP has been disabled on this router`	VRRP was disabled at the global config level.
`VRRP has been enabled on this router`	VRRP was enabled at the global config level.