Technical Guide

Virtual Router Redundancy Protocol (VRRP)

Feature Overview and Configuration Guide

VRRP Introduction

This guide describes the Virtual Router Redundancy Protocol (VRRP) feature provided by AlliedWare Plus Layer 3 devices (L3 switches and routers), and how to configure them to participate in a virtual router.

One function of an L3 device is to act as a gateway to the WAN for hosts on a LAN. On larger LANs, two or more L3 devices may act as the gateway, using a dynamic routing protocol, such as RIP or OSPF. However, there are a number of factors, such as administrative or processing overhead or even support for the protocols, which may make it undesirable to use a dynamic routing protocol. One alternative is to use static routing; however, if the statically configured first hop device fails, the hosts on the LAN are unable to communicate with those located on at remote networks via the WAN without any form of ICMP[1] redirect.

The Virtual Router Redundancy Protocol is defined in RFC 5798 (Virtual Router Redundancy Protocol (VRRP) Version 3 for IPv4 and IPv6). It provides a solution to the problem by combining two or more physical L3 devices into a logical grouping called a virtual router. The physical devices then operate together to provide a single logical gateway for hosts on the LAN.

A virtual router is configured as the host's gateway and comprises a number of physical devices. The hosts can only see the virtual router so the number of physical devices that make up the virtual router is transparent. If physical devices in the virtual router fail, then traffic to and from the hosts will still be forwarded, so as long as there is at least one functioning physical device, no configuration changes will be required by the hosts.

1.ICMP (Internet Control Message Protocol), sends network error messages

Products and software version that apply to this guide

This guide applies to AlliedWare Plus™ products that support VRRP, running version **5.4.4** or later.

To see whether your product supports VRRP, see the following documents:

- The product's Datasheet
- The product's Command Reference

These documents are available from the above links on our website at alliedtelesis.com.

Most features described in this document are supported from AlliedWare Plus 5.4.4 or later. The following features are available in later releases:

- Version 5.4.6-1.x and later supports multiple circuit-failover - see "VRRP multiple circuit-failover configuration" on page 25.
- Version 5.4.7-2.x and later supports preempt delay - see "VRRP election, preempt and preempt delay-time for IPv4" on page 7. This is also supported for IPv6.
- Version 5.5.2-2.1 and later supports VRRP on ethernet interfaces and 802.1q sub-interfaces on the 10GbE UTM Firewall and AR4000S-Cloud - see "VRRP preferred Master with Backup configuration on a 10GbE UTM firewall or an AR4000S-Cloud firewall" on page 18 for an example. Ethernet interfaces and 802.1q sub-interfaces are not supported on other UTM firewalls and VPN routers.

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Virtual Router Redundancy Protocol

The VRRP virtual router comprises a Master router and a number of Backup routers. The Master router is the router responsible for forwarding packets between the hosts and the remote network. It is also responsible for informing the Backup router(s) of its presence. Should the Master router fail, then one of the Backup routers takes over the Master router role.

The virtual router uses a special reserved MAC address, which is called the VRRP virtual MAC. This MAC address is returned by the Master router of the virtual router in any ARP responses relating to the gateway IP address, regardless of which device is acting as the Master router. By using this shared MAC address across routers, hosts maintain connectivity with the remote network if a router fails with a Backup taking over as Master.

Note: If there are PIM-SM routers using VRRP, the Bootstrap Router (BSR) function will not work properly.

The virtual router has a virtual MAC address that is known by all its participating L3 devices. The virtual MAC address is derived from the virtual router identifier, a user-defined value from 1 to 255. At the network level, all hosts on the LAN are configured with a common IP address that is used as the first hop. This IP address is typically owned by the virtual router's preferred individual L3 device. When available, this device performs the duties of the virtual router, and is referred to as the **Master**. The L3 device 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 L3 devices own the IP address, the virtual router has no preferred Master.

When an L3 device takes the role of Master for a virtual router, it is responsible for the following:

- Responding to ARP and Neighbor solicitation packets that contain IP addresses associated with the virtual router. The ARP reply or Neighbor 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. Note that with VRRPv3 supporting both IPv4 and IPv6, the IP address in this context can be an IPv4 or an IPv6 address.
- Forwarding packets with a destination Link Layer MAC address equal to the virtual router MAC address.
- The VRRPv3 **accept** mode is enabled by default in the AlliedWare Plus VRRPv3 implementation. This enables a VRRP Master to accept packets addressed to the virtual router IP address even if this IP address is not owned by the VRRP Master.
- Broadcasting advertisement packets at regular intervals (at the specified advertisement interval) to inform Backup devices that it is still acting as the Master device.

Each of the other devices participating in the virtual router is considered to be a Backup device.

An L3 device can be a member of several different virtual routers on one LAN, but each virtual router must have a unique identifier (VRID). When an L3 device has the role of Backup for a virtual router, it must be able to perform the following tasks:

- Receive advertisement packets from the Master and check that the information contained in them is consistent with their own configuration; ignoring and discarding advertisement packets that do not match.
- Assume 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 (for example, the command: **awplus(config-router)# advertisement-interval 5** will set the advertisement-interval to 5 seconds). The 'master-down' time is approximately three times the advertisement interval.
- Assume the role of Master if it receives an advertisement packet from another device with a lower priority than its own, and if **preempt** mode is on.

If a VRRP instance is running on a VLAN interface and the VLAN interface goes down, then the VRRP instance, whether it is a VRRP Master or a VRRP Backup, moves to an INIT state. When in the INIT state the VRRP instance on the VLAN interface cannot receive traffic, and will not be active until the VLAN interface is up

Note: When using VRRPv3 with VCStacking, ensure that the VRRPv3 'advertisement-interval' is configured to a longer time than the VCStacking failover time. If the VRRPv3 advertisement-interval is shorter than the VCStacking failover time, then a VRRPv3 failover will also occur whenever a VCStacking failover occurs. Use seconds not centiseconds to ensure interoperability with VRRPv2.

VRRP Configuration for IPv4

VRRP for IPv4 is disabled by default. Once you have defined a virtual router session, you must enable VRRP to make the session operational for a given interface.

You can then enable or disable the virtual router, and configure it as shown below. These examples use a switch as the physical L3 device. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

To enable VRRP

`awplus(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the virtual router ID (VRID) for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`awplus(config-router)#` `enable`	Enable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

To disable VRRP

`awplus(config)#` `router vrrp 1 vlan2`	Specify an existing VRRP session, specify the virtual router ID (VRID) for the session, and specify the interface that is participating in virtual routing (**vlan2** in this example).
`awplus(config-router)#` `disable`	Disable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

A virtual router must be defined on at least two L3 devices before it operates correctly. Use the following steps to configure virtual routing. Note that this example uses a switch and assumes that VLAN 2 already exists on the switch.

To configure virtual routing

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface (vlan2 in this example) that will participate in virtual routing.

`awplus(config-router)#` `virtual-ip 10.10.10.50 master`	Set the virtual IP address for the VRRP session. Define the default state (Master or Backup) of the VRRP router within the virtual router. This sets the default Master priority value of 255 without needing to issue a priority command separately.
`awplus(config-router)#` `enable`	Enable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

To destroy a virtual router on the LAN, it must be removed from all participating L3 devices. Use the following commands to remove a virtual router so that the L3 device no longer participates in virtual routing.

To remove the virtual router

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `no router vrrp 1 vlan2`	Remove the desired VRRP session for the specified interface (**vlan2** in this example).
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

Alternatively, you can simply disable the virtual router and retain the configuration.

To disable the router and retain the configuration

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router vrrp 1 vlan2`	Select the VRRP session, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `disable`	Disable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration prompt.

VRRP election, preempt and preempt delay-time for IPv4

If the L3 device that is the current VRRP Master becomes unavailable, the Master role is taken by the device with the next highest priority. The priority is a value from 1 to 255, with a default of 100. The value 255 is reserved for the device that owns the virtual router's IP address. The new Master takes over all the responsibilities of the original Master.

By default, when an L3 device becomes available that has a higher priority than the Master, this device takes over as Master. This is referred to as **preempt mode** and can be set **on** or **off**. Even with **preempt** mode **off**, the device that owns the IP address always becomes the Master when available. **Preempt** mode should be the same for all L3 devices in the virtual router.

Preempt delay

From software version **5.4.7-2.x** onwards, you can configure a preempt mode **delay-time**. If this is configured, the device will pause for the specified time before preempting the lower priority device and becoming master. The delay-time allows the device to become stabilized in the network before preempting the routing role from the lower priority device.

If two L3 devices are configured with the same priority and a conflict occurs when they both transition to master simultaneously, the one with the highest IP address has higher priority. Due to timing differences, the conflict may not always occur and simply the first device to respond will become the master. Hosts on the LAN can continue sending packets to the virtual MAC address they originally associated with the first hop IP address, even though the device that owns the IP address is not currently available. When the original device becomes available again, if it is a preferred device (i.e. it owns the virtual router IP address) then it resumes the role of master.

Note: If the device is the owner of the virtual-ip, it will ignore the preempt setting, and therefore also ignore the delay-time, and preempt immediately to become master. If the device doesn't detect another VRRP device on the network (by receiving an advertisement) when it is first enabled and has transitioned to the backup state, it will then ignore the delay-time and become master after the master down time has elapsed. In this case, this isn't a preempt situation so the delay-time won't be used.

Use the following commands to set the priority and **preempt** mode when you create the virtual router:

To set the priority and preempt mode for VRRP 1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `priority 255`	Set the VRRP priority for the device.
`awplus(config-router)#` `preempt-mode true`	Select the **preempt** mode for and optional delay-time for VRRP 1. Note, you only need to set **preempt** mode to true if this has been set to false, or if a delay time is required (see example below). Preempt is **true** with no delay-time by default.
`awplus(config-router)#` `enable`	Enable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration prompt.

The advertisement interval determines the rate at which the Master sends its advertisement packets. This rate must be the same value for all L3 devices in the virtual router. The default advertisement interval of 1 second can be used for most networks. However, you can modify this interval by using the **advertisement-interval** command, as shown in the following procedure:

To set the advertisement interval to 5 seconds on VRRP1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `advertisement-interval 5`	Set the advertisement interval to **5** seconds.

To set the preempt delay time to 30 seconds on VRRP1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `preempt-mode true delay-time 30`	Set the delay time to **30** seconds.

The preempt delay-time determines how long a higher priority VRRP device will wait before preempting a lower priority device. The default is **delay-time 0**. The default value of 0 means that the delay-time is disabled and that a preempt will occur immediately.

To disable the preempt delay-time on VRRP1

You can disable the preempt delay-time using any one of the three following ways (in Global Configuration mode):

1.

`awplus(config)#` `router vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `preempt-mode true delay-time 0`	Configure the ‘delay-time’ as 0. Note if you specify the ‘delay-time’ parameter, you must enter a value as well.

OR

2.

`awplus(config-router)#` `preempt-mode true`	Omit the ‘delay-time’ parameter from the command.

OR

3.

`awplus(config-router)#` `preempt-mode false`	Set **preempt-mode** to ‘false’ This will clear the delay-time and if you configure the preempt-mode to ‘true’ again, the delay-time will still be set to zero (0) until you set it to another value.

VRRP Configuration for IPv6

VRRP for IPv6 is disabled by default. Once you have defined a virtual router session, you must enable VRRP to make the session operational for a given interface.

These examples use a switch as the physical L3 device. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

You can enable or disable the virtual router as shown:

To enable VRRP

`awplus(config)#` `router ipv6 vrrp 1 vlan2`	Create a new VRRP session on the router, specify the virtual router ID (VRID) for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`awplus(config-router)#` `enable`	Enable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

To disable VRRP

`awplus(config)#` `router ipv6 vrrp 1 vlan2`	Specify an existing VRRP session, specify the virtual router ID (VRID) for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`awplus(config-router)#` `disable`	Disable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

A virtual router must be defined on at least two devices before it operates correctly. Use the following steps to configure virtual routing on a device. Note that this example uses a switch and assumes that vlan2 already exists on the switch.

To configure virtual routing

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router ipv6 vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example) .
`awplus(config-router)#` `virtual-ipv6 fe80::1 master`	Set the virtual IP address for the VRRP session. Define the default state (Master or Backup) of the VRRP router within the virtual router. This sets the default Master priority value of 255 without needing to issue a priority command separately. Note that fe80: :1 is an IPv6 link-local address. The AlliedWare Plus VRRPv3 implementation supports one IPv6 virtual link local address per virtual router ID. See the Usage note for the **virtual-ipv6** command for implementation information about link-local addresses in AlliedWare Plus.
`awplus(config-router)#` `enable`	Enable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

To destroy a virtual router on the LAN, it must be removed from all participating L3 devices. Use the following commands to remove a virtual router so that the device no longer participates in virtual routing.

To remove the virtual router VRRP 1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `no router ipv6 vrrp 1 vlan2`	Remove the VRRP session on the device for the specified interface **vlan2**.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration mode prompt.

Alternatively, you can simply disable the virtual router and retain the configuration.

To disable the router and retain the configuration

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router ipv6 vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `disable`	Disable the VRRP session.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration prompt.

VRRP election, preempt and preempt delay-time for IPv6

If the device that is the current VRRP Master becomes unavailable, the Master role is taken by the device with the next highest priority. The priority is a value from 1 to 255, with a default of 100. The value 255 is reserved for the device that owns the virtual router's IP address. The new Master takes over all the responsibilities of the original Master.

By default, when a device becomes available that has a higher priority than the Master, this device takes over as Master. This is referred to as **preempt mode** and can be set **on** or **off**. Even with **preempt** mode **off**, the device that owns the IP address always becomes the Master when available. **Preempt** mode should be the same for all devices in the virtual router.

If two devices are configured with the same priority and a conflict occurs when they both transition to Master simultaneously, the one with the highest IP address has higher priority. Due to timing differences the conflict may not always occur and simply the first device to respond will become the Master.

Hosts on the LAN can continue sending packets to the virtual MAC address they originally associated with the first hop IP address, even though the device that owns the IP address is not currently available. When the original device becomes available again, if it is a preferred device (i.e. it owns the virtual router IP address) then it resumes the role of Master.

Preempt delay-time

The preempt delay-time feature is available on IPv6 when preempt is set to 'true'. IPv6 has the exact same behavior and command line as IPv4 for the preempt command.

Please see: "VRRP election, preempt and preempt delay-time for IPv4" on page 7. A configuration example is described in the section "Preempt delay" on page 7.

Use the following commands to set the priority and **preempt** mode when you create the virtual router:

To set the priority and preempt mode for VRRP 1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `router ipv6 vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `priority 255`	Set the VRRP priority for the device.
`awplus(config-router)#` `preempt-mode true`	Select the **preempt** mode for VRRP 1. Note only select **preempt** mode to true if this has been set to false. **Preempt** is true by default.
`awplus(config-router)#` `enable`	Enable the VRRP session on the device.
`awplus(config-router)#` `exit`	Return to the Global Configuration mode.
`awplus(config)#`	Global Configuration prompt

The advertisement interval determines the rate at which the Master sends its advertisement packets. This rate must be the same value for all devices in the virtual router. The default advertisement interval of 1 second can be used for most networks.

However, you can modify this interval by using the **advertisement-interval** command, as shown in the following procedure:

To set the advertisement interval to 5 seconds on VRRP1

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config#` `router ipv6 vrrp 1 vlan2`	Select the VRRP session on the device, specify the VRID for the session, and specify the interface used for virtual routing (**vlan2** in this example).
`awplus(config-router)#` `advertisement-interval 5`	Set the advertisement interval to **5** seconds.

VRRP Debugging

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

To select and deselect VRRP debugging

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `debug vrrp [all|events|packet]`	Enable the selected debugging type.
`awplus(config)#` `no debug vrrp [all|events|packet]`	Disable the selected debugging type.

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

- 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.

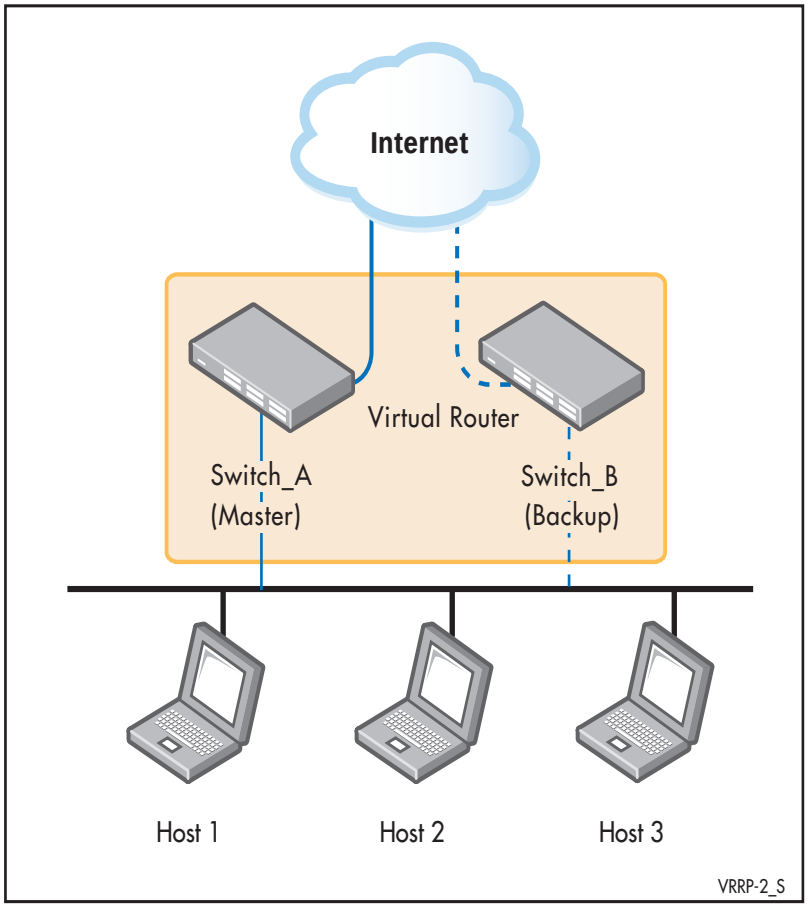
VRRP Configuration Examples

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

- "VRRP preferred Master with Backup configuration on a switch" on page 15
- "VRRP preferred Master with Backup configuration on a 10GbE UTM firewall or an AR4000S-Cloud firewall" on page 18
- "VRRP circuit failover configuration" on page 21
- "VRRPv2 to VRRPv3 transition configuration" on page 26
- "Virtual Router Redundancy Protocol IPv6 (VRRPv3) configuration" on page 32

VRRP preferred Master with Backup configuration on a switch

This example shows how to configure a basic 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.

Step 1: **Configure Switch_A**

At this point we assume that you have already created VLAN 2 on Switch_A.

a. **Configure an IP address on VLAN 2**

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_A`	Assign the host name Switch_A.
`Switch_A(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-if)#` `ip address 192.168.1.1/24`	Specify the IP address and mask for that interface.

b. **Create the Master virtual router**

`Switch_A(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-router)#` `virtual-ip 192.168.1.1 master`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Switch_A(config-router)` `enable`	Enable the VRRP session on the router.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `awplusexit#`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_A#`	Privileged Exec mode prompt.

Step 2: **Configure Switch_B**

At this point we assume that you have already created VLAN 2 on Switch_B.

a. **Configure an IP address on VLAN 2**

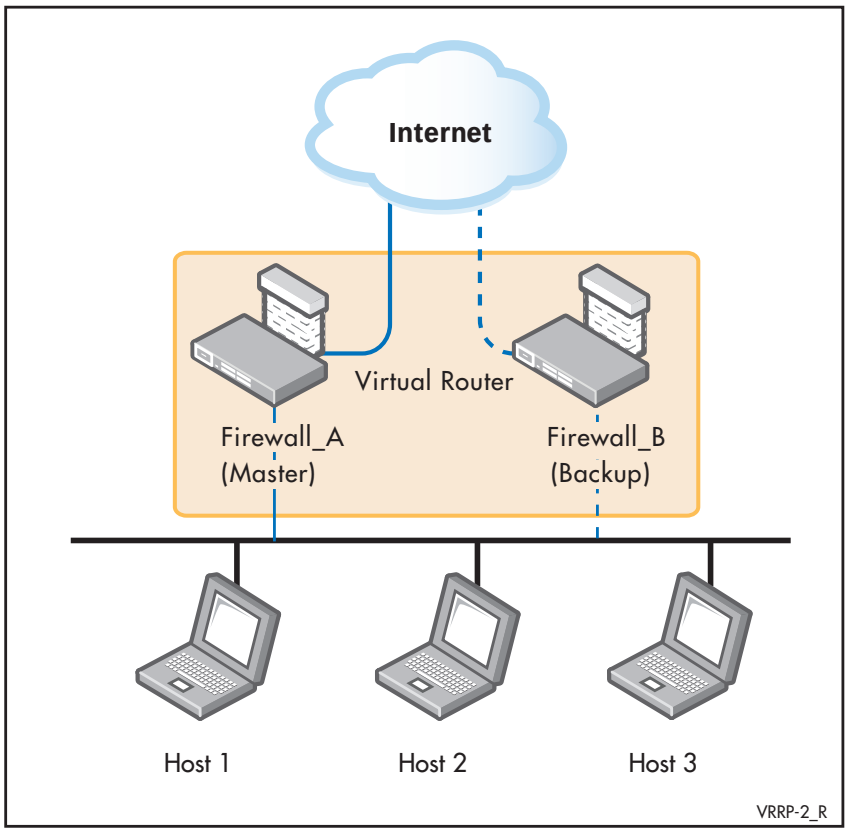
`awplus#` `configure terminal`	Enter Global Configuration mode.
`awplus(config)#` `hostname Switch_B`	Assign the host name Switch_B.
`Switch_B(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config)#` `ip address 192.168.1.2/24`	Specify the IP address and mask for that interface.

b. **Create the Backup virtual router**

`Switch_B(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config-router)#` `virtual-ip 192.168.1.1 backup`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Switch_B(config-router)#` `enable`	Enable the VRRP session on the router.
`Switch_B(config-router)` `exit`	Exit the Interface Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `exit`	Return to the Privileged Exec mode.
`Switch_B#`	Privileged Exec mode prompt.

VRRP preferred Master with Backup configuration on a 10GbE UTM firewall or an AR4000S-Cloud firewall

This example shows how to configure a basic virtual router with a preferred Master and a Backup.



Firewall_A owns the IP address of the virtual router, and always assumes the role of Master whenever it is available. Firewall_B is the Backup, and assumes the role of Master, backing up this IP address if A becomes unavailable.

Ethernet interfaces and 802.1q sub-interfaces are only supported on the 10GbE UTM firewall and AR4000S-Cloud firewall, not other UTM firewalls and VPN routers.

Step 1: **Configure Firewall_A**

a. **Configure an IP address on eth1**

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Firewall_A`	Assign the host name Firewall_A.
`Firewall_A(config)#` `interface eth1`	Specify the interface that will participate in virtual routing (**eth1** in this example).
`Firewall_A(config-if)#` `ip address 192.168.1.1/24`	Specify the IP address and mask for that interface.

b. **Create the Master virtual router**

`Firewall_A(config)#` `router vrrp 1 eth1`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**eth1** in this example).
`Firewall_A(config-router)#` `virtual-ip 192.168.1.1 master`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Firewall_A(config-router)` `enable`	Enable the VRRP session on the router.
`Firewall_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Firewall_A(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Firewall_A#`	Privileged Exec mode prompt.

Step 2: **Configure Firewall_B**

a. **Configure an IP address on eth1**

`awplus#` `configure terminal`	Enter Global Configuration mode.
`awplus(config)#` `hostname Firewall_B`	Assign the host name Firewall_B.
`Firewall_B(config)#` `interface eth1`	Specify the interface that will participate in virtual routing (**eth1** in this example).
`Firewall_B(config)#` `ip address 192.168.1.2/24`	Specify the IP address and mask for that interface.

b. **Create the Backup virtual router**

`Firewall_B(config)#` `router vrrp 1 eth1`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**eth1** in this example).
`Firewall_B(config-router)#` `virtual-ip 192.168.1.1 backup`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Firewall_B(config-router)#` `enable`	Enable the VRRP session on the router.
`Firewall_B(config-router)` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Firewall_B(config)#` `exit`	Return to the Privileged Exec mode.
`Firewall_B#`	Privileged Exec mode prompt.

VRRP circuit failover configuration

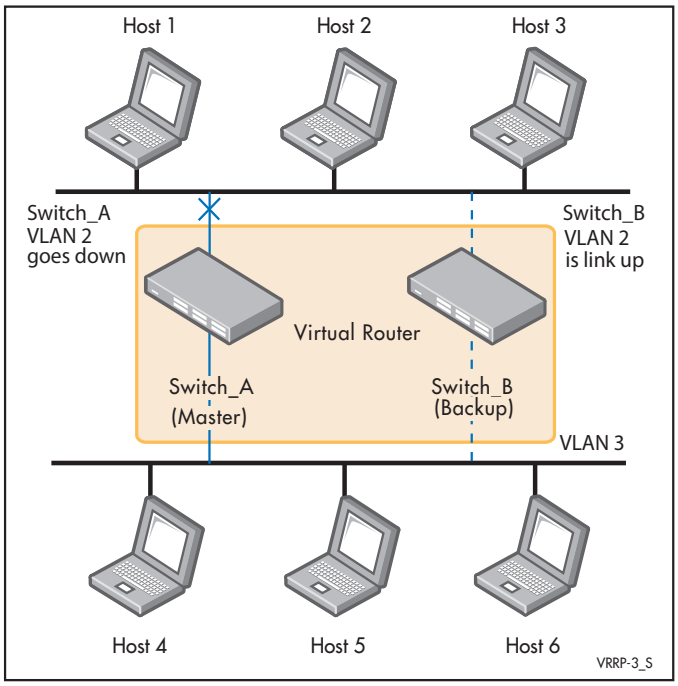
This example shows how to configure a circuit-failover on a virtual router. It configures redundancy between Switch_A and Switch_B for hosts on VLAN 2 and VLAN 3.

This example uses switches as the physical L3 devices. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

The need for VRRP Circuit Failover arose because VRRPv2 was unable to track the gateway interface status. The AlliedWare Plus VRRP Circuit Failover feature provides a dynamic failover of an entire circuit in the event that one of the members of the group fails.

This introduces the concept of a circuit, where two or more virtual routers on a single system are grouped. In the event of a failure occurring a virtual router performs the Master to Backup transition and notifies the other virtual routers. These are then forced into the Master to Backup transition, so that both incoming and outgoing packets are routed through the same gateway router, eliminating the problem for NAT environments.

To configure VRRP Circuit Failover, each circuit is configured to have a corresponding priority delta value, which is passed to VRRP when a failure occurs. The priority of each virtual router on the circuit is decremented by the priority delta value, which causes the virtual router Master to virtual router Backup transition. In this example, two switches Switch_A and Switch_B are configured as Backup routers with different priorities. The priority delta value is configured to be greater that the difference of both the priorities.



Switch_A is configured to have a priority of 100, and Switch_B is configured to have a priority of 90. Switch_A with a greater priority is the virtual router Master. The priority delta value is 20, greater than 10 (100 minus 90).

On Switch_A, when vlan2 fails, the priority of Switch_A becomes 80 (100 minus 20). Since Switch_B has a greater priority (90) than Switch_A, Switch_B becomes the virtual router Master, and routing of packets continues without interruption. When this virtual router Backup (Switch_A) is up again, it regains its original priority (100), and becomes the virtual router Master again.

Step 1: Configure Switch_A

a. Configure an IP address on VLAN 2

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_A`	Assign the host name **Switch_A**.
`Switch_A(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-if)#` `ip address 192.168.1.1/24`	Specify the IP address and mask for the interface.

b. Configure an IP address on VLAN 3

`Switch_A(config-if)#` `exit`	Exit the Interface Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `interface vlan3`	Specify the interface that will participate in virtual routing (**vlan3** in this example).
`Switch_A(config-if)#` `ip address 192.168.2.1/24`	Specify the IP address and mask for the interface.

c. Create the Master virtual router

`Switch_A(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-router)#` `virtual-ip 192.168.1.5 backup`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Switch_A(config-router)#` `priority 100`	Set the VRRP priority to 100 as the default priority for a Backup virtual router.
`Switch_A(config-router)#` `preempt-mode true`	Set **preempt** mode to true to specify that the highest priority will own the virtual IP address when there is a failure and will function as the Backup virtual router.

`Switch_B(config-router)#` `advertisement-interval 5`	Configure the default value for the advertisement interval. The configurable range for the advertisement interval is 1-10.
`Switch_A(config-router)#` `circuit-failover vlan2 20`	Configure circuit failover to 20 on Switch_A. This configures a priority delta value, greater than the difference of priorities on Master and Backup routers. This priority delta value is subtracted from the current virtual router Master Router priority value.
`Switch_A(config-router)#` `enable`	Enable the VRRP session on the router.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_A#`	Privileged Exec mode prompt.
`Switch_A#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.

Step 2: **Configure Switch_B**

At this point we assume that you have already created VLAN 2 on Switch_B.

a. **Configure an IP address on VLAN 2**

`awplus#` `configure terminal`	Enter Global Configuration mode.
`awplus(config)#` `hostname Switch_B`	Assign the host name **Switch_B**.
`Switch_B(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config-if)#` `ip address 192.168.1.2/24`	Specify the IP address and mask for the interface

b. Configure an IP address on VLAN 3

`Switch_B(config-if)#` `exit`	Exit the Interface Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `interface vlan3`	Specify the interface that will participate in virtual routing (**vlan3** in this example).
`Switch_B(config-if)#` `ip address 192.168.2.2/24`	Specify the IP address and mask for the interface

c. Create the Backup virtual router

`Switch_B(config)#` `router vrrp 1 vlan2`	Create a new VRRP session on the router, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config-router)#` `virtual-ip 192.168.1.5 backup`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router.
`Switch_B(config-router)#` `priority 90`	Set the VRRP priority to 90 (less than 100) because Switch_B is the Backup virtual router.
`Switch_B(config-router)#` `preempt-mode true`	Set **preempt** mode to true to specify that the highest priority will own the virtual IP address when there is a failure and will function as the Backup virtual router.
`Switch_B(config-router)#` `advertisement-interval 5`	Configure the default value for the advertisement interval. The configurable range for the advertisement interval is 1-10.
`Switch_B(config-router)#` `enable`	Enable the VRRP session on the router.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_A#`	Privileged Exec mode prompt.
`Switch_A#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.

VRRP multiple circuit-failover configuration

From software version 5.4.6-1.x onwards, VRRP can use Circuit Failover to monitor up to 32 interfaces per VRRP instance, by using the circuit-failover command.

If a VRRP instance is configured to monitor multiple interfaces, the VRRP priority will be cumulatively decremented by the configured delta for each interface as it goes down.

For example, if VRRP is configured to monitor VLAN2 and VLAN3 with the commands:

```
awplus#configure terminal
awplus(config)#interface vlan1
awplus(config-if)#ip address 192.168.1.1/24
awplus(config-if)#exit
awplus(config)#router vrrp 1 vlan1
awplus(config-router)#virtual-ip 192.168.1.10 backup
awplus(config-router)#priority 100
awplus(config-router)#circuit-failover vlan2 10
awplus(config-router)#circuit-failover vlan3 20
```

then the following examples explain the effect of each VLAN going down:

- If only VLAN2 fails, then the VRRP priority will be decremented by 10. VRRP priority would be adjusted to become 90, because 100 - 10 = 90.
- If only VLAN3 fails, then the VRRP priority will be decremented by 20. VRRP priority would be adjusted to become 80, because 100 - 20 = 80.
- If both VLAN2 and VLAN3 fail, then the VRRP priority will be decremented by the cumulative delta values of all monitored interfaces. VRRP priority would therefore be adjusted to become 70, because 100 - 10 - 20 = 70.

As each monitored interface recovers, the VRRP priority is incremented by the same delta value. When you configure the delta values of the monitored interfaces, make sure their sum is high enough to ensure that the VRRP priority stays above zero if all the interfaces go down.

This example uses switches as the physical L3 devices. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

VRRPv2 to VRRPv3 transition configuration

This example shows how to configure the transition from VRRPv2 to VRRPv3 on a virtual router. This example configures VRRPv3 from VRRPv2 on Switch_A and Switch_B for hosts on VLAN 3.

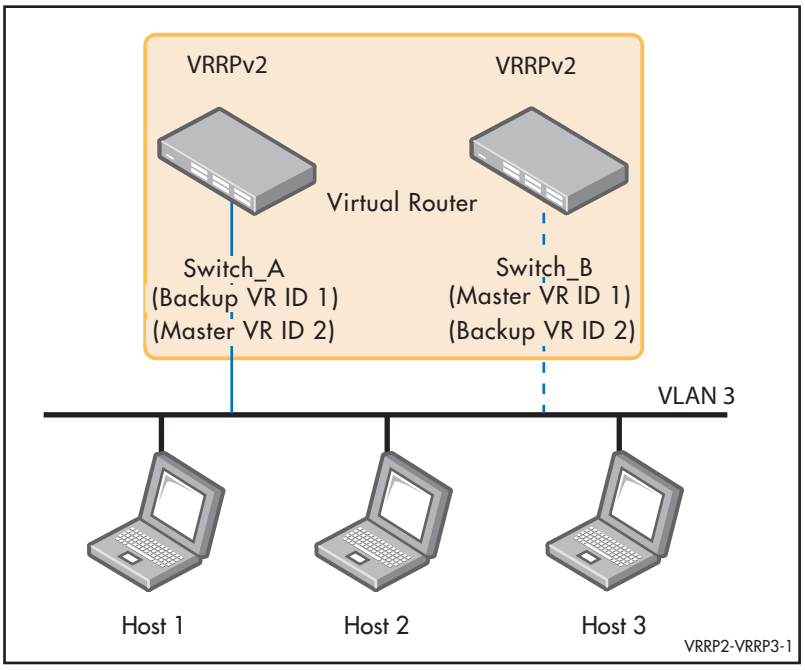
This example uses switches as the physical L3 devices. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

Transition mode allows interoperability for IPv4 VRRP instances between VRRPv2 and VRRPv3 virtual routers. RFC 5798 for VRRPv3 allows a VRRPv3 virtual router to send both VRRPv2 and VRRPv3 advertisements. Note that this feature is only for IPv4 interoperability. Note that when **transition-mode** is set to true then VRRPv3 will also accept and process VRRPv2 advertisement packets received should there be a VRRPv2 Master on the network.

You should upgrade your VRRPv2 virtual routers to VRRPv3 as a long term solution and only use transition mode for a staged VRRPv2 to VRRPv3 roll out. Transition mode is disabled by default and is enabled by issuing the **transition-mode true** command.

Note that you should ensure that the advertisement interval for a VRRPv2 instance is configured to greater than 1 second (100 centiseconds). If the advertisement interval is configured to less than 1 second (100 centiseconds) then ensure the VRRPv2 virtual router has a lower priority with the **priority** command than the VRRPv2/VRRPv3 virtual router.

When you configure a VRRPv3 instance with **transition-mode true** also configure it as the VRRP Master instance, either by configuring it to own the IP address or with a high priority. Also configure the advertisement interval to whole seconds to maintain compatibility with VRRPv2 hosts. All matching VRRP instances should be configured with the same advertisement interval to eliminate Master instance contention on VRRP startup as well.



Follow the steps listed below to disable VRRPv2 on Switch_A before saving the running and startup configurations then rebooting Switch_A to upgrade to VRRPv3. Note that after upgrading Switch_A to VRRPv3 you can leave Switch_B running VRRPv2, or you can upgrade Switch_B to VRRPv3. Running VRRPv3 on both is highly recommended. The above illustration shows both Switch_A and Switch_B running VRRPv2 to upgrade.

Follow **Step 1** to upgrade Switch_A from VRRPv2 to VRRPv3 and follow **Step 2** to upgrade Switch_B from VRRPv2 to VRRPv3. You can follow **Step 1** only if Switch_B is not upgraded. Only Switch_A needs transition-mode enabled to upgrade then disabled after upgrading.

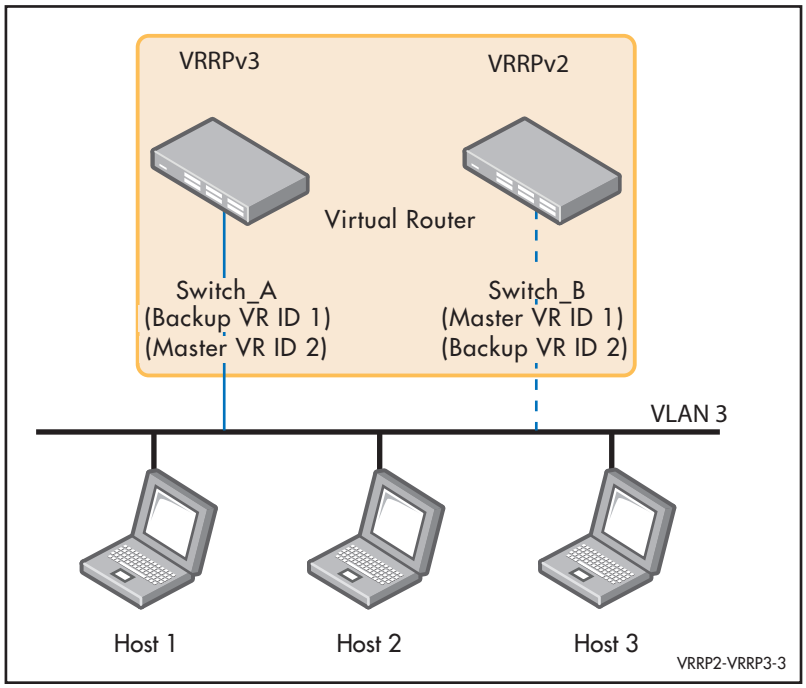
Step 1: **Upgrade Switch_A from VRRPv2 to VRRPv3**

At this point we assume that you have already copied the current release of AlliedWare Plus with VRRPv3 to Flash and only need to make this release the boot version and restart. We also assume that you have already created VLAN 3 on Switch_B.

Disable VRRPv2 on Switch_A and enable VRRPv3 on Switch_A

`Switch_A#` `configure terminal`	Enter the Global Configuration mode for **Switch_A**.
`Switch_A(config)#` `router vrrp 1 vlan3`	Select the VRRPv2 Backup session on the router, specify the VRID for the session (**1**), and specify the interface (**vlan3**).
`Switch_A(config-router)#` `disable`	Disable the VRRPv2 Backup on Switch_A.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `router vrrp 2 vlan3`	Select the VRRPv2 Master session on the router, specify the VRID for the session (**2**), and specify the interface (**vlan3**).
`Switch_A(config-router)#` `disable`	Disable the VRRPv2 Master on Switch_A.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_A#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.
`Switch_A#` `configure terminal`	Enter the Global Configuration mode.

`Switch_A(config)#` `reload`	Restart **Switch_A** to load the AlliedWare Plus release with VRRPv3 as configured with the **boot system** command earlier.
`Switch_A(config)#` `router vrrp 1 vlan3`	Enter Router Configuration mode for the Backup VRRPv3 session on the router, specifying the VRID for the session (**1**), and specifying the interface (**vlan3**).
`Switch_A(config-router)#` `transition-mode true`	Set transition mode to true to turn on transition mode enabling VRRPv2 and VRRPv3 advertisement on VRRPv3.
`Switch_A(config-router)#` `enable`	Enable the VRRPv3 Backup on Switch_A.
`Switch_A(config)#` `router vrrp 2 vlan3`	Create a VRRPv3 Master session on the router, specify the VRID for the session (**2**), and specify the interface (**vlan3**).
`Switch_A(config-router)#` `transition-mode true`	Set transition mode to true to turn on transition mode enabling VRRPv2 and VRRPv3 advertisement on VRRPv3.
`Switch_A(config-router)#` `enable`	Enable the VRRPv3 Master on Switch_A.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_A#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.



The above illustration shows Switch_A running VRRPv3 and Switch_B running VRRPv2. Note that Switch_A running VRRPv3 with **transition-mode true** configured sends both VRRPv3 and VRRPv2 advertisements. This is an interim solution for IPv4 VRRPv2 and VRRPv3 interoperability. Only VRRPv3 should be used on both devices for IPv6 use.

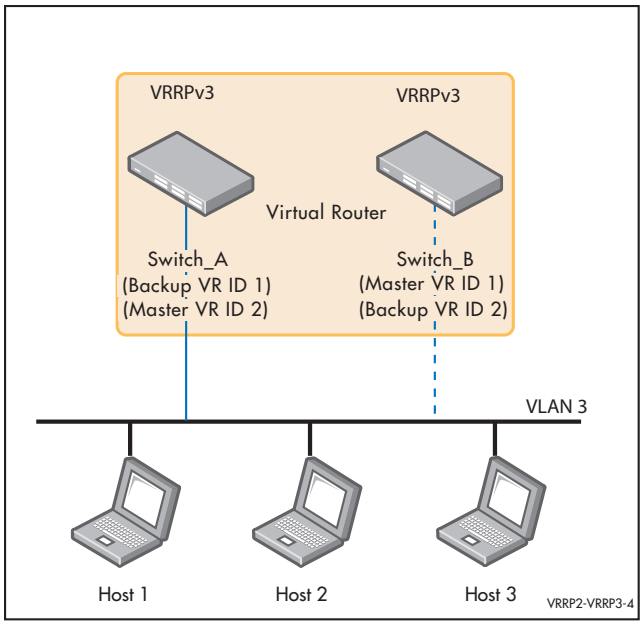
Step 2: **Upgrade Switch_B from VRRPv2 to VRRPv3**

At this point we assume that you have already copied the current release of AlliedWare Plus with VRRPv3 to flash and only need to make this release the boot version and restart. We also assume that you have already created VLAN 3 on Switch_B.

Disable VRRPv2 on Switch_B and enable VRRPv3 on Switch_B

`Switch_B#` `configure terminal`	Enter the Global Configuration mode for **Switch_B**.
`Switch_B(config)#` `router vrrp 1 vlan3`	Select the VRRPv2 Master session on the router, specify the VRID for the session (**1**), and specify the interface (**vlan3**).
`Switch_B(config-router)#` `disable`	Disable the VRRPv2 Master on Switch_B.
`Switch_B(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `router vrrp 2 vlan3`	Select the VRRPv2 Backup session on the router, specify the VRID for the session (**2**), and specify the interface (**vlan3**).
`Switch_B(config-router)#` `disable`	Disable the VRRPv2 Backup on Switch_B.

`Switch_B(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_B#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.
`Switch_B#` `configure terminal`	Enter the Global Configuration mode.
`Switch_B(config)#` `reload`	Restart **Switch_A** to load the AlliedWare Plus release with VRRPv3 as configured with the **boot system** command earlier.
`Switch_B(config)#` `router vrrp 1 vlan3`	Enter Router Configuration mode for the Master VRRPv3 session on the router, specifying the VRID for the session (**1**), and specifying the interface (**vlan3**).
`Switch_B(config-router)#` `enable`	Enable the VRRPv3 Master on Switch_B.
`Switch_B(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `router vrrp 2 vlan3`	Enter Router Configuration mode for the Backup VRRPv3 session on the router, specifying the VRID for the session (**2**), and specifying the interface (**vlan3**).
`Switch_B(config-router)#` `enable`	Enable the VRRPv3 Backup on Switch_B.
`Switch_B(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_B#` `copy running-config startup-config`	Copy the contents of the running-configuration to the startup-configuration.



The above illustration shows both Switch_A and Switch_B running VRRPv3. Note that transition mode should be turned off Switch_A once VRRPv3 is active on both to stop Switch_A from continuing to send VRRPv2 and VRRPv3 advertisements to Switch_B.

`Switch_A#` `configure terminal`	Enter the Global Configuration mode for **Switch_A**.
`Switch_A(config)#` `router vrrp 1 vlan3`	Enter Router Configuration mode for the Backup VRRPv3 session on the router, specifying the VRID for the session (**1**), and specifying the interface (**vlan3**).
`Switch_A(config-router)#` `transition-mode false`	Set transition mode to false to turn off transition mode now VRRPv3 is on Switch_A and Switch_B.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `router vrrp 2 vlan3`	Enter Router Configuration mode for the Master VRRPv3 session on the router, specifying the VRID for the session (**2**), and specifying the interface (**vlan3**).
`Switch_A(config-router)#` `transition-mode false`	Set transition mode to false to turn off transition mode now VRRPv3 is on Switch_A and Switch_B.

Virtual Router Redundancy Protocol IPv6 (VRRPv3) configuration

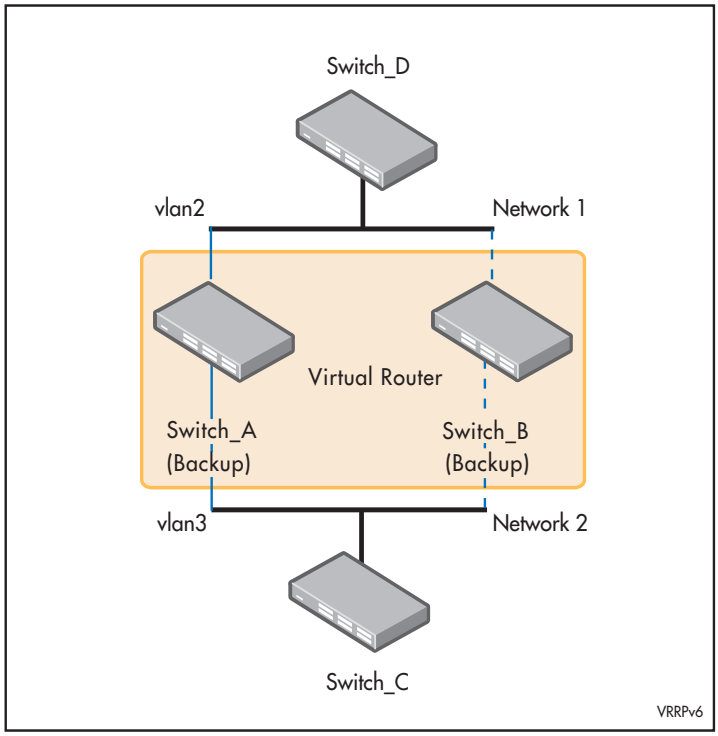
This section shows a Virtual Router Redundancy Protocol IPv6 (VRRPv3) configuration example.

VRRPv3 eliminates the risk of a single point of failure inherent in a static default routing environment. VRRPv3 specifies an election protocol that dynamically assigns responsibility for a virtual router to one of the devices configured with VRRPv3 on a LAN.

VRRRv3 only allows Master/Non-Owner setup. You can configure the priority of the routers. The router with the higher priority takes the role of Master.

This example uses switches as the physical L3 devices. The procedure is the same for a 10GbE UTM firewall or AR4000S-Cloud, except that the firewall uses interfaces such as interfaces such as eth1 or eth1.1 instead of VLANs.

In this example, VRRPv3 is enabled on Switch_A, the Backup virtual router, and on Switch_B, the Backup virtual router. In Switch_A, the static routes are redistributed.



Switch_A owns the IP address of the virtual router, and assumes the role of Master because it is configured with a higher priority. 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.

See the sample output following the sample command configuration tables for each device. See relevant VRRP **show** commands that are useful to validate configurations.

The AlliedWare Plus VRRPv3 implementation supports up to two IPv6 virtual link addresses per virtual router ID: primary and secondary. Note that the primary IPv6 address of the virtual link must be a link-local IPv6 address. In the examples below, fe80::1 is an IPv6 link-local address. An IPv6 link-local address is used because IPv6 link-local addresses are used by IPv6 ND (Neighbor

Discovery). A host's default route to a router points to the IPv6 link-local address, not a specific global IPv6 address for the router. For the host's traffic to switch over a Backup router, the IPv6 link-local address of the router is used by VRRPv3.

Step 1: **Configure Switch_A (Backup virtual router)**

At this point we assume that you have already created VLAN 2 and VLAN 3 on Switch_A.

a. **Configure IPv6 addresses on VLAN 2 and VLAN 3**

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_A`	Assign a host name to **Switch_A**.
`Switch_A(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-if)#` `ipv6 address 2001:db8:2::2/64`	Specify the IPv6 address and mask for the interface.
`Switch_A(config-if)#` `exit`	Return to Global Configuration mode.
`Switch_A(config)#` `ipv6 forwarding`	Enable IPv6 forwarding.
`Switch_A(config)#` `interface vlan3`	Specify the interface that will participate in virtual routing (**vlan3** in this example).
`Switch_A(config-if)#` `ipv6 address 2001:db8:3::2/64`	Specify the IPv6 address and mask for the interface.
`Switch_A(config-if)#` `exit`	Return to Global Configuration mode.

b. Create the Backup virtual router on Switch_A

`Switch_A(config)#` `router ipv6 vrrp 1 vlan2`	Create a new VRRPv3 session on Switch_A, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_A(config-router)#` `virtual-ipv6 fe80::1 backup`	Set the virtual IP address for the VRRPv3 session. Define the default state of the VRRPv3 router within the virtual router. Note that fe80::1 is an IPv6 link-local address. The AlliedWare Plus VRRPv3 implementation supports up to two IPv6 virtual link addresses per virtual router ID: primary and secondary. The primary IPv6 address of the virtual link must be a link-local IPv6 address. See the Usage note for the **virtual-ipv6** command for implementation information about link-local addresses in AlliedWare Plus.
`Switch_A(config-router)#` `advertisement-interval 5`	Configure the default value for the advertisement interval. The configurable range for the advertisement interval is 1-10.
`Switch_A(config-router)#` `priority 255`	Configure the default priority value of 255 when the device is the Master virtual router.
`Switch_A(config-router)#` `preempt-mode true`	Set the **preempt-mode** to true for Switch_A. The default **preempt** mode ensures that the highest priority switch available always takes the Master role.
`Switch_A(config-router)#` `enable`	Enable the VRRPv3 session on Switch_A.
`Switch_A(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_A(config)#` `exit`	Return to Privileged Exec mode.
`Switch_A#` `copy running-config startup-config`	Copy the running-config to the startup-config to enable this configuration to execute after restarting Switch_A.

Step 2: **Configure Switch_B (Backup virtual router)**

At this point we assume that you have already created VLAN 2 and VLAN 3 on Switch_B.

a. **Configure IPv6 addresses on VLAN 2 and VLAN 3**

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_B`	Assign a host name to **Switch_B**.
`Switch_B(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config-if)#` `ipv6 address 2001:db8:2::3/64`	Specify the IPv6 address and mask for the interface.
`Switch_B(config)#` `ipv6 forwarding`	Enable IPv6 forwarding.
`Switch_B(config-if)#` `exit`	Return to Global Configuration mode.
`Switch_B(config)#` `interface vlan3`	Specify the interface that will participate in virtual routing (**vlan3** in this example).
`Switch_B(config-if)#` `ipv6 address 2001:db8:3::3/64`	Specify the IPv6 address and mask for the interface.
`Switch_B(config-if)#` `exit`	Return to Global Configuration mode.

b. **Create the Backup virtual router on Switch_B**

`Switch_B(config)#` `router ipv6 vrrp 1 vlan2`	Create a new VRRPv3 session on Switch_B, specify the VRID for the session, and specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_B(config-router)#` `virtual-ipv6 fe80::1 backup`	Set the virtual IP address for the VRRP session. Define the default state of the VRRP router within the virtual router. Note that fe80::1 is an IPv6 link-local address. The AlliedWare Plus VRRPv3 implementation supports up to two IPv6 virtual link addresses per virtual router ID: primary and secondary. The primary IPv6 address of the virtual link must be a link-local IPv6 address. See the Usage note for the **virtual-ipv6** command for implementation information about link-local addresses in AlliedWare Plus.

`Switch_B(config-router)#` `advertisement-interval 5`	Configure the default value for the advertisement interval. The configurable range for the advertisement interval is 1-10.
`Switch_B(config-router)#` `priority 100`	Configure the priority value of 100 when the device is the Backup virtual router.
`Switch_B(config-router)#` `preempt-mode true`	Set the **preempt-mode** to true for Switch_B. The default **preempt-mode** ensures that the highest priority switch available always takes the Master role.
`Switch_B(config-router)#` `enable`	Enable the VRRPv3 session on Switch_B.
`Switch_B(config-router)#` `exit`	Exit the Router Configuration mode and enter the Global Configuration mode.
`Switch_B(config)#` `exit`	Exit the Global Configuration mode and enter the Privileged Exec mode.
`Switch_B#` `copy running-config startup-config`	Copy the running-config to the startup-config to enable this configuration to execute after restarting Switch_B.

Step 3: **Configure Switch_C**

At this point we assume that you have already created VLAN 3 on Switch_C.

Configure an IPv6 address on VLAN 3, and a static IPv6 route to reach Switch_D via the virtual router:

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_C`	Assign the host name **Switch_C**.
`Switch_C(config)#` `ipv6 forwarding`	Enable IPv6 forwarding.
`Switch_C(config)#` `interface vlan3`	Specify the interface that will participate in virtual routing (**vlan3** in this example).
`Switch_C(config-if)#` `ipv6 address 2001:db8:3::4/64`	Specify the IPv6 address and mask for the interface.
`Switch_C(config-if)#` `exit`	Return to Global Configuration mode.

`Switch_C(config)#`
`ipv6 route 2001:db8:2::/64 2001:db8:3::2`
`Switch_C(config)#`
`ipv6 route 2001:db8:2::/64 2001:db8:3::3`
	Configure Pv6 static routes to reach Switch_D via the virtual router.

`Switch_C(config)#` `exit`	Return to Privileged Exec mode.
`Switch_C#` `copy running-config startup-config`	Copy the running-config to the startup-config to enable this configuration to execute after restarting Switch_C.

Step 4: **Configure Switch_D**

At this point we assume that you have already created VLAN 2 on Switch_D.

Configure an IPv6 address on VLAN 2 and a static IPv6 route to reach Switch_C via the virtual router:

`awplus#` `configure terminal`	Enter the Global Configuration mode.
`awplus(config)#` `hostname Switch_D`	Assign the host name to **Switch_D**.
`Switch_D(config)#` `interface vlan2`	Specify the interface that will participate in virtual routing (**vlan2** in this example).
`Switch_D(config-if)#` `ipv6 address 2001:db8:2::1/64`	Specify the IPv6 address and mask for the interface.
`Switch_D(config-if)#` `exit`	Return to Global Configuration mode.
`Switch_C(config)#` `ipv6 forwarding`	Enable IPv6 forwarding.
`Switch_D(config)#` `ipv6 route 2001:db8::/64 fe80::1`	Configure an IPv6 static route to reach switch C via the virtual router.
`Switch_D(config)#` `exit`	Return to Privileged Exec mode.
`Switch_D#` `copy running-config startup-config`	Copy the running-config to the startup-config to enable this configuration to execute after restarting Switch_D.

VRRPv3 configuration validation commands and output

Switch_A To display information about the configured VRRPv3 session, to validate configuration as the Master virtual router following the earlier configuration steps, enter the command:

```
Switch_A# show vrrp ipv6 vlan2
```

Output Output 1: Example output from the **show vrrp** ipv6 vlan2 command on Switch_A

```
Switch_A#show vrrp ipv6 vlan2
VrId <2>
 State is Master
 Virtual IP is 2001:db8::1 (Not-owner)
 Interface is vlan2
 Priority is 255
 Advertisement interval is 1 sec
 Preempt mode is TRUE
```

Switch_B To display information about the configured VRRPv3 session, to validate configuration as the Backup virtual router following the earlier configuration steps, enter the command:

```
Switch_B# show vrrp ipv6 vlan2
```

Output Output 2: Example output from the **show vrrp** ipv6 vlan2 command on Switch_B

```
Switch_B#show vrrp ipv6 vlan2
VrId <2>
 State is Backup
 Virtual IP is 2001:db8::1 (Not-owner)
 Interface is vlan2
 Priority is 100
 Advertisement interval is 1 sec
 Preempt mode is TRUE
```

Then disable the Master virtual router and validate that the Backup virtual router takes over:

Switch_A# configure terminal	
Switch_A(config)# interface vlan2	Specify the interface that is participating in virtual routing as the Master virtual router on Switch_A.
Switch_A(config)# shutdown	Shut down the interface. This will make Switch_B, which is configured as the Backup virtual router, become the Master virtual router.
Switch_A(config)# exit	Return to Privileged Exec mode.
Switch_A# show vrrp ipv6 vlan2	Rerun the show command on Switch_A to confirm that it is no longer the Master virtual router.

`Switch_B#` `show vrrp ipv6 vlan2`	Rerun the show command on Switch_B to confirm that it is now the Master virtual router.

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