

Using the Virtual Router Redundancy Protocol for Gateway Redundancy

The standards-based Virtual Router Redundancy Protocol (VRRP) enables network administrators to design and implement default gateway redundancy on LAN segments. VRRP configurations can be implemented using Dell™ PowerConnect™ 6024 Gigabit Ethernet routing switches.

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The Virtual Router Redundancy Protocol (VRRP) is an Internet Engineering Task Force (IETF) standard protocol that provides gateway redundancy for LANs. All hosts on a LAN require a default gateway to be configured so all packets that have a destination outside the LAN can be routed properly. VRRP was developed to allow continuous connectivity despite a gateway router failure. This protocol enables grouped gateway routers to withstand a single router failure by having a preconfigured second router seamlessly take its place. As a result, all network hosts on the LAN segment can have continual connectivity to resources outside the local segment.

Standards-based VRRP versus proprietary protocols

Developed by the IETF, VRRP is well documented in RFC 3768¹ and has become an industry standard. Because it is an open standard and the inner workings and functionality of the protocol are available for anyone to study, VRRP is easier to understand and support than proprietary

protocols. As a result, training and support costs for VRRP configurations are typically lower than those for configurations using proprietary protocols.

As an open standard, VRRP can be implemented by multiple vendors without restriction. Because these vendors must comply with the established standard, product interoperability usually results. The Dell PowerConnect 6024 and 6024F routing switches comply with the IETF standard for VRRP.

VRRP benefits

VRRP allows multiple routers to use the same virtual IP address. If a router fails, VRRP enables a quick failover with minimal interruption of traffic flow to and from network hosts. Because VRRP provides redundancy, system administrators can assign a default gateway IP address to hosts and servers, and even if a router fails, the gateway address remains accessible. This also keeps administrators from having to physically visit individual systems to change the default gateway address, which is

¹ "IETF RFC 3768: Virtual Router Redundancy Protocol (VRRP)," by the Internet Engineering Task Force Network Working Group, April 2004, www.ietf.org/rfc/rfc3768.

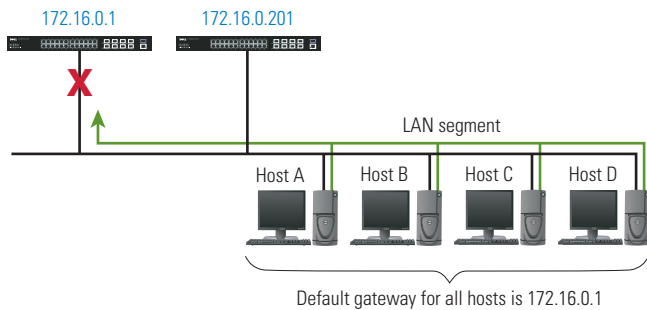


Figure 1. LAN using a single gateway router

required when a gateway fails. Remote access becomes impossible without network connectivity through gateway routers.

Another benefit of the redundancy that VRRP provides is that system administrators can include a default gateway IP address as a Dynamic Host Configuration Protocol (DHCP) option on their DHCP server, and this address will not change. Therefore, reconfiguration of DHCP servers is not necessary when a gateway router failure occurs.

Components of a VRRP configuration

VRRP uses the following components to create virtual router redundancy:

- **VRID:** VRRP uses a common virtual router identification (VRID) number to group the gateway routers. The number is arbitrary and can range from 1 to 255. Each VRID group has its own unique VRID number.
- **Master router:** The VRRP router controlling the IP address associated with the virtual router group is called the master. It answers Address Resolution Protocol (ARP) requests and forwards traffic for the network segment. If the IP address of the virtual router group and an interface in the VRRP group match, VRRP automatically selects that router to become the master if not configured statically.
- **Backup router:** The backup router remains available, ready to assume the role of master should the current master fail. The master and backup communicate via heartbeat messages sent by the master once every second (this is the default interval;

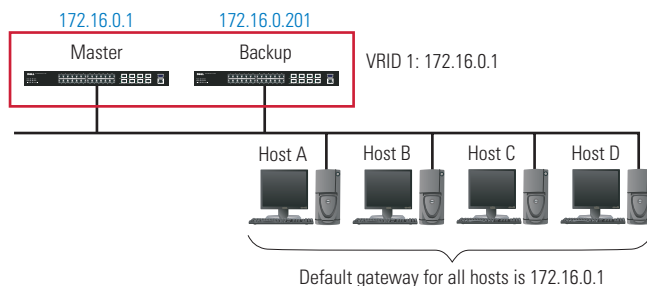


Figure 2. LAN using two gateway routers in an active/passive configuration

it is configurable) using the multicast address 224.0.0.18 (the multicast address assigned to VRRP routers). When three heartbeats are missed, the backup router becomes the master.

The role of VRRP in an enterprise environment is illustrated in Figures 1–4. In the example environment shown in Figure 1, all hosts have the IP address 172.16.0.1 configured as the default gateway address on the LAN segment. If the gateway router fails, connectivity to hosts or servers outside this segment also fails.

Two gateway routers: Active/passive

Figure 2 shows two gateway routers in an active/passive configuration for VRRP. Even though they have different IP addresses assigned to their network interfaces attached to this LAN segment, they have both been given a VRID in the form of a locally reached IP address. This address may be the same as one of the gateway router’s addresses.

In this example, the routers have been assigned roles of master (active) and backup (passive). The master router is the gateway through which all traffic flows in and out of the segment. The backup router remains in a standby mode until the master fails.

Two gateway routers: Active/active

To use the second gateway router and thus avoid stagnant hardware, administrators can provide each router with a VRID for an active/active configuration (see Figure 3). This provides two default gateways to the LAN segment. The hosts on the network can be divided into two groups, and each group assigned its own default gateway address. Each gateway address correlates to a different VRID, and the traffic is divided between the two gateway routers, resulting in load balancing. Along with load balancing, benefits of this configuration include full router redundancy and full device usage.

Three gateway routers

The next scenario, shown in Figure 4, provides additional redundancy to the gateway router group. This configuration is similar to the one shown in Figure 3, except a third router is used as a backup router for each VRID group. No traffic is sent through the backup

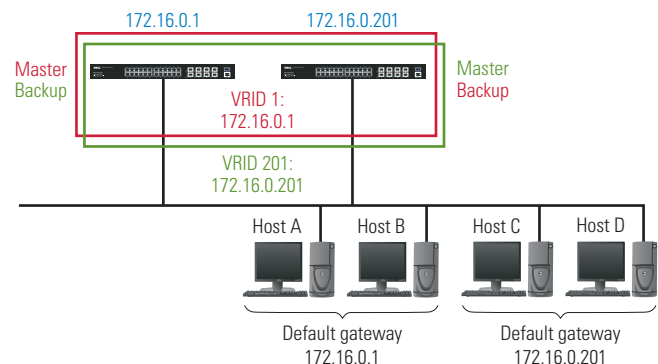


Figure 3. LAN using two gateway routers in an active/active configuration

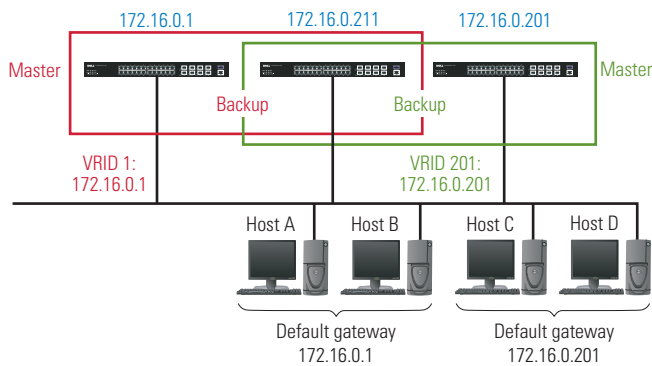


Figure 4. LAN using three gateway routers

router unless one of the master routers fails. This provides full redundancy for the master routers, although the backup router may become overloaded if both master routers fail at the same time.

Steps for setting up a VRRP configuration

VRRP configurations can use a single VRID or multiple VRIDs. This section outlines the steps administrators can take to configure the master gateway router and the backup router for single- or multiple-VRID environments as well as commands for saving and verifying VRRP configurations.

Configuring the master router

Administrators should enter the interface configuration mode for the interface running VRRP. Note that an IP address must first be defined on the interface before VRRP is configured:

```
switch-1(config)# interface ethernet g1
switch-1(config-if)# ip address 172.16.0.1 /16
```

To configure VRRP on the interface, administrators must first define the VRID for the gateway group. This address can be (but is not required to be) the same as the IP address for the interface:

```
switch-1(config-if)# vrrp 10 ip 172.16.0.1
```

Next, administrators should set the priority of the gateway group member. The priority determines which gateway router is the master. The priority values range from 1 to 255, with the higher number being the master:

```
switch-1(config-if)# vrrp 10 priority 255
```

It is also necessary to specify whether this gateway router will automatically regain its active status when it comes back online after a failure. To do this, administrators can use the `preempt` option:

```
switch-1(config-if)# vrrp 10 preempt
```

VRRP also allows definition of the advertisement interval, or *heartbeat*, between the routers. The default value is one second, which allows for rapid failover, but this can be changed if desired. All virtual routers must have the same timer value for the heartbeat:

```
switch-1(config-if)# vrrp 10 timer 2
```

Finally, administrators can activate the VRRP configuration on the router with the `up` option:

```
switch-1(config-if)# vrrp 10 up
```

At this point, half of the configuration is complete. An informational message similar to the following should appear:

```
1-Jan-2006 1:01:00 %VRRP-W-BCKMSTR: VRRP router
with id 10 and masterIpAddr 172.16.0.1 became
a master
```

Configuring the backup router

Figure 5 shows commands for configuring the backup router. The `priority` and `preempt` options are not needed because the master has been defined on another router. The backup router has the default priority value of 100 if no value is defined. A third and fourth backup router can be defined using the `priority` values, if desired.

Configuring multiple VRIDs

When configuring multiple VRIDs for full gateway redundancy, both routers can be configured with dual roles. For instance, the master for one VRID can be the backup for a second VRID. This way, both gateway routers are used. Both configurations can use the same interfaces, different physical interfaces, or virtual LAN (VLAN) interfaces. The commands shown in Figure 6 can be used, in addition to the commands already presented, to configure another VRID, resulting in a dual-gateway configuration.

Saving the configuration

All of these configuration settings can be saved in the `startup-config` file stored in the flash memory on each switch by using the `copy`

```
switch-2# configure
switch-2(config)# interface ethernet g1
switch-2(config-if)# ip address 172.16.0.201 /16
switch-2(config-if)# vrrp 10 ip 172.16.0.1
switch-2(config-if)# vrrp 10 timer 2
switch-2(config-if)# vrrp 10 up
```

Figure 5. Configuring the backup router

running-config startup-config command. This file can be transferred and stored on a Trivial File Transfer Protocol (TFTP) server for backup, restoration, and later review.²

```
switch-2(config)# interface ethernet g1
switch-2(config-if)# ip address 192.168.0.1 /24
switch-2(config-if)# vrrp 20 ip 192.168.0.1
switch-2(config-if)# vrrp 20 priority 255
switch-2(config-if)# vrrp 20 preempt
switch-2(config-if)# vrrp 20 timer 5
switch-2(config-if)# vrrp 20 up

switch-1(config)# interface ethernet g1
switch-1(config-if)# ip address 192.168.0.201 /24
switch-1(config-if)# vrrp 20 ip 192.168.0.1
switch-1(config-if)# vrrp 20 timer 5
switch-1(config-if)# vrrp 20 up
```

Figure 6. Creating a dual-VRID configuration

```
switch-1# show vrrp status
Interface VRID Address State Master MAC address
-----
g1 10 172.16.0.1 master 172.16.0.1 00:00:5e:00:01:0a
g1 20 192.168.0.1 backup 192.168.0.1 00:00:5e:00:01:14

switch-1# show vrrp configuration
Interface VRID Address Priority Timer Auth Preempt Source-ip State
-----
g1 10 172.16.0.1 100 2 No Yes 0.0.0.0 up
g1 20 192.168.0.1 255 3 No Yes 0.0.0.0 up

switch-2# show vrrp status
Interface VRID Address State Master MAC address
-----
g1 10 172.16.0.1 backup 172.16.0.1 00:00:5e:00:01:0a
g1 20 192.168.0.1 master 192.168.0.1 00:00:5e:00:01:14

switch-2# show vrrp configuration
Interface VRID Address Priority Timer Auth Preempt Source-ip State
-----
g1 10 172.16.0.1 100 2 No Yes 0.0.0.0 up
g1 20 192.168.0.1 255 3 No Yes 0.0.0.0 up
```

Figure 7. Verifying the VRRP configuration and operation on each virtual router

Verifying the VRRP configuration and operation


Figure 7 shows commands that can be used to verify the configuration and operation of VRRP on each virtual router. The show vrrp status command shows VRID status for each virtual router on the switch, including the IP address, current switch role, and master IP and Media Access Control (MAC) addresses. The show vrrp configuration command shows the configured VRRP settings for each virtual router, such as the priority value, heartbeat timer, preempt setting, and current status.

VRRP on Dell PowerConnect 6024 switches

The following additional VRRP features can be used on Dell PowerConnect 6024 routing switches:

- **Authentication:** A specific plain-text password can be set to verify that each virtual router is receiving the correct heartbeat messages.
- **Source IP:** The source IP address used for VRRP messages on an interface can be used to control the IP and MAC addresses that the virtual router uses to build packets and provide responses when queried by ARP.

Enhanced gateway redundancy for LANs

The Virtual Router Redundancy Protocol can provide three or more levels of gateway protection and redundancy for network hosts and servers. When failures occur, only minimal downtime—usually a matter of seconds—is typically experienced before access to the remote network is restored. Furthermore, as an open standard, VRRP allows for multi-vendor interoperability and low support costs. 

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FOR MORE INFORMATION

Dell networking:
www.dell.com/networking

²For more information about these configuration files, see the “Configuration and Image Files” section in the Dell PowerConnect 6024/6024F Systems CLI Reference Guide at support.dell.com/support/edocs/network/pc6024/en/cli/html/configim.htm.