BIG-IP® Advanced Routing™
Troubleshooting Guide

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CHAPTER 1 Debugging and Logging

ZebOS has a comprehensive debugging and logging facility in various protocols and components. This chapter describes how to start and stop debugging and logging. For complete information, see the *ZebOS Network Platform Network Services Manager Command Line Interface Reference Guide*. The protocol debug commands are in corresponding Command References.

About Debugging

In ZebOS, every protocol has debug commands that log parameter-specific information. For example, using the `debug ldp nsm` command results in ZebOS writing all messages exchanged between LDP and NSM such as interface, bandwidth, and address updates.

You can direct the output from the debug command to:

- Standard output (stdout)
- A file
- The system log (Linux syslog)

ZebOS generates debug output until the `no` form of the `debug` command is given.

Start Debugging Output

To start debugging output, turn on the debug options by giving the relevant `debug` command. For example:

```
ZebOS> enable
ZebOS# configure terminal
ZebOS(config)# log file <filename>
ZebOS(config)# debug <protocol> (parameter)
ZebOS(config)# exit
```

Log to Standard Output

To direct debugging output to `stdout`, give the `terminal monitor` command.

```
ZebOS# terminal monitor
```

This is a sample output of the `debug rsvp events` command displayed on the terminal:

```
ZebOS# terminal monitor

Dec 2 16:41:49 localhost RSVP[6518]: RSVP: RSVP message sent to 10.10.23.60/32 via
interface eth0

Dec 2 16:41:57 localhost RSVP[6518]: RSVP: Received an RSVP message of type RSVP
Reservation from 192.168.0.60 via interface eth0

Dec 2 16:41:57 localhost RSVP[6518]: RSVP: Received a RESV message from 10.10.23.60/
32
```

Log to a File

To send debugging output to a file:

1. Use the `log file` command and specify the path and file name where the information is to be logged.

   When logging to a file, you can simultaneously log to stdout by using the `terminal monitor` command.

2. Use the `no` form of the command to turn off logging to a file:

```
ZebOS(config)# no log file (filename)
```

Log to the System Log

To send debugging output to syslog:

1. Use the `log syslog` command:

```
ZebOS(config)# log syslog
```

2. Use the `no` form of the command to turn off system logging:

```
ZebOS(config)# no log syslog
```

Stop Debugging

To turn off debugging, use the `no debug` or `undebug` command. When a protocol is specified with the `no debug` or `undebug` commands, debugging is stopped for the specified protocol. To stop all debugging, use the `all` parameter with these commands.

```
ZebOS(config)# no debug bgp events
```

or

```
ZebOS# undebug all
```

CHAPTER 2 Troubleshooting BGP

This chapter contains steps for resolving BGP issues.

Refer to the *ZebOS Network Platform Border Gateway Protocol Command Line Interface Reference Guide* for details on commands used in this chapter.

No BGP Adjacency

1. Use the `show ip interface brief` command to make sure that the interface is not administratively shutdown. Remove this configuration setting with the `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that the BGP configuration is correct. To establish BGP, configure a TCP session with another router using the `neighbor remote-as` command.

   When using iBGP:

   - Make sure the two routers know how to reach each other's loopback addresses, if you have established iBGP using loopback interface. Typically, you have an IGP (say OSPF) running between the two routers. In this case, enable OSPF on the loopback interface or redistribute the loopback address into OSPF.
   - Ping to each other's loopback address to ensure mutual reachability.

   When using eBGP:

   - Make sure you have configured the multihop number for an eBGP neighbor that is not directly connected.
   - Use the `neighbor ebgp-multihop` command to specify the maximum hop count to reach the neighbor.

3. Make sure you can reach the neighbor using the `ping A.B.C.D` command.

4. Verify if a firewall is present. If there is a firewall, it might be configured to block TCP packets. Verify the existing firewall configurations (in Linux) by using:

   ```
   ipchains -L
   ```

   Flush the existing firewall configurations by using:

   ```
   ipchains -F
   ```

No BGP4+ Adjacency

1. Use the `show ipv6 interface brief` command to make sure that the interface is not administratively shutdown. Remove this configuration setting with the `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that the configuration is correct. To establish BGP, configure a TCP session with another router using the `neighbor remote-as` command. Refer to the *ZebOS BGP Command Reference* for details on this command.

   When using iBGP:

   - Make sure the two routers know how to reach each other's loopback address, if you have established iBGP using loopback interface. Typically, you have IGP (say OSPF) running between the two routers. In this case, enable OSPF on the loopback interface or redistribute the loopback address into OSPF.
   - Ping to each other's loopback address to ensure mutual reachability.

   When using eBGP:

   - Make sure you have configured the multihop number for an eBGP neighbor that is not directly connected.
   - Use the `neighbor ebgp-multihop` command to specify the maximum hop count to reach the neighbor.

3. Make sure you can ping to the neighbor using the `ping A.B.C.D` command.

4. Verify if a firewall is present. If there is a firewall, it might be configured to block TCP packets. Verify the existing firewall configurations (in Linux) by using:

   ```
   ipchains -L
   ```

   Flush the existing firewall configurations by using:

   ```
   ipchains -F
   ```

CHAPTER 3 Troubleshooting OSPF

This chapter contains steps for resolving OSPF issues.

Refer to the *ZebOS Open Shortest Path First Command Line Interface Reference Guide* for details on the commands used in this chapter.

No OSPFv2 Adjacency

1. Use the `show ip interface brief` command to make sure that the interface is not administratively shut down. Remove this configuration setting with the `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that OSPF is enabled on the interface. To enable OSPF on a particular interface, use the `network area` command with a specified Area ID. Use the `show ip ospf interface` to confirm that OSPF is enabled for the interface.

   ```
   eth2 is up, line protocol is up
    Internet Address 56.168.1.7/24, Area 0.0.0.0, MTU 1500
    Router ID 7.7.7.7, Network Type BROADCAST, Cost: 10
    Transmit Delay is 1 sec, State DR, Priority 1
      Designated Router (ID) 7.7.7.7, Interface Address 56.168.1.7
      Backup Designated Router (ID) 8.8.8.8, Interface Address 56.168.1.8
      Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
       Hello due in 00:00:05
    Neighbor Count is 1, Adjacent neighbor count is 1
    Crypt Sequence Number is 0
    Hello received 625 sent 645, DD received 3 sent 4
    LS-Req received 1 sent 1, LS-Upd received 5 sent 13
    LS-Ack received 8 sent 5, Discarded 0
   ```

3. Ensure that the interface is not configured as a passive using `show run`:

   ```
   !
   router ospf
   passive interface eth0
   !
   ```

   If the interface is passive, remove this configuration setting by using this command:

   ```
   no passive interface eth0
   ```

4. Check the interface to make sure that OSPF Hello packets are being sent and received correctly. You can use either a packet sniffer (such as Ethereal or TCP dump) or ZebOS log messages to verify the hello packet.

   To turn on ZebOS logging, type:

   ```
   ZebOS# configure terminal
   ZebOS(config)# debug ospf event
   ZebOS(config)# debug ospf packet hello
   ```

   To display the logging message on the terminal, type:

```
ZebOS# terminal monitor
```

5. It is possible that there is a mismatch between Hello parameters. Make sure that you have specified the same hello interval and dead interval values on both machines by using the `show ip ospf interface` command on each machine.

6. Run `show ip ospf neighbor` if you see the neighbor but the state is not full.

   Make sure that both routers have the same MTU size for the interfaces.

No OSPFv3 Adjacency

1. Use the `show ipv6 interface brief` command to make sure that the interface is not administratively shutdown. Remove this configuration setting with the `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that OSPF is enabled on the interface. To enable OSPF on a particular interface, use the `ipv6 router ospf area` command with a specified Area ID. Use the `show ipv6 ospf interface` to confirm that OSPF is enabled for the interface.

```
ZebOS# show ipv6 ospf interface
    eth0 is up, line protocol is up
      Interface ID 3, Instance ID 0, Area 0.0.0.0
      IPv6 Link-Local Address fe80::248:54ff:fec0:f32d/10
        Router ID 1.2.3.4, Network Type BROADCAST, Cost: 10
        Transmit Delay is 1 sec, State Backup, Priority 1
        Designated Router (ID) 5.6.7.8
          Interface Address fe80::203:47ff:fe4c:776e
        Backup Designated Router (ID) 1.2.3.4
          Interface Address fe80::248:54ff:fec0:f32d
        Timer interval configured, Hello 10, Dead 40, Wait 40, Retransmit 5
          Hello due in 00:00:01
        Neighbor Count is 1, Adjacent neighbor count is 1
    lo is up, line protocol is up
      OSPFv3 not enabled on this interface
    sit0 is down, line protocol is down
      OSPFv3 not enabled on this interface
```

3. Ensure that interface is not configured as a passive interface using `show run`:

   ```
   !
   router ipv6 ospf
   passive interface eth0
   !
   ```

   If the interface is configured as passive (as shown above), remove this configuration setting by using this command:

   ```
   no passive interface eth0
   ```

4. Check on the interface to make sure that OSPF Hello packets are being sent and received on the interface. You can use either packet sniffer (such as, Ethereal or TCP dump) or ZebOS log messages to verify the Hello packets.

   To turn on ZebOS logging, type:

   ```
   ZebOS# configure terminal
   ```

```
ZebOS(config)# debug ipv6 ospf event
ZebOS(config)# debug ipv6 ospf packet hello
```

To display the logging message on the terminal, type:

```
ZebOS# terminal monitor
```

5. It is possible that there is a mismatch between Hello parameters. Make sure that you have specified the same `hello interval` and `dead interval` values on both machines by using the `show ipv6 ospf interface` command.

6. Run the `show ipv6 ospf neighbor` command; if you see the neighbor but the state is not full, make sure that both routers have the same MTU size for the interfaces.

7. Verify if a firewall is present. If there is a firewall, it blocks the UDP packet. You must remove the firewall if you have one. To display the existing firewall configurations, in Linux, use:

   ```
   ipchains -L
   ```

   Flush the existing firewall configurations by using:

   ```
   ipchains -F
   ```

CHAPTER 4 Troubleshooting RIP

This chapter contains steps for resolving RIP issues.

Refer to the *ZebOS Routing Information Protocol Command Line Interface Reference Guide* for details on commands used in this chapter.

No RIP Adjacency

1. Use the `show ip interface brief` command to make sure that the interface is not administratively shutdown. Remove this configuration using the `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Confirm that RIP is enabled on the interface. To enable RIP on a particular interface, use the `network` command. Use the `show ip rip interface` to make sure that RIP is enabled for the interface.

   ```
   ZebOS# show ip rip interface
   fxp0 is up, line protocol is up
    Routing Protocol: RIP
       Receive RIP packets
       Send RIP packets
       Passive interface: Disabled
       Split horizon: Enabled with Poisoned Reversed
       IP interface address:
         10.15.0.60/16
   ```

3. Make sure that the interface is not configured as a passive interface using the `show run` command:

   ```
   !
   router rip
   passive interface eth0
   !
   ```

   If the interface is configured as passive (as shown above), remove this configuration setting by using this command:

   ```
   no passive interface eth0
   ```

4. Make sure that RIP advertisements are being sent and received on the interface. You can use either a packet sniffer (such as, Ethereal or TCP dump) or the ZebOS log messages to verify the RIP advertisements.

   To turn on ZebOS logging, type:

   ```
   ZebOS# configure terminal
   ZebOS(config)# debug rip event
   ZebOS(config)# debug rip packet detail
   ```

   To display the logging message on the terminal, type:

   ```
   ZebOS# terminal monitor
   ```

5. One router configured as RIPv1 and the other router as RIPv2 results in no RIP adjacency.

Configure the router running RIPv2 as follows:

```
!
interface eth1
ip rip send version 1-compatible
ip rip receive version 1 2
!
```

1. Verify whether a firewall is present. If there is a firewall, it blocks the UDP packet. You must remove the firewall if you have one. To display the existing firewall configurations, in Linux, use:

   ```
   ipchains -L
   ```

   Flush the existing firewall configurations by using:

   ```
   ipchains -F
   ```

No RIPng Adjacency

1. Use the `show ipv6 interface brief` command to make sure that the interface is not administratively shutdown. Remove this configuration by `no shutdown` command, if `shutdown` is configured.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that RIPng is enabled on the interface. To enable RIPng on a particular interface, use the `ipv6 router rip` command. Use the `show ipv6 rip interface` to confirm that RIP is enabled for the interface.

   ```
   ZebOS# show ipv6 rip interface eth1
   eth1 is up, line protocol is up
     Routing Protocol: RIPng
       Passive interface: Disabled
       Split horizon: Enabled with Poisoned Reversed
       IPv6 interface address:
         3ffe:1::10/64
         fe80::204:76ff:fec8:28cc/10
   ```

3. Make sure that interface is not configured as a passive interface using the `show run` command:

   ```
   !
   router ipv6 rip
   passive interface eth0
   !
   ```

   If the interface is configured as passive (as shown above), remove this configuration setting by using this command:

   ```
   no passive interface eth0
   ```

4. Check on the interface to make sure that RIPng advertisements are being sent and received on the interface. You can use either a packet sniffer (such as, Ethereal or TCP dump) or the ZebOS log messages to verify the RIPng advertisements.

   To turn on ZebOS logging, type:

   ```
   ZebOS# configure terminal
   ZebOS(config)# debug ipv6 rip event
   ZebOS(config)# debug ipv6 rip packet detail
   ```

   To display the logging message on the terminal, type:

```
ZebOS# terminal monitor
```

5. Verify if a firewall is present. If there is a firewall, it blocks the UDP packet. You must remove the firewall if you have one. To display the existing firewall configurations, in Linux, use:

   ```
   ipchains -L
   ```

   Flush the existing firewall configurations by using:

   ```
   ipchains -F
   ```

CHAPTER 5 Troubleshooting PIM

This chapter contains steps for resolving PIM issues.

Refer to the *ZebOS PIM Command Line Interface Reference Guide* for details on commands used in this chapter.

No PIM adjacency

1. Use the `show run` command to make sure that the interface is not administratively shutdown. If `shutdown` is configured, remove this configuration with the `no shutdown` command.

   ```
   ZebOS# configure terminal
   ZebOS(config)# interface eth0
   ZebOS(config-if)# no shutdown
   ```

   Use the `show interface` command to make sure that the interface is up.

2. Make sure that PIM is enabled on the interface by using the `show ip pim sparse-mode interface` command.

3. If you are trying to establish adjacency between ZebOS and CISCO and are not successful, use the `ip pim exclude-genid` command on the interface. Some old CISCO IOS do not recognize the `GenID` option in the PIM Hello packet and discard the packet.

No BSR and RP information

Check your Unicast routing configuration to make sure that you can reach BSR and RP. Use the `show ip route` command to display the unicast routing table.

RP not advertised in the BSR

This happens when CISCO is a BSR and ZebOS is the candidate RP. In this case, you must configure the following command, in the `Configure` mode, on ZebOS candidate RP router.

```
ip pim crp-cisco-prefix
```

Double Multicast Traffic

In this example, PIM is running on all routers, ZebOS and the Check Point FireWall are running on R3. NAT is configured to translate Source address of the packets coming from `eth1` to `eth2` interface address. The multicast Source address is `192.168.2.2`. R2 is the RP and has a Receiver attached to it.

The Source router sends multicast data packets to R3. R3 acts as the Designated Router (DR) of the Source and sends unicast Register packets to the RP. At the Receiver end, double multicast traffic is coming out. For each multicast packet sent by Source, the Receiver is receiving two copies of the packet instead of one.

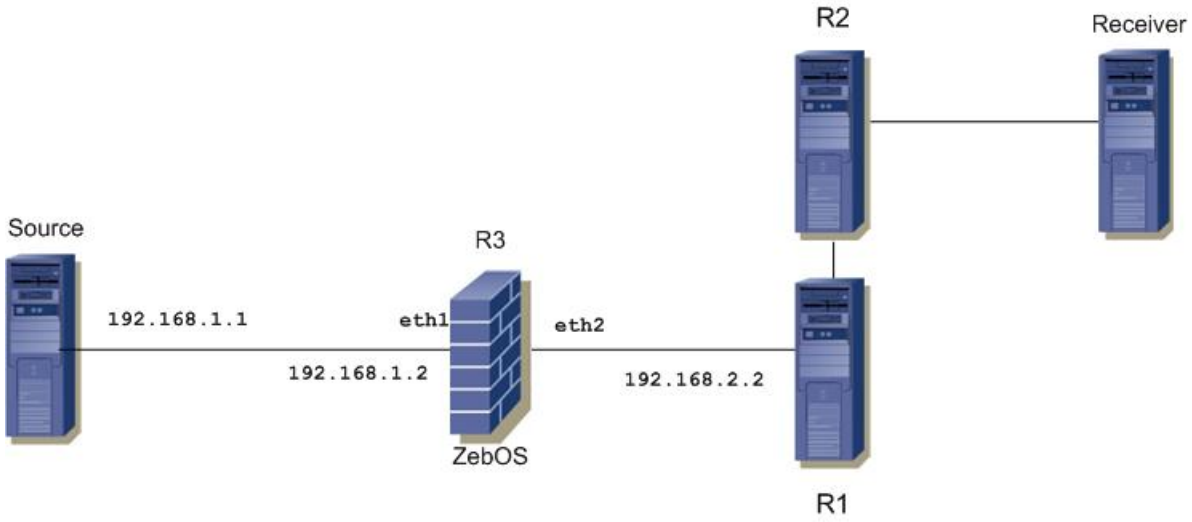


Figure 1: PIM-SIM Topology

1. Using your packet sniffer, observe the packets sent out by R3. Notice that both native multicast traffic and Register packets come out from `eth2` and the Register packet encapsulates the multicast packet.

2. Check the ZebOS multicast routing table by running the `show ip pim sparse-mode mroute` command on ZebOS:

```
ZebOS# show ip pim sparse-mode mroute
IP Multicast Routing Table

(*,*,RP) Entries: 0
(*,G) Entries: 0
(S,G) Entries: 1
(S,G,rpt) Entries: 1

(192.168.1.1, 224.0.1.3)
RPF nbr: 0.0.0.0
RPF idx: None
SPT bit: 1
Upstream State: JOINED
 Local     .l.............................
 Joined    ..j............................
 Asserted  ...............................
 Outgoing  .oo............................

(192.168.1.1, 224.0.1.3, rpt)
RP: 0.0.0.0
RPF nbr: 192.168.2.35
RPF idx: eth2
Upstream State: RPT NOT JOINED
 Pruned    ...............................
 Outgoing  ...............................
```

3. In this output, the SPT bit for the (S,G) state is set to 1, indicating that the source tree is formed on R3 and is already delivering multicast traffic over the source tree. However, Register VIF is still on outgoing list. This indicates that ZebOS is not receiving Register-Stop from RP. This is confirmed by observing packets coming in on R3 `eth2`. It also explains what we observed in `step 1`, both native multicast traffic and encapsulated Register packets come out from `eth2`.

4. Using your packet sniffer, observe the packet on R3 `eth2` further. All multicast packets coming out from `eth2` have the same source IP address `192.168.2.2`, except the Register packet, which has an IP address `192.168.1.2`.

5. Run the `show ip route` command on R2 (RP). There is no route to reach `192.168.1.2`. Because RP does not have a route to source, it failed to send the Register-stop message.

6. According to the protocol specification, the Source address of the Register packet is the DR address of the source, which is the IP address of the interface toward the source (in this case, 192.168.1.2).

   Typically, the firewall does not NAT locally generated packets. When the Register packet is sent out from `eth2` on R3, the Source address (in this case, `eth1`) is not NATed by the fireWall.

   A solution for this is to change the IP source address of the Register packet. Use the `ip pim register-source` command to configure the source address of Register packet:

   ```
   ZebOS# configure terminal
   ZebOS(config)# ip pim register-source 192.168.2.2
   ```

   After changing the source address, ZebOS sends Register packets with source address as 192.168.2.2 and receives Register-Stop packet from the RP. ZebOS stops encapsulating multicast data packet in the Register packet. The receiver now receives only one copy for each multicast data packet.

Note: When running ZebOS PIM with checkpoint NAT, the Register source address must be a reachable address (visible to the external network) to be used by the RP to send corresponding Register-Stop messages in response. You might use the `ip pim register-source` command to change the Register packet source address.

CHAPTER 6 Route Selection in NSM

This chapter describes the route selection process in NSM. Understanding the NSM route selection process helps in analyzing and troubleshooting route-related problems.

About the NSM Route Table

For every known prefix, NSM maintains a route node entry in its route table. NSM populates this table upon receiving routes from:

- Protocols such as BGP, OSPF, and RIP
- Static routes configured using the CLI
- The kernel's Forwarding Information Base (FIB)
- Connected routes derived from interface information

When multiple routes are available for the same prefix, NSM uses an internal route selection mechanism to select routes to be added to the FIB. The primary factor for route selection is the “Administrative Distance” of the protocol. The following table lists the default administrative distances of protocols.

Protocol	Administrative Distance	Preference
Connected	-	1 (highest)
Kernel	-	2
Static	1	3
eBGP	20	4
OSPF	110	5
ISIS	115	6
RIP	120	7
iBGP	200	8 (lowest)

How NSM Adds Routes

NSM prefers routes learned from protocols with a lower administrative distance over routes learned from protocols with a higher administrative distance.

For example, the following route entries display that the Static Routes (administrative distance 1) is preferred over the OSPF Route (administrative distance 110):

S *> 10.10.34.0/24 [1/0] via 10.10.31.16, eth2

O 10.10.34.0/24 [110/31] via 10.10.31.16, eth2, 00:21:19

Note: The administrative distance of routing protocols can be configured using the `distance` command.

Figure 2 on page 26 displays how a route is selected in NSM.

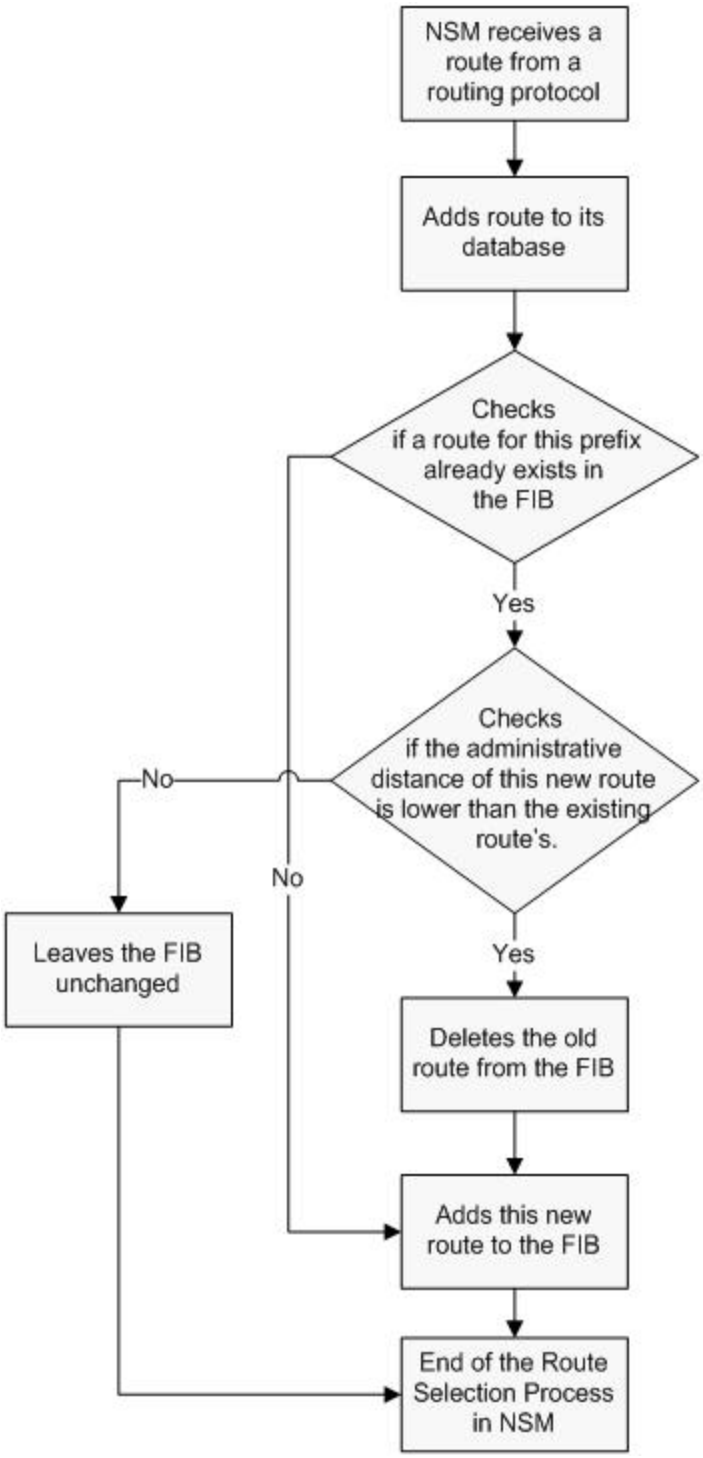


Figure 2: How NSM Adds a Route

Routing protocols use different metrics to calculate the best path for a destination. The best path is sent to NSM. However, when two paths have an equal cost/metric and Equal Cost Multipath (ECMP) is enabled on a system, NSM might receive two paths from the same protocol.

How NSM Deletes Routes

When NSM receives a route delete request from a routing protocol, NSM deletes the specified route from its database. Then it checks if the specified route is in the FIB. If the route is in the FIB, NSM deletes it from the FIB and checks if another route is available in its database for the same prefix. If there is another route in the database, NSM installs this route in the FIB. When multiple such routes exist, NSM runs the route selection mechanism to choose the best route to be added to the FIB.

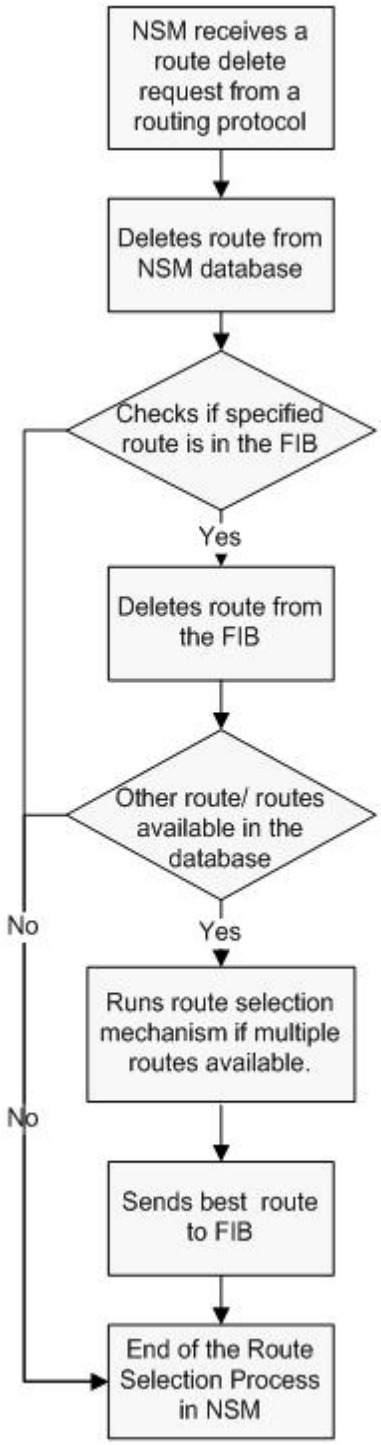


Figure 3: How NSM Deletes a Route

Show Commands

The `show ip route` and the `show ip route database` commands are important tools for troubleshooting. Use these commands in conjunction to get complete information about routes received and selected by NSM:

- Use the `show ip route database` command to list all the routes received by NSM

- Use the `show ip route` command to list only routes that are selected by NSM and installed in the FIB

Refer to the *NSM Command Reference* for details about these commands.

CHAPTER 7 Frequently-Asked Questions

The chapter contain answers to frequently-asked questions (FAQ) about ZebOS. This chapter is organized in these sections:

General

Q: How do I configure a loopback address?

Use the following command to configure the loopback interface lo with address 127.0.0.1:

```
ifconfig (loopback-address) 127.0.0.1
```

where (loopback-address) is “lo” for Linux and FreeBSD and “lo0” for Solaris.

Q: Is there a simple method to count the number of routes in the routing table?

To count the number of routes in the routing table, use the `show ip route` command, and direct the output to a text file using the “>” token.

```
ZebOS#show ip route > /home/ipi/route.txt
```

Open the text file in a text editor and turn on the line counter to see the total number of routes.

Q: How can I increase the size of the routing table in the Linux kernel?

By default, Linux allows installing a maximum number of 4096 routes (IPv4 or IPv6) in the kernel. To change this limit, edit the `max-size` file:

IPv4: `/proc/sys/net/ipv4/route/max-size`

IPv6: `/proc/sys/net/ipv6/route/max-size`

The maximum number of routes allowed in the kernel is 2147482645.

Q: Why does the DHCP server fail to start when an interface related to the server comes up?

The basic requirement to start the `dhcpd` daemon is:

- A pool must be defined in `dhcpd.conf`
- An interface must be associated with that network

So, when the interface is in “shutdown” although ZebOS tries to invoke the `dhcpd` daemon, it fails because there is no interface associated with it. So when you give the `dhcpd stop` command and then the `dhcpd start` command, both the above conditions are satisfied and the daemon runs.

Now, when the `dhcpd` daemon runs, it won't check whether the interface associated with it is up or down. That is just the initial requirement. This is inherent to DHCP.

Q: Is there any particular order in which the ZebOS daemons must be started?

It is strongly recommended that you start NSM first, followed by the protocol daemons, and then followed by IMI. However. there is no hard and fast rule regarding the sequence.

Q: What is the correct order in which I should start NSM and the protocols? Is there a reconnect procedure between NSM and the protocols?

There is no order to start NSM and the protocols. A protocol can be run independent of NSM. When NSM is killed, the protocols can still run. There is no reconnect procedure between NSM and the protocols.

Q: Assuming a ZebOS process fails, and we detect the failure, can we just restart that process? Or, will other processes (for example, HSL, NSM, IMI and other protocol modules) be affected by traffic impact if the restart is not performed in a specific order?

Protocol modules can start and stop dynamically. The advantage of using each module as a separate process is minimum impact on the device.

Q: How is memory initiation and clean up in protocol modules handled in ZebOS?

The `memmgr_init_memtable` and `memmgr_free_memtable` functions are called by each of the protocol modules for initiation and clean up.

In a flat memory model, such as, VxWorks - all protocol modules share the same memory space. Allocations and freeing happens local to that particular protocol module, and would not have an impact on other modules.

Q: What blocks of our code are GPL restricted?

ZebOS is pure commercial software: none of the software modules we sell are GPL-bound.

To evaluate our Layer-2 software modules, F5 Networks has developed the Linux kernel forwarder to allow some of our Layer-2 protocols to run on a Linux x86 PC environment. The F5 Networks Layer-2 forwarder for Linux has been adapted and enhanced for the Linux Ethernet bridge, which is GPL software. We provide it free of charge, and primarily for evaluation purposes.

To evaluate our MPLS software modules, F5 Networks has developed the Linux kernel forwarder to verify our MPLS modules for Layer-3 VPNs. The F5 Networks MPLS forwarder requires a patch to the Linux kernel, which is GPL software. We provide this free of charge.

Q: From the OS point of view, is each daemon is single threaded?

Yes, OS treats each daemon as a single thread.

Q: Do you have a detailed memory-consumption description that includes code size, variable size and dynamic memory allocation, as a function of routes, peers, and so on?

All calls to memory management within in ZebOS are associated with a type. ZebOS has a memory management implementation which maintains the memory statistics per type, for example: count and size of each type. ZebOS provides measurements for customers to engineer flash and DRAM requirements.

Q: Are there any hard limitations on the number of interfaces, peers, route entries, and so on?

No, ZebOS has no hard limitations on the number of interfaces, peers, routes, and so on

Q: Do you have In-Service Software Upgrade (ISSU) support?

Because ZebOS's architecture is modular, it is feasible to support ISSU. Although ZebOS does not have the system upgrade process, ZebOS can be integrated with an external ISSU module, which can upgrade ZebOS on a module-by-module basis.

Q: Which parts of the software packages can be distributed across different CPUs?

All protocol modules can be distributed across different CPUs.

Q: What are the debugging and logging tools used for remote debug and assistance?

ZebOS supports syslog which can be used for remote debug and assistance. At the protocol level, ZebOS has the ability to perform in depth-debugging and logging of protocol timers, packets, finite state machines, calculations, and so on.

Q: How do I enable the remote syslogging and kernel debugging options?

Perform the following:

1. Update `/etc/syslog.conf` in the machine generating logs:
   ```
   *.* @hostname --> Syslog server name/IP address
   ```
2. In the machine where `syslog` runs, add the “-r” option in the `/etc/sysconfig/syslog` file:
   ```
   SYSLOGD_OPTIONS="-m 0 -r"
   ```
3. Restart `syslogd`, and make sure that it is listening on port 514:
   ```
   #service syslogd restart
   #netstat -an | grep 514
   udp 0 0 0.0.0.0:514 0.0.0.0:*
   ```
4. To log kernel messages, update the `/etc/syslog.conf` file as:
   ```
   kern.* /var/log/messages
   ```

Q: How do I trigger/simulate alarms/traps, and so on in the code?

Use signals:

1. Register the signal in the code with the signal handler.
2. Do the processing in the signal handler. For example, in `nsm_main.c`, register the `SIGUSR1` signal:
   ```
   pal_signal_set(SIGUSR1, siguser_handler);
   ...
   int siguser_handler(int signo)
   {/* Do the processing */}
   ```
3. From the command line, invoke:
   ```
   kill -SIGUSR1 <pid of NSM>
   ```

Q: How can I handle crashes and generate a core file?

Perform the following:

1. Give the `ulimit -a` command on the box, and check whether or not the size is set for core (0 or unlimited).
2. If set for 0, set to unlimited using the `ulimit -c unlimited` command.
3. Copy the above command to the `/root/.bashrc` file to keep the settings for all sessions. The core file will be written to the root directory.
4. Use file core.5356 to get the module information. For example:
   ```
   [root@SJMCAST-1 /]# file core.5356
   core.5356: ELF 32-bit LSB core file Intel 80386, version 1 (SYSV), SVR4-style,
   SVR4-style, from 'mstpd'
   core file is for mstp
   ```
5. Run GDB for the daemon with the core file to get the back trace. For example:
   ```
   [root@SJMCAST-1 /]# gdb /usr/local/sbin/mstpd ./core.5356
   GNU gdb Red Hat Linux (6.1post-1.20040607.62rh) Copyright 2004 Free Software
   Foundation, Inc.
   GDB is free software, covered by the GNU General Public License, and you are
   welcome to change it and/or distribute copies of it under certain conditions.
   Type "show copying" to see the conditions.
   There is absolutely no warranty for GDB. Type "show warranty" for details.
   This GDB was configured as "i386-redhat-linux-gnu"...Using host libthread_db
   library "/lib/tls/libthread_db.so.1".
   ```

```
warning: exec file is newer than core file.
Reading symbols from shared object read from target memory...done.
Loaded system supplied DSO at 0xffffe000 Core was generated by `./mstpd -d'.
Program terminated with signal 11, Segmentation fault.
#0 0x0804da63 in mstp_msti_rr_timer_handler (t=0xbf8f2270) at
mstp_timer.c:444
444 mstp_timer.c: No such file or directory.
in mstp_timer.c

(gdb) bt
#0 0x0804da63 in mstp_msti_rr_timer_handler (t=0xbf8f2270) at
mstp_timer.c:444
#1 0x0804a145 in mstp_start (deamon_mode=1, config_file=0x0, vty_port=2618,
progname=0xbf8f3c30 "mstpd") at mstp_main.c:80
#2 0x08049fa4 in main (argc=5356, argv=0xbf8f2374)
at ../../platform/linux/mstp.c:105
(gdb) q
```

Q: Do I need to stop a process to start in gdb?

No. Use `attach <pid>` in `gdb`:

```
[root@Albatross_IDC:/root]# ps -ef | grep " -d"
root 6708 1 0 Jan01 ? 00:00:02 ./HSL -d
root 6710 1 0 Jan01 ? 00:00:00 ./nsm -d <<<<<<<<
[root@Albatross_IDC:/root]# ../Sai/gdb
GNU gdb 6.4
Copyright 2005 Free Software Foundation, Inc.
GDB is free software, covered by the GNU General Public License, and you are
welcome to change it and/or distribute copies of it under certain conditions.
Type "show copying" to see the conditions.
There is absolutely no warranty for GDB.  Type "show warranty" for details.
This GDB was configured as "powerpc-wrs-linux-gnu".
(gdb) attach 6710 <<<<<<<<
Attaching to process 6710 <<<<<<<<
```

Q: Does ZebOS mainly use socket-based interprocess communication (IPC) to communicate between NSM and the protocol modules and the data plane?

Yes, ZebOS uses a socket-based (UNIX domain for Linux) IPC mechanism to communicate between NSM and the protocol modules and the data plane.

Q: What is the Export Control Classification Number (ECCN) for ZebOS software?

ZebOS is classified under ECCN 5D991.

Q: Please provide more information about the reasons for having separate daemons for IPv4 and IPv6 for RIP and OSPF, whereas for BGP and IS-IS there is one daemon each.

There are separate daemons for IPv4 OSPF and RIP because they are defined in separate specifications. BGPv4 and v6 are defined in one specification, so ZebOS has a single daemon for BGP and ISIS.

Q: How is synchronization between the CLI, SNMP, and the configuration API done?

ZebOS is a single-threaded modular architecture. This architecture simultaneously resolves the synchronization issues when using the CLI, SNMP, and configuration API features, because only one of these features is serviced at a time.

Q: I am using MD5 authentication and notice a failure to reach full adjacency across different platforms.

Sometimes a different version of the libcrypto library might cause this problem. Check the libcrypto library version. IPI uses "libcrypto.so.0.9.7" in its testing environment.

Q: Is ZebOS compliant with the uClibc environment (http://www.uclibc.org/FAQ.html)?

ZebOS Layer-3 is compliant with uClibc, but the Layer-2 software forwarder is not compliant with uClibc.

Q: What additional value do we get from EmbeddedMind (http://www.oracle.com/us/industries/communications/communications-embedded-mind-1375715.html) integration with your code, compared to your package?

EmbeddedMind integration provides a unified management layer. Most importantly, it supports an XML and Web interface, apart from the CLI and SNMP. ZebOS supports only CLI and SNMP.

Q: Where are QoS and ACL management located within your architecture?

QoS is maintained as part of the Network Services Module (NSM). ZebOS does not support data-plane ACLs.

Q: Why is the prefix of an IPv6 link-local address /64 instead of /10.

The prefix of fe80::/10 identifies the link-local scope of an IPv6 address where the higher-order 10 bits indicate the scope. The actual prefix length is usually configured to be /64.

RFC 3515, section 2.5.6, states that the 54 bits following 1111111010 should be set to 0 in the link-local address. This implies an allowable prefix of /64 based on a 64-bit interface identifier that occupies the lower-order bits. Therefore, it is preferable to retain the prefix length as 64.

Q: Is a link-local address required for protocols such as RIPng and OSPFv3?

Yes, a link-local address is required for IPv6 protocols such as, RIPng or OSPv3 to get activated. ZebOS provides options to configure its own link-local address. Also, a user can visualize this using the `show running-config` command.

Q: How is IPv6 support enabled on RH9?

Perform the following:

1. Open the `/etc/sysconfig/network`.
2. Add the following two lines:
   ```
   NETWORKING_IPV6=yes
   IPV6INIT=yes
   ```
3. Restart the network service:
   ```
   #service network restart
   ```

It will show an additional interface (sit0) in the interface list (`ifconfig -a`) for ipv6-in-ipv4.

Q: How is an interface with an IPv6 address configured on RH9?

```
ifconfig <IFNAME>
inet6 add <IPV6 ADDR>
```

For example:

```
ifconfig eth1
inet6 add fec0::1111:2222:3333:4444/64
```

Q: Can “prefix-list” be used with the “distribute-list” command?

No. ZebOS supports only standard or extended access-lists in the `distribute-list` command and does not support “prefix-list”.

Q: Which modules support passive-interface?

Passive interface is supported in RIP, OSPF, and PIM.

Q: How many designated routers (DRs) can be present in an area?

A DR and/or back-up designated router (BDR) are elected per LAN segment. There can be zero or more DRs or BDRs in the segment depending on the type of connectivity.

IMI/IMISH

Q: I set the hostname using the ZebOS CLI, and it changed correctly, but when I set the hostname in the kernel, it did not change.

Changing the hostname using the ZebOS CLI takes precedence over changing the hostname in the kernel. If you change the hostname in the CLI and then change the hostname in the kernel, the hostname changed in the CLI will remain. For details on the `hostname` command, refer to the *NSM Command Reference*.

Q: Where is the configuration file for protocols?

Configuration files are stored in `/usr/local/etc`. Please refer to ZebOSIMIDevGde.pdf for more details.

Q: How are the configuration files organized? What is the ZebOS.conf file used for and what is stored at the per protocol (for example, ospf.conf)?

For configuration storage, F5 Networks provides two mechanisms: one using Integrated Management Interface (IMI), and the other using individual protocol modules. Using IMI, the configuration management is unified, and configuration for all protocol modules is maintained in the `ZebOS.conf` configuration file. In non-IMI mode, the configuration is maintained by individual protocol modules.

Q: How is configuration backward compatibility handled?

ZebOS maintains the configuration compatibility by maintaining the old CLI configuration. Because most configuration remains unchanged for a specific protocol module, we can guarantee back-compatibility.

Q: What does the “copy running-config startup-config” command do?

The `copy running-config startup-config` command copies the current running configuration to the startup configuration file.

Use this command if you want to write the current configuration to the file that is read at startup. This command is the same as the `write memory` command and is available in the Privileged Exec mode.

Example:

```
ZebOS>enable
ZebOS#copy running-config startup-config
```

Q: How do I enable logging in ZebOS?

See Chapter1, *Debugging and Logging*.

Q: What functions are called if the “write” command is entered?

Every module registers a callback function with the CLI using `cli_install_config`. This call back function is called to save the running configuration.

Q: What is the maximum length for the host name?

The host name can be set to any length but when displayed it is restricted to the `MAXHOSTNAMELEN` ZebOS constant.

Q: How do we display data using the “show” command? And in what mode should the “show” commands be registered?

For all `show` commands, you need to use the `cli_out` function to display the required data. All `show` commands, except `show running-config` need to be installed in EXEC_MODE. This is because `show` commands are handled in a different way from configuration commands. When a user gives a show command, this creates a show connection

between IMISH and the protocol module to fetch and display the data. This, in turn, calls the respective `cli_out` function to display the required data. This is mentioned in ZebOSIMIDevGde.pdf.

Q: What function should be used to dump “debug” command related data?

To dump debug related data, the various `zlog_*` functions available in ZebOS can be used. They will automatically take care of sending the message to the terminal. For example, look into the code to understand how `zlog_info` can be turned on or off for different debug settings.

Q: What is the “privilege” command for?

The `privilege` command is used to set a new command privilege level. Refer to the ZebOS IMI Command Reference for the syntax and command modes to set and show the privilege level.

Understanding Privilege Levels

By default, the ZebOS CLI has two levels of access to commands:

- User EXEC mode (level 1)
- Privileged EXEC mode (level 15).

However, you can configure additional levels of access to commands called privilege levels to protect your system from unauthorized access. Up to 16 privilege levels can be configured, from level 0, which is the most restricted level, to level 15, which is the least restricted level.

For example, if you want a certain set of users to be able to configure only certain interfaces, but not allow them access to other configuration options, you could create a separate privilege level for only specific interface configuration commands, and distribute the password for that level to those users.

Q: What is the use of the cli_install_gen and cli_install_imi functions?

If the command is to be executed only by the IMISH module (as `show history`), it must be installed using the `cli_install_gen` function.

If the command is to be executed only by a protocol module (as `aggregate-address A.B.C.D/M`), it must be installed only inside the protocol module by using the `cli_install_gen` function.

If the command is to be executed by the IMISH module and by IMI (as `write`), it must be installed:

- In IMISH by using the `cli_install_imi` function
- In IMI by using the `cli_install_gen` function

All IMI related commands common to many protocols should be installed using `cli_install_imi` with the suitable module mask. To be specific, all the commands related to DHCP, NAT, NTP, access list, prefix lists and route map are installed using the `cli_install_imi` function.

If the command is to be executed by IMISH, IMI, and by a protocol module PM_Y (as `hostname WORD`), it must be installed:

- In the protocol module by using the `cli_install_gen` function
- In IMISH by using `cli_install_imi` in this way:
  ```
  cli_install_imi (ctree, X_MODE, PM_Y, PRIVILEGE_NORMAL, 0, &imish_func);
  ```
- In IMI by using `cli_install_imi` in this way:
  ```
  cli_install_imi (ctree, X_MODE, PM_Y, PRIVILEGE_NORMAL, 0, &imi_func);
  ```

Also, all commands, except the mode change commands in ZebOS are installed in IMI and IMISH using the `cli.pl` script to build the CLI tree during compilation. For all such commands, IMISH and IMI simply pass on the command to the respective the protocol module. You can confirm this from the generated files `imi_cmd.c` and `imish_cmd.c`.

Q: How does the “show running-config” (or the “write”) commands work? Who decides the order of commands on the configuration file?

The interface mode is a subset of the config mode, that is, to access interface mode, you need to be in the config mode.

The command tree is organized and indexed based on the modes in which the commands are installed. Hence, a command installed in config mode is always placed before a command installed in interface mode.

The `show running-config` and `write` commands use the same order to display and save the configuration. To understand the implementation, refer to the `imi_config_write_full` function in `imi_config.c`. This function is called from both the `show running-config` and `write` commands.

The `imi_config_write_full` function, in turn, calls the `imi_config_write_config` function, which decides the order in which the configuration is displayed or saved

Q: How do we get the CLI in imish and imi to do different tasks in a particular order?

The flag CLI_FLAG_LOCAL_FIRST is used when you want the command in `imish` and `imi` to do different tasks in a particular order. If this flag is not set, the command will always be executed in IMI.

Take the example of the `reload` command defined in imish_cli.c. Here, the CLI in `imish` waits for the user input, “yes/no”, before rebooting the system. Note that the actual system reboot is done only in `imi`.

Q: The “do show run” command, though executed at the Interface mode (config-if), returns to config mode, upon execution

The `do show run` command does not exist at the interface level. It is a config level command. Even though we provide the functionality to execute this command from the interface level, on exiting the CLI, it will return to the config level to which it belongs.

Q: What type of access lists can be used for NAT?

The ZebOS type access-list supports NAT.

Q: How do I enable an access-list when I create an access-list and an IP NAT pool with the necessary commands?

The `ip access-group access-list-name in/out` command is necessary to enable the access-list on that interface:

- “in” works on packets coming into the interface.
- “out” works on packets being sent from the interface.

Q: Does IMISH prompt the user name and password?

IMISH only invokes the shell, and does not prompt for a user name. With IMI builds, there is no way to specify a user name. Password protection is only available for the `enable` command.

Q: With the cli_out function, how many characters is it possible to display?

The `cli_out` function internally calls the `fprint` function, which writes the formatted string to a specified output stream (such as `stdout` or file). Thus, the limit for `fprintf` is same as the limit of `cli_out`.

Q: Can the IMISH inactivity timeout be changed?

Yes, by using the `exec-timeout <0-35791>` command, where the value is in minutes.

Q: “no” commands do not work in additional “configure terminal” sessions.

It is related to the `--enable-multi-conf-ses` build option, which allows multiple configuration sessions to be simultaneously active (2 or more users configuring the system via different IMISH sessions). The “no ... commands are disabled” message is displayed when at least 2 sessions are configuring the same daemon, one user has opened a nested configure mode, and another user is trying to execute the “no ...“ command. This prevents deletion of the context for the other command.

Q: Does ZebOS provide a password encryption service?

Yes, CLI encrypts passwords for:

- Enable passwords
- Passwords with a user name. For example, if the command `username test password test123` is given, the “test123” string is encrypted.

However, the passwords are encrypted only after the configuration is saved using the `write` command.

Q: Which encryption standard does ZebOS use when the password encryption service is activated?

ZebOS uses the Data Encryption Standard (DES) using the Linux crypt function.

Q: How can configured passwords be removed, and when is the password removal effective?

Remove the password line in the corresponding `.conf` file and restart the daemons to access the router to make the password removal effective.

Q: When using the “terminal monitor” command to display the debug logs, the debug logs are not displayed in the output. Does this command require any specific daemons to be started?

To make the `terminal monitor` command effective, the Linux `syslogd` utility must be running with the configuration file `/etc/syslog.conf`.

Q: If there are more than 1000 routes, and the show ip route command is entered, why does the CLI display only the first 20 entries, stop, then wait for the user to press enter, space, or q to quit?

To avoid this, enter the command `term length 0` in Exec mode; then enter the `show ip route` command.

NSM

Q: What is the default status of the if-arbiter? When do I need to enable/disable the if-arbiter?

In the ZebOS implementation, the if-arbiter is disabled by default. When interface-related operations are performed outside of ZebOS (for example, when using OS ifconfig), enable if-arbiter for a transient time to complete synchronization. When synchronization is complete, disable it using the if-arbiter CLI. Refer to the *NSM Command Reference* for details on this command.

Q: How does NSM notify the protocols about MTU/metric updates? In Solaris and VxWorks, how do I get the kernel to notify NSM about MTU/metric updates?

Live MTU/metric updates are sent by NSM to the protocols on Linux and all flavors of BSDs (FreeBSD, NetBSD, OpenBSD, LynxOS, VxWorks-IPNET and OSE-IPNET).

For Solaris and VxWorks, the kernel does not notify NSM about the MTU/metric updates. To trigger this information from NSM to protocols, you need to administratively bring the interface down, modify the MTU/metric, and then bring the interface up. This will send the new MTU/metric update to the protocols.

Q: How can I limit bandwidth? I used the bandwidth command, but it did not limit the bandwidth.

ZebOS uses bandwidth limitation only when TE protocols such as RSVP request bandwidth from NSM for setting up LSPs.

The `bandwidth` command does not affect the physical bandwidth of a system. It defines the logical bandwidth available to the protocols. It simply allows users to define the total bandwidth of an interface for operating systems in which the kernel does not send bandwidth information to NSM when interfaces come up.

Thus, QoS is configured through the kernel, not through NSM.

Note: Refer to the *NSM Command Reference* for details on the `bandwidth` command.

Q: I have ripd and ospfd running: what will happen when I restart NSM?

Restarting NSM does not affect `ripd` or `ospfd`. Even when NSM is killed, it does not affect the functionality of other protocol daemons.

Q: Why does setting the MTU size under ZebOS conf not affect the kernel MTU size?

To change the MTU size in ZebOS, use the `ifconfig` command. Use the `ip ospf mtu` command to control the MTU size of OSPF packets.

Q: I have configured an IP address on an interface using “ip address A.B.C.D/M”. Yet, I am unable to ping the interface.

The command `show interface IFNAME` will confirm if the interface is up and if it is a VLAN, whether the VLAN is active. Also Layer 3 support is necessary. This is as per design; we cannot ping an interface in pure Layer 2 support.

Q: The IPC between NSM and other daemons takes place through UNIX domain sockets. Is it possible to change this communication mechanism to use TCP (AF_INET) sockets? Is it possible for NSM and IMI to reside on one machine, and the protocols on another machine?

Yes, TCP/IP sockets can be used for IPC between NSM and the protocol modules. Add `--enable-tcp-message` in the `config.sh` file, and follow the steps in the install manual to compile the code. Technically, it is possible for NSM and IMI to reside on a different machine from the protocols, but the code may have to be modified to ensure that NSM is aware of all interfaces participating in routing across all machines.

Q: Is there a command that can register the MAC table and the ARP table in Static?

1. Create a static ARP entry:
   ```
   ZebOS(config)#arp 1.1.1.10 aaaa.bbbb.cccc
   ```
2. Register the MAC Table:
   ```
   ZebOS(config)#bridge 1 address aaaa.bbbb.cccc forward eth1
   ```

Q: How do you enable Neighbor Discovery?

The Route Advertisement in neighbor discovery is suppressed by default. To enable it, use the `no ipv6 nd suppress-ra` command.

Q: Does NSM recover the routing information from the underlying platform during graceful restart?

Yes, NSM recovers the routing information from the underlying platform/kernel while restarting. During NSM restart process, NSM keeps the kernel FIB intact, and all protocol modules repopulate their routing information after NSM starts.

Note: To retain NSM routers in the FIB, use the `fib retain` command. Otherwise, NSM cleans up the FIB when it exits.

Please refer to the ZebOS Architecture Developer Guide for more details.

Q: I am not able to set the MTU to 2000 on a fast Ethernet interface. What is the problem?

The accepted MTU values are from 65 to 1500 for a fast Ethernet interface.

Q: What is the difference between the ip-access-list and access-list commands?

The `access-list` command configures an access list for filtering packets. This filtering list will be used by all protocol modules.

The `ip-access-list` command creates an IP access-control list (ACL) (based on the source address) or creates an IP extended ACL (based on the source and destination address.) This command is related to QoS and until QoS is enabled using `mls qos enable`, an IP access list cannot be created.

Q: How do you merge routes from different sources into the main RIB? Is it possible to configure the weights of routing information from the various sources?

In ZebOS, the Routing Information Base (RIB) is part of the Network Services Module (NSM). Each protocol module populates the routes to NSM, which runs the route selection process, based on administrative weights attached to each protocol module. The administrative weights assigned to each protocol type are based on industry-standard implementations, but can be changed through the source code.

Q: Is it possible to create ACLs that also inspect Layer-4 parameters?

No.

Q: From NSM's point of view, is there any constraint with regard to the time between stopping the daemon and restarting it?

This depends on the graceful restart period configured before the restart. The helper router retains the routes and adjacency, until the grace time expires. If the other router restarts before the graceful restart time expires, then the helper router maintains the state; otherwise, it flushes the neighbor adjacency and routes learned from the neighbor.

Q: What are summary addresses and what is the use of a NULL0 interface?

Summary addresses are aggregation of routes.

The installation of a NULL interface occurs as soon as a summary address is created. For example, if the `show ip route` command is issued, the following is displayed:

```
 i      4.4.4.0/22 [115/0] is a summary, Null, 00:04:54
```

Any packets destined for summarized routes have a longer match in the routing table. Packets that do not match one of the summarized routes, but match the summary route, are dropped. For example, if the `show ip route` command is issued, the following is displayed:

```
i       4.4.4.0/22 [115/0] is a summary, Null, 00:09:45
C       4.4.4.0/24 is directly connected, eth1
```

The example above shows that 4.4.4.0/24 is directly connected and has a route in the routing table.

Q: If a summary address matches multiple routes, which metric is chosen?

The metric chosen for the advertised summary is the smallest metric of the matching routes.

Q: If a summary address matches both internal and external routes, which route is preferred?

The internal route is preferred over external routes, even though the external metric is less than the internal metric.

Q: Is there a command to configure the ISATAP (Intra-Site Automatic Tunnel Addressing Protocol) prefix for the ISATAP subnet?

When the IPv6 address is configured on the ISATAP router, the IPv4 address is embedded into the IPv6 address: this provides the ISATAP address.

Q: Does ZebOS support LDP-ISIS synchronization?

Yes, ZebOS supports LDP-ISIS synchronization. LDP-ISIS synchronization occurs by default because in ZebOS all daemons send learned routes to NSM, and NSM handles routing between systems. In LDP-ISIS synchronization, ISIS sends routes to NSM, and LDP assigns labels to the routes found in the NSM database. The functions that correspond to these operations are:

- `nsm_server.c`: `nsm_server_send_route_ipv4`
- `ldp_nsm.c`: `ldp_nsm_recv_route_ipv4`

Q: What happens if LDP is not ready after ISIS has converged? How does ZebOS route the packets? Is it possible to control LDP so it is synchronized before the IGP converges?

- If LDP comes up *after* ISIS has converged, it will get all current routes from NSM, exchange FEC, and assign labels for the route (standard LDP behavior). If there is no FEC, the packet will be forwarded as a normal IP packet.
- If LDP comes up *before* ISIS has converged, it registers with NSM, and once NSM gets the routes from ISIS, LDP starts assigning labels to those routes found in the NSM routing table.

Q: What is the meaning of recursive next-hop flag in the RIB?

Consider the following case:

10.1.1.0/24

(OSPF) Box 1 eth1 (.1) ---------- (.2) eth1 Box 2 (OSPF)

199.1.1.0/24 is learned through 10.1.1.1 on Box 1. If you configure a static route on Box 1 such as 188.1.1.0/24 through 199.1.1.0, this will show as a recursive route, because 188.1.1.0 is resolved through 199.1.1.0,which is resolved through 10.1.1.0.

Q: What is non-stop-forwarding?

Non-stop forwarding (also called graceful restart) is available for OSPF, ISIS, RIP, NSM, LDP, RSVP and BGP. On a high level, for example: in ISIS, if R1 is configured as the restarting router, until the restart-hold time is expired, NSM maintains the routes learned through ISIS. If ISIS comes back up before the hold time, the routing continues normally. If ISIS does not come back up before the configured hold time, NSM removes all of the routes learned through ISIS.

Q: What is the difference between router-id commands in configure mode and in router mode?

If there is no router-id defined for a protocol, the highest IP address in the router is used as the router ID. This can be changed by either specifying an NSM-level router ID or a protocol-level router ID. Note that when an NSM-level router ID is specified, it supersedes any other configured protocol router ID.

Q: Is the following procedure possible? 1) Start ZebOS with configuration A. 2) Call the stop_zebos function. 3) Replace ZebOS.cong via some means (resulting in configuration B). 4) Call the start_zebOS function. 5) ZebOS is now running with configuration B.

Yes. After the ZebOS.conf is replaced, and a call is issued to `stop_zebos` then to `start_zebos`, the new configuration is seen.

Q: The interface index (ifindex) value is not the same when interface changes are made between switchport and router port from IMISH.

The `ifindex` for a Layer 3 interface is generated by the TCP/IP stack in the kernel, while an `ifindex` for a Layer 2 interface is generated by ZebOS. The reason for this is that the TCP/IP stack only maintains information about Layer 3 interfaces, but does not maintain information about Layer 2 interfaces. ZebOS assigns the `ifindex` for all Layer 2 interfaces beginning with 5001.

The kernel assigns a new `ifindex` every time an interface is changed from Layer 2 to Layer 3. For example, if GE1 is configured as a Layer 3 interface with an `ifindex` of 3, each time the `switchport` or `no switchport` command is given, GE1 is assigned a new `ifindex` by the kernel.

Since there is no control over the `ifindex` assignment for Layer 3 interfaces, it is not possible to maintain the same `ifindex` for both Layer 2 and Layer 3.

Q: How do I enable Equal-Cost Multipath (ECMP) on NSM?

The Equal-Cost Multipath (ECMP) enables a router to have several next-hops available for any given destination. To enable ECMP, follow the steps below.

To enable multipath support in the kernel:

- Under Networking Options:
    - TCP/IP Networking
    - IP: advanced router
    - IP: equal cost multipath
- Under Network Device Support options:
    - EQL (serial line load balancing) support

To enable multipath support in NSM, modify the following option in the configure script:

```
./configure --enable-multipath=NUM
```

Change NUM to your preferable maximum entry such as 2, 4, 8. The default value is 1.

Now, the kernel and NSM will support equal cost multiple paths to the same destination. For example, if you configure the following static routes in NSM:

```
ip route 1.1.1.1/32 10.0.0.2
```

```
ip route 1.1.1.1/32 10.0.0.3
```

Run the `ip route` command in the kernel. The static routes will be displayed in the kernel routing table as:

```
1.1.1.1 proto zebra
nexthop via 10.0.0.2 dev eth0 weight 1
nexthop via 10.0.0.3 dev eth0 weight 1
```

If ECMP is not enabled, the NSM kernel will display only one path in the kernel routing table.

How do I verify load balancing on a Linux kernel?

The ZebOS implementation leverages the Forwarding Plane Load Balancing when the underlying kernel supports ECMP (Equal Cost Multipath).

ZebOS installs the maximum number of ECMP routes supported by the kernel. With this, load balancing can be performed with more than one nexthop to reach a destination. In case the router receives and installs multiple paths with the same administrative distance and cost to a destination, load balancing is possible.

Ideally, multiple nexthops have different interfaces to the destination, but this is not mandatory. The algorithm for distributing traffic across ECMP routes is dependant on the kernel, and typically based on the protocol, source address, destination address and the port.

To verify if load balancing is working on the Linux kernel, use the `ping` utility to verify that more than more than one nexthop is being used to send packets to destinations.

```
N2
> -------- N4
> R1------------R2 R3-----+-----R4
> (.1) N1 (.2)-------(.3) | (.4)
> N3 |
> |
> R5
> (.5)
```

In this topology, OSPF is enabled on all the routers. R2 is ECMP enabled, and ethereal is enabled on both links of R2.

Once R1 learns about R4 and R5 through R2, ping to R4, and see ping packets on one link (for example N3) of R2. Then, ping to R5 from R1, and see ping packets on the other link (N2) of R2.

In this example, R2's kernel is load balancing, as it is using both the links to send packets.

In case only one link is used to send packets to R4 and R5, R2's kernel is not load balancing and might not be supporting ECMP.

Q: How does load balancing on NSM work for a Linux kernel?

NSM relies on the underlying kernel for load balancing. For example, suppose there are two static routes to the same destination - this can be seen from the following output:

Note: The `route -n` or `netstat -rn` commands do not show the Equal Cost Multipath Routes (ECMP) routes; the `ip route` command does shows the ECMP routes.

```
[root@localhost ~]# ip route
192.168.2.0/30 dev vlan1.3 proto kernel scope link src 192.168.2.1
192.168.1.0/30 dev vlan1.2 proto kernel scope link src 192.168.1.1
216.20.15.128/25 dev eth0 proto kernel scope link src 216.20.15.225
169.254.0.0/16 dev eth0 scope link
10.0.0.0/8 proto zebra
nexthop via 192.168.1.2 dev vlan1.2 weight 1 ------> ECMP
nexthop via 192.168.2.2 dev vlan1.3 weight 1 -------> ECMP
default via 216.20.15.254 dev eth0
```

```
[root@localhost ~]# route -n <--------Does not show the ECMP routes
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
192.168.2.0 0.0.0.0 255.255.255.252 U 0 0 0 vlan1.3
192.168.1.0 0.0.0.0 255.255.255.252 U 0 0 0 vlan1.2
216.20.15.128 0.0.0.0 255.255.255.128 U 0 0 0 eth0
169.254.0.0 0.0.0.0 255.255.0.0 U 0 0 0 eth0
10.0.0.0 192.168.1.2 255.0.0.0 UG 0 0 0 vlan1.2
0.0.0.0 216.20.15.254 0.0.0.0 UG 0 0 0 eth0
```

Also, the Linux stack treats the ECMP routes as flow based. That is, even if the kernel has two routes to the same destination, as long as the source IP is the same, the path taken to deliver the packets will not change. But, if you ping the same destination with a different source IP address, the other path will be used for load balancing.

Q: Does NSM acknowledge whether DCHP is enabled on a particular interface?

No, NSM does not acknowledge whether DHCP is enabled on an interface. For example, when the `ip address dhcp` command is executed through IMISH, it is directly executed in the kernel from IMISH.

Q: Is there a way to configure a VLAN such that the configured VLAN takes precedence over the default VLAN?

In interface mode, give the `switchport access vlan 2` command. This command makes VLAN 2 take precedence over the default VLAN.

RIP

Q: While redistributing routes using route maps and access lists in a telnet build, the redistribution does not occur as per the route map.

Whenever a telnet build is used, make sure that all RIP related commands are entered in the RIP protocol module daemon. For example:

```
telnet <ip address> 2602
```

The access lists and route maps to use for route redistribution must be entered through the RIP daemon, not the NSM daemon, even though they are not configured through the RIP router mode. If the route maps and access lists are configured through NSM (port 2601), and redistributing routes in RIP is done using them, all routes will be blocked by default, because the route map will not be found. Thus, access lists and route maps to be used for redistribution of routes must be configured through the RIP daemon itself.

Q: What happens to the RIP learned routes whose network address is same as one of the directly connected IPs, when the prefix length is greater than, less than, or equal to, that of the directly connected interface?

All routes with greater prefix length and less prefix length will be displayed in the RIP routing table. The equal prefix-length entry will be discarded.

For example. if the 1.1.0.0/24, 1.1.0.0/25 and 1.1.0.0/23 routes are redistributed into RIP, and a neighbor has an interface with IP 1.1.0.2/24, the RIP route entry of the 1.1.0.0/24 network will not be available. But, the 1.1.0.0/23 and 1.1.0.0/25 entries will be available in the RIP routing table. The 1.1.0.0/24 entry is available as a directly connected entry in the routing table. If this interface is down, the RIP route will become active, until the interface comes up.

Q: When redistributing other routes to RIP, why does the redistributed route always override the routes learned by RIP?

RIP learned routes have lower priority than redistributed routes (for example, connected/static/ISIS). Therefore, the redistributed routes always override the routes learned by RIP.

BGP

Q: Why is the BGP session reset after any BGP capability is configured?

In BGP, capabilities are advertised in the OPEN message during session initialization. If a capability is enabled or disabled after the session is established, the BGP session needs to be reset, and a new capability is included in the OPEN message.

The draft-ietf-idr-dynamic-cap-02.txt document proposes a mechanism to dynamically update BGP capabilities without resetting the session. F5 Networks supports this draft for the following capabilities:

- BGP address family
- Graceful restart
- ORF (not Route-reflector capability)

If two peers are configured to dynamically update BGP capabilities for the capabilities above, the BGP session will not need to be reset.

Q: How do I set up “neighbor send-community” in BGP?

The “neighbor send-community” is set up by default. By default, on receiving the communities attribute, the router re-announces them to the neighbor. This command does not appear in the list of available commands in the Router mode. It is visible only when the user has used the `no neighbor send-community` command. Please refer to the *BGP Command Reference* for details on how to use this command.

Use the `show ip bgp neighbor` command to confirm that the neighbor send-community is set up.

Q: What is Route Reflection used for?

Route Reflection is used in IBGP to resolve the IBGP full mesh problem. Configuring one or more routers as Route Reflectors reduces the number of connections between BGP peers within an Autonomous System (AS).

The Route Reflecting BGP peer has to be configured with the peer addresses of all its route reflection Clients. The Route Reflector is responsible for:

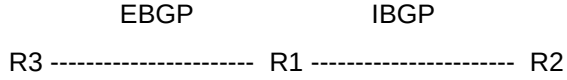
- Sending updates from a client peer to other client peers, as well as non-client peers.
- Sending updates from non-client peers to client peers.

Q: When I set up router BGP views, the sessions come up, but when I run the “show ip bgp summary” command, I only see the first view under the same ASN.

Since you are using BGP in a BGP route-server-client setup, you must use the `show ip bgp view summary` command, instead of the `show ip bgp summary` command to check the status of the BGP sessions. Refer to the *BGP Command Reference* to see details of this command.

Q: Can you explain more about the BGP “neighbor next-hop-self” command?

The neighbor next-hop-self command is only effective in the case of IBGP. For example:



On executing the `neighbor <a.b.c.d> next-hop-self` command on R1, the R1 router advertises the routes (if any) with the next-hop attribute that equals the R1 IP address.

This command is useful for advertising the routes learned by R1 from other routers, and are not reachable by R2.

Q: Does the “no bgp graceful restart” command turn off graceful restart? Or does it just set the parameters back to the default?

The `no bgp graceful-restart` command turns off the graceful restart functionality.

The `no bgp graceful-restart restart-time` and `no bgp graceful-restart stalepath-time` commands reset the timer values to the default values.

Q: Which BGP draft version is used to test conformance?

F5 Networks uses the IXIA ANVL test suite for testing conformance. The latest version of ANVL is based on draft-ietf-idr-bgp4-26.txt.

Q: What does “internal attribute hash information” mean in the “show ip bgp attribute-info” command?

ZebOS maintains a hash table for all BGP attributes. The `show ip bgp attribute-info` command, iterates the BGP attribute hash table to display all BGP attributes (such as nexthop, community list, and as-path). Currently, ZebOS displays only nexthop attribute information.

Q: What does the duration field mean in the “show ip bgp dampening” command?

The duration field displays the time elapsed since the router flap dampening (RFD) record was created, that is, since the first penalty points were evaluated.

Q: According to the description in the BGP Command Reference of the “neighbor remove-private-as” command: if the update includes both private and public AS numbers, the system treats it as an error. Does this mean ZebOS drops the packet or is an error message generated?

No, ZebOS does not drop the packet, it just checks whether or not the given value is within the range (1-65535).

While sending the UPDATE packet, it checks whether or not the remove-private-as flag is set on that EBGP peer. If it is set, it sends the UPDATE packet, which moves the private-AS number (for the routes received from another EBGP peer with a private-AS number in the message) to the configured EBGP peer.

Q: How does the route reflector use the cluster ID? Does it send it out in packets?

The cluster ID is used by the route reflectors to reflect the routes between different clusters. By default, a single route reflector for a cluster is identified by its router ID. When more than one route reflector is configured for a cluster, all route reflectors in the cluster must be configured with the cluster ID.

While sending updated packets, the cluster ID gets appended to the cluster list. A cluster list is a sequence of cluster IDs that the route has passed. When a route reflector reflects a route from the route reflector clients to non-clients outside of the cluster, the route reflector appends the local cluster ID to the cluster list.

Q: Does ZebOS support BGP multipath?

ZebOS does not support BGP multipath. However, NSM supports load balancing.

Q: In BGP, when the prefixes are limited by using the neighbor maximum-prefix command, is the route information input exceeding the maximum value deleted?

The behavior depends upon the warning-only option associated with the neighbor maximum-prefix command:

- If the warning-only option is used with this command, the software displays a warning message on reaching the limit, and will not remove the old routing information. It also accepts more prefixes from the neighbor
- If the warning-only option is not used with this command, if any extra prefixes are received, the router ends the peering. That is, the router sends a notification message, removes all prefixes received from that particular neighbor, and resets the peer session.

Q: Explain BGP auto-summary functionality.

When auto-summary is enabled, it summarizes the locally originated BGP networks to their classful boundaries. When a subnet exists in the routing table, and the following three conditions are satisfied, any subnet of that classful network in the local routing table prompts BGP to install the classful network into the BGP table:

- Classful network statement for a network in the routing table
- Classful mask on that network statement
- Auto-summary enabled

For example, if the subnet in the routing table is 75.75.75.0 mask 255.255.255.0, auto-summary is enabled, and you configure network 75.0.0.0 under the router bgp command, BGP introduces the classful network 75.0.0.0 mask 255.0.0.0 in the BGP table.

Q: What is the preferential order of attributes when some attributes, or all attributes, are applied to one neighbor in BGP?

For inbound updates, the preferential order of attributes is:

1. route-map
2. filter-list
3. prefix-list, distribute-list

For outbound updates, the preferential order of attributes is:

1. prefix-list, distribute-list
2. filter-list
3. route-map

Q: What is the difference between the AS_PATH and NEW_AS_PATH attributes?

AS_PATH is a well-known transitive attribute, whereas, NEW_AS_PATH is an optional transitive attribute. NEW_AS_PATH is used to propagate four-byte based AS path information across BGP speakers that do not support four-byte AS numbers.

Q: What is the significance of AS number 23456 in the AS_PATH attribute in BGP?

AS number 23456 is reserved. If the BGP speaker is new BGP, and its neighbor is old BGP, while sending the OPEN/UPDATE message in the packet, it sets the AS number in the AS_PATH attribute to 23456 and sets the original AS number in the NEW_AS_PATH attribute.

Q: Please clarify the behavior of the BGP neighbor command collide-established.

This command is used to detect connection collision upon receipt of an OPEN message. The local system must examine all of its connections in the OpenConfirm and OpenSent states, and then perform the conflict resolution, accordingly.

This command is enabled by default for graceful restart.

Q: How does ZebOS implementation of the Extended ASN Capability feature function?

ZebOS implements the Extended ASN Capability feature by allowing either 2-byte capable or 4-byte capable BGP speakers to communicate with other neighbors, regardless of whether the neighbor is a 2-byte or 4-byte BGP speaker.

Q: The BGP “neighbor password” command does not exist and MD5 authentication cannot be configured without this command.

There is no configuration option to enable BGP MD5. When the Linux kernel is patched with the MD5 patch while configuring ZebOS, it finds the MD5 patch and builds BGP with the command shown below.

```
#ifdef HAVE_LINUX_TCP_MD5_H
CLI (neighbor_password,
     neighbor_password_cmd,
     NEIGHBOR_CMD2 "password WORD",  CLI_NEIGHBOR_STR
     NEIGHBOR_ADDR_STR2.
     "Set password to the neighbor",
     "The password")
```

If BGP does not find the corresponding header file (the kernel was not patched with the MD5 patch), this command is not available.

Q: When configuring BGP, the redistribute command can be used under Router mode (not address-family ipv4) and also under address-family ipv6 mode. How is the behavior affected by the modes?

When the redistribute command is configured under Router mode, only IPv4 route information redistribution is controlled; when configured under address-family IPv6 mode, only IPv6 route information redistribution is controlled.

OSPF

Q: Can I change the Area ID of an existing OSPF network configuration?

No, you cannot change the Area ID without deleting the existing configuration. You need to remove the network A.B.C.D/X area Y before changing the area ID of this network.

For example, entering “network 10.73.0.0/16 area 0.0.0.5” when “network 10.73.0.0/16 area 0.0.0.1” already exists, will display a warning message.

Q: What is the function of the “refresh timer” command?

The `refresh timer` command sets the Refresh Timer value in seconds. OSPF requires each LSA to be refreshed by the originating router every 30 minutes. The `refresh timer` command sets the time interval for refresh function call of an LSA. This causes all the LSAs to be refreshed which have almost reached OSPF_LS_REFRESH_TIMER. The default value of the refresh timer is set to 10 seconds. The range of this timer is 10 - 1800 seconds.

Please refer to the “OSPF Command Reference” for details on this command.

Q: How do I display information about max-age? I used the “show ip ospf database max-age” command: max-age was not displayed.

The `show ip ospf database max-age` command maintains a list of the all the LSAs in the database that have reached the max-age (3600 seconds).

If the LSAs have not reached the max-age, it is not displayed.

To test the functionality of max-age, follow these steps:

1. Connect two routers, R1 and R2 both of them running the OSPF daemon.
2. After a few minutes, kill the OSPF daemon on one of the routers (say on R2).
3. Wait for one hour to get a display of the list of LSAs that have reached the max-age on R1.

The following is a sample output of the `show ip ospf database max-age` command on R1:

```
ZebOS# show ip ospf database max-age
OSPF Router process 100 with ID (3.3.3.4)
MaxAge Link States:
Link type: 7
Link State ID: 37.37.37.0
Advertising Router: 3.3.3.1
LSA lock count: 6
Link type: 7
Link State ID: 10.0.0.0
Advertising Router: 3.3.3.1
LSA lock count: 6
Link type: 7
Link State ID: 20.255.37.37
Advertising Router: 3.3.3.1
LSA lock count: 6
```

Q: How do I create a secondary loopback address? This address has to be advertised by LSAs to make it reachable from other routers and hosts.

Configure a secondary loopback address as follows:

```
ZebOS(config)# interface lo
```

```
ZebOS(config-if)# ip address A.B.C.D/32
```

For this loopback address to be advertised by LSAs, enable OSPF on this interface by configuring the routing process, and specifying the Process ID. The Process ID should be a unique positive integer identifying the routing process. Then define the interface and associate the area ID with the interface.

```
ZebOS(config)# router ospf [process id]
ZebOS(config-router)# network A.B.C.D/32 area 0
```

Q: What is the effect of cost on different routes: default, redistributed: and static?

To explain the effect of cost on different routes, we have used the following topology. Router R1 and R2 are connected. Interface eth1 on R2 has been assigned a cost of 25:

```
ZebOS(config)# interface eth1
ZebOS(config-if)# ip ospf cost 25
```

Now. three different routes are advertised from R2 to R1:

- Default route 0.0.0.0/0
- Static route 192.168.0.0/16
- Regular

Only the network of eth1 is assigned metric 25. The metric of the static route is 20. The metric of the default route is 10

All redistributed routes will not be advertised with this metric. In ZebOS, redistributed routes (static, kernel, connected, as well as, routes learned from other protocols) are advertised with a metric of 20.

Note: Only BGP routes redistributed into OSPF are advertised as 1 (for compatibility with Cisco).

The metric of the default routes depends on the configuration. If “default-information-originate” is configured, the existing default routes are advertised with a metric of 10. Whereas, if “default-information originate always” is configured, the metric is advertised as 1.

The effect of cost does not affect the cost on default, redistributed, and static routes.

Please refer to the “OSPF Command Reference” for details on the commands above.

Q: Is there a limit to the size of the database in OSPF? How does the “overflow-database-external” command affect the maximum size of the OSPF database?

There is no limit to the size of the OSPF database. However, the OSPF external database alone can be limited in size by using the `overflow-database-external` command. The `overflow-database-external` command does not affect the maximum size of the OSPF database.

Refer to the *OSPF Command Reference* for details about this command.

Q: We have limited the number of ZebOS routes to 5000. How does this affect the maximum OSPF database size?

Limiting the maximum routes to 5000 does not affect OSPF. OSPF learns routes from its neighbor and sends them to NSM. It is up to NSM to enter them into the kernel. After NSM has reached its maximum routes limit it drops received routes.

Q: The CPU utilization by our OSPF daemon went up to 100%.

The OSPF daemon could be stuck in an infinite loop, due to the system clock going backward. This issue has been fixed in the ZebOS ARS 5.3 Release. Please request F5 Networks Technical Support for a patch for this issue.

Q: When I change the system clock (move it back or forward), the OSPF daemon on Solaris loses the adjacency. The OSPF adjacency is lost, and stuck in “init” state.

This is a known Solaris issue. When changing the system time using any mechanism, users need to shut down the system, then bring it up. So when changing system time on Solaris, you must shut down the system, and restart ZebOS protocols.

Q: I configured 445 loopback interfaces with unique addresses. When I enabled OSPF on these loopbacks, the OSPF daemon could not send out the ls-update because of the size of the packet.

The Linux kernel does not support fragmentation of outbound RAW IP packets. Even if the packet is fragmented by the application, the kernel will only forward the first fragment, and ignore the rest.

The workaround for this is to run the `redistribute connected` command in OSPF. This will allow the connected routes to be redistributed into OSPF, thus providing reachability for these networks.

Q: Is there a way to log neighbor changes in OSPF?

You can log to a file or turn on `terminal monitor` and turn on `debug ospf nfsm`. This will log neighbor finite state machine information.

Q: How can I control the routes that are installed into NSM from the OSPF database? That is, while I cannot control which routes get into the OSPF database, I would like to be able to control which routes get installed into my routing table from the database.

The `distribute-list in` functionality achieves this requirement:

```
ZebOS(config-router)#distribute-list 1 ?
  in   Filter incoming routing updates   <----------
  out  Filter outgoing routing updates
```

Q: According to RFC 2328, a router running OSPF should become the Area Border Router (ABR) if it has more than one actively attached area (though no backbone area). But, ZebOS router behavior is not the same.

ZebOS can accept the following ABR types:

- Cisco Alternative ABR, Cisco implementation (RFC3509)
- IBM Alternative ABR, IBM implementation (RFC3509)
- Shortcut ABR standard (RFC 2328)

Per RFC 2328, a router running OSPF should become the ABR, if it has more than 1 actively attached area, even if there is no backbone area. This is supported by the ZebOS ABR type “standard” which you must explicitly configure using the command:

```
config-router> ospf abr-type standard
```

The default ABR type of ZebOS router is Cisco (if not explicitly configured using the above command), as per RFC 3509, which says a “router connected to multiple areas without a backbone connection is not an ABR and should function as a router internal to every attached area”. This is because most routers are the Cisco type, or support behavior like Cisco.

Therefore, if the topology requirement is that ZebOS should become the ABR if it has more than one active area, even if that does not include a backbone area, configure the OSPF ABR type as standard.

Q: In OSPF, how much time does it take for the transition of a border router as NSSA translator, if configured as an explicit translator?

It takes 40 seconds. The NSSA elected translator router should continue as the translator for 40 seconds, once the other border router is configured as the explicit translator. This delay is introduced for more stable translator transition.

Q: Among NSSA ABRs, which is elected as the NSSA translator (type 7 to type 5 translation)?

Election is done only if an NSSA ABR is not configured exclusively as a translator: in this case, the NSSA ABR router with highest router ID is elected as NSSA translator.

Q: How does OSPFv3 achieve authentication even though the header does not contain an authentication field?

When running over IPv6, OSPFv3 relies on the IP authentication header (AH) and the IP encapsulating security payload (ESP) to ensure integrity and authentication of routing exchanges.

Q: What is NSSA in OSPF?

Not So Stubby Area. NSSA is a stubby area that can have an ASBR. It uses a Type 7 LSA to advertise external routes. The ABR takes the Type 7 LSA from the ASBR, and changes it into a Type 5, to send to the rest of the OSPF domain.

Q: There are a few OSPF commands (such as “export-list” and “import-list”) with no help access. However, these commands can be successfully executed in the CLI.

These commands are registered with a hidden flag, which is why they do not have help strings. These commands are F5 Networks internal use.

Q: Is Equal-Cost Multipath (ECMP) supported for OSPFv2 and OSPFv3?

ZebOS supports OSPFv2, OSPFv3, and IPv4/IPv6 static routes for ECMP.

Q: What happens when the designated router (DR) with the higher router ID goes down in an OSPF network?

When the DR goes down, the backup designated router (BDR) becomes the DR. If the original router comes up, the original DR becomes the BDR.

For example: Router1 with router ID 50.50.50.50 is the DR, and Router2 with router ID 40.40.40.40 is initially the BDR. If 50.50.50.50 goes down, 40.40.40.40 becomes the DR. When 50.50.50.50 comes up, 40.40.40.40 remains the DR, and 50.50.50.50 becomes the BDR.

Q: When the command overflow database hard is executed, when the router enters overflow, the OSPF process is terminated. Is there a command or time-out to re-launch the process when the router enters overflow? Is it required to manually restart the OSPF process?

If the overflow database is configured with the parameter, hard, the OSPF process will be terminated when its LSA database reaches the maximum limit after which the OSPF process must be manually restarted.

Q: What is the behavior if the MAXLSAs are configured to a lesser value with the OSPF command, overflow database external?

If:

- A limit is put on the number of external LSAs on a router, for example 5
- The router learned 4 external routes from another router
- The router itself is generating more than 1 external LSA

Then all of these self-generated LSAs are flushed.

Once the router exits the overflow state, a trigger is sent to NSM to re-populate the self-generated LSAs. However, the router still has the 4 external LSAs learned from the other router, and once it gets the first self-generated LSA, it again goes into the overflow state and flushes the self-generated LSAs.

Only when the number of external routes from other routers is reduced, or the limit is increased, does the router exit this loop, and self-generated LSAs are installed.

Q: What is the meaning of “network” in the “network A.B.C.D/M area ID” command? Is it:

- Only network A.B.C.D/M can run OSPF?

or

- The network matched interface can run OSPF?

OSPF only runs on interfaces with IP addresses that match the specified network address.

ISIS

Q: How do we use the ISIS protocol on Ethernet when we have more than one interface in the same subnet?

ISIS needs to be configured in individual interfaces, for it to be enabled on that interface (or subnet); the scenario in which one of the two interfaces in the same subnet is configured for ISIS, and the other not. This is possible, as ISIS is a dual-stack protocol, and explicit interface-wise configuration is necessary.

Q: Does the ZebOS ISIS module create adjacencies on point-to-point links?

Yes. ISIS has been tested using T1 interface cards. Interoperability testing with Cisco routers has been successfully completed.

Q: When do I get the ISIS “SRM already cleared” warning log?

This SRM flag warning should not generally occur.

If between the time the timer expires and is scheduled, the same LSP is received from a neighbor, the LSP does not then need to be flooded and the SRM flag is reset. In this case, when the timer expires, it checks the flag, acknowledges the LSP flag is not set, and does nothing except print the message.

Q: Why is the Sequence 1 LSP not included in the ISIS TLV?

The Sequence 1 LSP is created when the ISIS process is initiated. However, when the adjacent neighbor becomes active, the Sequence 1 LSP is refreshed, becomes Sequence 2, and is sent to the neighbor. This can be viewed in the output of the `show isis database` command.

Q: Which metric is used for narrow SPF calculation in the wide-transition metric style?

In wide transition, only the configured wide metric is considered for both narrow and wide SPF calculation. However, in narrow transition, only the configured narrow metric is considered for both narrow and wide SPF calculation.

Q: Do you support ISIS incremental/partial SPF calculation?

No, we do not support this functionality.

Q: Do you support IS-IS Fast Convergence?

Yes. We schedule SPF when the topology changes. If, between the current time and the time the last SPF is more than the SPF Interval (10 seconds), the hold-time period (default value, 2 seconds) is used as the schedule interval. If the value is less than 10 seconds, the number of seconds left for the 10 second timer to expire is calculated. If that value is greater than the hold time (2 seconds), the SPF at the SPF Interval delay (10 seconds) is calculated, otherwise, the hold-time delay (2 seconds) is used. However, the Exponential Backoff algorithm is not used.

Q: In ISIS, when an L1/L2 router is redistributing prefixes from L1 to L2, or L2 to L1, in which TLV should the prefix be sent?

When an L1/L2 router advertises an L1 route into L2, where that L1 route was learned via a prefix advertised in an “IP External Reachability Information” TLV, that L1/L2 router should advertise that prefix in its L2 LSP within an “IP External Reachability Information” TLV. L1 routes learned via an “IP Internal Reachability Information” TLV should still be advertised within an “IP Internal Reachability Information” TLV. These rules should also be applied when advertising IP routes derived from L2 routing into L1. And in this case, the up/down bit must also be set.

Q: Does ZebOS support multiple instances in ISIS?

Yes, but the Layer-1 routes are not redistributed to the Layer-2 database between various instances.

Q: Does ZebOS allow removing the last net in ISIS?

Yes.

Q: What is the ISIS behavior if max-lsp-lifetime is smaller than lsp-refresh-interval?

F5 Networks recommends making the lsp-refresh-interval smaller than the max-lsp-lifetime value because LSPs must be periodically refreshed before their lifetimes expire. Otherwise, LSPs time out before they are refreshed and are dropped from the database, if the lifetime is exceeded before a refresh LSP arrives.

Q: Does ZebOS ISIS support the log-adjacency-changes command?

No.

Q: When dynamic host-name is disabled, is there a way to manually configure a static name to the system ID mapping table? Is there any command to show the ISIS host name in ZebOS?

In ZebOS, there is no option to manually configure a static name to the system ID mapping table. To see the host name, use the command show isis database details.

Q: What is the functionality of the “restart isis graceful” command?

If the `restart isis graceful` command is executed (with the optional grace-period parameter), ISIS graceful restart is initialized, and the ISIS daemon immediately shuts down. Also, the ISIS routing information and grace period is preserved by NSM. The ISIS daemon should be manually started after shut-down before the grace period expires to successfully complete the graceful restart.

Q: ISIS parameters configured on an interface are not deleted when the routing instance associated with it is removed.

To provide the flexibility of moving an interface to another routing instance, without having to re-configure the parameters (in case similar parameters are required).

Multicast

Q: What are the requirements to use the “mtrace” and “mstat” command?

The `mtrace | mstat` command needs a route to forward its multicast packets out of the box. PIM does not install any routes in the routing table: it relies on the routes provided by the other protocols, such as, OSPF, RIP, BGP or the kernel routes.

Q: What is the meaning of “ip mroute count route limit” and threshold?

The `ip multicast route-limit` command to limit the number of multicast routes that can be added to a router, and generate an error message when the limit is exceeded.

The default values of the limit and threshold are 2147483647.

IGMP

Q: In IGMP, will a group-specific query (GSQ) be flooded to all VLANs or only to the port on which the IGMP Leave is received?

A GSQ is sent to the port that received an IGMP LEAVE. If it does not get a response, and the host from which it received the LEAVE is the last member (or only member) of the group, the Non-Querier deletes the group, and sends a LEAVE to the Querier. On receiving a GSQ from the Querier, it floods to all the ports of that VLAN, because it no longer has the information of the originator that sent the IGMP LEAVE for that group.

Q: Why, when GMRP is configured on a bridge, is there a need to disable IGMP snooping?

IGMP Snooping needs to be disabled in order to enable GMRP. IGMP snooping and GMRP cannot be enabled at the same time on the same bridge. Refer to the ZebOS Network Platform Layer 2 Configuration Guide where this requirement is documented.

Q: Sometimes ZebOS does not use the IP address of a VLAN interface even though the IP address is assigned on the interface and uses source IP as 0.0.0.0 for queries.

Refer to the extract below from section 1b of part 2.1.1 of RFC 4541, “IGMP and MLD Snooping Switches Considerations”, which discusses this special case:

“The 0.0.0.0 address represents a special case where the switch is proxying IGMP Queries for faster network convergence, but is not itself the Querier. The switch does not use its own IP address (even if it has one), because this would cause the Queries to be seen as coming from a newly-elected Querier. The 0.0.0.0 address is used to indicate that the Query packets are NOT from a multicast router.”

Q: In IGMP, is a Group-specific query flooded to all VLANs or only to the port on which the IGMP Leave was received?

A Group-Specific query is sent to the port from which an IGMP LEAVE was received. If there is no response and the host from which the LEAVE was received is the last, or only, member of the group, the Non-Querier deletes the group and sends a LEAVE to the Querier. Upon receiving a Group-Specific query from the Querier, it is flooded to all ports of that VLAN, because there is no longer any information about which port sent the IGMP LEAVE for that group.

PIM

Q: Are there any APIs for SPT switchover in ZebOS PIM-SM? If I implement SPT switchover in the forwarding engine, which type of message should be reported to ZebOS PIM-SM?

ZebOS PIM-SM does not support data-rate-based SPT switchover in the Linux forwarding engine. This is because most standard kernel multicast forwarders do not currently directly support PIM-SM switchover.

If you implement SPT switchover in your own forwarding engine, then the Keep Alive Timer Message (KATMSG) is required to be sent to the PIM-SM daemon. This starts the switchover.

Q: Can ZebOS PIM-SM support only one register interface? If this is true, does ZebOS PIM-SM use one RP for all group ranges?

First of all, we must disassociate the concept of register interface and the number of RPs. The register interface is used to get the whole multicast packet at the DR at source S, so that PIM can send Register packets to the RP. At the RP, the register interface is used for accepting incoming packets from source, and forwarding them based on (*,G) sources.

ZebOS PIM-SM allows static RP and Candidate-RP configuration for only one group range 224/4. However, ZebOS PIM-SM does support multiple group ranges that are reported from the BSR. This means you can configure a router to be a static RP or a Candidate-RP only for one group range, but you can use multiple group ranges for RP selection of different groups.

Q: How can I support multiple RPs with one register interface?

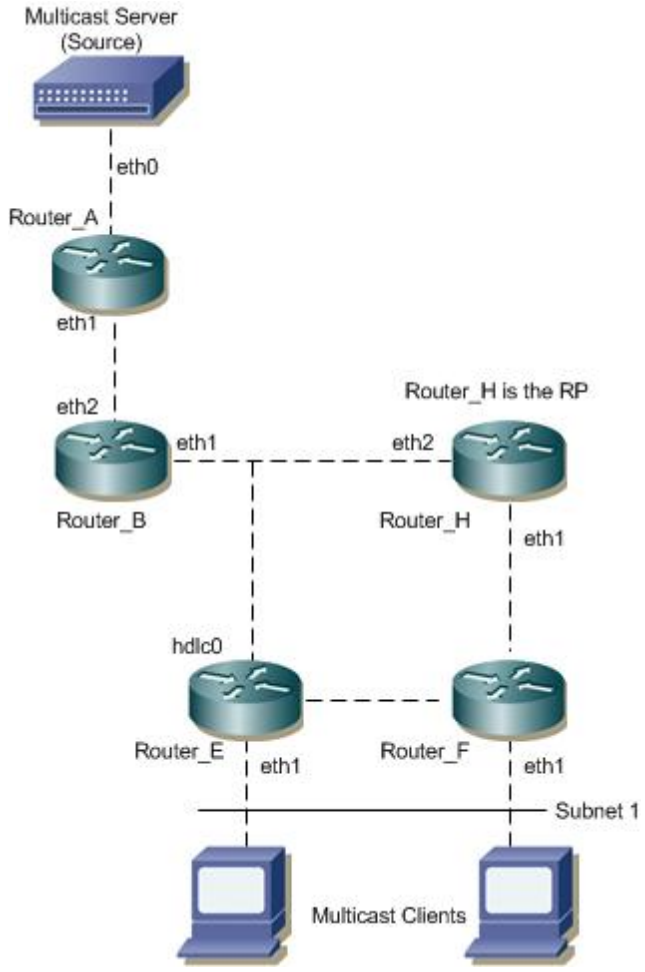
Here is a step-by-step description of how the register interface works, and how multiple RPs are supported by DR at the source.

1. When a packet arrives from a directly connected source, and the forwarder does not have a forwarding entry, the PIM daemon gets a NOCACHE message.
2. The PIM daemon initializes a Register state, and also a (S,G) state. The register interface is added to the outgoing list of the (S,G) forwarding entry in the kernel.
3. The kernel then forwards the packet on the (S,G) interface. When the register interface is in the outgoing list of the (S,G) entry, the kernel sends a WHOLEPKT message to the PIM daemon. The WHOLEPKT message has the whole IP multicast data packet.
4. The PIM daemon receives the WHOLEPKT message, looks up the RP for the group, and then sends a unicast Register message to the RP.

Since the RP for the group is known to the PIM daemon, multiple RPs can be supported.

Q: I want to know about the test beds used by F5 Networks for testing the PIM-SM daemon.

Following is one of our test beds. PIM-SM and OSPF-V2 are running on all the routers used in this topology. Refer to the illustration of the topology.



In this topology, router RH is the Rendezvous Point (RP). RA is directly connected to the source server, and RE is directly connected to a multicast client that sends a “Join” to receive a group.

After the multicast tree is established, the client is able to receive data from the server for that group.

Q: What are Forwarding Cache Record (FCR) entries in the PIM mroute table?

The initial multicast forwarders for the Linux and NetBSD operating systems were designed to support Dense-Mode multicast protocols, in which the receivers knew the sender's IP and vice-versa.

However, PIM Sparse-Mode supported (*,G) entries, in which the receivers were not required to be aware of the sender, as long as the multicast data was destined to group “G”. To support (*,G) forwarding using existing multicast forwarders supporting (S,G) forwarding of the operating systems, FCR entries were used.

For example, S1 and S2 are sending multicast traffic for group G, and receiver R1 sends a (*,G) join: FCR entries will be created for both (S1,G) and (S2,G). If S2 stops sending traffic, (*,G) is still maintained while the FCR entry for (S2,G) is deleted.

Q: What is the function of the generation identifier (genid) in PIM Hello messages?

The generation identifier contains a randomly generated 32-bit value that is regenerated each time PIM forwarding is started, or restarted, on the interface, including when the router itself restarts. When a Hello message with a new generation identifier is received from a neighbor, any old Hello information about that neighbor is discarded and

updated with new Hello message information. This may cause a new designated router (DR) to be chosen on that interface.

Q: How many Rendezvous Points (RPs) can ZebOS support? Is there any limitation?

There is no limit to the number of static and candidate RPs that ZebOS can support.

Q: How should I enable PIM-DM on VLAN interfaces?

1. Assign an IP address on the VLAN interface.
2. Enable PIM-DM using the `ip pim dense-mode` command in VLAN interface mode.
3. Verify using the `show ip pim dense-mode interface` command.

Q: While configuring PIM, an interface named “Interface pimreg” is created. What is the use of this interface?

This interface is used by designated routers (DRs) and rendezvous points (RPs). On the DR side, the register packets are encapsulated and transmitted to the RP by this interface. On the RP side, the receiving and decapsulation of these packets happens through this interface. This interface is created by the Linux stack.

Q: The ZebOS's implementation of PIM-SM is running on our router. Will it be able to inter-operate with another router running another vendor's implementation of PIM-SM? Are there any inter-operability issues with ZebOS's PIM-SM?

Since our implementation is based on standards, it will inter-operate with any other implementation based on the standard.

Q: Can multiple static-RPs be configured? If yes, what algorithm is used for selection?

Yes, multiple static RPs can be configured. The selection algorithm is explained in the “ZebOS PIM-SM Command Reference”, under the usage description of the `ip pim rp-address` command.

Q: Can the same RP be configured with multiple group ranges? If yes, how is the deletion handled?

Yes, a single static-RP can be configured for multiple group ranges using Access Lists. However, the same IP address cannot be used as a parameter with two `pim ip rp-address` commands. Deletion of the RP-address is handled by removing the static-RP from all the existing group ranges and re-computing the RPs for existing TIB states if required.

For further details, refer to the usage description of the `pim ip rp-address` command in the “ZebOS PIM-SM Command Reference”.

Q: Can the static-RP and BSR mechanisms be used simultaneously? If yes, what is the selection policy?

Yes, static-RP and BSR mechanism can be used simultaneously. If the RP is available from the BSR, it is selected first. If not, then the statically configured RP is selected.

SNMP

Q: How do you enable/disable some MIBs in SNMP during initial configuration?

There are options to enable/disable MIBs in SNMP while running the initial configuration script. For example, the option `--with-mib-modules="smux",` is to enable SNMP with SMUX during configuration of ZebOS. The "mibII/interface" options can be either enabled or disabled to use values from NSM.

Q: Does the SNMPC viewer return NSM's implementation of mibII/interfaces and mibII/system_mib, or net-snmp's default module?

When NSM is running, SNMP returns NSM 's implementation of mibII/interfaces and mibII/system_mib. When NSM is not running, it returns net-snmp's default values. To specifically override the default values from Linux, use the -I -tcp,ip,system_mib option while running ./snmpd.

Q: Which SNMP MIBs are supported by ZebOS?

The MIB files are located under the respective protocol directory. For example, for BGP, you can find the MIB file in:

- `/bgpd/BGP4-MIB.txt`

The corresponding SNMP files are located under the protocol directory, as `protocolname_snmp.h` and `protocolname_snmp.c.` For example, for BGP, you can find the SNMP files in:

- `/bgpd/bgp_snmp.h`
- `/bgpd/bgp_snmp.c`.

Q: Which RMON MIB does F5 Networks support? (HC-RMON with 64 bit counters or RFC 2819?)

For SNMP operations in RMON, F5 Networks uses RFC 2819 as the basis for all of the counters. For interface-related counters, F5 Networks supports a wide range. These consist of counters defined in RFC 2020, section 3.3.6, and in RFC 2819.

For example, in our implementation of the `hal_if_counters` function we support brdc_pkts_rcv and brdc_pkts_sent as defined in the MIB-related entry for the interface in RFC 2020

Apart from this we also support counters like: pkts_65_127_octets and pkts_128_255_octets which are not part of a standard interface MIB structure, but are part of RMON related MIBs.

All counters in `hal_if_counters` are 64 bit counters. The value of these counters depends on the underlying hardware. Possibly, there are some extra counters supported by ZebOS but not supported by the hardware, and vice versa.

Q: What is the default SNMP agent in ZebOS?

SMUX. AgentX requires explicit enabling.

Q: Can you explain the SNMP callback function parameters?

The parameters of the get/getnext SNMP callbacks are as follows:

`struct variable *v`
: Entry in the variableN array for the object.

  Note: The name field of this structure has been completed into a fully qualified OID by pretending the prefix is common to the whole array.

`oid *name`
: OID from the request.

`size_t *length` Length of the OID.

`int exact` Flag to indicate whether this is an exact request (get/set) or an “inexact” request (getnext).

`size_t *var_len`

Length (in bytes) of the answer being returned.

`WriteMethod` Pointer to the set function (WriteMethod) for this variable.

`u_int32_t vr_id`

Virtual Router ID.

The parameters of the Set SNMP callbacks are as follows:

`int action` This variable will be used by SMUX, and it will have a value of action, such as, “commit” or “free”.

`u_char *var_val` Value of the variable to be set, such as, an IP address of “10.2.2.3”.

`u_char var_val_type`

Type of value, for example, integer, char, or IP addresses.

`size_t var_val_len`

Length of the value to be set, for example, if it is an integer, its length should be `sizeof(int)`.

`u_char *statP` This variable is also used by the SMUX which will have a return value of the callback function.

`oid *name` OID from the request.

`size_t length` Length of this OID.

`struct variable *v`

Entry in the variableN array for the object.

`u_int32_t vr_id`

Virtual Router ID.

Q: The IMI daemon has read/write access to ZebOS.conf. Is there a similar access from the SNMP path?

All ZebOS modules act as a subagent to an SNMP agent. We can integrate with any third-party SNMP agent that supports the SMUX or AgentX protocol.

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