ZebOS-XP®
Network Platform

Version 1.4
Extended Performance

Hybrid Switch Router
Configuration Guide

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IP Infusion Inc.
3965 Freedom Circle, Suite 200
Santa Clara, CA 95054
+1 408-400-1900
http://www.ipinfusion.com/

For support, questions, or comments via E-mail, contact:
support@ipinfusion.com

Contents

Preface

This guide describes how to configure a hybrid switch in ZebOS-XP.

Audience

This guide is intended for network administrators and other engineering professionals who configure switches.

Conventions

Table P-1 shows the conventions used in this guide.

Table P-1: Conventions

Convention	Description
Italics	Emphasized terms; titles of books
Note:	Special instructions, suggestions, or warnings
`monospaced type`	Code elements such as commands, functions, parameters, files, and directories

Contents

This guide contains these chapters:

- Chapter 1, *Overview*
- Chapter 2, *Hybrid Switch Router Configuration*

Related Documents

Use this guide with the *Layer 2 Command Reference* for details about the commands used in the configurations.

Note: All ZebOS-XP technical manuals are available to licensed customers at http://www.ipinfusion.com/support/document_list.

Chapter Organization

The chapters in this guide are organized into these major sections:

- An overview that explains a configuration in words
- Topology with a diagram that shows the devices and connections used in the configuration

- Configuration steps in a table for each device where the left-hand side shows the commands you enter and the right-hand side explains the actions that the commands perform
- Validation which shows commands and their output that verify the configuration

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CHAPTER 1 Overview

A ZebOS-XP Hybrid Switch Router offers Layer 3 forwarding found in routers with the high-speed performance associated with traditional Layer 2 switches. The following are some advantages of Hybrid Switch Routers:

- Reduced system cost and infrastructure. Traditionally you would require a separate box for switching and a separate box for routing.
- Off-loading IP traffic from backbone routers thus making them more efficient for firewalls and WAN connectivity.
- Simplified network design and maintenance.

Routing and Switching

Layer 2 and Layer 3 switches are similar at a high-level. Both look at the packet headers, and steer the packet towards its destination port. Therefore, after being passed through a switch or router, the packet is closer to its destination.

Layer 2 Switching

Layer 2 switches are typically used to provide connectivity within high bandwidth local area networks (LANs). A Layer 2 switch makes forwarding decisions based on the MAC or the Layer 2 header. It extracts the Layer 2 header from the packet, finds a matching destination address in the forwarding table, and transmits the packet out to the port associated with the specific destination address in the forwarding table. The forwarding table is populated through a self-learning process, whereby each arriving packet is used to update the entries in the table. Typically, the Layer 2 switch implements the switching function in the hardware as that requires stripping of the packet only in two layers (the physical and data link layer) to get to the useful part of the packet header. This allows switches to steer packets at wire-speed rates without slowing down arriving streams of packets to process them.

Layer 3 Routing

Layer 3 (L3) routers are typically used to provide connectivity between different LANs. A Layer 3 router discards MAC headers and indexes further into the packet, making decisions based on the IP or Layer 3 header. It extracts the Layer-3 header from the packet, finds a matching destination address in a routing table, identifies a new MAC address for the packet from an ARP cache, wraps the IP packet in a new MAC header, then transmits the packet out to the port associated with that destination address in the routing table.

The routing table is populated through statically configured command line interface entries or through routing protocol messages from neighboring routers. A Layer 3 router must strip through 3 layers (physical, data link, and network) and as such, is intrinsically more complicated than a Layer 2 switch. Layer 3 routers historically implement the routing function in software. This often results in limited packet-forwarding rates. However, improvements in VLSI circuit technology have allowed Layer 3 routing functions to be implemented rapidly in hardware, enabling wire-speed performance similar to the performance of Layer 2 switches. As a result, along with the complexity of next-generation of Layer 3 routers, the throughput of these routers has also been increasing.

An architecture is required that is flexible enough to accommodate the demands of different customers, and accommodate the changing demands of a single customer whose requirements may change over time. Typical Layer 2 switches and Layer 3 routers fail to provide this flexibility.

An optimal configuration can be an integrated solution, a Layer 3 router with Layer 2 bridge groups around it. The ZebOS-XP Hybrid Switch Router implementation allows easy configuration of different combinations of routers and switches. ZebOS-XP can be configured as an absolute Layer 3 router, absolute Layer 2 switch (Figure 1-1), absolute

Layer 2 switch with multiple bridge groups, or a hybrid Layer 2/Layer 3 switch router, (Figure 1-2) that can easily change modes with the use of a single command.

Hybrid Switch Router Configurations

With only Layer 2 protocols configured, the ZebOS-XP Hybrid Switch Router can become an absolute Layer 2 switch.

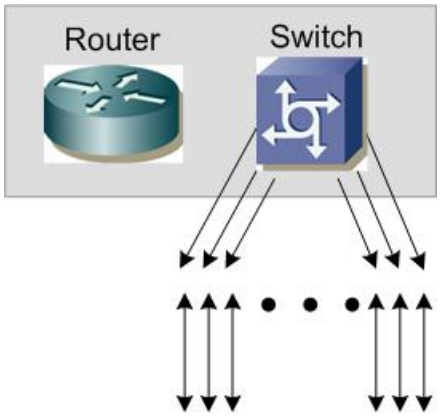

Figure 1-1: Layer 2 Switch

With Layer 2 and Layer 3 protocols configured, the ZebOS-XP Hybrid Switch Router can become a Switch or/and a Router.

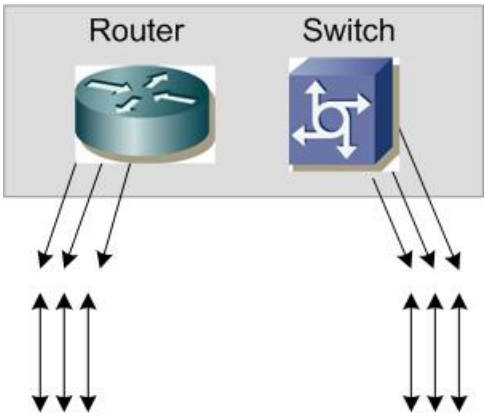

Figure 1-2: Working as a Router or a Switch

With only Layer 3 protocols enabled, the ZebOS-XP Hybrid Switch Router can become an absolute router.

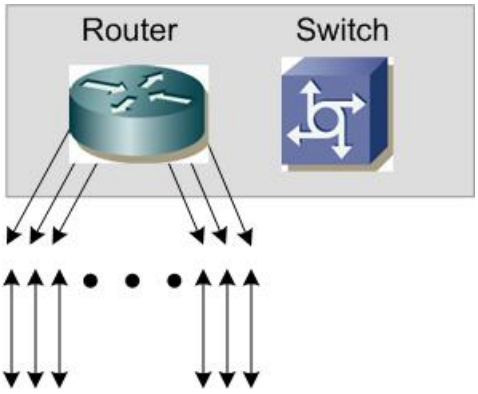

Figure 1-3: Working as Layer 3 Router

On switch ports, VLANs can be created for different broadcast domains.

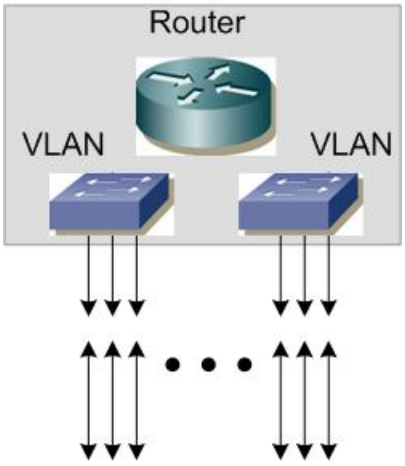

Figure 1-4: Port- or Policy-based VLANs

For routing between VLANs, the ZebOS-XP routing protocols or static routing via NSM can be utilized.

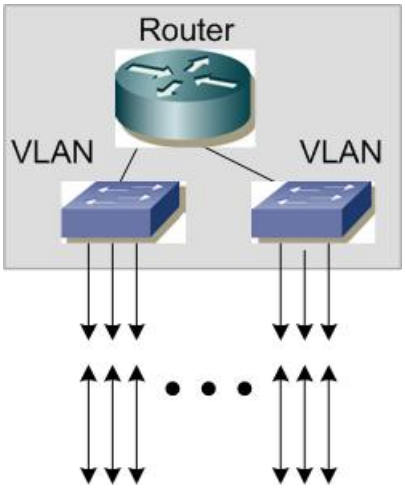

Figure 1-5: Routing Between VLANs

For routing between VLANs and other routing ports, ZebOS-XP routing protocols or static routing via NSM can be utilized.

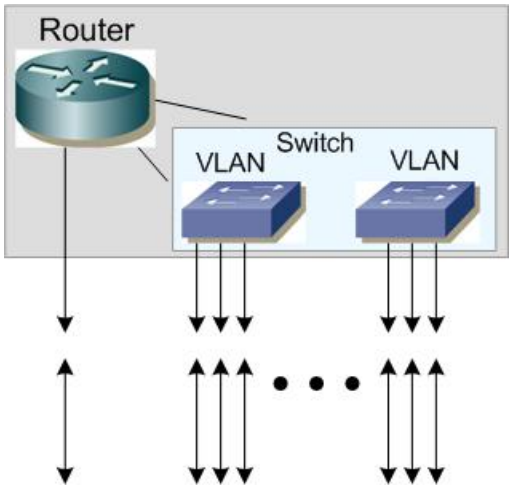

Figure 1-6: Routing Between VLANs and Routing Ports

Compilation Options

The Layer 2 Switch, Layer 3 Router, or Hybrid Switch Router behavior in ZebOS-XP is decided, based on the compilation options. ZebOS-XP follows these rules to decide on the behavior of the system:

Switching Only

System behaves as a switch when only Layer 2 protocols are enabled (STP, RSTP, MSTP and/or 802.1x).

Routing Only

System behaves as a router when only Layer 3 protocols are enabled (OSPF, RIP, BGP, RIPnG, OSPFv3, RSVP, LDP, PIM).

Hybrid Switch Routing

System behaves as a Hybrid Switch Router when at least one Layer 2 and at least one Layer 3 protocols are enabled.

CHAPTER 2 Hybrid Switch Router Configuration

This chapter describes various configurations that can be done with the Hybrid Switch Router solution. ZebOS-XP can be configured as a Layer 2 switch, a Layer 3 router or a Hybrid Switch Router, based on the compilation flags.

Configuring a Hybrid Switch Router

When a port changes from a switched port to a routed port, an `Interface Delete` message is sent to the Layer 2 protocols and an `Interface Add` message is sent to the Layer 3 protocols. The following figure shows the port, `eth0`, changing from a switched port to routed port:

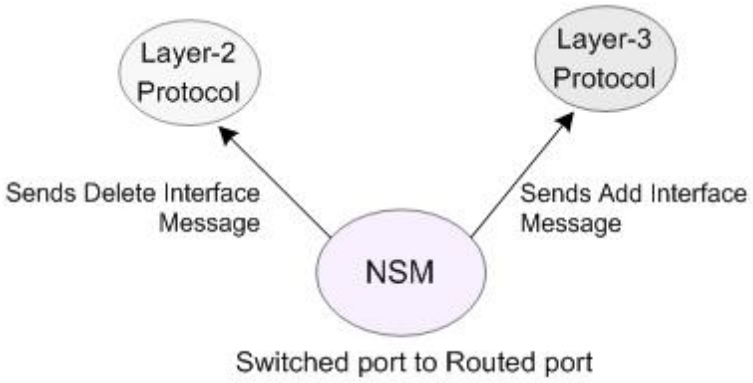

Figure 2-1: Switched Port to Routed Port

When a port changes from a routed port to a switched port, an `Interface Delete` message is sent to the Layer 3 protocols and an `Interface Add` message is sent to the Layer 2 protocols. In this case, all properties of the Layer 3 interfaces are deleted: for instance, this interface is deleted from all Layer 3 management, all routes pointing to this interface are invalidated, and IP addresses are deleted. The following figure shows the port `eth0` changing from a routed port to a switched port.

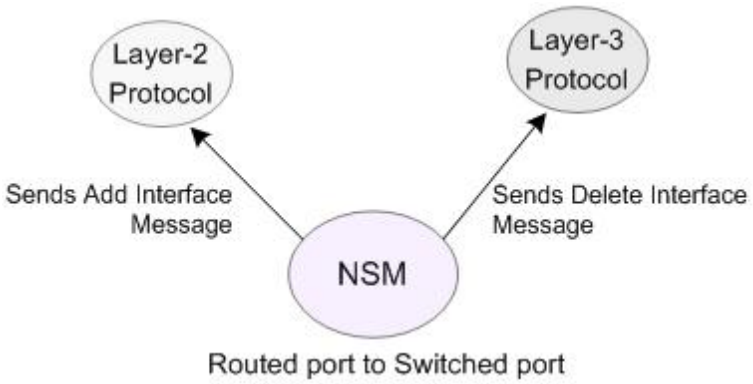

Figure 2-2: Switched Port to Switched Port

Configuring Layer 2 Interfaces

In the Switch-only mode, the interfaces are Layer 2 ports by default. For the Hybrid Switch Router, it is important to understand that by default, all interfaces are configured as routed interfaces. To configure a Layer 2 interface (switched interface), you must explicitly configure this using the `switchport` command in the interface mode. For example:

`#configure terminal`	Enter the Configure mode.
`(config)#interface eth0`	Specify an interface to configure and enter the Interface mode.
`(config-if)#switchport`	Configure eth1 as a Layer 2 port.
`(config-if)#no shutdown`	Start the interface.

Configuring Layer 3 Interfaces

In the Router-only mode, the interfaces are Layer 3 interfaces by default. For the Hybrid Switch Router, it is important to understand that by default, all interfaces are configured as routed interfaces; and to change the behavior of a port from switched to routed, you must explicitly configure this using the `no switchport` command in the interface mode. For example:

`#configure terminal`	Enter the Configure mode.
`(config)#interface eth0`	Specify an interface to configure and enter the Interface mode.
`(config-if)#no shutdown`	Start the interface.

In the Hybrid Switch Router mode, if a VLAN is configured, a Layer 3 interface based on the bridge-group number and VLAN ID is created. This Layer 3 interface is advertised to all the Layer 3 protocols. For example:

`#configure terminal`	Enter the Configure mode.
`(config)#vlan database`	Enter the VLAN configuration mode.
`(config-vlan)#vlan 2 bridge 1`	Enable VLAN 2 on bridge 1.

This interface is dynamically given a name with the following format:

```
vlanXXXX.YY
```

where `XXXX` is the VLAN ID, and `YY` is the bridge-group ID.

The name, `vlan3.1`, indicates that it is a VLAN IP interface in the VLAN 3 and bridge-group 1.

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