Manual Supplement

for the HP ProCurve Routing Switch 9304M and 9308M

Features

Software Version Requirement

The above-listed features require software release 05.0.84 (or later), available *free*, as follows:

- Included in routing switches shipped from the factory beginning in mid-August, 1999. To determine the software version currently installed in your routing switch, do the following:

  Using the CLI:

  Enter the `show version` command. The current software version number appears at the top of the resulting list.

  Using the Web management interface:

  1. Enter the device's IP address in the browser's Location or Address field.
  2. When the Web management interface login dialog box appears, enter `set` in the `User Name` field and `public` in the password field to display the Web management interface.
  3. Under View, click on `Show`.
  4. In the resulting window, click on `Device` to display the software version.

- Available on HP's ProCurve website at `http://www.hp.com/go/procurve`:

  1. Click on Free Software Updates.
  2. Click on Switches and execute the download process for the file named **J4138084.exe**.

For information on how to update your routing switch software, refer to chapter 3, "Updating Software Images and Configuration Files" in the *Installation and Configuration Guide* you received with the device.

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Applicable Products

HP J4138A, HP J4139A

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Contents

Configuring VRRP

This section describes how to configure HP 9300M routers to use Virtual Router Redundancy Protocol (VRRP), a standard protocol described in RFC 2338.

Details for configuring VRRP with the CLI and the Web management interface are shown. *For complete syntax information for CLI commands, see appendix B, "Command Line Interface Commands" in the HP ProCurve 9304M and 9308M Routing Switches Installation and Configuration Guide.*

For information about the differences between VRRP and the Standby Router Protocol (SRP), see "Differences Between VRRP and SRP" on page 9.

Overview of Virtual Router Redundancy Protocol (VRRP)

VRRP is a protocol that provides redundancy to routers within a LAN. VRRP allows you to provide alternate router paths for a host without changing the IP address or MAC address by which the host knows its gateway. Consider the situation shown in Figure 1.

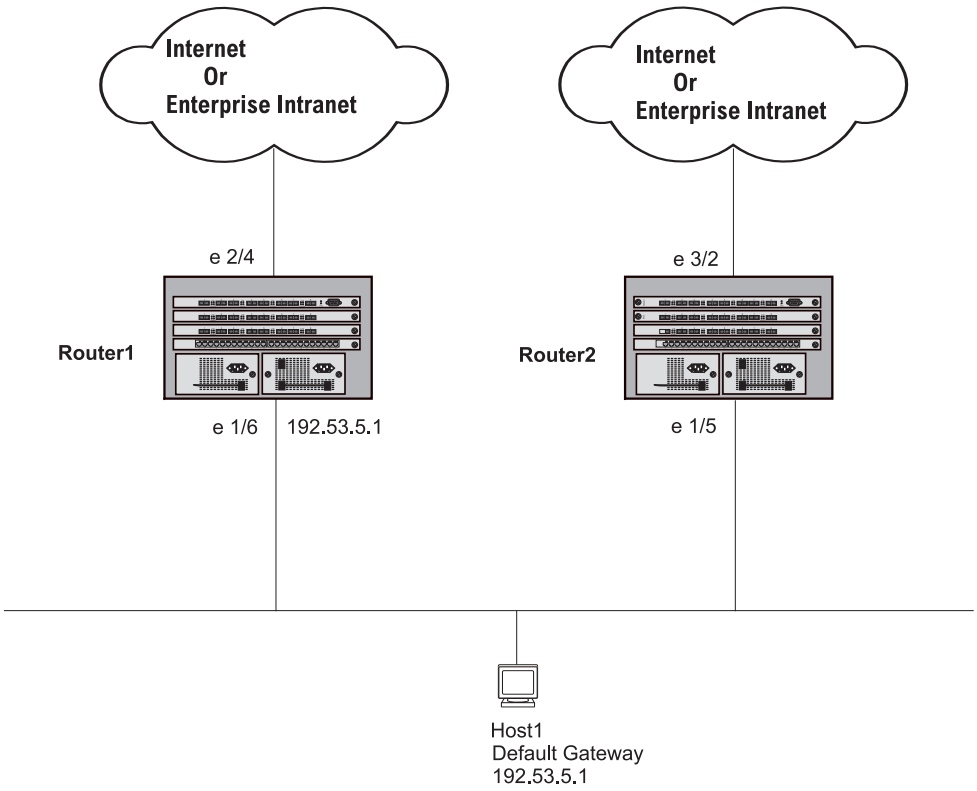


Figure 1 Router1 is Host1's default gateway but is a single point of failure

As shown in this example, Host1 uses 192.53.5.1 on Router1 as the host's default gateway out of the sub-net. If this interface goes down, Host1 is cut off from the rest of the network. Router1 is thus a single point of failure for Host1's access to other networks.

If Router1 fails, you could configure Host1 to use Router2. Configuring one host with a different default gateway might not require too much extra administration. However, consider a more realistic network with dozens or even hundreds of hosts per sub-net; reconfiguring the default gateways for all those hosts is impractical. It is much simpler to configure a VRRP virtual router on Router1 and Router2 to provide a redundant path for the host(s).

Figure 2 shows the same example network shown in Figure 1, but with a VRRP virtual router configured on Router1 and Router2.

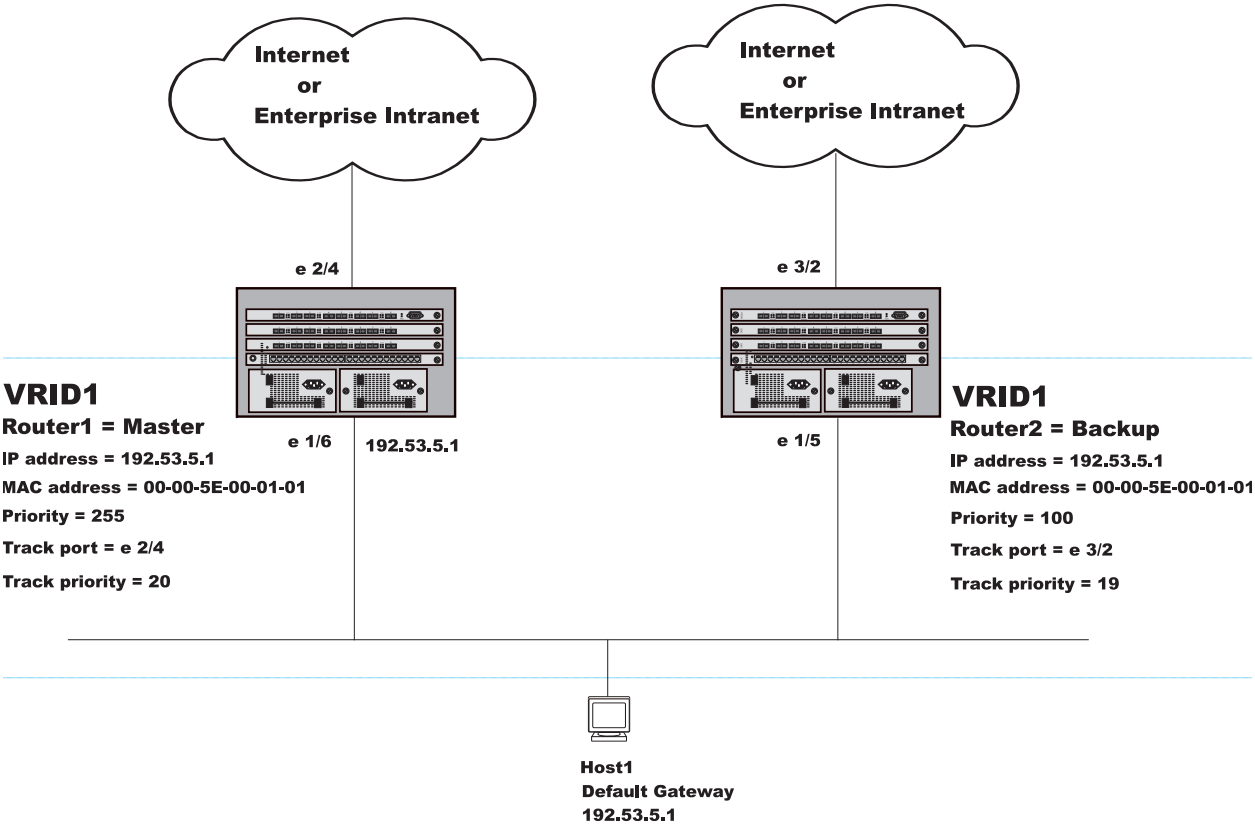


Figure 2 Router1 and Router2 are configured as a VRRP virtual router to provide redundant network access for Host1

The dashed box in Figure 2 represents a VRRP virtual router. When you configure a virtual router, one of the configuration parameters is the virtual router ID (VRID), which can be a number from 1 – 255. In this example, the VRID is 1. The VRID must be unique within the LAN. VRIDs do not cross LAN boundaries. Thus, there is no restriction against reusing a VRID with a different address mapping on different LANs.

NOTE: You can provide more redundancy by also configuring a second VRID with Router2 as the owner and Router1 as the Backup. This type of configuration is sometimes called Multigroup VRRP.

Virtual Router ID (VRID)

A ***VRID*** consists of one Master router and one or more Backup routers. The Master router is the router that owns the IP address(es) you associate with the VRID. For this reason, the Master router is sometimes called the "owner". Configure the VRID on the router that owns the default gateway interface. The other router in the VRID does not own the IP address(es) associated with VRID but provides the backup path if the Master router becomes unavailable.

Virtual Router MAC Address

Notice the MAC address associated with VRID1. The first five octets of the address are the standard MAC prefix for VRRP packets, as described in RFC 2338. The last octet is the VRID. THE VRID number becomes the final octet in the virtual MAC address associated with the virtual router.

When you configure a VRID, the software automatically assigns its MAC address. When a VRID becomes active, the Master router broadcasts a gratuitous ARP request containing the virtual router's MAC address for each IP address associated with the virtual router. In this example, Router1 sends a gratuitous ARP with MAC address 00-00-5E-00-01-01 and IP address 192.53.5.1. Hosts use the virtual router's MAC address in routed traffic they send to their default IP gateway (in this example, 192.53.5.1).

Virtual Router IP Address

Unlike the Standby Router Protocol (SRP), VRRP does not use virtual IP addresses. Thus, there is no virtual IP address associated with a virtual router. Instead, you associate the virtual router with one or more real interface IP addresses configured on the router that owns the real IP address(es). In this example, the virtual router with VRID1 is associated with real IP address 192.53.5.1, which is configured on interface e1/6 on Router1. VRIDs are interface-level parameters, not system-level parameters, so the IP address you associate with the VRID must already be a real IP address configured on the owner's interface.

When you configure the Backup router for the VRID, specify the same IP address as the one you specify on the owner. This is the IP address used by the host as its default gateway. The IP address cannot also exist on the Backup router. The interface on which you configure the VRID on the Backup router must have an IP address in the same sub-net.

NOTE: If you delete a real IP address used by a VRRP entry, the VRRP entry also is deleted automatically.

NOTE: When a Backup takes over forwarding responsibilities from a failed Master router, the Backup forwards traffic addressed to the VRID MAC address, which the host believes is the MAC address of the router interface for its default gateway. **However, the Backup cannot reply to IP pings sent to the IP address(es) associated with the VRID. Because the IP address(es) are owned by the owner, if the owner is unavailable, the IP addresses are unavailable as packet destinations.**

Master Negotiation

The routers within a VRID use the VRRP priority values associated with each router to determine which router becomes the Master. When you configure the VRID on a router interface, you specify whether the router is the owner of the IP address(es) you plan to associate with the VRID or a Backup. If you indicate that the router is the owner of the IP address(es), the software automatically sets the router's VRRP priority for the VRID to 255, the highest VRRP priority. The router with the highest priority becomes the Master.

Backup routers can have a priority from 3 – 254, which you assign when you configure the VRID on the Backup router's interfaces. The default VRRP priority for Backup routers is 100.

Because the router that owns the IP addresses associated with the VRID always has the highest priority, when all the routers in the virtual router are operating normally, the negotiation process results in the owner of the VRID's IP address(es) becoming the Master router. Thus, the VRRP negotiation results in the normal case, in which the hosts' path to the default route is to the router that owns the interface for that route.

Advertisement Messages

VRRP routers use Advertisement messages for negotiation to determine the Master router. VRRP routers send Advertisement messages to IP Multicast address 224.0.0.18. The frequency with which the Master sends Advertisement messages is the Hello Interval. Only the Master sends Advertisement messages. However, a Backup uses the Hello interval you configure for the Backup if it becomes the Master.

The Backup routers wait for a period of time called the Dead Interval for an Advertisement message from the Master. If a Backup router does not receive an Advertisement message by the time the dead interval expires, the Backup router assumes that the Master router is dead and negotiates with the other Backups to select a new Master router. The Backup router with the highest priority becomes the new Master.

If the owner becomes unavailable, but then comes back online, the owner again becomes the Master router. The owner becomes the Master router again because it has the highest priority. The owner always becomes the Master again when the owner comes back online.

NOTE: If you configure a track port on the owner and the track port is down, the owner's priority is changed to the track priority. In this case, the owner does not have a higher priority than the Backup that is acting as Master and the owner therefore does not resume its position as Master. For more information about track ports, see "Track Ports and Track Priority", below.

By default, if a Backup is acting as the Master, and the Master is still unavailable, another Backup can "preempt" the Backup that is acting as the Master. This can occur if the new Backup has a higher priority than the Backup who is acting as Master. You can disable this behavior if you want. When you disable preemption, a Backup router that has a higher priority than the router who is currently acting as Master does not preempt the new Master by initiating a new Master negotiation. See “Backup Preempt” on page 18.

NOTE: Regardless of the setting for the preempt parameter, the owner always becomes the Master again when it comes back online.

Track Ports and Track Priority

The HP implementation of VRRP enhances the protocol by giving a VRRP router the capability to monitor the state of the interfaces on the other end of the route path through the router. For example, in Figure 2, interface e1/6 on Router1 owns the IP address to which Host1 directs route traffic on its default gateway. The exit path for this traffic is through Router1's e2/4 interface.

Suppose interface e2/4 goes down. Even if interface e1/6 is still up, Host1 is nonetheless cut off from other networks. In conventional VRRP, Router1 would continue to be the Master router despite the unavailability of the exit interface for the path the router is supporting. However, if you configure interface e1/6 to track the state of interface e2/4, if e2/4 goes down, interface e1/6 responds by changing Router1's VRRP priority to the value of the track priority. In this example, Router1's priority changes from 255 to 20. One of the parameters contained in the Advertisement messages the Master router sends to its Backups is the Master router's priority. If the track port feature results in a change in the Master router's priority, the Backup routers quickly become aware of the change and initiate a negotiation for Master router.

In this example, the track priority results in Router1's VRRP priority becoming lower than Router2's VRRP priority. As a result, when Router2 learns that it now has a higher priority than Router1, Router2 initiates negotiation for Master router and becomes the new Master router, thus providing an open path for Host1's traffic. To take advantage of the track port feature, make sure the track priorities are always lower than the VRRP priorities. The default track priority for the router that owns the VRID IP address(es) is 2. The default track priority for Backup routers is 1. If you change the track port priorities, make sure you assign a higher track priority to the owner of the IP address(es) than you assign to the track priority on the Backup routers.

Suppression of RIP Advertisements for Backed Up Interfaces

The HP implementation also enhances VRRP by allowing you to configure the protocol to suppress RIP advertisements for the backed up paths from Backup routers. Normally, a VRRP Backup router includes route information for the interface it is backing up in RIP advertisements. As a result, other routers receive multiple paths for the interface and might sometimes unsuccessfully use the path to the Backup rather than the path to the Master. If you enable the HP implementation of VRRP to suppress the VRRP Backup routers from advertising the backed up interface in RIP, other routers learn only the path to the Master router for the backed up interface.

Authentication

The HP implementation of VRRP can use simple passwords to authenticate VRRP packets. The VRRP authentication type is not a parameter specific to the VRID. Instead, VRRP uses the authentication type associated with the interfaces on which you define the VRID. For example, if you configure your router interfaces to use a simple password to authenticate traffic, VRRP uses the same simple password and VRRP packets that do not contain the password are dropped. If your interfaces do not use authentication, neither does VRRP.

NOTE: The MD5 authentication type is not supported by HP 9300M routing switches.

Independent Operation of VRRP alongside RIP, OSPF, and BGP4

VRRP operation is independent of the RIP, OSPF, and BGP4 protocols. Their operation is unaffected when VRRP is enabled on a RIP, OSPF, or BGP4 interface.

Dynamic VRRP Configuration

All VRRP global and interface parameters take effect immediately. You do not need to reset the system to place VRRP configuration parameters into effect.

Differences Between VRRP and SRP

The Standby Router Protocol (SRP) is a proprietary router redundancy protocol that supplies many of the same features as HP's implementation of VRRP. HP's implementation of VRRP enhances the protocol by including support for track ports, which also is a feature of SRP. (Track ports are described in "Track Ports and Track Priority" on page 8.)

If you are configuring HP routing switches for redundancy, you can use either protocol. The features provided by the two protocols are similar yet the protocols do differ in the following ways:

- VRRP uses an IP multicast address for VRRP management traffic, while SRP uses pre-defined unicast addresses.
- VRRP uses real IP addresses or virtual interfaces assigned to an interface, but does not use virtual IP addresses, whereas SRP must use one pre-defined virtual IP address for each virtual router. You can associate a VRRP virtual router with an IP address or with a virtual interface (a named set of physical interfaces).
- Each VRRP virtual router (denoted by a unique VRID) can have one Master router and one or more Backup routers. In contrast, each SRP router can have one Primary Router and only one Standby Router.
- HP's implementation of VRRP supports authentication using simple clear text passwords. SRP does not support authentication.

NOTE: If your HP routing switches already are using SRP and you do not need redundancy with devices that cannot use SRP, you do not need to reconfigure to use VRRP.

HP recommends that you do not use VRRP and SRP on the same device.

Configuring VRRP

To configure a router for VRRP, do the following:

1. Enable VRRP on the router.
2. Indicate the authentication method used for the interface on which you are configuring the VRID (optional). VRRP uses the authentication method in use on the interface.
3. Add a VRID to an interface.
4. Indicate whether the router is the "owner" of the IP addresses you plan to associate with the VRID or a Backup. If the router is not the owner of the IP address(es), the router is a Backup.
5. Enter the IP address(es) associated with the VRID. The IP addresses must already be configured on the owner, on the same interface as the VRID. Additionally, the VRID interface on the Backup router must have at least one interface in the same sub-net.
6. Disable RIP advertisements om the Backup routers for the backed up interface (optional).
7. Configure track ports (optional).
8. Change the Hello interval (optional).
9. Change the Dead interval (optional).
10. Disable the preempt mode (optional).
11. Activate the virtual router.
12. Repeat these steps for the other routers in the virtual router.
13. Save the VRRP configuration to the system configuration file.

NOTE: *You initially enable VRRP at the global CONFIG level of the CLI using the router vrrp command. All other parameters are assigned or modified at the interface level of the CLI using ip vrrp... commands.*

If you are using the Web management interface, enable VRRP on the System configuration sheet. All other VRRP parameters are configured on the VRRP configuration sheet.

Configuration Rules for VRRP

- The interfaces of all routers in a VRID must be in the same IP sub-net.
- The IP address(es) associated with the VRID must already be configured on the router that will be the owner router.
- An IP address(es) associated with the VRID must be on only one router.
- The Hello interval must be set to the same value on both the owner and Backup router(s) in the virtual router.
- The Dead interval must be set to the same value on both the owner and Backup router(s) in the virtual router.
- The track priority on a router must be lower than the router's VRRP priority. Also, the track priority on the owner must be higher than the track priority on the Backup router(s).

Enabling VRRP

Before configuring an interface for VRRP, you must enable the feature on the router.

USING THE CLI

To enable VRRP on a router, enter the following command. Enter the same command on each routing switch that you are configuring for VRRP.

```
9300M(config)# router vrrp
```

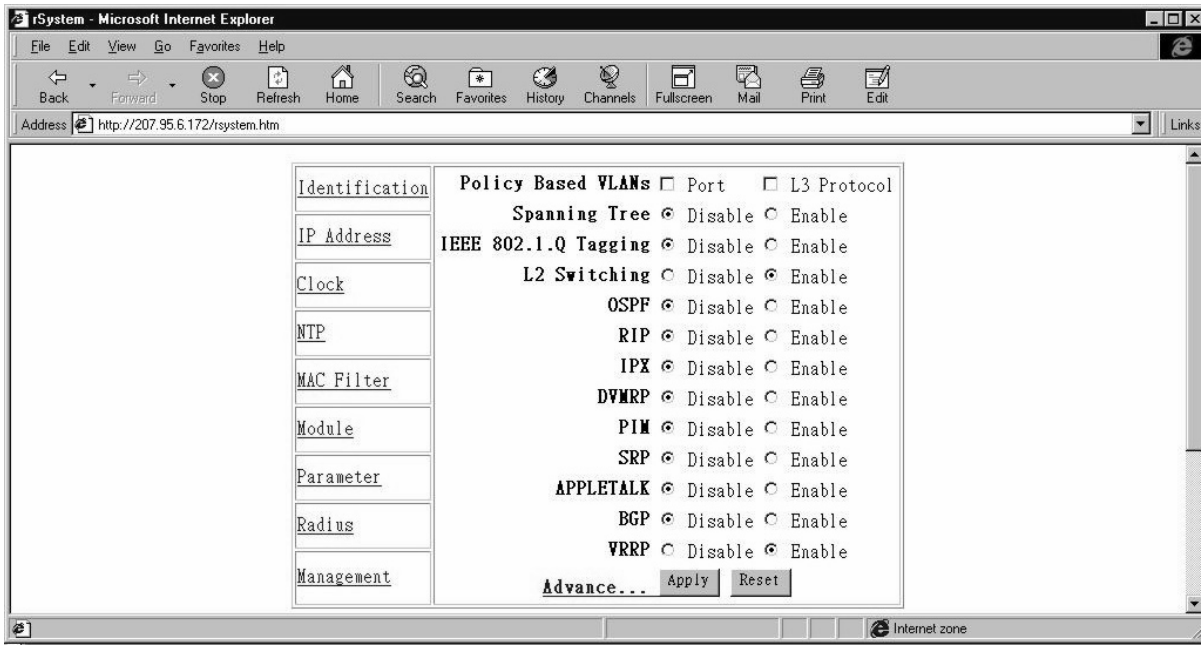
syntax: router vrrp

USING THE WEB MANAGEMENT INTERFACE

To enable VRRP on a router:

1. Select the System link from the main menu to display the panel shown in “Configuring a Virtual Router” on page 11.
2. Enable VRRP on the System configuration sheet.
3. Select the Apply button to assign the changes.

NOTE: All VRRP configurations are implemented using a single configuration panel of the Web management interface.



Configuring a Virtual Router

The command examples in this section show how to configure the routers in Figure 2.

USING THE CLI

Configuring Router1 Using the CLI

To configure VRRP Router1 in Figure 2 after you enable VRRP, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# owner track-priority 20
Router1(config-if-1/6-vrid-1)# track-port ethernet 2/4
Router1(config-if-1/6-vrid-1)# ip-address 192.53.5.1
Router1(config-if-1/6-vrid-1)# activate
```

NOTE: When you configure the Master (owner), the address you enter with the **ip-address** command must already be configured on the interface.

The **ip vrrp owner** command specifies that this router owns the IP address you are associating with the VRID. Because this router owns the IP address, this router is the default Master router and its VRRP priority is thus 255.

Configuring Router2 Using the CLI

To configure Router2 in Figure 2 after enabling VRRP, enter the following commands:

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup priority 100 track-priority 19
Router2(config-if-1/5-vrid-1)# track-port ethernet 3/2
Router2(config-if-1/5-vrid-1)# ip-address 192.53.5.1
Router2(config-if-1/5-vrid-1)# activate
```

The **backup** command specifies that this router is a VRRP Backup for virtual router VRID1. The IP address entered with the **ip-address** command is the same IP address as the one entered when configuring Router1. In this case, the IP address cannot also exist on Router2, but the interface on which you are configuring the VRID Backup must have an IP address in the same sub-net. By entering the same IP address as the one associated with this VRID on the owner, you are configuring the Backup to back up the address, but you are not duplicating the address.

NOTE: When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the owner. However, the address cannot be the same.

The **priority** parameter establishes the router's VRRP priority in relation to the other VRRP router(s) in this virtual router. The **track-priority** parameter specifies the new VRRP priority that the router receives for this VRID if the interface goes down. See "Track Ports and Track Priority" on page 8.

syntax: ip vrrp vrid <VRID>

syntax: owner [track-priority <value>]

syntax: backup [priority <value>] [track-priority <value>]

syntax: track-port ethernet <slot/port>

syntax: ip-address <ipaddr>

syntax: activate

USING THE WEB MANAGEMENT INTERFACE

Use the following procedures to create a virtual router using the Web management interface.

NOTE: Some of the data entry fields contain zeros. When you save a VRRP definition, the software uses the default values for the parameters instead of zeros. The Web management interface shows zeros instead of the defaults because the defaults differ depending on whether you are creating an owner or a Backup. The software does not know which type of VRID entry you are creating until you select Add to add the entry.

Configuring Router1 Using the Web Management Interface

To configure VRRP Router1 in Figure 2 after you enable VRRP:

1. Select VRRP from the System configuration sheet. The panel shown in Figure 3 appears.

   NOTE: If you have already created VRRP definitions on the router, the VRRP Virtual Router panel is displayed instead. In this case, click on Add VRRP Virtual Router.

   ---

2. Select the interface from the pulldown list on the Port field. In this example, select 1/6.
3. Enter the VRID in the Router ID field the Router ID field. In this example, use the default value, 1.
4. Enter the track priority or leave the field blank to use the default. In this example, enter 20.

5. Enter the Hello interval or leave the field unchanged to use the default. The software fills in the default after you select Add. In this example, leave the field unchanged.
6. Select the mode (Owner or Backup). Select Owner in this example.
7. Select Enable to activate the VRRP entry after you select Add.
8. Enter the interface's IP address in the IP Address List field. In this example, enter 192.53.5.1.
9. Enter the virtual interface if applicable. (In this example, the VRRP interface is not defined on a virtual interface.)
10. Select the track port. In this example, select 2/4.
11. Select Add to add the entry.

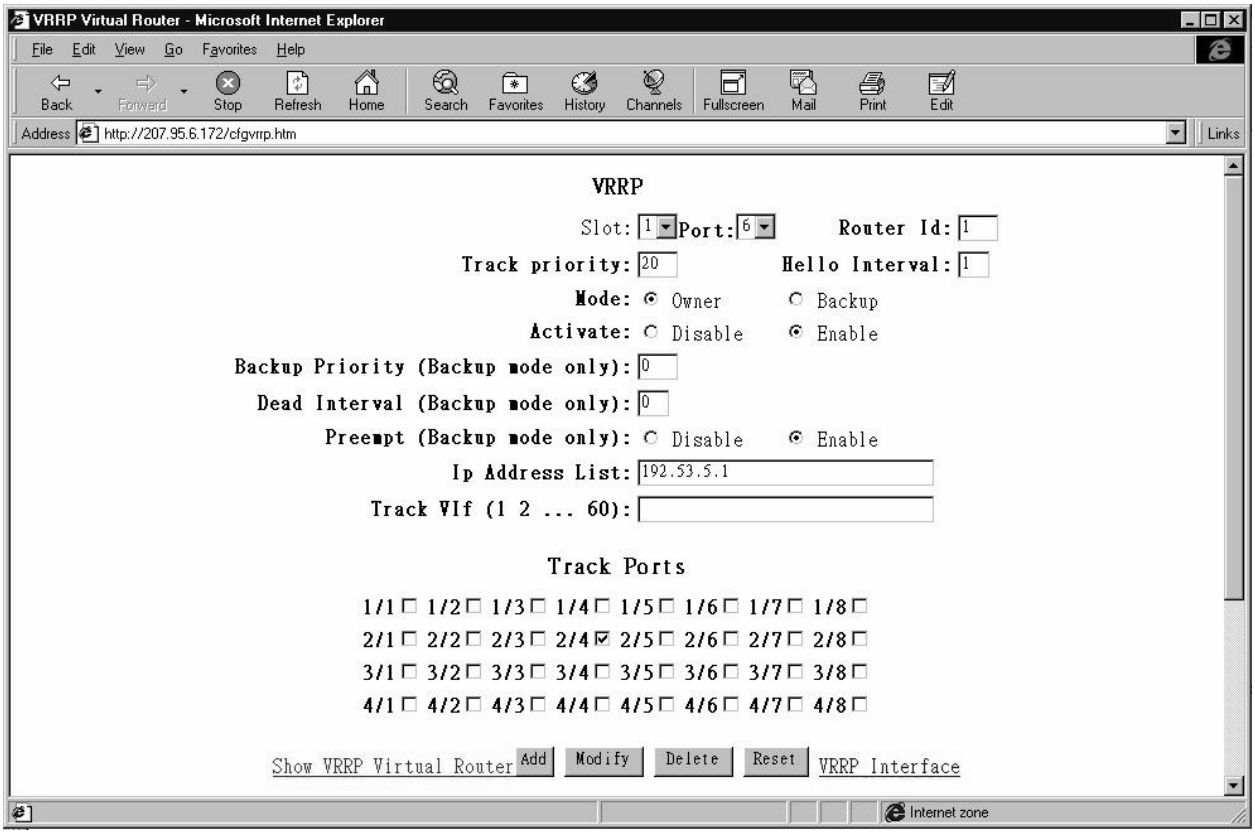


Figure 3 Configuration panel for owner

Configuring Router2 Using the Web Management Interface

To configure VRRP Router2 in Figure 2 after you enable VRRP:

1. Select VRRP from the System configuration sheet. The panel shown in Figure 4 appears.

NOTE: If you have already created VRRP definitions on the router, the VRRP Virtual Router panel is displayed instead. In this case, click on Add VRRP Virtual Router.

---

2. Select the interface from the pulldown list on the Port field. In this example, select 1/5.
3. Enter the VRID in the Router ID field the Router ID field. In this example, use the default value, 1.
4. Enter the track priority or leave the field blank to use the default. In this example, enter 19.

5. Enter the Hello interval or leave the field as is to use the default. The software fills in the default after you select Add. In this example, leave the field unchanged.
6. Select the mode (Owner or Backup). Select Backup in this example.
7. Select Enable to activate the VRRP entry after you select Add.
8. Enter the backup priority or leave the value unchanged. In this example, enter 100.

NOTE: This is the default for Backups. You also can leave the field unchanged and the software will automatically assign 100 as the priority when you select Add.

---

9. Enter the Dead interval or leave the field unchanged to use the default value.
10. Enable preempt mode if desired. In this example, leave preempt mode disabled.
11. Enter the interface's IP address in the IP Address List field. In this example, enter 192.53.5.1. By entering the same IP address as the one associated with this VRID on the owner, you configure the Backup to back up the address, but you are not duplicating the address.

NOTE: When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the owner. However, the address cannot be the same.

---

12. Enter the virtual interface if applicable. (In this example, the VRRP interface is not defined on a virtual interface.)
13. Select the track port. In this example, select 3/2.
14. Select Add to add the entry.

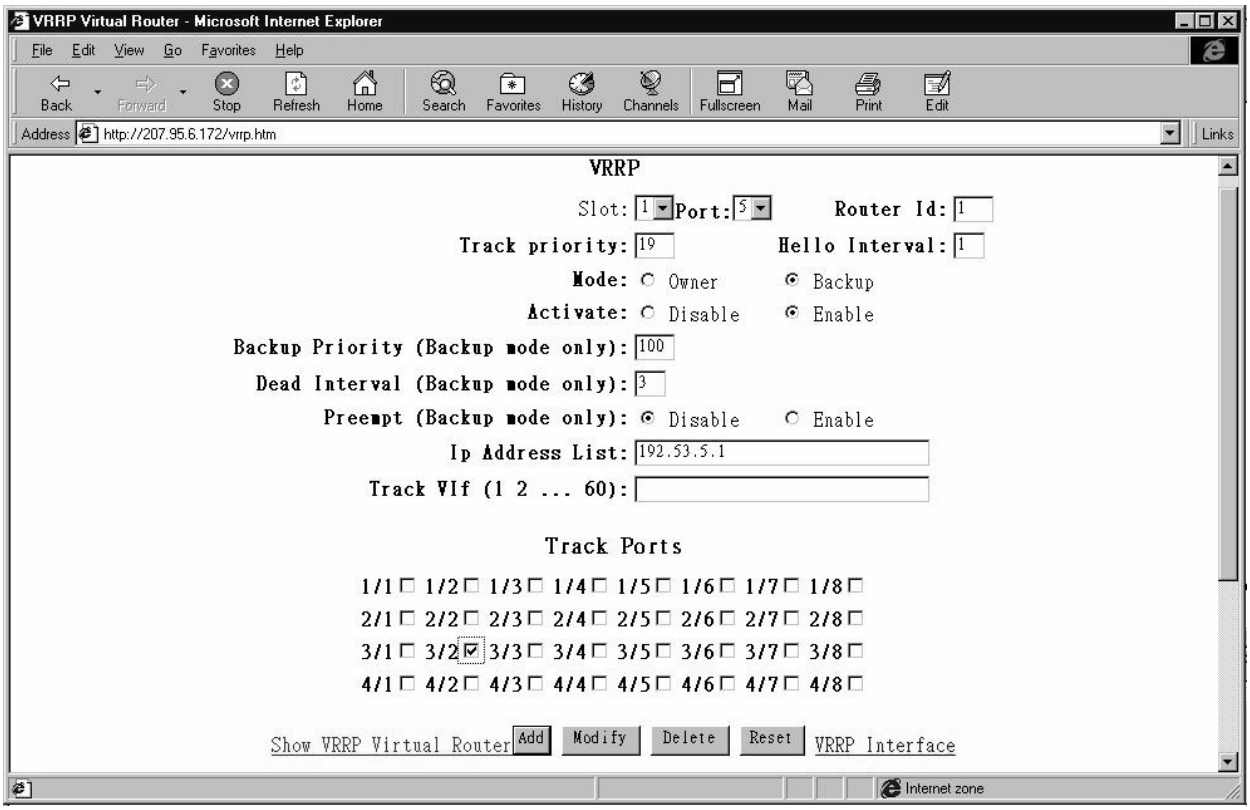


Figure 4 Configuration panel for Backup

Modifying VRRP Parameters

You can modify the following VRRP parameters on an individual VRID basis:

- Authentication type (if the interfaces on which you configure the VRID use authentication)
- Router type (owner or Backup)

NOTE: Change the router type only if you have moved the real IP address from one router to another or you accidentally configured the IP address owner as a Backup.

- Backup priority
- Suppression of RIP advertisements on Backup routes for the backed up interface
- Hello interval
- Dead interval
- Track port
- Track priority
- Backup preempt mode

USING THE WEB MANAGEMENT INTERFACE

You can set some of these parameters using the VRRP configuration panel of the Web management interface, shown in “Configuring a Virtual Router” on page 11. For information about the fields, see the parameter descriptions in the following sections. To access this panel, select VRRP from the System configuration sheet, then click Modify next to the VRRP entry you want to edit.

Authentication Type

If the interfaces on which you configure the VRID use authentication, the VRRP packets on those interfaces also must use the same authentication. HP’s implementation of VRRP supports the following authentication types:

- No authentication – The interfaces do not use authentication. This is the VRRP default.
- Simple – The interfaces use a simple text-string as a password in packets sent on the interface. If the interfaces use simple password authentication, the VRID configured on the interfaces must use the same authentication type and the same password.

USING THE CLI

To configure the VRID interface on Router1 for simple-password authentication using the password "ourpword", enter the following commands:

Configuring Router 1

```
Router1(config)# inter e 1/6

Router1(config-if-1/6)# ip vrrp auth-type simple-text-auth ourpword
```

Configuring Router 2

```
Router2(config)# inter e 1/5

Router2(config-if-1/5)# ip vrrp auth-type simple-text-auth ourpword
```

syntax: ip vrrp auth-type <no-auth|simple-text-auth> <auth data>

Router Type

A VRRP router is either an owner or a Backup. By default, the owner becomes the Master following the negotiation. A Backup becomes the Master only if the Master becomes unavailable.

NOTE: The IP address(es) you associate with the owner must be a real IP address (or addresses) on the interface on which you configure the VRID.

When you configure a Backup router, the router interface on which you are configuring the VRID must have a real IP address that is in the same sub-net as the address associated with the VRID by the owner. However, the address cannot be the same.

USING THE CLI

To configure Router1 as the owner, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# owner
```

To configure Router2 as a Backup, enter the following commands:

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup
```

syntax: owner [track-priority <value>]

syntax: backup [priority <value>] [track-priority <value>]

Backup Priority

Each router in a VRRP virtual router has a priority. VRRP uses the priority to determine which router wins in the negotiation for Master router. A Backup VRRP router's priority can be from 3 – 254. Priority 255 is the highest and designates the Master VRRP router. When you configure a VRRP router interface as the owner for that virtual router, VRRP assigns priority 255 to the router by default.

If the Master VRRP router becomes unavailable, the Backup VRRP router with the next highest priority becomes the Master router.

USING THE CLI

To change the VRRP priority of interface 1/5 on Router2 to 50, enter the following commands:

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# backup priority 50
```

syntax: backup [priority <value>] [track-priority <value>]

Suppression of RIP Advertisements on Backup Routers for the Backup Up Interface

Normally, a VRRP Backup router includes route information for the interface it is backing up in RIP advertisements. As a result, other routers receive multiple paths for the interface and might sometimes unsuccessfully use the path to the Backup rather than the path to the Master.

You can prevent the Backup routers from advertising route information for the backed up interface by enabling suppression of the advertisements.

USING THE CLI

To suppress RIP advertisements for the backed up interface in Router2, enter the following commands:

```
Router2(config)# router rip
Router2(config)# use-vrrp-path
```

syntax: use-vrrp-path

Hello Interval

The Master VRRP router periodically sends Advertisement messages to the LAN segment using IP Multicast address 224.0.0.18. The Backup routers use the Advertisement messages as verification that the Master router is still online. If the Backup routers stop receiving the Advertisement messages for the period of time specified by the Dead interval, the Backup routers determine that the Master router is dead. At this point, the Backup router with the highest priority becomes the new Master router. The Hello interval can be from 1 – 84 seconds. The default is 1 second.

USING THE CLI

To change the Hello interval on the Master router to 10 seconds, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# hello-interval 10
```

syntax: hello-interval <value>

NOTE: The default Dead interval is 3 times the Hello Interval plus one-half second. Generally, if you change the Hello interval, you also should change the Dead interval on the Backup routers.

Dead Interval

The Dead interval is the number of seconds a backup VRRP router waits for an Advertisement message from the Master router before determining that the Master router is dead. When Backup routers determine that the Master router is dead, the Backup router with the highest priority becomes the new Master router. The Dead interval can be from 1 – 84 seconds. The default is 3.5 seconds. This is three times the default Hello interval (1 second) plus one-half second added by the router software. The software automatically adds one-half second to the Dead interval value you enter.

USING THE CLI

To change the Dead interval on the Backup VRRP router to 30 seconds, enter the following commands:

```
Router2(config)# inter e 1/5
Router2(config-if-1/5)# ip vrrp vrid 1
Router2(config-if-1/5-vrid-1)# dead-interval 30
```

syntax: dead-interval <value>

Track Port

You can configure the VRID on an interface to track another interface on the router. This is quite useful for tracking the state of the exit interface for the path for which the VRID is providing redundancy. See “Track Ports and Track Priority” on page 8.

USING THE CLI

To configure 1/6 on Router1 to track interface 2/4, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# track-port e 2/4
```

syntax: track-port ethernet <slot/port>|ve

Track Priority

If a tracked interface goes down, VRRP changes the VRRP priority of the router to the track priority, which typically is lower than the router’s VRRP priority and lower than the VRRP priorities on the Backup routers. See “Track Ports and Track Priority” on page 8. The default track priority for the owner of the VRID’s IP address(es) is 2. The default track priority for Backup routers is 1.

You enter the track priority as a parameter with the **owner** or **backup** command. See “Configuring a Virtual Router” on page 11.

syntax: owner [track-priority <value>]

syntax: backup [priority <value>] [track-priority <value>]

Backup Preempt

By default, a Backup VRRP router that has a higher priority than another Backup router that has become Master can preempt that router to become the new Master router. If you want to prevent this behavior, disable preemption.

NOTE: Regardless of the setting for the preempt parameter, the owner always becomes the Master again when it comes back online.

USING THE CLI

To disable preemption on the backup VRRP interface for VRID1 on Router2, enter the following commands:

```
Router1(config)# inter e 1/6
Router1(config-if-1/6)# ip vrrp vrid 1
Router1(config-if-1/6-vrid-1)# non-preempt-mode
```

syntax: non-preempt-mode

Displaying VRRP Configuration Information and Statistics

You can use the CLI or Web management interface to display configuration information and statistics for VRRP.

Displaying Configuration Information

To display VRRP configuration information for an HP routing switch, use one of the following methods.

USING THE CLI

To display VRRP configuration information for a router, enter the following command:

```
Router1(config)# show ip vrrp
```

Here is an example of the information displayed by this command:

```
Total number of VRRP routers defined: 1
Interface ethernet e 1/6
 auth-type no authentication
 VRID 1
  state master
  administrative-status activated
  mode owner
  priority 255
  current priority 255
  hello-interval 1 sec
  ip-address 192.53.5.1
```

USING THE WEBMANAGEMENT INTERFACE

To display VRRP configuration information, select VRRP from the System configuration sheet. A panel such as the ones shown in Figure 5 and Figure 6 is displayed.

- To modify an entry, select Modify.
- To delete an entry, select Delete.

NOTE: If you delete the real IP address associated with a VRRP entry, the VRRP entry also is deleted automatically.

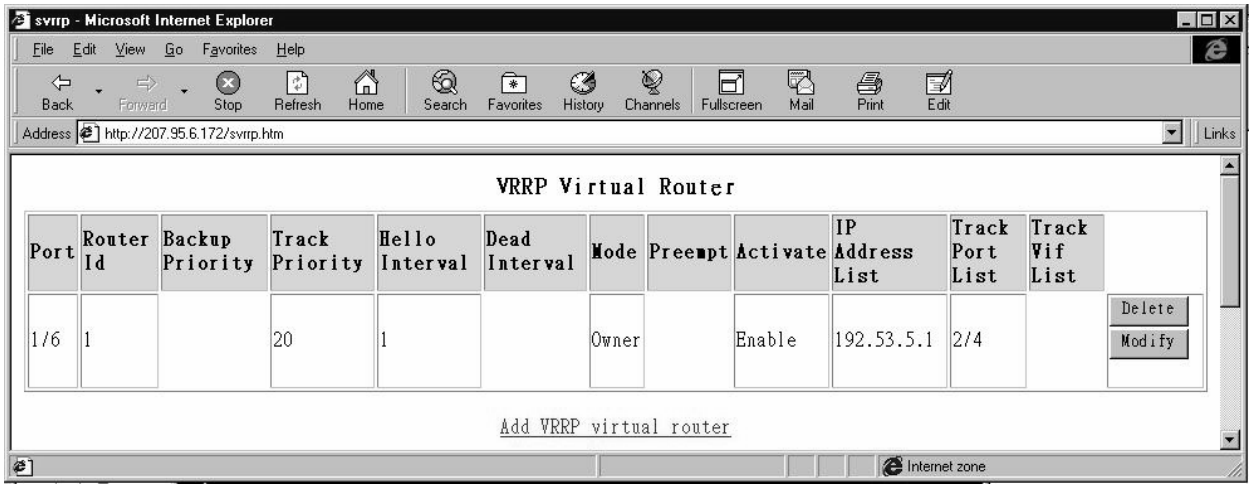


Figure 5 VRRP configuration information for owner

NOTE: If the parameter is not defined or does not apply to this type of entry, the field is blank. For example, in Figure 5, the Backup Priority parameter does not apply to this entry because the entry is for an owner.

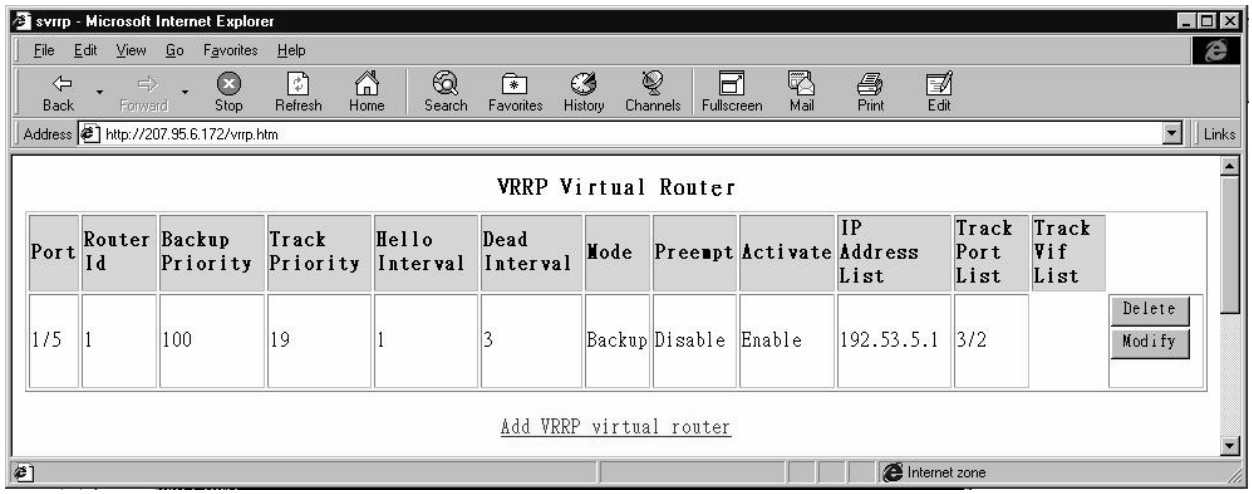


Figure 6 VRRP configuration information for Backup

Each display shows a separate set of information for each VRRP interface configured on the router. Note that the displays contain two fields for priority. The first priority field lists the VRRP priority of the interface. The second priority field (current priority or Track Priority) normally contains the same value as the first priority field. However, if you configure a track port for this VRRP interface and the interface goes down, the track port changes the interface's priority to match the track priority. The new priority value is then displayed in the current priority field.

Displaying VRRP Statistics

Use the following methods to display VRRP statistics.

NOTE: It is normal for the VRRP statistics to be zero. Zeros indicate that no errors have occurred and that the owner is still the Master.

USING THE CLI

To display VRRP statistics for a router, enter the following command:

```
Router1(config)# show ip vrrp stat
```

Here is an example of the information displayed by this command:

```
Interface ethernet e 1/6
 rxed vrrp header error count = 0
 rxed vrrp auth error count = 0
 rxed vrrp auth passwd mismatch error count = 0
 rxed vrrp vrid not found error count = 0
 VRID 1
 rxed arp packet drop count = 0
 rxed ip packet drop count = 0
 rxed vrrp port mismatch count = 0
 rxed vrrp ip address mismatch count = 0
 rxed vrrp hello interval mismatch count = 0
 rxed vrrp priority zero from master count = 0
 rxed vrrp higher priority count = 0
 transitioned to master state count = 1
 transitioned to backup state count = 0
```

USING THE WEBMANAGEMENT INTERFACE

To display VRRP statistics, select Show from the System configuration sheet, then select either Virtual Router or Interface:

- If you select Virtual Router, the panel shown in Figure 7 is displayed.
- If you select Interface, the panel shown in Figure 8 is displayed.

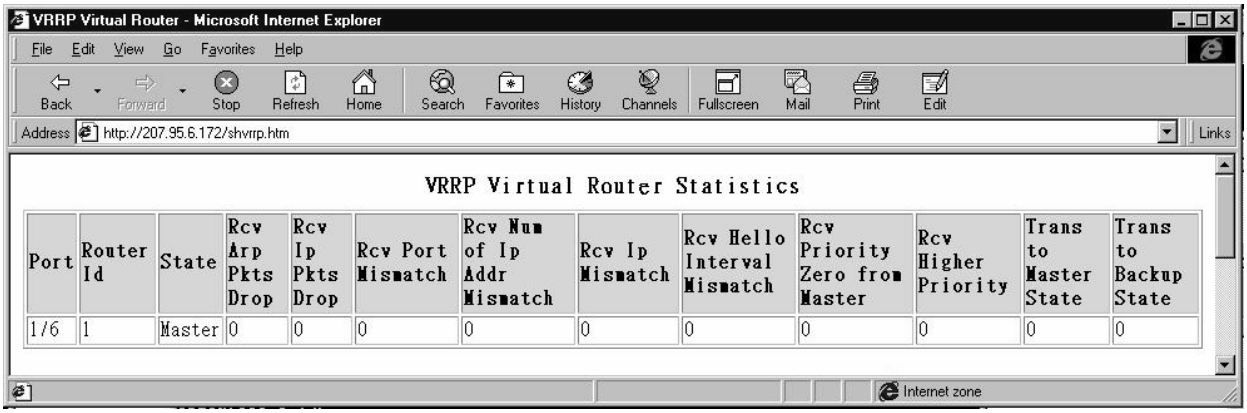


Figure 7 VRRP router statistics

NOTE: It is possible for the statistics display for a Backup to show "Master" in the state field even when you have not yet configured another VRRP router. When you activate a Backup, if the Backup's Dead interval expires before the Backup hears from another VRRP router, the Backup becomes the Master.

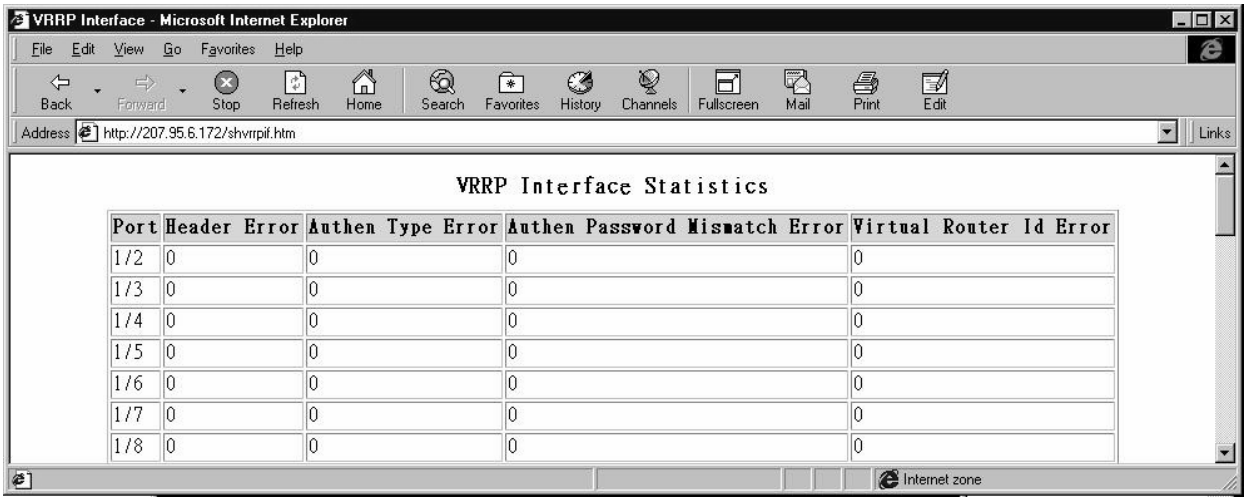


Figure 8 VRRP interface statistics

This panel shows a row for each interface on the router.

Clearing VRRP Statistics

Use the following methods to clear VRRP statistics.

USING THE CLI

To clear VRRP statistics information for a router, enter the following command:

```
Router1(config)# clear ip vrrp-stat
```

USING THE CLI

To clear VRRP statistics information for a router:

1. Select Clear from the System configuration sheet.
2. Select VRRP.
3. Select Apply.

Quality of Service (QoS) Algorithms

This section describes the Quality-of-Service (QoS) algorithms used by the HP 9300M routing switches. You can apply QoS priorities to the following:

- Ports
- VLANs
- Static MAC entries
- Layer 4 sessions
- AppleTalk sockets.

QoS Priorities

You can select one of the following priorities:

- 0 or 1 – These priorities correspond to queue 0, the normal priority queue.
- 2 or 3 – These priorities correspond to queue 1, a higher priority queue.
- 4 or 5 – These priorities correspond to queue 2, a higher priority queue.
- 6 or 7 – These priorities correspond to queue 3, the highest priority queue.

Each port and each module has four queues for outbound traffic.

NOTE: Each module also has a queue in which the module places packets for prioritized transmission onto the backplane to other modules. However, you do not need to configure these queues. The prioritization queues you assign to interfaces are used for traffic waiting to be sent to a module for transmission on the interface.

QoS Algorithm

QoS queues are serviced using a chained round-robin scheme. This scheme services each of the four queues on a given port during a single queue cycle. A queue cycle is one full pass through all four queues. Each queue has a non-configurable weight that determines how many packets the system processes for each queue during a given cycle and how many times the queue is processed during the cycle.

You can calculate the minimum guaranteed percentage of a port's bandwidth a set of queue weights yields by using the following equations:

$q3/(q3 + 1) = p3$

$(1 - p3) * q2/(q2 + 1) = p2$

$(1 - p3 - p2) * q1/(q1 + 1) = p1$

$(1 - p3 - p2 - p1) = p0$

where:

- p3 is the percentage for queue 3
- p2 is the percentage of what is left over from queue 3 that is allocated to queue 2
- p1 is the percentage of what is left over from queue 2 that is allocated to queue 1
- p0 is the percentage of what is left over from queue 1 that is allocated to queue 0

For the default weights, these calculations yield the following guaranteed minimum percentages:

- p0 = 1.7%
- p1 = 3.3%
- p2 = 15%
- p3 = 80%

Example Queue Cycle

You can compare the queue cycle to the operation of a gasoline pump with multiple dials. Some dials turn only once during a cycle and are triggered by the smaller dials, which turn multiple times during a cycle. For example, the dollars dial moves only slightly after many revolutions of the cents dials. Note that this comparison does not exactly match because the slower dials on the gas pump are the more important dials. (For example, the dollars dial has more effect on your pocket-book than the cents dials). Figure 9 shows an example of the queues represented as dials.

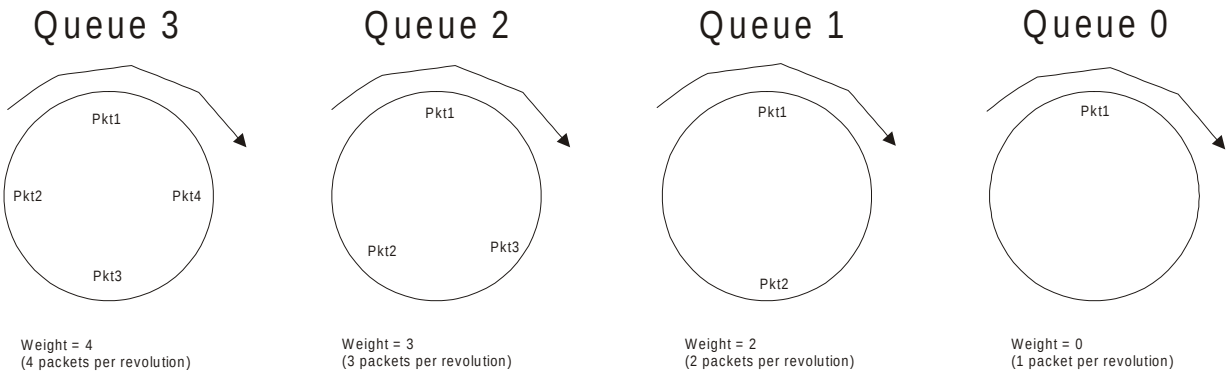


Figure 9 Queues represented as dials on a meter

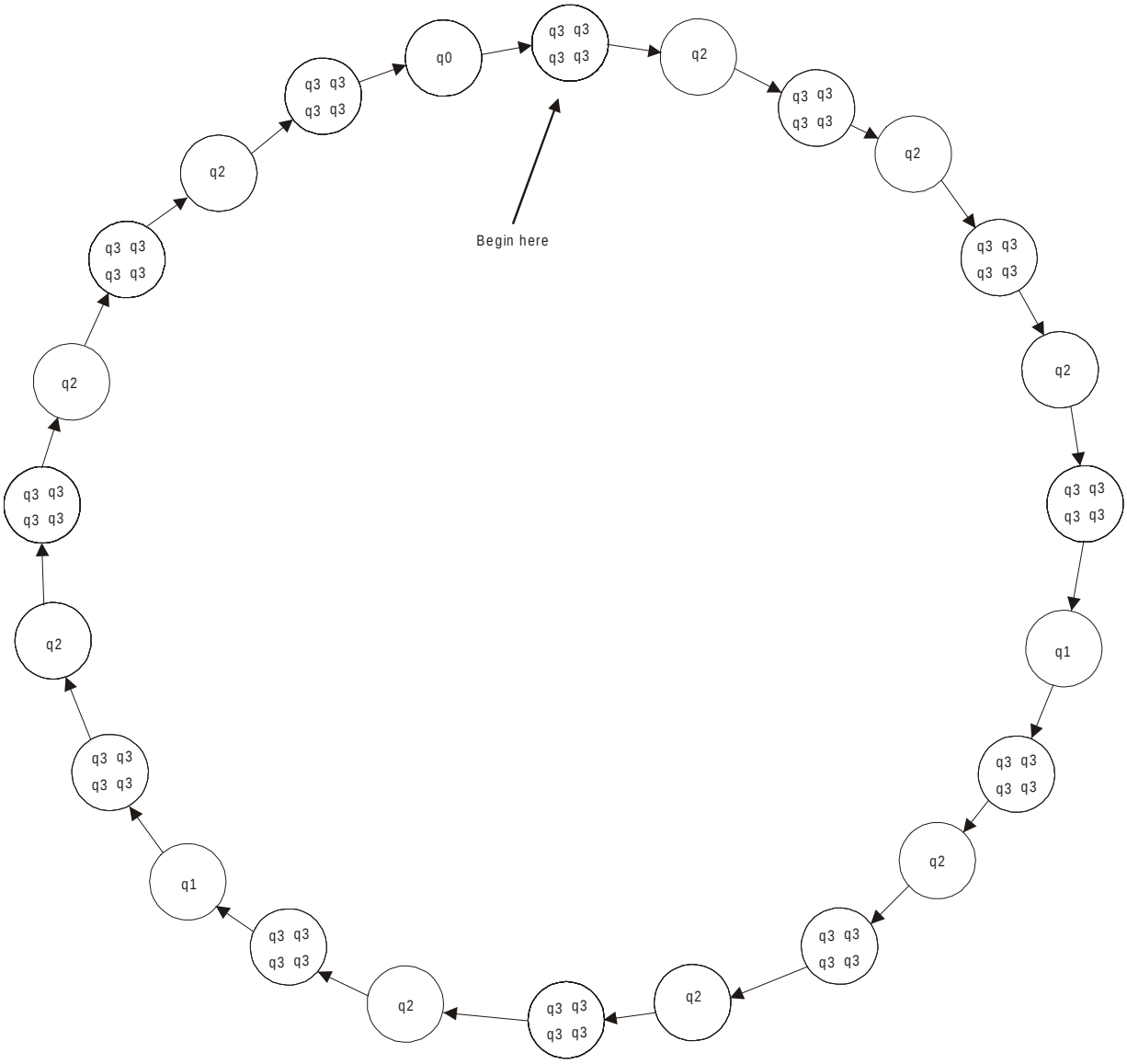
Queue 3 receives the most servicing during a cycle. The routing switch interleaves service for the lower queues in between servicing queue 3. QoS queue 0 receives the least servicing during a QoS cycle. Notice that queue 3 always makes a complete revolution before a lower queue advances. When a queue completes a revolution, the system has serviced the number of packets equal to the weight of the queue. Assuming that queue 3 is using the default weight 4, four packets are serviced in queue 3 before the system advances to the next queue to process a packet.

Table 1:, “Queue time-line using default weights,” on page 25 shows the progress of packets through the queue at each stage in the rotation of the dials shown in Figure 9.

Table 1: Queue time-line using default weights

Queue 3 (weight 4)		**Queue 2 (weight 3)**		*Queue 1* **(weight 2)**		*Queue 0* **(weight 0)**	
Total Revolutions	**Total Packets**	**Total Revolutions**	**Total Packets**	**Total Revolutions**	**Total Packets**	**Total Revolutions**	**Total Packets**
1	4		1				
2	8		2				
3	12	1	3				
4	16				1		
5	20		4				
6	24		5				
7	28	2	6				
8	32			1	2		
9	36		7				
10	40		8				
11	44	3	9				
12	48					1	1

Figure 10 shows one cycle of the QoS algorithm.



Queue 3: weight=4, minimum percentage=80%

Queue 2: weight=3, minimum percentage=15%

Queue 1: weight=2, minimum percentage=3.3%

Queue 0: weight=0, minimum percentage=1.7%

Figure 10 One full QoS cycle on an HP Routing Switch

As shown in this example, queue 3 is always processed first in a queue cycle. Queue 3's weight determines how many packets from the queue are processed before the algorithm chains to the next queue level.

The weights of the lower queues determine how many times the next higher queue will chain to them before moving to an even lower queue. Because queue 2's weight is 3, the algorithm chains from queue 3 to queue 2 three times before chaining farther down to queue 1. Because queue 1's weight is 2, the algorithm chains to queue 1 twice during the cycle, once after each iteration of servicing queue 2. Queue 0 always has a weight of 0 and always is serviced only once during the cycle, at the very end.

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