Technical configuration guide

HP Network Simulator

Lab 3 – Port-based and protocol-based VLANs

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Introduction

This technical configuration guide describes how to create, configure, and connect virtual Comware v7 devices using the HP Network Simulator (HNS) tool.

Comware v7 is a network operating system that runs on HP high-end network devices. The HNS is an ideal Comware v7 learning tool. With the HNS users can create:

- Fixed form-factor and modular routers
- Stackable and modular switches
- LAN and WAN links

This lab assumes that HNS has been downloaded and installed according to the user guide provided with the download. Installation of the HNS tool is outside the scope of this guide. This lab also assumes that the reader has read the HNS Basics and configuration examples provided in the user guide.

Requirements

The following hardware is required:

- A PC with:
  - CPU frequency: 3.0 GHz or more
  - Memory: 4GB or more
  - Hard Disk: 80GB or more
  - Operating System: Windows 7/8 or Ubuntu (32-bit or 64-bit)

The following software is required:

- HP Network Simulator
- Oracle VM Virtual Box Release 4.2.18 or later

Notes

If running HNS on Windows, use the name "VirtualBox Host-Only Ethernet Adapter" for the Virtual Box Ethernet adapter.

If running HNS on Ubuntu, use the name "vboxnet0" for the Virtual Box Ethernet adapter.

Objective

In this guide, readers will learn the main concepts for ports and VLANs. Additionally, the labs will teach readers how to:

- create port-based VLANs
- create protocol-based VLANs

The layout of the lab consists of two virtual switches and two virtual routers.

Lab concepts

VLAN overview

VLANs enable users to be grouped by logical function instead of physical location. This helps to control bandwidth usage within a network by allowing high-bandwidth users to be grouped on low-traffic segments, and to organize users from different LAN segments according to their need for common resources and/or their use of individual protocols. VLANs can be port-based, protocol-based, MAC-based, auto voice, or basic QinQ.

This guide focuses on the following types of VLANs:

- port-based VLANs
- protocol-based VLAN

Port-based VLANS

Port-based VLANs allow for VLAN members to be grouped by port. A port forwards traffic for a VLAN only after it is assigned to the VLAN. With port-based VLANs, the network administrator must manually map ports to their associated VLANs. This is the most common implementation of VLANs.

Defining switch ports

When applying VLANs to ports on HP Comware switches, it is important to understand how VLANs can be tagged or untagged, and the terminology used. HP Comware switches support the following switch port link-types:

- Access:
  - Supports a single untagged VLAN
  - Generally used to connect client devices like PCs and printers
- Trunk:
  - Supports a single untagged VLAN and zero or more tagged VLANs
  - Generally used to connect to another switch
- Hybrid:
  - Supports zero or more tagged and untagged VLANs
  - If more than one untagged VLAN is configured on the port, an additional VLAN identification mechanism is required for untagged ingress traffic, such as MAC-based VLAN, protocol-based VLAN, IP-subnet-based VLAN, or RADIUS
  - Can be used to connect any type of device

Protocol-based VLANs

Protocol-based VLANs apply to hybrid ports only. Hybrid ports allow for multiple tagged and untagged VLANs. Inbound frames are assigned to different VLANs based on their Ethernet protocol types and encapsulation formats. The protocols that can be used for VLAN assignment include IP, IPX, and AppleTalk. The encapsulation formats include Ethernet II, 802.3 Raw, 802.2 LLC, and 802.2 SNAP. A protocol type and an encapsulation format comprise a protocol template. Multiple protocol templates can be created for a protocol-based VLAN, and different protocol templates are assigned different protocol index values. A protocol template can be uniquely identified by a protocol-based VLAN ID and a protocol index combined. When using commands to associate protocol templates with ports, use the protocol-based VLAN ID (VID) and the protocol index to specify the protocol templates. An untagged frame reaching a port associated with protocol templates will be processed as follows.

- If the protocol type and encapsulation format carried in the frame matches a protocol template, the frame will be tagged with the VLAN tag corresponding to the protocol template.
- If the frame matches no protocol templates, the frame will be tagged with the default VLAN ID of the port.

The port processes a tagged frame as it processes tagged frames of a port-based VLAN.

Defining layer 2 and layer 3 ports

HP Comware routers and layer 3 switches provide layer 2 and layer 3 Ethernet interfaces.

- Layer 2 Ethernet interface - physical Ethernet interfaces operating at the data link layer (Layer 2) to forward traffic within a subnet between hosts
- Layer 3 Ethernet interface - physical Ethernet interfaces operating at the network layer (Layer 3) to forward traffic between different subnets. An IP address can be assigned to a Layer 3 Ethernet interface

The following commands allow for a port to be switched between Layer 2 (bridge) and Layer 3 (route).

```
port link-mode { bridge | route }
undo port link-mode
```

By default, HNS router ports are configured for port link-mode route.

Note
Changing the link mode of an Ethernet interface causes all settings to be restored to their default values in the new link mode.

Device creation

1. Copy paste the following within the HNS tool to create two simulated switches and two simulated routers, as well as the connections between the devices.

```
#*****************************************************************************
# Router A
device_id = 1
# Device type: 32-bit centralized device
device_model = SIM1100
# Card model: SIM1103
board = SIM1103 : memory_size 1024
#*****************************************************************************
# Switch A
device_id = 2
# Device type: 32-bit centralized device
device_model = SIM2100
# Card model: SIM2101
board = SIM2101 : memory_size 1024
#*****************************************************************************
# Switch B
device_id = 3
# Device type: 32-bit centralized device
device_model = SIM2100
# Card model: SIM2101
board = SIM2101 : memory_size 1024
#*****************************************************************************
# Router B
device_id = 4
# Device type: 32-bit centralized device
device_model = SIM1100
# Card model: SIM1103
board = SIM1103 : memory_size 1024
#*****************************************************************************
# Connections between Devices
# Connection between interface 2 on Router A and interface 2 on Switch A
device 1 : interface 2 <---> device 2 : interface 2
# Connection between interface 3 on Router A and interface 3 on Switch A
device 1 : interface 3 <---> device 2 : interface 3
# Connection between interface 4 on Switch A and interface 4 on Switch B
device 2 : interface 4 <---> device 3 : interface 4
# Connection between interface 2 on Switch B and interface 2 on Router B
device 3 : interface 2 <---> device 4 : interface 2
# Connection between interface 3 on Switch B and interface 3 on Router B
device 3 : interface 3 <---> device 4 : interface 3
#*****************************************************************************
```

2. Save and run the file.
3. Two simulated switches and two simulated routers will be created in VirtualBox Manager.
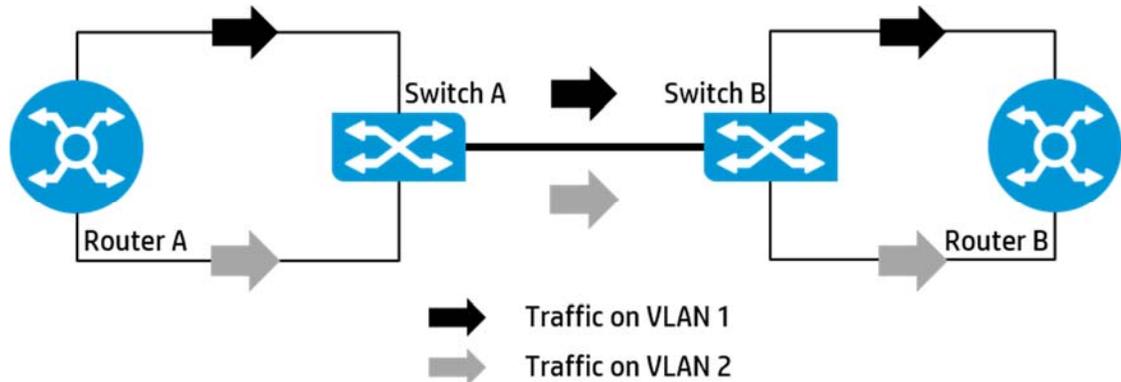4. Start all four devices.

Configure: Port-based VLAN

This section of the configuration guide will focus on configuring a port-based VLAN between the simulated devices

Network diagram

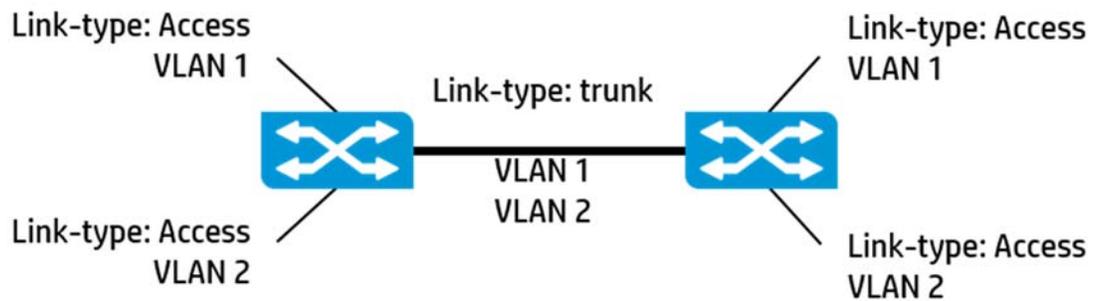The diagram below provides a logical view of how traffic will flow through the network.

Figure 1. Port-based VLAN diagram

Device roles

In this lab, port-based VLANs and trunk ports will be configured between switches A and B. Routers A and B will be used to create traffic, and test the configuration between the switches.

Figure 2. Link-type diagram

Router configuration

The information in the following table will be used to assign IP addresses to the routers.

Table 1. Router configuration

	Interface	IP address	Mask Length
Router A	g0/0/2	10.0.1.1	24
Router B	g0/0/2	10.0.1.2	24
Router A	g0/0/3	10.0.2.1	24
Router B	g0/0/3	10.0.2.2	24

1. Configure the system name for Router A

```
<HP> system-view
[HP] sysname Router A
[Router A]
```

2. Configure IP addresses on Router A

```
[Router A] interface g0/0/2
[Router A-gig0/0/2] ip address 10.0.1.1 24
[Router A-gig0/0/2] interface g0/0/3
[Router A-gig0/0/3] ip address 10.0.2.1 24
```

3. Configure the system name for Router B

```
<HP> system-view
[HP] sysname Router B
[Router B]
```

4. Configure IP addresses on Router B

```
[HP] sysname Router B
[Router B] interface g0/0/2
[Router B-gig0/0/2] ip address 10.0.1.2 24
[Router B-gig0/0/2] interface g0/0/3
[Router B-gig0/0/3] ip address 10.0.2.2 24
```

Switch configuration

Using the following table, configure the switch ports with the appropriate VLANs.

Table 2. Switch port configuration

Switch ports	Link-Type	VLAN
gig 1/0/2	Access Port	VLAN 1
gig 1/0/3	Access Port	VLAN 2
gig 1/0/4	Trunk Port	VLAN 1 (untagged)
		VLAN 2 (tagged)

1. Configure the system name for Switch A

```
<HP> system-view
[HP] sysname Switch A
[Switch A]
```

2. Create VLAN 2 and assign port gig 1/0/3 to it

```
[Switch A] vlan 2
[Switch A-vlan2] port gig 1/0/3
[Switch A-vlan2] quit
```

3. Enable ports gig 1/0/3 and gig 1/0/2

```
[Switch A] interface gig 1/0/3
[Switch A-gig1/0/3] undo shutdown
[Switch A-gig1/0/3] interface gig 1/0/2
[Switch A-gig1/0/2] undo shutdown
[Switch A-gig1/0/2] quit
```

4. Configure port gig 1/0/4 as a trunk port and configure the VLANs

```
[Switch A] interface gig 1/0/4
[Switch A-gig1/0/4] undo shutdown
[Switch A-gig1/0/4] port link-type trunk
[Switch A-gig1/0/4] port trunk permit vlan all
[Switch A-gig1/0/4] quit
```

Verify

The next steps will test and verify that the configuration has been properly executed.

1. Ping from Router A to Router B with interface g0/0/3 shutdown on both routers. This represents traffic flowing through VLAN 1.

```
[Router B] interface g0/0/3
[Router B-gig0/0/3] shutdown
[Router B-gig0/0/3] interface g0/0/2
[Router B-gig0/0/2] undo shutdown

[Router A] interface g0/0/3
[Router A-gig0/0/3] shutdown
[Router A-gig0/0/3] interface g0/0/2
[Router A-gig0/0/2] undo shutdown
[Router A-gig0/0/2] ping 10.0.1.2
```

2. Now, ping from Router B to Router A with interface g0/0/3 shutdown on both routers.

```
[Router B] interface g0/0/2
[Router B-gig0/0/2] ping 10.0.1.1
```

3. Ping from Router A to Router B with interface g0/0/2 shutdown on both routers. This represents traffic flowing through VLAN 2.

```
[Router B] interface g0/0/3
[Router B-gig0/0/3] undo shutdown
[Router B-gig0/0/3] interface g0/0/2
[Router B-gig0/0/2] shutdown

[Router A] interface g0/0/2
[Router A-gig0/0/2] shutdown
[Router A-gig0/0/2] interface g0/0/3
[Router A-gig0/0/3] undo shutdown
[Router A-gig0/0/3] ping 10.0.2.2
```

4. Now, ping from Router B to Router A with interface g0/0/2 shutdown on both routers.

```
[Router B] interface g0/0/3
[Router B-gig0/0/2] ping 10.0.2.1
```

Reset

1. Return port gig 1/0/4 to a VLAN 1 access port on both switches

```
[switch-gig 1/0/4] undo port link-type
```

2. Remove VLAN 2 from both switches

```
[switch] undo vlan 2
```

3. Remove IPv4 address from ports g0/0/3 on both routers

```
[router] interface g0/0/3
[router-gig0/0/3] undo ip address 10.0.2.x
```
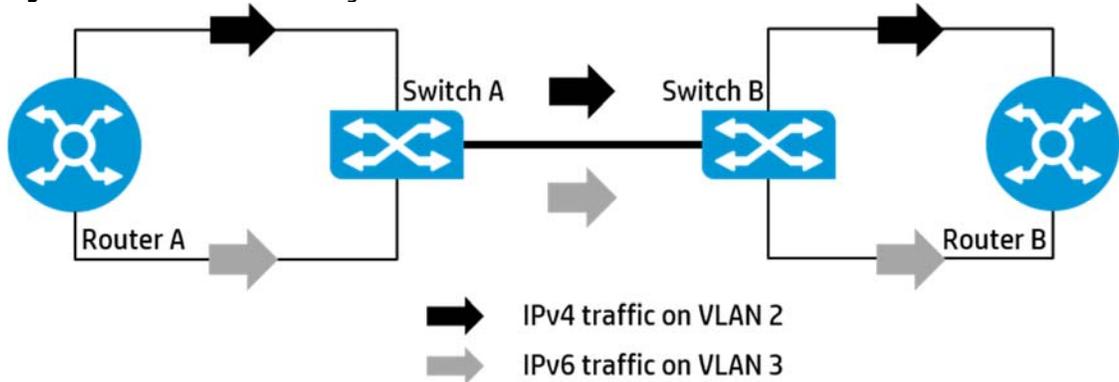
Configure: Protocol-based VLAN

This section of the configuration guide will focus on configuring a protocol-based VLAN between the simulated devices

Network diagram

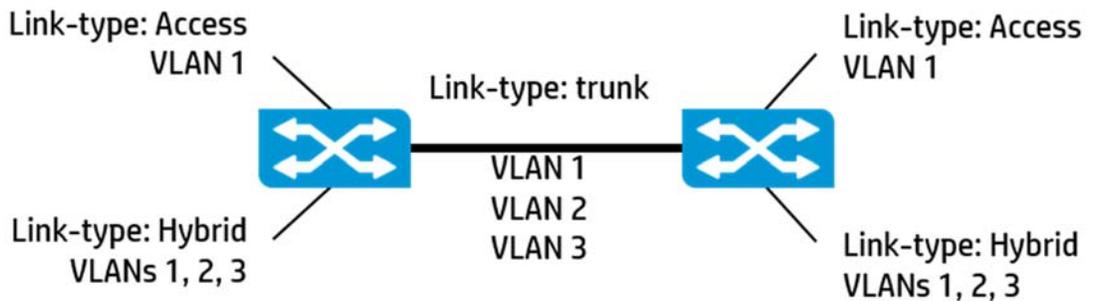The diagram below provides a logical view of how traffic will flow through the network.

Figure 3. Protocol-based VLAN diagram

Device roles

In this lab, protocol-based VLANs will be configured, as well as multiple link-types on switches A and B. The routers will be used to create traffic, and test the configuration between the switches.

Figure 4. Link-type diagram

Router configuration

The information in the following table will be used to assign IP addresses to the routers.

Table 3. Router configuration

	Interface	IP address	Mask Length
Router A	g0/0/3	3001::1	64
Router B	g0/0/3	3001::2	64

1. Configure IPv6 addresses on port g0/0/3 on both routers

```
[router] interface gig0/0/3
[router-gig0/0/3] ipv6 address auto link-local
[router-gig0/0/3] ipv6 address 3001::n/64
[router-gig0/0/3] undo shutdown
[router-gig0/0/3] quit
```

Note

In the router configuration above, *n* equals 1 or 2, depending upon the router being configured

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Switch configuration

The table below indicates the link-type and VLANs that will be configured for each switch port.

Table 4. Switch port configuration

Switch ports	Link-Type	Switch 1	Switch 2
gig1/0/2	Access Port	VLAN 1	VLAN 1
gig1/0/3	Hybrid Port	VLAN 1 untagged	VLAN 1 untagged
		VLAN 2 untagged	VLAN 2 untagged
		VLAN 3 untagged	VLAN 3 untagged
gig1/0/4	Trunk Port	VLAN all	VLAN all

1. Create VLANs 2 and 3 on Switch A, configure them as protocol-based VLANs, and assign IPv4 as the protocol for VLAN 2 and IPv6 as the protocol for VLAN 3.

```
[Switch A] vlan 2
[Switch A-vlan2] protocol-vlan ipv4
[Switch A-vlan2] protocol-vlan mode ethernetii etype 806
[Switch A-vlan2] quit
[Switch A] vlan 3
[Switch A-vlan3] protocol-vlan ipv6
[Switch A-vlan3] quit
```

2. Configure the switch ports according to Table 4.

```
[Switch A] interface gig 1/0/3
[Switch A-g-g1/0/3] undo shutdown
[Switch A-g-g1/0/3] port link-type hybrid
[Switch A-g-g1/0/3] port hybrid vlan 1 2 3 untagged
[Switch A-g-g1/0/3] port hybrid pvid vlan 1
[Switch A-g-g1/0/3] port hybrid protocol-vlan vlan 2 all
[Switch A-g-g1/0/3] port hybrid protocol-vlan vlan 3 all
[Switch A-g-g1/0/3] quit

[Switch A] interface gig 1/0/4
[Switch A-gig1/0/4] undo shutdown
[Switch A-gig1/0/4] port link-type trunk
[Switch A-gig1/0/4] port trunk permit vlan all
[Switch A-gig1/0/4] quit
```

3. Repeat the previous steps on Switch B.

Verify

The next steps will test and verify that the configuration has been properly executed.

1. Ping from Router A to Router B with interface g0/0/3 shutdown on both routers. This represents traffic flowing through VLAN 2.

```
[Router B] interface g0/0/3
[Router B-gig0/0/3] shutdown
[Router B-gig0/0/3] interface g0/0/2
[Router B-gig0/0/2] undo shutdown

[Router A] interface g0/0/3
[Router A-gig0/0/3] shutdown

[Router A-gig0/0/3] interface g0/0/2
[Router A-gig0/0/2] undo shutdown
[Router A-gig0/0/2] ping 10.0.1.2
```

2. Now, ping from Router B to Router A with interface g0/0/3 shutdown on both routers.

```
[Router B] interface g0/0/2
[Router B-gig0/0/2] ping 10.0.1.1
```

3. Ping from Router A to Router B with interface g0/0/2 shutdown on both routers. This represents traffic flowing through VLAN 3.

```
[Router B] interface g0/0/3
[Router B-gig0/0/3] undo shutdown
[Router B-gig0/0/3] interface g0/0/2
[Router B-gig0/0/2] shutdown

[Router A] interface g0/0/2
[Router A-gig0/0/2] shutdown
[Router A-gig0/0/2] interface g0/0/3
[Router A-gig0/0/3] undo shutdown
[Router A-gig0/0/3] ping ipv6 3001::2
```

4. Now, ping from Router B to Router A with interface g0/0/2 shutdown on both routers.

```
[Router B] interface g0/0/3
[Router B-gig0/0/2] ping ipv6 3001::1
```

Reset

1. Return ports gig 1/0/3 and gig 1/0/4 to VLAN 1 access ports

```
[switch-gig1/0/3] undo port hybrid protocol-vlan all
[switch-gig1/0/3] undo port link-type
[switch-gig1/0/4] undo port hybrid protocol-vlan all
[switch-gig1/0/4] undo port link-type
```

2. Remove VLANs 2 and 3

```
[switch] vlan 2
[switch-vlan2] undo protocol-vlan all
[switch-vlan2] quit
[switch] undo vlan 2
[switch] vlan 3
[switch-vlan3] undo protocol-vlan all
[switch-vlan3] quit
[switch] undo vlan 3
```

Resources, contacts, or additional links

End User License Agreement

HNS configurations are similar to those of the HP 5900 Switch Series. See the HP 5900 Switch Series manuals for configuration guidance.

Learn more at
hp.com/networking/hns