Chapter 30

Virtual Router Redundancy Protocol (VRRP)

Introduction

This chapter describes the Virtual Router Redundancy Protocol (VRRP) support provided by the switch, and how to configure the switch to participate in a virtual router.

One of the functions performed by switches is to act as a gateway to the WAN for hosts on a LAN. On larger LANs, two or more switches may act as the gateway, and hosts use a dynamic routing protocol, such as RIP or OSPF, to determine the gateway switch to use as the next hop in order to reach a specific IP destination. However, there are a number of factors, such as administrative or processing overhead, that may make it undesirable to use a dynamic routing protocol. One alternative is to use static routing. However, if the statically configured first hop switch fails, the hosts on the LAN are unable to communicate with hosts on the WAN.

The Virtual Router Redundancy Protocol, defined in RFC 2338, provides a solution to the problem by combining two or more physical switches into a logical grouping called a *virtual router* (VR). The physical switches in the virtual router operate together to provide a single logical gateway for hosts on the LAN.

Overview

The virtual router has a virtual MAC address known by all the switches participating in the virtual router. The virtual MAC address is derived from the *virtual router identifier*, which is a user-defined value from 1 to 255. All hosts on the LAN are configured with an IP address to use as the first hop. This IP address is typically owned by the preferred switch in the group of switches that constitute the virtual router. When available, this switch performs the duties of the virtual router, and is referred to as the *master*. The switch that owns the IP address associated with the virtual router is referred to as the *preferred master*. When a virtual router is configured so that none of the participating switches owns the IP address, the virtual router has no preferred master.

When a switch takes the role of master for a virtual router, it is responsible for the following:

- Responding to ARP packets for the IP addresses associated with the virtual router. The ARP response contains the virtual MAC address of the virtual router so that the hosts on the LAN associate the virtual MAC address with their configured first hop IP address.
- Forwarding packets with a destination link layer MAC address equal to the virtual router MAC address.
- Accepting packets addressed to the IP address(es) associated with the virtual router, but only if it actually owns the address(es).
- Broadcasting advertisement packets at regular intervals (at the specified advertisement interval) to inform backup switches that it is still acting as the master switch.

In accordance with the RFC standard, a user does not receive a response to ping or Telnet packets sent to the VR address unless the switch owns this address.

Each of the other switches participating in the virtual router is considered to be a *backup* switch. A switch can be part of several different virtual routers on one LAN, provided all the virtual routers have different virtual router identifiers. When a switch has the role of backup for a virtual router, it is responsible for the following:

- Receiving advertisement packets from the master and checking that the information contained in them is consistent with their own configuration; ignoring and discarding advertisement packets that do not match.
- Assuming the role of master for the virtual router if an advertisement packet is not received for a given period, (the "*master-down*" time), based on the specified advertisement interval. The "master-down" time is approximately three times the advertisement interval.
- Assuming the role of master if it receives an advertisement packet from another switch with a lower priority than its own, if preempt mode is on.

When the master switch fails, the backup switch assumes control and starts processing traffic.

If a backup switch is about to assume the role of master of the VR because it has not received an advertisement for the "master-down" period, it firsts check the operational status of the interface to which the VR is attached. If the interface is down, it does not enter the master state. Instead, it stays in the backup state and checks the interface again after another "master-down" period, assuming it does not receive an advertisement during that time.

Interface Monitoring

Specific interfaces can be monitored with the virtual router to change the priority of switches should the master switch lose its connection to the outside world. This is known as *interface monitoring*. Interface monitoring reduces the priority of the switch when an important interface connection is lost. The reduction in priority causes a backup switch with a higher priority to take over as master.

A monitored interface is one that the virtual router is dependent on for full operation. VRRP is informed if the operational status of the interface changes. If the interface is not operational, the switch's priority is reduced.

If a master switch loses its connection to the outside world, the connection to the LAN is not affected. Advertisement packets are still sent by the master and received by backup switches, but the master is unable to send data to other networks because its connection to the outside world has been lost. Interface monitoring in this situation reduces the current master's priority, causing a backup switch to take over as master and restore connectivity.

Port Monitoring

Ports that are part of a VLAN that a VR is running over can be monitored to detect port failure. This is known as *port monitoring*. Port monitoring ensures that if a port fails or is disabled, the VRRP priority is reduced by a configured step value or by an amount that reflects the proportion of the VLAN's ports that are out of service. If the switch is the master and a backup switch has a higher priority, the backup switch preempts the master and becomes the new master.

Port monitoring is a way of implementing a connectivity metric. When the connectivity to the VLAN changes, the switch drops its priority proportionally or by a specific amount when you use **stepvalue** in the command:

```
set vrrp=vr-identifier [portmonitoring={on|off}]
    [stepvalue={stepvalue|proportional}]
```

If the **stepvalue** parameter is specified, the priority of the VR is reduced by this value each time a VLAN port fails or is disabled.

If **proportional** is specified, the virtual router reduces the priority to a percentage of the original priority in proportion the percentage of available ports. For example, if a switch has five ports and a port fails, the switch drop its priority by a fifth of the original priority.

Note the following points:

- An IP interface can be deleted if it is a monitored interface, because VRRP is only monitoring the state of the interface and does not need the interface to have an IP address.
- A VLAN cannot be destroyed if it is a monitored interface of VRRP.

VRRP on the Switch

VRRP is disabled by default. When a virtual router is created on the switch, it is enabled by default, but the VRRP module must be enabled before it is operational. The VRRP module or a specific virtual router can be enabled or disabled afterwards by using the commands:

```
enable vrrp[={vr-identifier|all}]
```

```
disable vrrp[={vr-identifier|all}]
```

A virtual router must be created on at least two switches before it operates correctly. To create a virtual router for an IP address over an Ethernet interface, so that the switch participates in the virtual router, use the command:

```
create vrrp=vr-identifier over=physical-interface
    ipaddress=ipadd [adinterval=1..255] [adoptvrip={on|off}]
    [authentication={none|plaintext}] [password=password]
    [portmonitoring={on|off}
    [stepvalue={stepvalue|proportional}]] [preempt={on|off}]
    [priority=1..254]
```

To destroy a virtual router on the LAN, it must be removed from all participating switches. To remove a virtual router so that the switch no longer participates in it, use the command:

```
destroy vrrp={vr-identifier|all}
```

If the switch in the master role for the virtual router becomes unavailable, the master role is taken by the switch with the highest *priority* amongst the available switches. The priority is a value from 1 to 255, with a default of 100. The highest value of 255 is reserved for the switch that owns the virtual router's IP address. The new master takes over all the responsibilities of the original master. Hosts on the LAN can continue sending packets to the same virtual MAC address with which they associate the configured first hop IP address, even though the switch that owns the IP address is not currently available. When the preferred switch that owns the IP address becomes available again, it resumes the role of master.

By default, when a switch becomes available with a higher priority than the master, it takes over as master. This is referred to as *preempt* mode and can be set on or off. Even with preempt mode off, the switch that owns the IP address always becomes the master when available. If two or more switches that are configured with the same priority attempt to become the master at the same time, the switch with the highest IP address has higher priority. Preempt mode must be the same for all switches in the virtual router. Set the priority and preempt mode when you create the virtual router; modify it later by using the command:

```
set vrrp=vr-identifier [preempt={on|off}] [priority=1..254]
```

The frequency with which the master sends advertisement packets must be set to the same value for all switches in the virtual router. The default advertisement interval of 1 second is recommended for most networks; however, to modify this interval, use the command:

```
set vrrp=vr-identifier adinterval=1..255
```

Each of the switches in the virtual router can be configured for plaintext authentication or none. No authentication is suitable when there is minimal security risk, and the configuration is so simple (for example, two switches on a LAN) that there is little chance of configuration errors. Plaintext password authentication protects against accidental misconfiguration and prevents a switch from inadvertently backing up another switch. The authentication type and, in the case of plaintext authentication, the password, must be the same for all switches in the virtual router. By default, the virtual router has no authentication. Set authentication when you create the virtual router; modify it later by using the command:

```
set vrrp=vr-identifier authentication={none|plaintext}
   [password=password]
```

In order for the security level of the LAN to be maintained, each switch in the virtual router must have at least the minimum allowable level of security.

VRRP debugging displays data that is typically useful for troubleshooting. To enable or disable VRRP debugging, use the commands:

```
enable vrrp={vr-identifier|all} debug
```

```
disable vrrp={vr-identifier|all} debug
```

A virtual router is always created to back up one primary IP address on all the switches in the virtual router. Up to 16 secondary IP addresses can be backed up by the same virtual router, as long as they are compatible with the IP address and mask associated with the Ethernet interface over which the IP address of the virtual router is operating. Such secondary addresses must be added to all the switches in the virtual router. The virtual router's primary IP address cannot be deleted.

To add or remove secondary IP addresses, use the commands:

```
add vrrp=vr-identifier ipaddress=ipadd

delete vrrp=vr-identifier ipaddress=ipadd
```

A monitored interface is one that the virtual router is dependent on for full operation. VRRP is informed if the operational status of the interface changes. If the interface is not operational, the switch's priority is reduced. To add or remove a monitored interface to or from a virtual router, use the commands:

```
add vrrp=vr-identifier monitoredinterface=monitored-interface
    [newpriority={1..254}]

delete vrrp=vr-identifier
    monitoredinterface=monitored-interface
```

It is important that all switches involved in a virtual router be configured with the same values for the following:

- the VRRP virtual router identifier
- IP address
- advertisement interval
- preempt mode
- authentication type
- password

Inconsistent configuration causes advertisement packets to be rejected and the virtual router cannot perform properly.

Adopting the VRRP IP Address

Benefits The VRRP master router can *adopt* the IP address of the virtual router (VR), and respond to the following packets destined for the VR IP address, even if it does not own this IP address on any of its interfaces:

- ICMP echo requests (pings)
- Telnet and SSH connection requests
- HTTP and SSL GUI management requests
- SNMP requests, and
- DNS relay requests

VRRP IP address adoption allows continuous accessibility of the VR IP address even as the VR master changes. Using this feature:

- You can easily tell whether the VR is functioning, by pinging the single VR IP address.
- You can easily monitor the performance of the VR, regardless of which participating router is acting as master.
- DNS relay can continue functioning via the same IP address at all times.

Risks When VR IP address adoption is used, the master router accepts packets destined for the virtual router, even though it may not own this IP address. This does not conform to RFC 2338. Because the same IP address refers to different devices at different times, there is a risk of confusion. This risk can be reduced by a suitable network management policy.

Recommendations

Before using VR IP address adoption, consider the following guidelines:

- Ensure that the VR has an IP address that is different from the interface IP addresses of any of the individual routers in the VR.
- Ensure that all routers in the virtual router use VRRP IP address adoption (or that none do).
- Use the VR IP address to monitor the VR master. Be aware that this does not give information about one particular participating router, but about the current VR master, whichever participating router is acting as the master at the time.
- When changing the configuration of the participating routers using Telnet, GUI, or SNMP, configure each device individually by pointing to their individual IP addresses.
- When changing the configuration of the participating routers, do not use the VR IP address. Only one device, the VR master, is responding to this IP address, and you may not know which device it is.

Configuration

To configure VR IP address adoption, use **adoptvrip** in the **create vrrp** or **set vrrp** commands as follows:

```
create vrrp=vr-identifier over=physical-interface
    ipaddress=ipadd [adoptvrip={on|off}]
    [other-vrrp-parameters]

set vrrp=vr-identifier [adoptvrip={on|off}]
    [other-vrrp-parameters]
```

The **adoptvrip** parameter specifies that when the switch is acting as the VR master it should respond to requests directed at any IP address that it is backing up, even if it does not own that address. If it does not own the address, the access requests that the switch allows are limited to: ICMP echo requests (pings), Telnet, SSH, HTTP and SSL GUI, SNMP, and DNS relay. All other types of access to the address are ignored. The default is **off**.

Configure all the switches in a virtual router with the same values for the following:

- the VRRP virtual router identifier
- IP address
- adopt VR IP address mode
- advertisement interval
- preempt mode
- authentication type
- password

Inconsistent configuration causes advertisement packets to be rejected and the virtual router cannot perform properly.

To display the value of **adoptvrip**, use the command:

```
show vrrp
```

Triggers

The Trigger Facility automatically runs specified command scripts when particular triggers are activated. When an event activates a trigger, parameters specific to the event are passed to the script that must run. The **module={vrrp|88}** parameter identifies the VRRP module in trigger commands. The following table explains the two events for which triggers can be created: when the switch becomes a master, and when it ceases to be a master and becomes the backup.

Event	Description	Parameter	Argument Passed to Script
downmaster	A virtual router has been disabled or destroyed on a switch with a priority of 255, or the switch has been superseded as master for a virtual router by another switch with a higher priority and has become a backup.	The **vrid=0..255** parameter is the virtual router identifier of the virtual router for which the switch has ceased to be master, and becomes a backup. This parameter is required in the **create trigger** command and is optional in the **set trigger** command.	%1 VR ID
upmaster	A virtual router has been created or enabled on a switch with a priority of 255, or the switch has assumed the role of master for the virtual router because it has the highest priority of the switches currently available to participate in the virtual router.	The **vrid=0..255** parameter is the virtual router identifier of the virtual router for which the switch has become the master. This parameter is required in the **create trigger** command and is optional in the **set trigger** command.	%1 VR ID for which the event occurs

To create or modify a module trigger, use the commands:

```
create trigger=trigger-id module=module event=event
    [module-parameters...] [after=hh:mm] [before=hh:mm]
    [{date=date|days=day-list}] [name=name]
    [repeat={yes|no|once|forever|count}] [script=filename...]
    [state={enabled|disabled}]
    [test={yes|no|on|off|true|false}]

set trigger=trigger-id [module] [module-parameters...]
    [after=hh:mm] [before=hh:mm] [{date=date|days=day-list}]
    [name=name] [repeat={yes|no|once|forever|count}]
    [test={yes|no|on|off|true|false}]
```

Example To create trigger 1 that activates whenever the switch becomes the master of the virtual router with a VRID of 25, initiating the script MAST.SCP, use the command:

```
cre trig=1 mod=vrrp ev=upmaster vrid=25 sc=mast.scp rep=yes
```

To modify trigger 1 to activate whenever the switch becomes the master for virtual router 26, use the command:

```
set trig=1 vrid=26
```

For a full description about using triggers, see Chapter 37, Trigger Facility.

Configuration Example

The following examples show how to configure a virtual router in a LAN:

- **Master with Backup Switch**
- **Authenticated Virtual Router with No Preferred Master**

Master with Backup Switch

This example show how to configure a virtual router with a preferred master and a backup. Switch A owns the IP address of the virtual router, and always assumes the role of master whenever it is available. Switch B is the backup, and assumes the role of master, backing up this IP address if A becomes unavailable. No authentication is used for this simple virtual router.

1. **Configure IP.**

   On switch A, add an IP interface to the physical interface for the virtual router.

   ```
   enable ip
   add ip interface=vlan1 ipaddress=192.168.1.1
   ```

   On switch B, add a different IP interface to the physical interface for the virtual router.

   ```
   enable ip
   add ip interface=vlan1 ipaddress=192.168.1.2
   ```

2. **Create the virtual router.**

   On switch A, create the virtual router for this IP address with a virtual router identifier of 1.

   ```
   enable vrrp
   create vrrp=1 over=vlan1 ipaddress=192.168.1.1
   ```

   On switch B, create the same virtual router.

   ```
   enable vrrp
   create vrrp=1 over=vlan1 ipaddress=192.168.1.1
   ```

Authenticated Virtual Router with No Preferred Master

This example shows how to configure a virtual router with its own IP address. The address is not owned by any of the switches participating in the virtual router. Switch A has a higher priority for becoming the master, Switch B has the next highest priority, and Switch C takes the master role when A or B are not available. The default preempt mode ensures that the highest priority switch takes the master role when it becomes available from a lower priority switch acting as master. Plaintext authentication protects against accidental misconfiguration.

1. **Configure IP.**

   On switch A, add an IP interface to the physical interface for the virtual router.

   ```
   enable ip
   add ip interface=vlan1 ipaddress=192.168.1.1
   ```

   On switch B, add a different IP interface to the physical interface.

   ```
   enable ip
   add ip interface=vlan1 ipaddress=192.168.1.2
   ```

   On switch C, add a third IP interface.

   ```
   enable ip
   add ip interface=vlan1 ipaddress=192.168.1.3
   ```

2. **Create the virtual router.**

   On switch A, create virtual switch 2 with IP address 192.168.1.4, plaintext authentication with password "trip4e", and a high priority.

   ```
   enable vrrp
   create vrrp=2 over=vlan1 ipaddress=192.168.1.4
      authentication=plaintext password=trip4e priority=254
   ```

   On switch B, create the same virtual router, with a lower priority.

   ```
   enable vrrp
   create vrrp=2 over=vlan1 ipaddress=192.168.1.4
      authentication=plaintext password=trip4e priority=200
   ```

   On switch C, create the same virtual router with the default priority of 100.

   ```
   enable vrrp
   create vrrp=2 over=vlan1 ipaddress=192.168.1.4
      authentication=plaintext password=trip4e
   ```

   The default preempt mode ensures that the highest priority switch available always takes the master role.

   If there are no significant disadvantages to the lower priority switches having the master role, and changes where the switch takes the master role are to be avoided (for example, when a high cost is associated with each change), turn the preempt mode off on all three switches by using the command:

   ```
   set vrrp=2 preempt=off
   ```

Command Reference

This section describes the commands available on the switch to configure and manage virtual routers using VRRP.

VRRP requires the IP module to be enabled and configured correctly. See Chapter 13, Internet Protocol (IP) for detailed descriptions of the commands required to enable and configure IP.

The shortest valid command is denoted by capital letters in the Syntax section. See "Conventions" on page -xxxviii of , About this Software Reference in the front of this manual for details of the conventions used to describe command syntax. See Appendix A, Messages, for a complete list of messages and their meanings.

add vrrp

Syntax `ADD VRRP=`*`vr-identifier`* `IPaddress=`*`ipadd`*

where:

- *vr-identifier* is a decimal number from 1 to 255.
- *ipadd* is an IP address in dotted decimal form.

Description This command adds a secondary IP address to the group of IP addresses that are backed up by the specified virtual router. The maximum number of secondary IP addresses is 16.

The **ipaddress** parameter specifies the new IP address to be added to the group of IP addresses backed up by the virtual router. The IP address must be compatible with the IP address and mask associated with the Ethernet interface over which the virtual router is operating.

The new IP address must be added to all the switches participating in the virtual router.

Examples To add the IP address 202.36.163.159 to the group of IP addresses that are backed up by the virtual router whose VRID is 25, use the command:

```
add vrrp=25 ip=202.36.163.159
```

Related Commands **delete vrrp**
show vrrp

add vrrp monitoredinterface

Syntax

```
ADD VRRP=vr-identifier
   MONitoredinterface=monitored-interface
   [Newpriority=1..254]
```

where:

- *vr-identifier* is a decimal number from 1 to 255.
- *monitored-interface* is a valid interface name.

Description

This command adds a new monitored interface to a virtual router. The monitored interface is one that the VR is dependent on for full operation. VRRP is informed of changes in the interface's operational status. If the interface is not operational, the switch's priority is reduced. If the interface becomes operational again, the switch's priority is restored. If several monitored interfaces are down, the lowest new priority value is used.

The maximum number of interfaces that may be monitored by a virtual router is 60.

The **vrrp** parameter specifies the VRID of the VR that is dependent on the interface.

The **monitoredinterface** parameter specifies the interface that the VR is dependent upon. This is usually an interface that provides a WAN link to the switch and must not be the same interface over which the VR is operating (specified by the **over** parameter in the **create vrrp** command on page 30-13). The valid interface is:

- VLAN (such as vlan1)

The interface must already exist. To see a list of interfaces currently available, use the **show interface** command on page 12-36 of Chapter 12, Interfaces. A virtual router can monitor up to 60 interfaces.

The **newpriority** parameter specifies the value that is to be used as the switch's priority if the interface specified by the **monitoredinterface** parameter becomes inoperative. The default is 50.

Examples

To add the interface vlan1 to the group of interfaces monitored by the VR with VRID 5, use the command:

```
add vrrp=5 mon=vlan1 n=30
```

The **newpriority** parameter indicates that, should interface PPP1 become inoperative, the new priority value for the switch is 30.

Related Commands

create vrrp
delete vrrp monitoredinterface
destroy vrrp
show vrrp

create vrrp

Syntax

```
CREate VRRP=vr-identifier OVER=physical-interface
   IPaddress=ipadd [ADINTerval=1..255]
   [ADOPTvrip={ON|OFF}]
   [ADVertisements={ON|OFF|YES|NO|TRUE|FALSE}]
   [AUTHentication={NONE|PLAINtext}] [PASSword=password]
   [PORTMOnitoring={ON|OFF}
   [STEPVALue={stepvalue|PRoportional}]
   [PREEmpt={ON|OFF}] [DELay=0..3600] [PRIOrity=1..254]
```

where:

- *vr-identifier* is a decimal number from 1 to 255.
- *physical-interface* is a valid physical interface name.
- *ipadd* is an IP address in dotted decimal form.
- *password* is the password to use for authentication 1 to 8 characters long. It may contain any printable character, and is case sensitive.
- *stepvalue* is a decimal number from 1 to 254.

Description

This command creates a VRRP virtual router with the specified *vr-identifier* (VRID). If other VRRP virtual routers have been created on the LAN with the same VRID, the combined group forms a single virtual router. The combined virtual router performs the functions associated with the virtual router redundancy protocol. Note that the virtual router must be created on at least two routers for VRRP to operate correctly.

Inconsistent configuration causes advertisement packets to be rejected and the virtual router does not perform properly. Configure all switches involved in a virtual router with the same values for:

- the VRRP virtual router identifier
- IP address
- adopt VR IP address mode
- advertisement interval
- preempt mode
- authentication type
- password

The **adinterval** parameter specifies the time interval in seconds between advertisement packets. The default is 1 second. All switches participating in the same virtual router must be configured with the same value for this parameter.

The **adoptvrip** parameter specifies that when the switch is acting as the VRRP master it should respond to requests directed at any IP address that it is backing up, even if it does not own that address. If it does not own the address, the access requests that the switch permits are limited to: ICMP echo requests, Telnet, GUI, SNMP, and DNS relay. All other types of access to the address are ignored. The default is **off**.

Caution Setting the **adoptvrip** parameter to **on** is a departure from the RFC 2338 requirement that it "MUST NOT accept packets addressed to the IP address(es) associated with the virtual router if it is not the IP address owner".

We recommend that virtual router IP addresses not be assigned to participating switches. IP addresses should be restricted to monitoring operations and not used to configure the switches. Use with extreme caution because of confusion that may result from the adoption of the IP address.

The **advertisements** parameter specifies whether the master sends advertisement packets to inform backups it is still acting as master. When **on**, this parameter ensures the normal functionality of VRRP, which means only one device is active at any time. When **off**, this parameter could lead to more than one device responding to the same IP and MAC addresses. The default is **on**.

Caution Setting the **advertisements** parameter to **off** is a departure from RFC 2338, and could cause serious network problems. We recommend you set this parameter to **off** only in special instances when the same IP and MAC addresses are required on multiple devices. Use with extreme caution.

The **authentication** parameter specifies the type of authentication VRRP uses. If **none** is specified, no authentication is used. If **plaintext** is specified, a plaintext password is included in all transmitted VRRP packets. VRRP packets without the password are discarded when received. If **plaintext** is specified, then the **password** parameter is required. The default is **none**. All switches in the same virtual router must be configured with the same password.

The **ipaddress** parameter specifies the primary IP address backed up by the virtual router. The IP address must be compatible with the IP address and mask associated with the Ethernet interface over which the virtual router is operating. All switches in the same virtual router must be configured with the same IP address.

The **over** parameter specifies the Ethernet interface over which the virtual router sends and receives packets. The valid interface is:

- VLAN (such as vlan1)

The interface must already exist. To see a list of interfaces that are currently available, use the **show interface** command on page 12-36 of Chapter 12, Interfaces.

The **password** parameter specifies the character string to be used to authenticate the VRRP packets that are exchanged. If authentication is **plaintext**, the **password** parameter is required. If authentication is **none**, the **password** parameter is invalid. All switches in the same virtual router must be configured with the same password.

The **portmonitoring** parameter is specified when the VR is providing redundancy over a VLAN. The **portmonitoring** parameter specifies whether the VRRP should monitor the ports of the VLAN and alter the priority value if ports fail or are disabled. If the **portmonitoring** parameter is **on**, the **stepvalue** parameter may also be specified. The default is **off**.

The **preempt** parameter specifies whether a higher priority switch preempts a lower priority switch acting as the master. If **on**, preempt mode is used. The default is **on**. If this parameter is **off**, preemption cannot occur; if any preemptions are in progress, they are immediately cancelled.

The preferred master (with a priority of 255) always assumes the master role when it is available, regardless of the setting of this parameter. Note that all switches in the same virtual router must be configured with the same value for this parameter. The default is **on**.

The **delay** parameter specifies the number of seconds that a higher priority switch must wait before preempting a lower priority switch. The **delay** parameter is valid only when the **preempt** parameter is **on**. After the switch determines it has the highest priority, it waits the delay time, and then assumes control. A delay can ensure that there is adequate time for the master to update its routing tables before taking over. The default is **0** or off.

We recommend that all switches participating in the same virtual router be configured with the same **delay** value. This should be the case if all switches have an equal amount of routing information to update before becoming the new master. Command checking does not enforce this because it cannot determine the values of delays set on other switches. In some cases it may be valid to have different values on different devices; doing so does not affect the delay function as long as the value covers the "worst case" time required to fully update routing tables.

The **priority** parameter specifies the switch's priority for becoming the master for the virtual router. The higher the value the greater the priority of the switch. The value of 255 is reserved for the switch that is the preferred master (the switch owning the virtual router's IP address), and this value cannot be specified by the user. The **priority** parameter defaults to 255 for the preferred master, regardless of the value specified with this command. The default for all other switches is 100.

The **stepvalue** parameter specifies the value by which the priority of the VR should be decremented each time a VLAN port fails, or is disabled when the **portmonitoring** parameter is **on**. If **proportional** is specified, the VR reduces the priority in proportion to the percentage of available ports.

Examples

To create a virtual router with a virtual router identifier of 25 and a priority of 130 to back up the IP address 202.36.163.156, use the command:

```
cre vrrp=25 ip=202.36.163.156 prio=130
```

To create a virtual router with a virtual router identifier of 7, an IP address of 10.8.0.2 over *vlan1*, with the **portmonitoring** option enabled and a **stepvalue** of 45, use the command:

```
cre vrrp=7 over=vlan1 ip=10.0.8.2 portmo=ON stepval=45
```

Related Commands

add vrrp
destroy vrrp
set vrrp
show vrrp

delete vrrp

Syntax `DELete VRRP=`*`vr-identifier`* `IPaddress=`*`ipadd`*

where:

- *vr-identifier* is a decimal number from 1 to 255.
- *ipadd* is an IP address in dotted decimal form.

Description This command deletes a secondary IP address from the group of IP addresses backed up by the specified virtual router.

The **ipaddress** parameter specifies the IP address that is to be deleted from the group of secondary IP addresses backed up by the virtual router. This IP address must also be deleted from all other switches involved in the specified virtual router. It is impossible to delete the virtual router's primary IP address, specified when the virtual router was created.

Examples To delete IP address 202.36.163.159 from the group of IP addresses backed up by virtual router 25, use the command:

```
del vrrp=25 IP=202.36.163.159
```

Related Commands

add vrrp
disable vrrp
show vrrp

delete vrrp monitoredinterface

Syntax `DELete VRRP=`*`vr-identifier`* `MONitoredinterface=`*`monitored-interface`*

where:

- *vr-identifier* is a decimal number from 1 to 255
- *monitored-interface* is a valid interface name

Description This command deletes a monitored interface from a virtual router. The monitored interface is one that the VR is no longer dependent on for full operation. The valid interface is:

- VLAN (such as vlan1)

The interface must already have been assigned and configured. To see a list of all currently available interfaces, use the **show interface** command on page 12-36 of Chapter 12, Interfaces.

Examples To delete the interface PPP0 from the group of interfaces monitored by the VR with VRID 5, use the command:

```
del vrrp=5 mon=ppp0
```

Related Commands
add vrrp monitoredinterface
create vrrp
destroy vrrp
show vrrp

destroy vrrp

Syntax `DESTroy VRRP={`*`vr-identifier`*`|ALL}`

where *vr-identifier* is a decimal number from 1 to 255

Description This command removes the specified VRRP virtual router from the group that forms the specified VRRP virtual router. If **all** is specified, the switch is removed from all the virtual routers in which it is participating. To completely destroy a virtual router on the LAN, you must destroy all the switches participating in it.

Examples To stop the switch participating in virtual router 25, use the command:

```
dest vrrp=25
```

Related Commands
create vrrp
disable vrrp
show vrrp

disable vrrp

Syntax `DISable VRRP[={`*`vr-identifier`*`|ALL}]`

where *vr-identifier* is a decimal number from 1 to 255

Description This command disables the VRRP module on the switch, or disables the switch's participation in the specified virtual router. If **all** is specified, the switch's participation in all its current virtual routers is disabled.

The VRRP module is disabled by default, and virtual routers are enabled by default when they are created. Both the VRRP module and the virtual router must be enabled for the virtual router to operate.

Examples To disable the VRRP module on the switch, use the command:

```
dis vrrp
```

To disable the switch from participating in virtual router 25, use the command:

```
dis vrrp=25
```

Related Commands **destroy vrrp**
enable vrrp
set vrrp
show vrrp

disable vrrp debug

Syntax `DISable VRRP={`*`vr-identifier`*`|ALL} DEBug`

where *vr-identifier* is a decimal number from 1 to 255

Description This command disables the display of debugging data for the specified virtual router or all virtual routers. VRRP debugging is disabled by default.

Examples To disable the display of debugging data for virtual router 25, use the command:

```
dis vrrp=25 deb
```

Related Commands **enable vrrp debug**
show vrrp
disable debug active in Chapter 4, Configuring and Monitoring the System
show debug active in Chapter 4, Configuring and Monitoring the System

enable vrrp

Syntax `ENAble VRRP[={`*`vr-identifier`*`|ALL}]`

where *vr-identifier* is a decimal number from 1 to 255

Description This command enables the VRRP module on the switch, or enables the switch's participation in a specific virtual router. If **all** is specified, the switch's participation in all its current virtual routers is enabled.

The VRRP module is disabled by default, and virtual routers are enabled by default when they are created. Both the VRRP module and the virtual router must be enabled for the virtual router to operate.

Examples To enable the switch to participate in virtual router 25, use the command:

```
ena vrrp=25
```

Related Commands
add vrrp
create vrrp
disable vrrp
show vrrp

enable vrrp debug

Syntax `ENAble VRRP={`*`vr-identifier`*`|ALL} DEBug`

where *vr-identifier* is a decimal number from 1 to 255

Description VRRP debugging is disabled by default. This command enables the display of debugging data for all virtual routers or a specific one. The data displayed includes:

- contents of advertisement packets that are sent
- contents of advertisement packets that are received
- notification of state changes that occur within the VRRP state machine
- information about bad VRRP advertisement packets that are received.

Example To enable the display of debugging information for all the virtual routers in which the switch is participating, use the command:

```
ena vrrp=all deb
```

Related Commands
disable vrrp debug
show vrrp
disable debug active in Chapter 4, Configuring and Monitoring the System
show debug active in Chapter 4, Configuring and Monitoring the System

set vrrp

Syntax

```
SET VRRP=vr-identifier [ADINTerval=1..255]
   [ADOPTvrip={ON|OFF}]
   [ADVertisements={ON|OFF|YES|NO|TRUE|FALSE}]
   [AUTHentication={NONE|PLAINtext}] [PASSword=password]
   [PORTMOnitoring={ON|OFF}
   [STEPVALue={stepvalue|PRoportional}]
   [PREEmpt={ON|OFF}] [DELay=0..3600] [PRIOrity=1..254]
```

where:

- *vr-identifier* is a decimal number from 1 to 255.
- *password* is the password to use for authentication 1 to 8 characters long. It may contain any printable character, and is case sensitive.
- *stepvalue* is a decimal number from 1 to 254.

Description

This command changes the parameters of the specified virtual router after the virtual router has been created.

It is important that all switches involved in a virtual router be configured with the same values for:

- the VRRP virtual router identifier
- IP address
- adopt VR IP address mode
- advertisement interval
- preempt mode
- authentication type
- password

Inconsistent configuration causes advertisement packets to be rejected and the virtual router does not perform properly.

The **adinterval** parameter specifies the interval in seconds between advertisement packets. The default is 1 second. Note that all switches participating in the same virtual router must be configured with the same value for this parameter.

The **adoptvrip** parameter specifies that when the switch is acting as the VRRP master, it should respond to requests directed at all IP addresses that it is backing up, even if it does not own the address. If it does not own the address, requests that the switch permits are limited to: ICMP echo requests, Telnet, GUI, SNMP, and DNS relay. Other types of access to the address are ignored. The default is **off**.

Caution Setting the **adoptvrip** parameter to **on** is a departure from the RFC 2338 requirement that it "MUST NOT accept packets addressed to the IP address(es) associated with the virtual router if it is not the IP address owner". We recommend that virtual router IP addresses not be assigned to participating switches. IP addresses should be restricted to monitoring operations and not used to configure the switches. Use with extreme caution because of confusion that may result from the adoption of the IP address.

The **advertisements** parameter specifies whether the master sends advertisement packets to inform backups it is still acting as master. When **on**, this parameter ensures the normal functionality of VRRP, which means only one device is active at any time. When **off**, this parameter could lead to more than one device responding to the same IP and MAC addresses. The default is **on**.

Caution Setting the **advertisements** parameter to **off** is a departure from RFC 2338, and could cause serious network problems. We recommend you set this parameter to **off** only in special instances when the same IP and MAC addresses are required on multiple devices. Use with extreme caution.

The **authentication** parameter specifies the type of authentication that VRRP uses. If **none** is specified, no authentication is used. If **plaintext** is specified, a plaintext password is included in all transmitted VRRP packets.VRRP packets without the password are discarded when received. If **plaintext** is specified, then the **password** parameter is required. The default is **none**. All switches in the same virtual router must be configured with the same password.

The **password** parameter specifies the character string to be used to authenticate the VRRP packets that are exchanged. This parameter is valid if authentication is **plaintext**. All switches in the same virtual router must be configured with the same password.

The **portmonitoring** parameter is valid when the VR is providing redundancy over a VLAN. The **portmonitoring** parameter specifies whether the VRRP should monitor the ports of the VLAN and alter the priority value if ports fail or are disabled. If the **portmonitoring** parameter is **on**, the **stepvalue** parameter may also be specified. The default is **off**.

The **preempt** parameter specifies whether a higher priority switch preempts a lower priority switch acting as the master. If **on**, preempt mode is used. The default is **on**. If this parameter is **off**, preemption cannot occur; if any preemptions are in progress, they are immediately cancelled.

The preferred master (with a priority of 255) always assumes the master role when it is available, regardless of how the **preempt** parameter is set. Note that all switches participating in the same virtual router must be configured with the same value for this parameter.

The **delay** parameter specifies the number of seconds that a higher priority switch must wait before preempting a lower priority switch. The **delay** parameter is valid only when the **preempt** parameter is **on**. After the switch determines it has the highest priority, it waits the delay time, and then assumes control. A delay can ensure that there is adequate time for the master to update its routing tables before taking over. The default is **0** or off.

We recommend that all switches participating in the same virtual router be configured with the same **delay** value. This should be the case if all switches have an equal amount of routing information to update before becoming the new master. Command checking does not enforce this because it cannot determine the values of delays set on other switches. In some cases it may be valid to have different values on different devices, and doing so does not affect the delay function as long as the value covers the “worst case” time required to fully update routing tables.

The **priority** parameter specifies the switch's priority for becoming the master for the virtual router. The higher the value, the greater the priority of the switch. The value of 255 is reserved for the switch that is the preferred master (the switch owning the virtual router's IP address), and this value cannot be specified by the user. The **priority** parameter defaults to 255 for the preferred master, regardless of the value specified with this command. The default for all other switches is 100.

The **stepvalue** parameter specifies the value by which the priority of the VR should be decremented each time a VLAN port fails, or is disabled when the **portmonitoring** parameter is **on**. If a number is specified, the priority of the VR is reduced by this value each time a VLAN port fails or is disabled. If **proportional** is specified, the VR reduces the priority to a percentage of the original priority in proportion to the percentage of available ports. The value specified for the **stepvalue** parameter is retained when port monitoring is disabled.

Examples

To change the authentication settings of virtual router 25 to plaintext password authentication with password *baN8na*, use the following command:

```
set vrrp=25 auth=plain pass=baN8na
```

To enable the **portmonitoring** feature on the virtual router number 10 and set the **stepvalue** to 100, use the following command:

```
set vrrp vrid=10 portmo=on stepval=100
```

Related Commands

add vrrp
create vrrp
delete vrrp
destroy vrrp
disable vrrp
enable vrrp
show vrrp

show vrrp

Syntax `SHow VRRP[=`*`vr-identifier`*`]`

where *vr-identifier* is a decimal number from 1 to 255

Description This command displays information about a specific virtual router or all the virtual routers in which the switch is participating (Figure 30-1, Table 30-1 on page 30-24).

Figure 30-1: Example output from the **show vrrp** command

```
Virtual Router Identifier ............. 1

 Configuration:
  VR MAC ADDRESS ..................... 00-00-5E-00-01-01
  Interface .......................... ppp0
  Priority ........................... 255
  State .............................. INITIAL
  Authentication ..................... None
  Password ........................... NOT SET
  IP Address(es) ..................... 202.36.163.156
  Advertisements ..................... ON
  Advertisement Interval ............. 1
  Preempt Mode ....................... ON
  Preempt Mode Delay (seconds)....... 60
  Port Monitoring .................... ON
  Step value ......................... 40
Monitored Interfaces:
  Interface .......................... ppp1
    New Priority ..................... 40
  Interface .......................... ppp4
    New Priority ..................... 55

Triggers:
  UpMaster Trigger ID ................ 0
  Down Master Trigger ID ............. 4

Counters:
  Good Advertisements Received ...... 0
  Bad Advertisements Received ....... 0
  Master Periods ..................... 0
  Advertisements Sent ................ 0
  Up Master Trigger Activations ..... 0
  Down Master Trigger Activations ... 1
```

Table 30-1: Parameters in output of the **show vrrp** command

Parameter	Meaning
Virtual Router Identifier	Virtual router identifier.
VR MAC Address	Virtual router's MAC address, derived from the virtual router identifier
Interface	LAN interface the VR is operating on.
Priority	Priority of the switch for assuming the master role for the virtual router
State	Current status of the switch in the virtual router, which may be master, backup or initial. *Initial* indicates that either the virtual router or the VRRP module is disabled.
Master IP Address	IP address of the switch that is currently the master. This is not displayed when the switch is the master.
Authentication	Whether the virtual router uses no authentication or plaintext.
Password	Whether the authentication password is set.
Adopt VR IP Address(es)	Whether the switch should respond to ICMP echo, Telnet, GUI, SNMP and DNS relay service requests targeted at the VR IP addresses associated with the virtual router, even if it does not own those addresses.
IP Address(es)	Shows IP addresses associated with the virtual router.
Advertisements	Whether the master sends advertisement packets to inform backups it is still acting as master.
Advertisement Interval	Period in seconds between advertisement packets.
Preempt Mode	Whether preempt mode is on. When on, the switch determines whether a higher priority switch assumes the master role over one with lower priority.
Preempt Mode Delay (seconds)	Period in seconds that the switch delays before assuming the master role after it has determined that its priority is greater than all other switches. Valid only when preempt mode is on.
Port Monitoring	Whether the port monitoring feature is on. This parameter is displayed when the VR operates over a VLAN interface.
Step value	If a number is shown, this is the value by which the priority of the VR is reduced for each VLAN port that fails or is disabled. If "PROPORTIONAL" is shown, the priority is reduced in proportion to the percentage of VLAN ports that are out of service.
Monitored Interfaces	List of interfaces on which the VR is dependent and those that VRRP monitors.
Interface	Name of an interface being monitored by VRRP for this VR.
New Priority	New priority that the switch uses when this interface becomes inoperative.
Triggers	
Up Master Trigger ID	ID number of the trigger to be activated when the VR becomes the master router (upmaster trigger).
Down Master Trigger ID	ID number of the trigger to be activated when the VR ceases to be the master router (downmaster trigger).
Counters	

Table 30-1: Parameters in output of the **show vrrp** command (Continued)

Parameter	Meaning
Original Priority	The original priority of the port before being affected by either the port monitoring or monitored interface feature.
Good Advertisements Received	Number of acceptable advertisement packets received by the switch for this virtual router.
Bad Advertisements Received	Number of unacceptable advertisement packets received by the switch for this virtual router.
Master Periods	Number of periods when the switch has been the master switch.
Advertisements Sent	Number of advertisement packets sent by the switch.
Up Master Trigger Activations	Number of times an upmaster trigger has been activated for this VR.
Down Master Trigger Activations	Number of times a downmaster trigger has been activated for this VR.

Examples

To display information about a virtual router whose VRID is 25, use the command:

```
sh vrrp vrid=25
```

Related Commands

add vrrp
create vrrp
delete vrrp
destroy vrrp
disable vrrp
disable vrrp debug
enable vrrp
enable vrrp debug
set vrrp