

Sun Ethernet Fabric Operating System IPv6 Administration Guide

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Contents

Using This Documentation	7
Product Documentation Library	7
Acronyms and Abbreviations	7
CLI Command Modes	8
Feedback	8
Protocol Description	9
Introduction	9
Topologies	11
Basic SEFOS IPv6 Topology	11
Route Redistribution Topology in IPv6	12
General Configurations	13
Default Settings	13
Completing Preliminary Configurations	14
▼ Create an Interface	14
▼ Configure an IPv4 Address for an Interface	14
Configuring the Basic IPv6 Topology	15
▼ Configure Switch 1	15
▼ Configure Switch 2	16
Configuring the Route Redistribution Topology	19
▼ Configure Switch 1	20
▼ Configure Switch 2	21
▼ Configure Switch 3	22
IPv6 Feature Configuration	25
Configuring IPv6 Support in an Interface	25
▼ Enable IPv6 Support	26
▼ Disable IPv6 Support	26

Configuring IPv6 Addressing	27
▼ Add IPv6 Addresses to an Interface	27
▼ Remove IPv6 Addresses From an Interface	28
Configuring IPv6 Routing	29
▼ Enable IPv6 Routing	29
▼ Disable IPv6 Routing	29
Configuring IPv6 Static Routes	30
▼ Add a Static Route	30
▼ Remove a Static Route	31
Configuring Static Neighbor Cache Entries	31
▼ Add a Neighbor Cache Entry	32
▼ Delete a Neighbor Cache Entry	32
Checking a Local or Remote Endpoint	32
▼ Check an Endpoint Using Default Values	33
▼ Check an Endpoint Using the Link-Local Address	33
Configuring Router Advertisement Parameters	33
▼ Configure Router Advertisement Parameters	34
Configuring DAD Entries	36
▼ Set the DAD Attempts	36
▼ Reset the DAD Attempts	37
Configuring PMTU Discovery	37
▼ Enable PMTU Discovery	38
▼ Disable PMTU Discovery	38
Setting the MTU for Use in PMTU Discovery	39
▼ Set the MTU for Use in PMTU Discovery	39
Configuring the IPv6 Route Redistribution Policy for Routing Protocols	40
▼ Configure the IPv6 Route Redistribution Policy for Routing Protocols	40

Using This Documentation

- **Overview** – Provides descriptions and procedures for configuring IPv6 in Oracle SEFOS
- **Audience** – System administrators who configure and maintain SEFOS switch management software
- **Required Knowledge** – Basic knowledge of the IPv6 protocol

Product Documentation Library

Documentation and resources for this product and related products are available at:

- http://www.oracle.com/goto/es2-72_es2-64/docs
- <http://www.oracle.com/goto/ES1-24/docs>
- <http://www.oracle.com/goto/sn-10gbE-72p/docs>
- <http://www.oracle.com/goto/sb6k-24p-10gbe/docs>

Acronyms and Abbreviations

Acronym or Abbreviation	Explanation
DAD	Duplicate address detection
ICMPv6	Internet Control Message Protocol version 6
IETF	Internet Engineering Task Force
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
MTU	Maximum transmission unit
ND	Neighbor discovery
NDP	Neighbor Discovery Protocol
NEM	Network express module
OSPF	Open shortest path first
PMTU	Path MTU

Acronym or Abbreviation	Explanation
RA	Router advertisement
RIP6	Routing Information Protocol version 6
RRD	Route redistribution
RTMv6	Route table manager version 6
SNMP	Simple Network Management Protocol
TOR	Top of the rack
TTL	Time-to-live
VLAN	Virtual LAN

CLI Command Modes

The following table lists the configuration modes used in this document with their access and exit methods.

Command Mode	Access Method	Prompt	Exit Method
User EXEC	Access SEFOS from Oracle ILOM with read-only rights (privilege level 1).	SEFOS>	Use the <code>logout</code> or <code>exit</code> command to return to the Oracle ILOM prompt.
Privileged EXEC	Access SEFOS from Oracle ILOM with full administrative rights (privilege level 15).	SEFOS#	Use the <code>logout</code> or <code>exit</code> command to return to the Oracle ILOM prompt.
Global Configuration	From Privileged EXEC mode, use the <code>configure terminal</code> command.	SEFOS(config)#	Use the <code>end</code> command to return to Privileged EXEC mode.
Interface Configuration	From Global Configuration mode, use the <code>interface interface-type interface-id</code> command.	SEFOS(config-if)#	Use the <code>exit</code> command to return to Global Configuration mode, or use the <code>end</code> command to return to Privileged EXEC mode.

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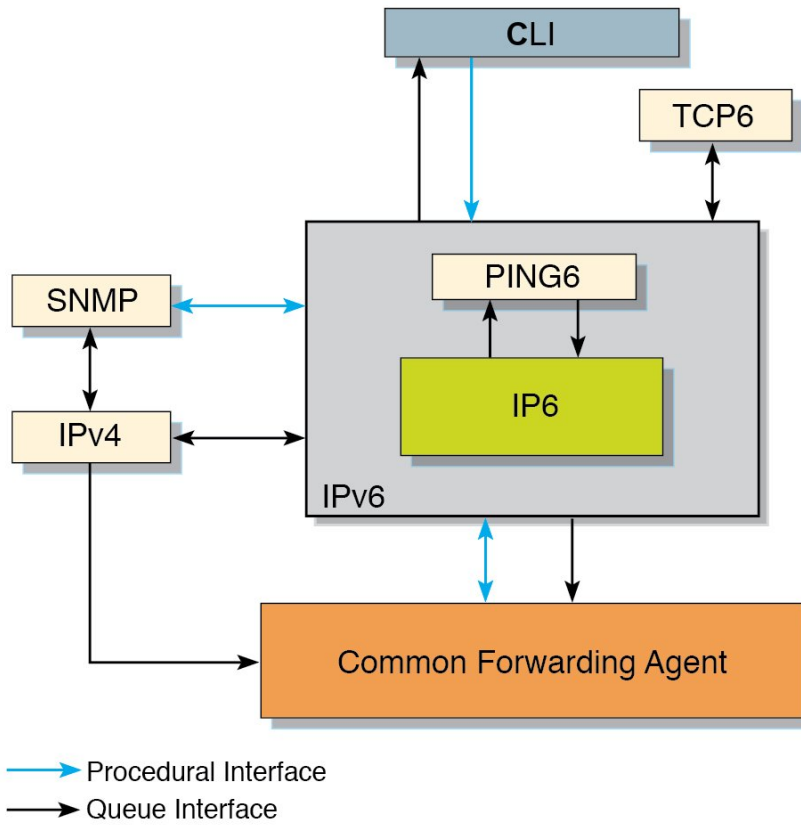
Protocol Description

This section describes the IPv6 protocol.

- [“Introduction” on page 9](#)

Introduction

Oracle's SEFOS IPv6 is an implementation of the core set of IPv6 protocols. The major issues being faced with IPv4 are the exhaustion of the IP address space and enormous growth of the routing tables in the main routers on the Internet. IPv6 solves these problems by providing features such as address auto-configuration. You can use SEFOS IPv6 either as a router with router-specific functionality or as a host with host-specific functionality. This figure shows the position of IPv6 within the SEFOS architecture.



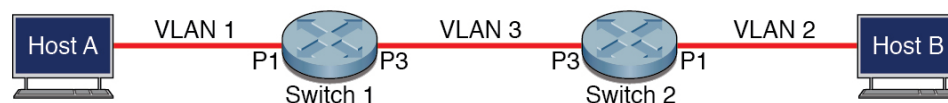
Topologies

These example topologies are used as a reference for the configuration steps in this guide.

- [“Basic SEFOS IPv6 Topology” on page 11](#)
- [“Route Redistribution Topology in IPv6” on page 12](#)

Basic SEFOS IPv6 Topology

This illustration depicts a basic Oracle's SEFOS IPv6 topology that is referenced in this guide. In this topology, two switches (switch 1 and switch 2) are connected to each other over port 0/3 (P3). Host A and host B are connected through port 0/1 to their respective switches. Finally, three VLANs are enabled. VLAN 3 connects the two switches, and VLAN 1 and VLAN 2 connect the hosts to the switches.

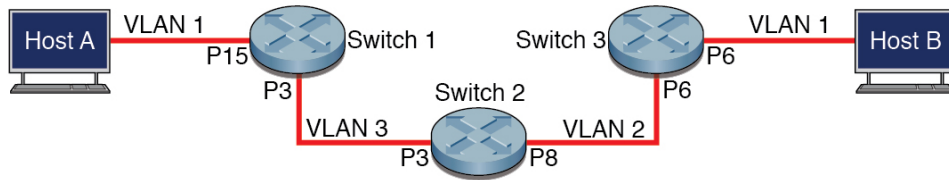


The following table lists the IPv4 and IPv6 addresses of the interfaces and hosts shown in the example topology.

Switch or Host	Interface	IPv4 Address and Mask	IPv6 Address and Prefix Length
Switch 1	VLAN 1	11.0.0.1 / 255.0.0.0	fec0::1111:0:1 / 96
	VLAN 3	33.0.0.1 / 255.0.0.0	fec0::3333:0:1 / 96
Switch 2	VLAN 2	22.0.0.2 / 255.0.0.0	fec0::2222:0:1 / 96
	VLAN 3	33.0.0.2 / 255.0.0.0	fec0::3333:0:2 / 96
Host A		11.0.0.10 / 255.0.0.0	fec0::1111:0:10 / 96
Host B		22.0.0.20 / 255.0.0.0	fec0::2222:0:20 / 96

Route Redistribution Topology in IPv6

This illustration depicts an example topology of route redistribution in IPv6. This topology is referenced throughout this guide.



In this topology, P15, P3, P6, and P8 represent ports on the SEFOS switches. Switch 1 and switch 2 are NEM switches, and switch 3 is a TOR switch. The following table lists the IPv4 and IPv6 addresses of all the interfaces in both switches and the hosts.

Switch or Host	Interface	IPv4 Address and Mask	IPv6 Address and Prefix Length
Switch 1	VLAN 1	11.0.0.1 / 255.0.0.0	fec0::1111:0:1 / 96
	VLAN 3	22.0.0.1 / 255.0.0.0	fec0::2222:0:1 / 96
Switch 2	VLAN 2	33.0.0.1 / 255.0.0.0	fec0::3333:0:1 / 96
	VLAN 3	22.0.0.10 / 255.0.0.0	fec0::2222:0:10 / 96
Switch 3	VLAN 1	44.0.0.1 / 255.0.0.0	fec0::4444:0:1 / 96
	VLAN 2	33.0.0.10 / 255.0.0.0	fec0::3333:0:10 / 96
Host A		11.0.0.10 / 255.0.0.0	fec0::1111:0:10 / 96
Host B		44.0.0.10 / 255.0.0.0	fec0::4444:0:10 / 96

General Configurations

You can use CLI commands to configure and manage the Oracle's SEFOS IPv6 module. These procedures show how to configure a basic IPv6 topology. See the [“Basic SEFOS IPv6 Topology” on page 11](#).

- [“Default Settings” on page 13](#)
- [“Completing Preliminary Configurations” on page 14](#)
- [“Configuring the Basic IPv6 Topology” on page 15](#)
- [“Configuring the Route Redistribution Topology” on page 19](#)

Default Settings

This table contains the default values assigned to the IPv6 features during the startup of the switch. These values are referenced throughout this guide.

Feature	Default Setting
IPv6 on an interface	DisabledEnabled on the default VLAN interface
Unicast routing	Enabled
Default prefix	Unicast
Route administrative distance	1
Router advertisement status	Disabled (suppressed)
Hop limit	64
RA lifetime	1800 seconds
Number of duplicate address detection attempts	1
ND reachable-time	30 seconds
RA interval	600 seconds
RA valid lifetime	25,9200 seconds
RA preferred lifetime	60,4800 seconds
Data to be sent in the ping(1) message	a5a5
ping(1) messages repeat count	5
Size of the ping(1) message	100 bytes
ping(1) timeout value	5 seconds

Completing Preliminary Configurations

You can configure SEFOS IPv6 features by accessing Global Configuration mode or Interface Configuration mode. The configuration steps in this document begin with accessing one or both of these modes. See the [“CLI Command Modes” on page 8](#). These procedures are part of the preliminary configurations that you must execute before you can configure the IPv6 features.

- [“Create an Interface” on page 14](#)
- [“Configure an IPv4 Address for an Interface” on page 14](#)

▼ Create an Interface

The interface is explicitly created, and SEFOS features are configured for that particular interface to customize the interface as required.

1. **Enter Global Configuration mode.**

```
SEFOS# configure terminal
```

2. **Create the interface (2 in this example).**

```
SEFOS(config)# interface vlan 2
```

▼ Configure an IPv4 Address for an Interface

The IPv4 address is a 32-bit unique identifier that identifies a host or a destination in a network.

1. **Create the interface (1 in this case).**

```
SEFOS# configure terminal  
SEFOS(config)# interface vlan 1
```

2. **Configure the IPv4 address on the interface.**

```
SEFOS(config-if)# ip address 11.0.0.1 255.0.0.0
```

Configuring the Basic IPv6 Topology

These procedures show how to configure the basic IPv6 topology. See [“Basic SEFOS IPv6 Topology”](#) on page 11.

- [“Configure Switch 1”](#) on page 15
- [“Configure Switch 2”](#) on page 16

▼ Configure Switch 1

1. Shut down the spanning tree.

```
SEFOS# configure terminal
SEFOS(config)# shutdown spanning-tree
```

2. Disable GVRP and GMRP.

```
SEFOS(config)# set gvrp disable
SEFOS(config)# set gmrp disable
```

3. Create the interface for VLAN 1, and enable IPv6.

```
SEFOS(config)# interface vlan 1
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::1111:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

4. Create the interface for VLAN 3, and enable IPv6.

```
SEFOS(config)# interface vlan 3
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::3333:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

5. Configure the P3 interface in VLAN 3.

```
SEFOS(config)# vlan 3
SEFOS(config-vlan)# ports extreme-ethernet 0/3 untagged extreme-ethernet 0/3
```

```
SEFOS(config-vlan)# exit
```

6. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/3
SEFOS(config-if)# switchport pvid 3
SEFOS(config-if)# no shutdown
SEFOS(config-if)# end
```

7. Configure the IPv6 routing on switch 1.

```
SEFOS# configure terminal
SEFOS(config)# ipv6 route fec0::2222:0:0 96 fec0::3333:0:2
SEFOS(config)# exit
```

▼ Configure Switch 2

1. Shut down the spanning tree.

```
SEFOS# configure terminal
SEFOS(config)# shutdown spanning-tree
```

2. Disable GVRP and GMRP.

```
SEFOS(config)# set gvrp disable
SEFOS(config)# set gmrp disable
```

3. Create the interface for VLAN 2, and enable IPv6.

```
SEFOS(config)# interface vlan 2
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::2222:0:2 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

4. Create the P15 interface in VLAN 2.

```
SEFOS(config)# vlan 2
SEFOS(config-vlan)# ports extreme-ethernet 0/15 untagged extreme-ethernet 0/15
SEFOS(config-vlan)# exit
```

5. Configure the extreme-ethernet interface.


```
SEFOS(config)# interface extreme-ethernet 0/15
SEFOS(config-if)# switchport pvid 2
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

6. Enable IPv6 in VLAN 3.

```
SEFOS(config)# interface vlan 3
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::3333:0:2 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

7. Create the P3 interface in VLAN 3.

```
SEFOS(config)# vlan 3
SEFOS(config-vlan)# ports extreme-ethernet 0/3 untagged extreme-ethernet 0/3
SEFOS(config-vlan)# exit
```

8. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/3
SEFOS(config-if)# switchport pvid 3
SEFOS(config-if)# no shutdown
SEFOS(config-if)# end
```

9. Configure the IPv6 routing on switch 2.

```
SEFOS# configure terminal
SEFOS(config)# ipv6 route fec0::1111:0:0 96 fec0::3333:0:1
SEFOS(config)# exit
```

10. Review the IPv6 information on switch 1.

```
SEFOS# show ipv6 interface

vlan1 is up, line protocol is up
Link local address:
    fe80::201:2ff:fe03:501
Global unicast address(es):
    fec0::1111:0:1/96
Joined group address(es):
    ff02::1
    ff02::2
    ff02::1:ff00:1
```

```
ff02::1:ff03:501
MTU is 9216
ICMP redirects are enabled
ND DAD is enabled, Number of DAD attempts: 1
ND router advertisement is disabled
vlan3 is up, line protocol is up
Link local address:
  fe80::201:2ff:fe03:501
Global unicast address(es):
  fec0::2222:0:1/96
Joined group address(es):
  ff02::1
  ff02::2
  ff02::1:ff00:1
  ff02::1:ff03:501
MTU is 1500
ICMP redirects are enabled
ND DAD is enabled, Number of DAD attempts: 1
ND router advertisement is disabled
```

11. Review the IPv6 routing table on switch 1.

```
SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::1111:0:0/96   [1/1]
    via ::, vlan1

C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3

S   fec0::3333:0:0/96   [1/20]
    via fec0::2222:0:10, vlan3
```

12. Review the IPv6 information on switch 2.

```
SEFOS# show ipv6 interface
vlan1 is up, line protocol is up
Link local address:
  fe80::202:2ff:fe03:401
Global unicast address(es):
  Not Configured.
Joined group address(es):
  ff02::1
  ff02::2
  ff02::1:ff03:401
MTU is 1500
ICMP redirects are enabled
ND DAD is enabled, Number of DAD attempts: 1
ND router advertisement is disabled
```

```

vlan2 is up, line protocol is up
  Link local address:
    fe80::202:2ff:fe03:401
  Global unicast address(es):
    fec0::3333:0:1/96
  Joined group address(es):
    ff02::1
    ff02::2
    ff02::1:ff00:1
    ff02::1:ff03:401
  MTU is 1500
  ICMP redirects are enabled
  ND DAD is enabled, Number of DAD attempts: 1
  ND router advertisement is disabled
vlan3 is up, line protocol is up
  Link local address:
    fe80::202:2ff:fe03:401
  Global unicast address(es):
    fec0::2222:0:10/96
  Joined group address(es):
    ff02::1
    ff02::2
    ff02::1:ff00:10
    ff02::1:ff03:401
  MTU is 1500
  ICMP redirects are enabled
  ND DAD is enabled, Number of DAD attempts: 1
  ND router advertisement is disabled

```

13. Review the routing table information in switch 2.

```

SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
S   fec0::1111:0:0/96  [1/20]
    via fec0::2222:0:1, vlan3

C   fec0::2222:0:0/96  [1/1]
    via ::, vlan3

C   fec0::3333:0:0/96  [1/1]
    via ::, vlan2

```

Configuring the Route Redistribution Topology

These procedures show how to configure the route redistribution topology. See [“Route Redistribution Topology in IPv6”](#) on page 12.

- [“Configure Switch 1” on page 20](#)
- [“Configure Switch 2” on page 21](#)
- [“Configure Switch 3” on page 22](#)

▼ Configure Switch 1

1. Shut down the spanning tree.

```
SEFOS# configure terminal
SEFOS(config)# shutdown spanning-tree
```

2. Disable GVRP and GMRP.

```
SEFOS(config)# set gvrp disable
SEFOS(config)# set gmrp disable
```

3. Create the interface for VLAN 1, and enable IPv6.

```
SEFOS(config)# interface vlan 1
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::1111:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

4. Create the interface for VLAN 3, and enable IPv6.

```
SEFOS(config)# interface vlan 3
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::2222:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

5. Create the extreme-ethernet interface in VLAN 3.

```
SEFOS(config)# interface vlan 3
SEFOS(config-if)# ports extreme-ethernet 0/3 untagged extreme-ethernet 0/3
SEFOS(config-if)# exit
```

6. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/3
```

```
SEFOS(config-if)# switchport pvid 3
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

▼ Configure Switch 2

1. Shut down the spanning tree.

```
SEFOS# configure terminal
SEFOS(config)# shutdown spanning-tree
```

2. Disable GVRP and GMRP.

```
SEFOS(config)# set gvrp disable
SEFOS(config)# set gmrp disable
```

3. Create the interface for VLAN 3, and enable IPv6.

```
SEFOS(config)# interface vlan 3
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::2222:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

4. Create the extreme-ethernet interface for VLAN 3.

```
SEFOS(config)# vlan 3
SEFOS(config-vlan)# ports extreme-ethernet 0/3 untagged extreme-ethernet 0/3
SEFOS(config-vlan)# exit
```

5. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/3
SEFOS(config-if)# switchport pvid 3
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

6. Create the interface for VLAN 2, and enable IPv6.

```
SEFOS(config)# interface vlan 2
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
```

```
SEFOS(config-if)# ipv6 address fec0::3333:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

7. Create the extreme-ethernet interface for VLAN 2.

```
SEFOS(config)# vlan 2
SEFOS(config-vlan)# ports extreme-ethernet 0/8 untagged extreme-ethernet 0/8
SEFOS(config-vlan)# exit
```

8. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/8
SEFOS(config-if)# switchport pvid 2
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

▼ Configure Switch 3

1. Shut down the spanning tree.

```
SEFOS# configure terminal
SEFOS(config)# shutdown spanning-tree
```

2. Disable GVRP and GMRP.

```
SEFOS(config)# set gvrp disable
SEFOS(config)# set gmrp disable
```

3. Create the interface for VLAN 2, and enable IPv6.

```
SEFOS(config)# interface vlan 2
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::3333:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

4. Create the extreme-ethernet interface for VLAN 2.

```
SEFOS(config)# interface vlan 2
SEFOS(config-if)# ports extreme-ethernet 0/6 untagged extreme-ethernet 0/6
SEFOS(config-if)# exit
```

5. Configure the extreme-ethernet interface.

```
SEFOS(config)# interface extreme-ethernet 0/6
SEFOS(config-if)# switchport pvid 2
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```

6. Create the interface for VLAN 1, and enable IPv6.

```
SEFOS(config)# interface vlan 1
SEFOS(config-if)# shutdown
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# ipv6 address fec0::4444:0:1 96 unicast
SEFOS(config-if)# no shutdown
SEFOS(config-if)# exit
```


IPv6 Feature Configuration

These sections show how to configure Oracle's SEFOS IPv6 features:

- IPv6 addressing
- Static routing
- Neighbor discovery
- Duplicate address detection
- PMTU discovery
- Address resolution
- ping(1)
- Tunneling IPv6 over IPv4
- Route redistribution policy
- Trace Route 6

All of the procedures in this section use the parameters and settings that are defined in the IPv6 example configurations in [“Topologies”](#).

- [“Configuring IPv6 Support in an Interface” on page 25](#)
- [“Configuring IPv6 Addressing” on page 27](#)
- [“Configuring IPv6 Routing” on page 29](#)
- [“Configuring IPv6 Static Routes” on page 30](#)
- [“Configuring Static Neighbor Cache Entries” on page 31](#)
- [“Checking a Local or Remote Endpoint” on page 32](#)
- [“Configuring Router Advertisement Parameters” on page 33](#)
- [“Configuring DAD Entries” on page 36](#)
- [“Configuring PMTU Discovery” on page 37](#)
- [“Setting the MTU for Use in PMTU Discovery” on page 39](#)
- [“Configuring the IPv6 Route Redistribution Policy for Routing Protocols” on page 40](#)

Configuring IPv6 Support in an Interface

IPv6 is the latest version of IP, which assigns a 128-bit IP address for the host and receiver. This IP address increases the address space and solves the IP address exhaustion caused by the

IPv4 feature. To configure IPv6 support in an interface, you must enable IPv6 support in that interface.

These procedures show how to configure IPv6 support in an interface:

- [“Enable IPv6 Support” on page 26](#)
- [“Disable IPv6 Support” on page 26](#)

▼ Enable IPv6 Support

1. **Enter Interface Configuration mode for VLAN 3.**

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 3
```

2. **Enable IPv6 support in the interface.**

The IPv6 link-local address is automatically configured on the interface when you enable IPv6 processing in the interface. IPv6 support is disabled in an interface by default.

```
SEFOS(config-if)# ipv6 enable
SEFOS(config-if)# exit
SEFOS(config)# exit
```

3. **Review the IPv6 information of the VLAN 3 interface.**

```
SEFOS# show ipv6 interface vlan 3

vlan3 is up, line protocol is up
  IPv6 is Enabled
  Link local address:
    fe80::214:4fff:fe6c:560f
  Global unicast address(es):
    fec0::2222:0:1/96
  ...
```

▼ Disable IPv6 Support

1. **Enter Interface Configuration mode for VLAN 3.**

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 3
```

2. Disable IPv6 support in the interface.

The IPv6 link-local address and joined group address on the interface are brought down after you disable IPv6 in the interface.

```
SEFOS(config-if)# no ipv6 enable
SEFOS(config-if)# exit
SEFOS(config)# exit
```

3. Review the IPv6 information the VLAN 3 interface.

The IPv6 link-local address and joined group address on the interface are not shown in the output.

```
SEFOS# show ipv6 interface vlan 3

vlan3 is down, line protocol is down
  IPv6 is Enabled
  Link local address:
    fe80::214:4fff:fe6c:560f    [Down]
  Global unicast address(es):
    fec0::2222:0:1/96        [Down]
  ...
```

Configuring IPv6 Addressing

An IPv6 address is a 128-bit unique number that identifies the particular host and destination in a network. The different types of IPv6 addressing are:

- **Unicast** - These addresses identify network interfaces.
- **Anycast** - These addresses identify a group of interfaces that are placed at different locations. The same address is assigned to different interfaces. The traffic always flows to the nearest interface.
- **Multicast** - These addresses are identify a group containing several interfaces. The traffic intended for that group is sent to all of the interfaces of that group.

The following procedures show how to add and remove IPv6 addressess from an interface:

- [“Add IPv6 Addresses to an Interface” on page 27](#)
- [“Remove IPv6 Addresses From an Interface” on page 28](#)

▼ Add IPv6 Addresses to an Interface

1. Enter Interface Configuration mode for VLAN 1, and enable IPv6.

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 1
SEFOS(config-if)# ipv6 enable
```

2. Assign IPv6 address for the interface.

```
SEFOS(config-if)# ipv6 address fec0::1111:0:1/96
```

The default prefix type is set as unicast. You can configure the prefix type as anycast, eui64, or link-local address by defining the prefix type in the command.

3. Configure the IPv6 link-local address for the interface.

```
SEFOS(config-if)# ipv6 address fe80::203:2ff:fe03:501 link-local
SEFOS(config-if)# end
```

4. Review the IPv6 information for the VLAN 1 interface.

```
SEFOS# show ipv6 interface vlan 1
```

```
vlan1 is up, line protocol is up
  IPv6 is Enabled
  Link local address:
    fe80::203:2ff:fe03:501
  Global unicast address(es):
    fec0::1111:0:1/96
  ...
```

▼ Remove IPv6 Addresses From an Interface

1. Enter Interface Configuration mode for the VLAN 1 interface.

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 1
```

2. Delete the IPv6 address configured for that interface.

```
SEFOS(config-if)# no ipv6 address fec0::1111:0:1 96
SEFOS(config-if)# no ipv6 address fe80::203:2ff:fe03:501 link-local
SEFOS(config-if)# exit
SEFOS(config)# exit
```

3. Review the IPv6 information for the VLAN 1 interface.

```
SEFOS# show ipv6 interface vlan 1
```

```
vlan1 is up, line protocol is up
  IPv6 is Enabled
  Link local address:
    fe80::214:4fff:fe6c:560f
  ...
```

The link-local address is auto-configured when you remove a link-local address in the IPv6 interface.

Configuring IPv6 Routing

Configuring IPv6 routing is similar to configuring IPv4 routing. IPv6 includes simple routing extensions that support the following routing capabilities:

- Provider selection that is based on policy, performance, and cost
- Host mobility (route to current location)
- Auto-readdressing (route to new address)

These procedures show how to enable or disable IPv6 routing:

- [“Enable IPv6 Routing” on page 29](#)
- [“Disable IPv6 Routing” on page 29](#)

▼ Enable IPv6 Routing

1. Enter Global Configuration mode.

```
SEFOS# configure terminal
```

2. Enable IPv6 unicast routing in the interface.

```
SEFOS(config)# ipv6 unicast-routing
SEFOS(config)# end
```

▼ Disable IPv6 Routing

1. Enter Global Configuration mode.

```
SEFOS# configure terminal
```

2. **Disable IPv6 unicast routing in the interface.**

```
SEFOS(config)# no ipv6 unicast-routing  
SEFOS(config)# exit
```

3. **Review the configuration information.**

```
SEFOS# show running-config
```

```
interface vlan1  
 ip address 12.0.0.1 255.0.0.0  
 no shutdown  
 !  
 no ipv6 unicast-routing
```

Configuring IPv6 Static Routes

Routing defines the paths over which packets travel in the network. Manually configured static routes are used instead of dynamic routing protocols for smaller networks or for sections of a network that have only one path to an outside network.

These procedures show how to configure IPv6 static routes:

- [“Add a Static Route” on page 30](#)
- [“Remove a Static Route” on page 31](#)

▼ Add a Static Route

1. **On switch 1, add a static route for the VLAN 2 interface.**

```
SEFOS# configure terminal  
SEFOS(config)# ipv6 route fec0::3333:0:0 96 fec0::2222:0:10  
SEFOS(config)# exit
```

These steps add one static route to the routing table for the destinations of prefix `fec0::3333:0:0` and prefix length 96 with the next hop as `fec0::2222:0:10`. The default administrative distance is 1.

2. **On switch 1, review the information about the static routes in the routing table.**

```
SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::1111:0:0/96   [1/1]
    via ::, vlan1
C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3
S   fec0::3333:0:0/96   [1/20]
    via fec0::2222:0:10, vlan3
```

▼ Remove a Static Route

1. On switch 1, delete a static route for the VLAN 2 interface.

```
SEFOS# configure terminal
SEFOS(config)# no ipv6 route fec0::3333:0:0 96 fec0::2222:0:10
SEFOS(config)# exit
```

2. Review the information about the static routes in the routing table.

```
SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::1111:0:0/96   [1/1]
    via ::, vlan1
C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3
```

Configuring Static Neighbor Cache Entries

The neighbor cache contains a set of entries about individual neighbors to which traffic has been sent. Each neighbor cache entry contains the information about the interface, IPv6 address, link-layer address, and reach state of the neighbors. Routers and hosts record the neighbor information in the local neighbor cache in NDP. You can add entries statically in the neighbor cache.

These procedures show how to configure static neighbor cache entries:

- [“Add a Neighbor Cache Entry” on page 32](#)

- [“Delete a Neighbor Cache Entry” on page 32](#)

▼ Add a Neighbor Cache Entry

1. Add a static neighbor entry for host A in the neighbor cache table.

```
SEFOS# configure terminal
SEFOS(config)# ipv6 neighbor fec0::1111:0:10 vlan 1 00:11:11:11:12:12
SEFOS(config)# exit
```

2. Review the neighbor entries in the neighbor cache table.

```
SEFOS# show ipv6 neighbors
IPv6 Address          Age  Link-layer Addr      State  Interface
-----
fec0::1111:0:10      0   00:11:11:11:12:12   Static  vlan1
fec0::2222:0:10      0   00:02:02:03:04:01   Stale   vlan3
```

▼ Delete a Neighbor Cache Entry

1. Remove an existing entry.

```
SEFOS# configure terminal
SEFOS(config)# no ipv6 neighbor fec0::1111:0:10 vlan 1 00:11:11:11:12:12
SEFOS(config)# exit
```

2. Review the neighbor entries in the neighbor cache table.

```
SEFOS# show ipv6 neighbors
IPv6 Address          Age  Link-layer Addr      State  Interface
-----
fec0::2222:0:10      0   00:02:02:03:04:01   Stale   vlan3
```

Checking a Local or Remote Endpoint

You can use the `ping(1)` utility to check if a local or remote endpoint is working and reachable from a node.

These procedures show how to check a local or remote endpoint:

- [“Check an Endpoint Using Default Values” on page 33](#)
- [“Check an Endpoint Using the Link-Local Address” on page 33](#)

▼ Check an Endpoint Using Default Values

- **Send IPv6 echo messages with the default values for a ping-related configuration.**

For example:

```
SEFOS# ping ipv6 fec0::2222:0:1

ping6 fec0::2222:0:1 100 bytes of data
100 bytes from fec0::2222:0:1 : ICMP6_seq = 0
100 bytes from fec0::2222:0:1 : ICMP6_seq = 1
100 bytes from fec0::2222:0:1 : ICMP6_seq = 2
100 bytes from fec0::2222:0:1 : ICMP6_seq = 3
100 bytes from fec0::2222:0:1 : ICMP6_seq = 4
--- Ping Statistics ---
5 Packets Transmitted, 5 Packets Received, 0% Packet Loss
```

▼ Check an Endpoint Using the Link-Local Address

- **Type:**

```
SEFOS# ping ipv6 fe80::201:2ff:fe03:401 source vlan 3

ping6 fe80::201:2ff:fe03:401 100 bytes of data
100 bytes from fe80::201:2ff:fe03:401 : ICMP6_seq = 0
100 bytes from fe80::201:2ff:fe03:401 : ICMP6_seq = 1
100 bytes from fe80::201:2ff:fe03:401 : ICMP6_seq = 2
100 bytes from fe80::201:2ff:fe03:401 : ICMP6_seq = 3
100 bytes from fe80::201:2ff:fe03:401 : ICMP6_seq = 4
--- Ping Statistics ---
5 Packets Transmitted, 5 Packets Received, 0% Packet Loss
```

Configuring Router Advertisement Parameters

Routers advertise their presence along with various link and Internet parameters either periodically or in response to a router solicitation message. Router advertisements contain prefixes that are used for various reasons, such as on-link determination, address configuration, and suggested hop-limit value. Router advertisements also allow routers to inform hosts on how

to perform address auto-configuration. For example, routers can specify whether hosts should use stateful (DHCPv6) or autonomous (stateless) address configuration.

This procedure shows how to configure router advertisement parameters:

- [“Configure Router Advertisement Parameters” on page 34](#)

▼ Configure Router Advertisement Parameters

1. **Enter Interface Configuration mode for the VLAN 1 interface.**

```
SEFOS# configure terminal  
SEFOS(config)# interface vlan 1
```

2. **Enable IPv6 support, and assign a unicast address for the interface.**

```
SEFOS(config-if)# ipv6 enable  
SEFOS(config-if)# ipv6 address fec0::1111:0:1/96
```

3. **Enable IPv6 RA in the interface.**

```
SEFOS(config-if)# no ipv6 nd suppress-ra
```

4. **Configure RA-related parameters, such as RA flags, hop-limit, and lifetime.**

5. **Set the M-bit in the router advertisement to either stateful or stateless.**

- a. **To indicate that the host should configure an address using the stateful address configuration, use the following command:**

```
SEFOS(config-if)# ipv6 nd managed-config flag
```

- b. **To indicate that the host should configure an address using the stateless address configuration, use the following command:**

```
SEFOS(config-if)# no ipv6 nd managed-config flag
```

6. **Set the O-bit in the router advertisement to either stateful or stateless.**

- a. **To indicate that the host should configure nonaddress information by stateful means, use the following command**

```
SEFOS(config-if)# ipv6 nd other-config flag
```

- b. To indicate that the host should configure nonaddress information by stateless means, use the following command**

```
SEFOS(config-if)# no ipv6 nd other-config flag
```

- 7. Configure the hop-limit to be placed in the router advertisements sent from the IPv6 interface.**

```
SEFOS(config-if)# ipv6 hop-limit 10
```

- 8. Configure the default router time.**

The default router time is given in seconds. This value represents the time taken until the entity acts as the default router for all of the hosts on the interface.

```
SEFOS(config-if)# ipv6 nd ra-lifetime 1000
```

- 9. Configure the reachable-time.**

The reachable-time is given in milliseconds. This value represents the time taken until a neighboring node is considered to be reachable after having received the reachability confirmation from that node.

```
SEFOS(config-if)# ipv6 nd reachable-time msec 500000
```

- 10. Configure the retransmit time.**

The retransmit time is given in milliseconds. This value represents the time taken between retransmitted neighbor solicitations, and it is used during address resolution, reachability detection, and duplicate address detection.

```
SEFOS(config-if)# ipv6 nd ns-interval 500000
```

- 11. Configure the value to be placed in the MTU options sent by the router on the interface.**

```
SEFOS(config-if)# ipv6 nd ra-mtu 1500
```

- 12. Configure the minimum and maximum router advertisement time.**

Router advertisements are sent periodically at a random interval between the values specified by the minimum and maximum time values.

```
SEFOS(config-if)# ipv6 nd ra-interval 300 200
```

13. Configure the prefix to be advertised in the IPv6 RA.

```
SEFOS(config-if)# ipv6 nd prefix fec0::1111:0:0 96 500 400
```

14. Review the IPv6 information for all of the IPv6 interfaces.

```
SEFOS# show ipv6 interface vlan 1
```

```
vlan1 is up, line protocol is up
...
  ICMP redirects are enabled
  ND DAD is enabled, Number of DAD attempts: 1
  ND router advertisement is enabled
  ND reachable time is 500000 milliseconds
  ND retransmit time is 500000 milliseconds
  ND router advertisements are sent every 300 seconds
  ND router advertisement Link MTU 1500
```

Configuring DAD Entries

DAD helps a node to determine if an IPv6 address is not already being used by another node. The address could have been assigned either manually or automatically in a stateful or stateless configuration.

These procedures show how to configure DAD entries:

- [“Set the DAD Attempts” on page 36](#)
- [“Reset the DAD Attempts” on page 37](#)

▼ Set the DAD Attempts

1. Enter Interface Configuration mode for the VLAN 1 interface

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 1
```

2. Set the number of DAD attempts.

```
SEFOS# ipv6 nd dad attempts 5
SEFOS(config)# exit
```

3. Review the DAD attempts in the VLAN 1 interface information.

```
SEFOS# show ipv6 interface vlan 1
vlan1 is up, line protocol is up
...
ND DAD is enabled, Number of DAD attempts: 5
...
```

▼ Reset the DAD Attempts

1. Enter Interface Configuration mode for the VLAN 1 interface.

```
SEFOS# configure terminal
SEFOS(config)# interface vlan 1
```

2. Reset the number of DAD attempts.

```
SEFOS(config-if)# no ipv6 nd dad attempts
```

3. Review the DAD attempts in the VLAN 1 interface information.

```
SEFOS# show ipv6 interface vlan 1

vlan1 is up, line protocol is up
...
    ND DAD is enabled, Number of DAD attempts: 0
...
```

Configuring PMTU Discovery

The PMTU discovery feature enables the source node to dynamically discover the PMTU for a topology, which ensures optimal usage of network resources. PMTU discovery dynamically discovers the MTU of a path so that the packet can be sent with a size that is equal to the PMTU of the path, not a size that is equal to the IPv6 minimum link MTU. The source node assumes that the PMTU of a path is the MTU of the first hop in that path, so the node sends the packet with the assumed size. If any node along the path is not able to forward the packets due to a large size, that node discards the packet and returns ICMPv6 Packet-Too-Big messages. The source node reduces the assumed PMTU based on the MTU of the constricting node, and resends the packets. This process is iterated until an acceptable PMTU value is derived.

These procedures show how to configure PMTU discovery:

- [“Enable PMTU Discovery” on page 38](#)

- [“Disable PMTU Discovery” on page 38](#)

▼ Enable PMTU Discovery

1. **Enter Global Configuration mode.**

```
SEFOS# configure terminal
```

2. **Enable PMTU discovery.**

Type one of these commands.

```
SEFOS(config)# ipv6 path mtu discover
```

```
SEFOS(config)# ipv6 path mtu 2004::0 1500
```

where:

- 2400::0 is the prefix address.
- 1500 is the MTU value.

3. **Review the IPv6 PMTU status.**

```
SEFOS# show ipv6 pmtu
```

▼ Disable PMTU Discovery

1. **Enter Global Configuration mode.**

```
SEFOS# configure terminal
```

2. **Disable PMTU discovery.**

Type one of these commands.

```
SEFOS(config)# no ipv6 path mtu discover
```

```
SEFOS(config)# no ipv6 path mtu 2004::0
```

where 2400::0 is the prefix address.

Setting the MTU for Use in PMTU Discovery

Each PMTU value is associated with a specific path traversed by packets that are exchanged between the source and destination nodes. The PMTU value for a destination is discovered dynamically, which is the minimum PMTU of all paths through which the destination can be reached.

This procedure shows how to set the MTU for use in PMTU discovery:

- [“Set the MTU for Use in PMTU Discovery” on page 39](#)

▼ Set the MTU for Use in PMTU Discovery

1. Enter Global Configuration mode.

```
SEFOS# configure terminal
```

2. Set the MTU value for use in PMTU discovery.

```
SEFOS(config)# ipv6 path mtu 2004::0 1500
```

where:

- 2004::0 is the prefix address.
- 1500 is the MTU value.

3. Use the ping command to connect to host B from switch 1 with the packet sizing as 1800.

```
SEFOS# ping ipv6 fec0::3333:0:10 size 1800
```

```
ping6 fec0::3333:0:10 1800 bytes of data
1800 bytes from fec0::3333:0:10 : icmp_seq = 0
1800 bytes from fec0::3333:0:10 : icmp_seq = 1
1800 bytes from fec0::3333:0:10 : icmp_seq = 2
1800 bytes from fec0::3333:0:10 : icmp_seq = 3
1800 bytes from fec0::3333:0:10 : icmp_seq = 4
--- Ping Statistics ---
5 Packets Transmitted, 5 Packets Received, 0% Packet Loss
```

4. On switch 1, review the MTU value.

```
SEFOS# show ipv6 pmtu
```

```
PMTU discovery is enabled
```

```
    Ipv6 Path MTU Table
    -----
Destination      PMTU
-----
fec0::1111:0:01200
```

Configuring the IPv6 Route Redistribution Policy for Routing Protocols

The RRD policy feature uses a routing protocol to advertise routes that are learned by other routing protocols. The routes can be static routes or directly connected routes. This procedure shows how to configure the policy set for routing IPv6 routes. The IPv6 routes are maintained in the RTM6 table that is used for IPV6 routes, ensuring that the route table manager redistributes the best route.

This procedure shows how to configure the IPv6 route redistribution policy for routing protocols:

- [“Configure the IPv6 Route Redistribution Policy for Routing Protocols” on page 40](#)

▼ Configure the IPv6 Route Redistribution Policy for Routing Protocols

1. Review the routing information in the routing table on switch 1.

```
SEF0S# show ipv6 route

VRF    Name:      default
IPv6 Routing Table
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::1111:0:0/96  [1/1]
    via ::, vlan1
C   fec0::2222:0:0/96  [1/1]
    via ::, vlan3
```

2. Review the routing information in the routing table on switch 2.

```
SEF0S# show ipv6 route

IPv6 Routing Table:
```



```
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3
C   fec0::3333:0:0/96   [1/1]
    via ::, vlan2
```

3. Review the routing information in the routing table on switch 3.

```
SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::3333:0:0/96   [1/1]
    via ::, vlan2
C   fec0::4444:0:0/96   [1/1]
    via ::, vlan1
```

All of the connected routes are listed in all of the routing tables.

4. On switch 1, configure the redistribution policy for the destination IP so that the redistribution of that route to the destination protocol is permitted or not permitted by switch 2.

```
SEFOS# configure terminal
SEFOS(config)# redistribute-policy ipv6 deny fec0::4444:0:0 96 rip ospf
```

Redistribution of each route is permitted by default in each router. If the redistribution of a particular route is to be denied, configure the redistribution policy for that route.

5. On switch 1, enable the OSPF routing protocol for the VLAN 3 interface.

```
SEFOS(config)# ipv6 router ospf
SEFOS(config-router)# router-id 1.1.1.1
SEFOS(config-router)# ASBR Router
SEFOS(config-router)# redistribute connected
SEFOS(config-router)# exit
SEFOS(config)# interface vlan 3
SEFOS(config-if)# ipv6 ospf area 0.0.0.0
SEFOS(config-if)# end
```

6. On switch 2, enable the OSPF routing protocol for the VLAN 3 interface.

```
SEFOS# configure terminal
SEFOS(config)# ipv6 router ospf
SEFOS(config-router)# router-id 2.2.2.2
SEFOS(config-router)# ASBR Router
SEFOS(config-router)# redistribute connected
```

```
SEFOS(config-router)# redistribute ripng
SEFOS(config-router)# exit
SEFOS(config)# interface vlan 3
SEFOS(config-if)# ipv6 ospf area 0.0.0.0
SEFOS(config-if)# exit
```

7. On switch 2, enable the RIP routing protocol for the VLAN 2 interface.

```
SEFOS(config)# ipv6 router rip
SEFOS(config-router)# redistribute connected
SEFOS(config-router)# redistribute ospf
SEFOS(config-router)# exit
SEFOS(config)# interface vlan 2
SEFOS(config-if)# ipv6 rip enable
SEFOS(config-if)# end
```

8. On switch 3, enable the RIP routing protocol for the VLAN 2 interface.

```
SEFOS# configure terminal
SEFOS(config)# ipv6 router rip
SEFOS(config-router)# redistribute connected
SEFOS(config-router)# exit
SEFOS(config)# interface vlan 2
SEFOS(config-if)# ipv6 rip enable
SEFOS(config-if)# end
```

9. Review the routing information in the routing table for switch 1.

```
SEFOS# show ipv6 route

IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
C   fec0::1111:0:0/96   [1/1]
    via ::, vlan1
C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3
O   fec0::3333:0:0/96   [10/110]
    via fe80::203:2ff:fe03:201, vlan3
```

The information about route `fec0::3333:0:0` is not learned because the policy is set to deny. To permit the redistribution of this route, execute the following commands in switch 2:

```
SEFOS# configure terminal
SEFOS(config)# no redistribute-policy ipv6 fec0::4444:0:0 96
SEFOS(config)# redistribute-policy ipv6 permit fec0::4444:0:0 96 rip ospf
SEFOS(config)# exit
SEFOS# show ipv6 route
```

```
...
O   fec0::4444:0:0/96   [10/110]
    via fe80::203:2ff:fe03:201, vlan3
```

10. Review the routing information in the routing table on switch 2.

```
SEFOS# show ipv6 route
```

```
IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
O   fec0::1111:0:0/96   [10/110]
    via fe80::201:2ff:fe03:401, vlan3
C   fec0::2222:0:0/96   [1/1]
    via ::, vlan3
C   fec0::3333:0:0/96   [1/1]
    via ::, vlan2
R   fec0::4444:0:0/96   [2/120]
    via fe80::203:2ff:fe03:401, vlan2
```

11. Review the routing information in the routing table on switch 3.

The routes to all of the networks are learned using the routing protocols in each router after the route redistribution is configured.

```
SEFOS# show ipv6 route
```

```
IPv6 Routing Table:
Codes : C - Connected, S - Static
        O - OSPF, R - RIP, B - BGP
R   fec0::1111:0:0/96   [2/120]
    via fe80::202:2ff:fe03:401, vlan2
R   fec0::2222:0:0/96   [2/120]
    via fe80::202:2ff:fe03:401, vlan2
C   fec0::3333:0:0/96   [1/1]
    via ::, vlan2
C   fec0::4444:0:0/96   [1/1]
    via ::, vlan1
```

