OSPFv3 Software Configuration Guide

Application Note

CONFIDENTIAL

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1. Disclaimer

Microchip is aware that some terminology used in this technical document is antiquated and inappropriate. As a result of the complex nature of software where seemingly simple changes have unpredictable, and often far-reaching negative results on the software’s functionality (requiring extensive retesting and revalidation) we are unable to make the desired changes in all legacy systems without compromising our product or our clients' products.

2. Introduction

This document gives examples on how to configure OSPFv3 using the Command Line Interface (CLI).

- Using CLI as the management interface requires a serial console connection between the device and the management platform. No network connection is required to use CLI, but a terminal emulator software has to be installed.

3. Audience

This document is for software and application developers who need to understand and use the OSPF functionality in Microchip switch products.

4. OSPFv3 Introduction

Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol (IP) networks. It is an Interior Gateway Protocol (IGP) developed by the OSPF working group of the Internet Engineering Task Force (IETF). RFC 2328 defines OSPF Version 2 for IPv4 and RFC 5340 defines OSPF Version 3 for IPv6..

OSPF is a link-state routing protocol and designed to be run internally within a single Autonomous System. Each router maintains a link-state database describing the Autonomous System’s topology. From this database, each router constructs a shortest path first tree (SPF tree), from which it determines the (lowest cost) routes to different networks.

The implementation utilizes an open-source router called Free Range Router (FRR), which is a fork of the open-source Quagga router. FRR supports a variety of routing protocol daemons including BGP, IS-IS, LDP, OSPF, PIM, and RIP, of which OSPFv2, RIPv2 and OSPFv3 are the only ones currently supported in selected Microchip products.

Before diving into details of configuration setup, some basic concepts of OSPF networking are needed.

4.1. AS and Router Types

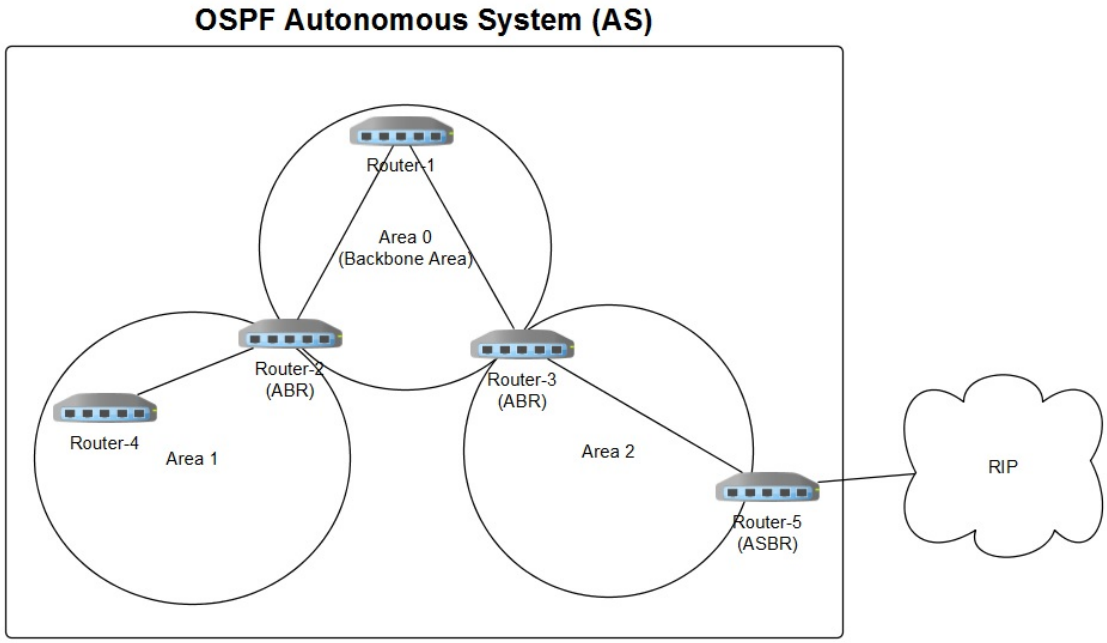


Figure 1. AS and Border Router Types

- Autonomous system (AS)

  A group of networks under a single administrative control. An Interior Gateway Protocol (IGP) refers to a routing protocol that handles routing within a single autonomous system. IGPs include RIP, IGRP, EIGRP, and OSPF.

- Area border router (ABR)

  A router that connects to multiple areas.

- Autonomous system border router (ASBR)

  A router that connects different ASs, that is, it acts as a gateway between OSPF and other routing protocols (IGRP, RIP, BGP and etc.)

- Designated router (DR)

  A designated router is elected on every broadcast network. It generates link-state packets for the network and synchronizes the link-state database with all other routers on the network. The designated router concept also reduces the amount of routing protocol traffic.

- Backup designated router (BDR)

  The backup designated router also synchronizes the link-state databases with all other routers on the network but does not generate link-state packets for the network. When a DR fails, the BDR becomes the new DR. This transition doesn’t need to resynchronize the link-state database which can potentially take quite some time. The backup designated router concept makes the transition smoother.

4.2. OSPF Areas

OSPF allows for grouping contiguous networks and hosts into so-called areas. The topology of an area is invisible from the outside of the area. A router has a separate link-state database for each area it is connected to. This reduces the OSPF traffic sent on the network and also the size of the topology database a router must maintain.

- Backbone Area

  The OSPF backbone is the central area of an AS and all other areas must be directly connected to the backbone area. The backbone area distributes routing information between non-backbone areas. The backbone area needs to be contiguous.

- Transit Area

  When an area can carry data traffic that neither originates nor terminates in the area itself, it’s an transit area.

- Stub Area

  OSPF allows certain areas to be configured as "stub areas". AS external routing information is not flooded into stub areas. Instead, a default route is advertised into the stub area through one or more of the stub area’s ABRs.

- Not-So-Stubby Area (NSSA)

  NSSA is similar to the existing OSPF stub area but has the additional capability of importing AS external routes in a limited fashion. All routers in the NSSA must agree on the "N" bit (NSSA capable) and allow to carry AS external route information Note: NSSA is not supported in the current release of FRR for OSPFv3.

4.3. Link-State Packet Types

There are six major Link-State packet types (LS Types).

OSPF Link-State Packet Types

- Router LSA (Type 0x2001)

  Originated by a router. Describes the state and cost of the router’s link (interfaces) to the intra area.

- Network LSA (Type 0x2002)

  Originated by a DR. Describes all routers attached to the network segment.

- Inter-Area LSA (Type 0x2003 and 0x2004)

  Originated by an ABR. Describes networks between backbone area and inter area.

- External LSA (Type 0x4005 and 0x2007)

  Originated by an ASBR. Describes networks outside of the AS.

- Link LSA (Type 0x0008)

  Originated by a Router. It has the following purposes - notify the link-local address of the router’s interface to the routers attached to the link - inform other routers attached to the link of the list of IPv6 prefixes to associate with the link - allow the router to assert the collection of Option bits to associate with the Network LSA that will be originated for the link

- Intra-Area-Prefix LSA (Type 0x2009)

Originated by a Router. This LSA carries all IPv6 prefix information that in IPv4 is included in router-LSAs and network-LSAs

4.4. DR Election

OSPF Hello packets are exchanged using IP multicast packets on each network segment. Designated router (DR) and backup designated router (BDR) election is done via the Hello packet. The router with the highest OSPF priority will be elected as the DR on the segment and the one with the second-highest OSPF priority will be elected as the BDR.

NOTE Priority value 0 indicates that an interface is not to be elected as DR or BDR. This is known as a DROTHER router.

4.4.1. Neighbor and Adjacency

OSPF neighbor is the relationship that is established among OSPF intra-area routers that share a common network segment and area. The states are same as for OSPFv2.

Adjacencies are created when neighboring routers exchange routing information with each other. The adjacency states are listed below.

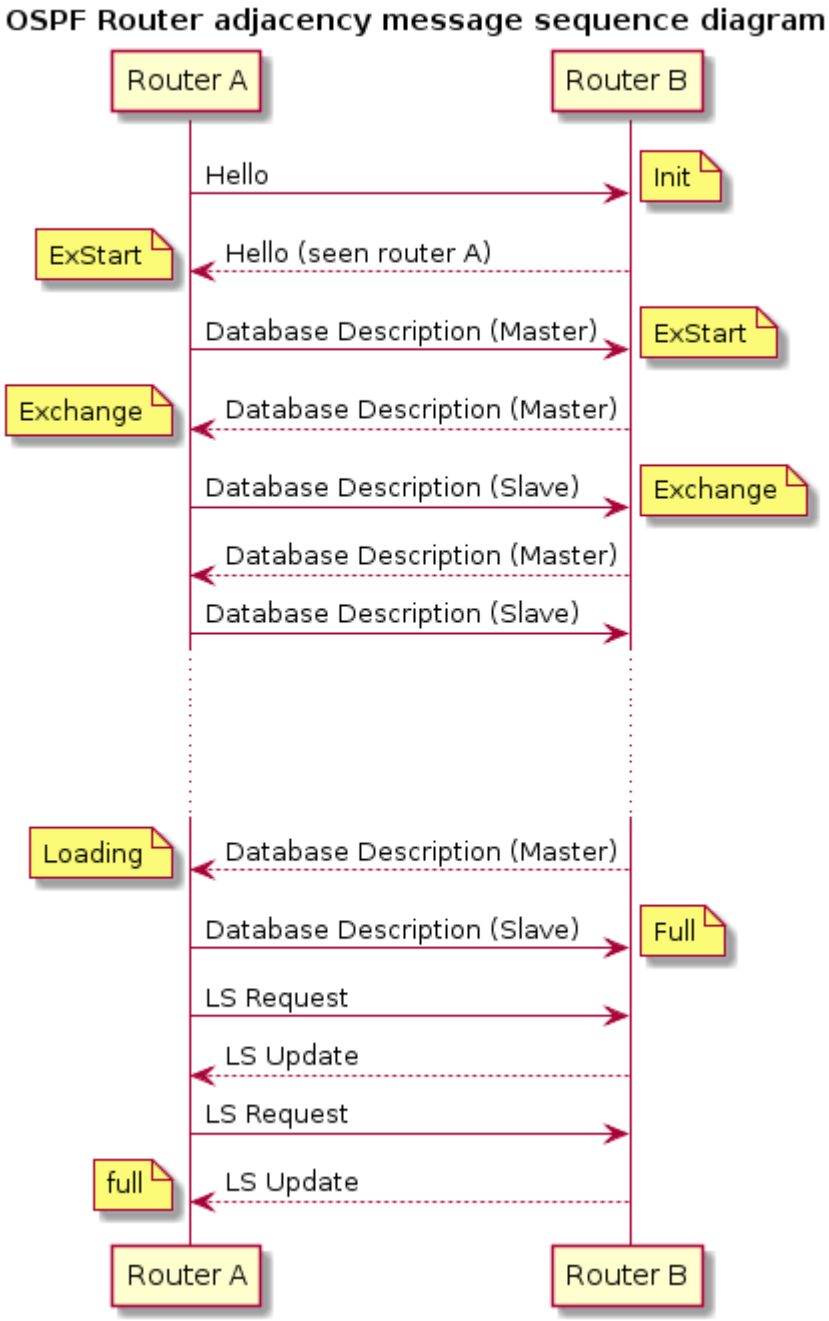


Figure 2. OSPF Adjacency Example

- Down: The initial state of a conversation when no information has been exchanged.
- Attempt: Similar to the Down state, but is only used on Non-broadcast multiple-access (NBMA) networks.
- Init: Hello packet has been received from neighbor. But bidirectional communication has not yet been established with the neighbor.
- 2-Way: Communication with neighbor is bidirectional.
- ExStart: Decide a master/slave relationship and an initial sequence number for later adjacency building process.
- Exchange: Describe the entire link state database to the neighbor.

- Loading: Request the most recent LSAs from neighbor.
- Full: The adjacency is completed.

5. Simple OSPF Configuration Example

In this section we present a simple example to show how to enable OSPF on two routers in the backbone area. This involves two actions: Enable OSPF process and enable OSPF on the specified interface.

When OSPF is disabled, no OSPF control frames will be transmitted and the router will not react to OSPF control frames sent by others. No OSPF status will be available when disabled.

When OSPF routing is enabled and OSPF is also enabled on a VLAN interface, the ports that are members of this VLAN will transmit OSPF control frames periodically, advertising routing updates. The frames received from the corresponding port(s) will also be processed.

5.1. Configuration Example

Suppose we have two routers, Router-1 and Router-2, both connected to Area 0 (a.k.a. 0.0.0.0). Router-1 can reach 2003::/124 and Router-2 can reach both 2003::/124 and 2000::/124.

5.1.1. Topology Setup

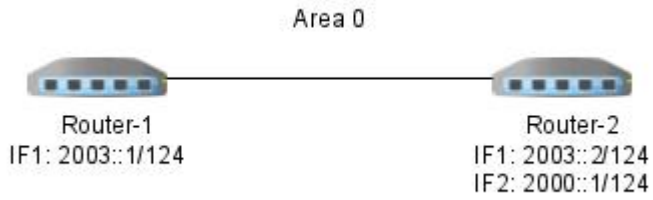


Figure 3. Simple backbone area topology

5.1.2. Via CLI

Use the 'ip routing' command in global configuration mode to enable the IP routing capability. Use the 'no' form to disable the IP routing capability.

Syntax

- ip routing
- no ip routing

Default

IP routing capability is disabled. The default is therefore host mode.

Use the 'router ospf6' command in global configuration mode to enable OSPFv3 routing. Use the 'no' form to disable OSPFv3 routing.

Syntax

- router ospf6

- no router ospf6

Default

OSPFv3 routing is disabled.

Use the 'interface area' command in router configuration mode to set the OSPF area ID for a specific interface. The area ID is typically formatted as an IPv4 address. Use the 'no' form to remove the setting. To enable OSPFv3 on multiple network segments you need to issue the command multiple times.

Syntax

- interface vlan <vlan_id> area <area_id>
- no interface vlan <vlan_id> area <area_id>

Parameters

- <vlan_id>: VLAN ID of the interface
- <area_id>: The OSPF area ID is a 32-bit number used to associate the interface with a particular area. It can be specified as either an IPv4 address format (A.B.C.D) or as a decimal value from 0 to 4294967295.

Default

No area is configured for an interface.

Example

Step 1 (both Router-1 and Router-2). Enable OSPFv3.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# vlan 2	Create a VLAN, and enter VLAN configuration mode.
3	(config-vlan)# interface GigabitEthernet 1/4	Specify the port interface to configure, and enter the interface configuration mode.
4	(config-if)# switchport access vlan 2	Set the access mode of the interface to the specified VLAN.
5	(config-if)# interface vlan 2	Specify the VLAN interface to configure, and enter the VLAN interface configuration mode.

Step	Command	Description
6	For Router-1: Configure IP address 2003::1/124. (config-if-vlan)# ipv6 addr 2003::1/124 For Router-2: Configure IP address 2003::2/124. (config-if-vlan)# ipv6 addr 2003::2/124	Configure an IP address for a VLAN interface.
7	(config)# router ospf6	Enable the OSPF routing process and enter the OSPF router configuration mode.
9	(config-router)# interface vlan 2 area 0	Configure the OSPF interface area.

Step 2 (Router-2, only). Enable OSPF on network 2000::/124 in area 0 via CLI.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# vlan 3	Create a VLAN, and enter VLAN configuration mode.
3	(config-vlan)# interface GigabitEthernet 1/2	Specify the interface to configure, and enter the interface configuration mode.
4	(config-if)# switchport access vlan 3	Set the access mode of the interface to the specified VLAN.
5	(config-if)# interface vlan 3	Specify the interface to configure and enter the VLAN interface configuration mode.
6	(config-if-vlan)# ipv6 addr 2000::1/124	Configure an IP address for an interface.
7	(config)# router ospf6	Enable the OSPF routing process and enter the OSPF router configuration mode.
8	(config-router)# interface vlan 3 area 0	Add vlan 3 to area 0

TIP Use the 'show ipv6 ospf' command to verify the current settings. See also General/Area Status via CLI.

5.1.3. Via Web

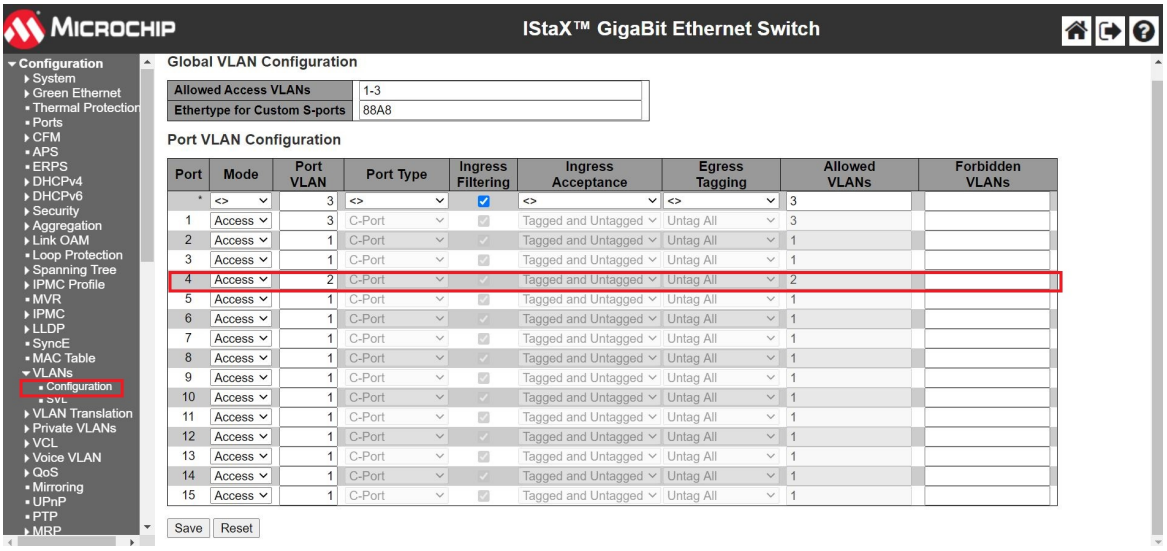


Figure 4. Configure VLAN via Web

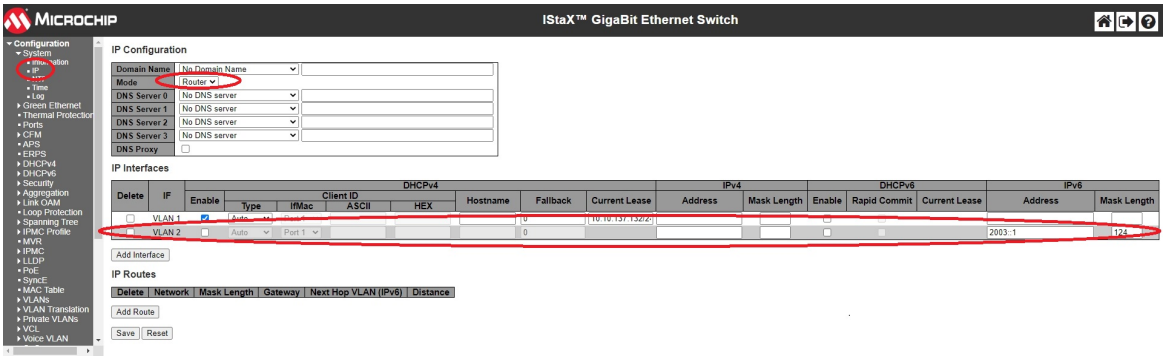


Figure 5. Configure IP address and enable IP routing via Web

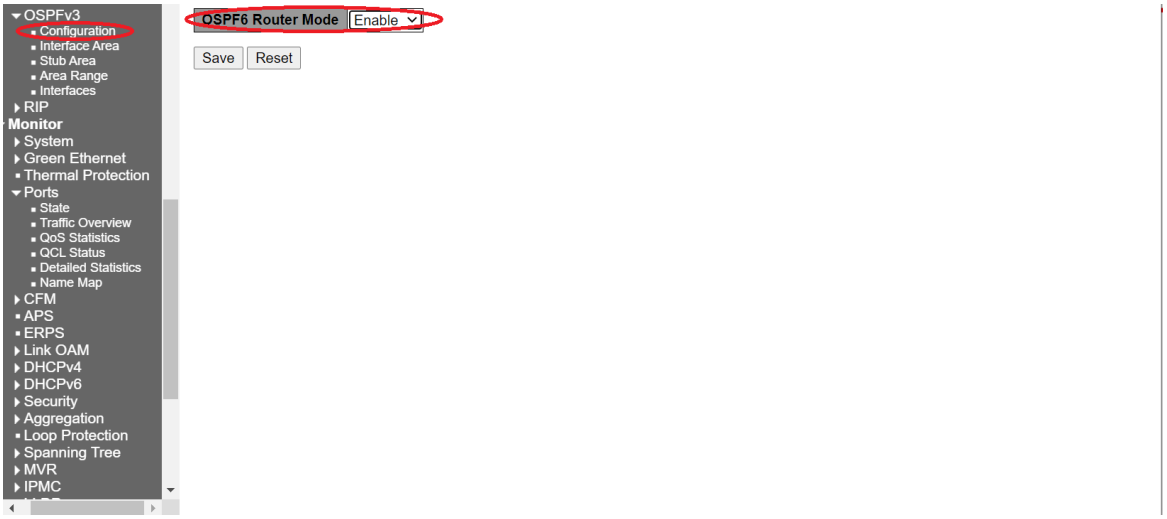


Figure 6. Enable OSPFv3 via Web

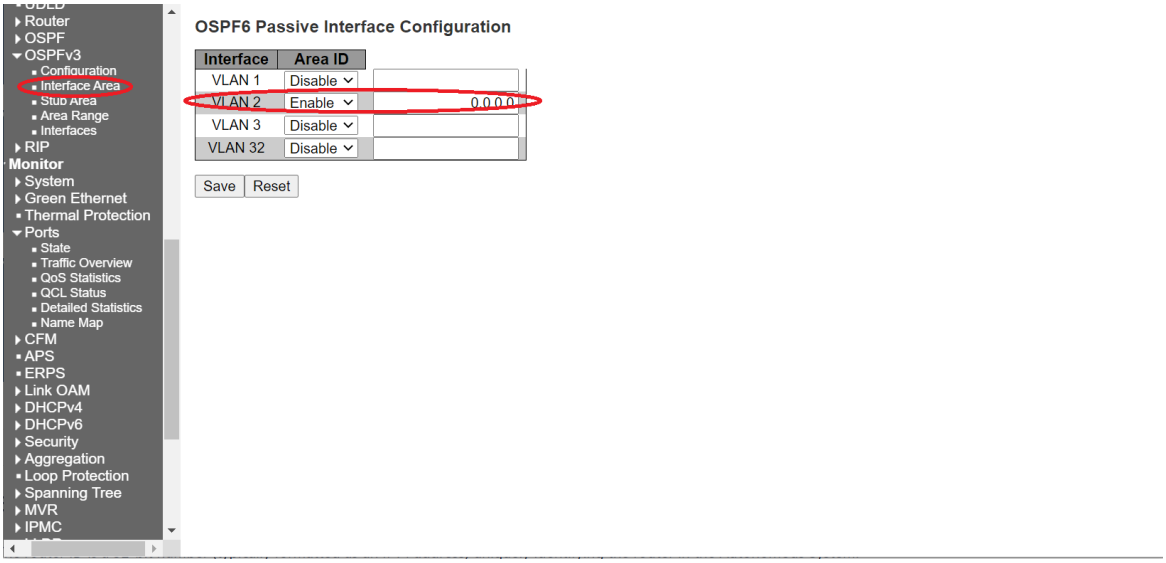


Figure 7. Configure OSPFv3 interface area via Web

TIP

Use the 'OSPFv3 Status' web page to verify the current settings. See also General/Area Status via Web.

6. OSPF Router ID

The router ID is a 32-bit number (typically formatted as an IPv4 address) uniquely identifying the router in the Autonomous System.

When the Router ID is changed, you must restart the OSPF router process. See Clear IPv6 OSPF Process for a description of this.

NOTE

It is the user’s responsibility to ensure that the ID is unique within the entire OSPF domain. If the router ID is not set explicitly, then the router will use the highest active interface IP addresses as its router ID.

6.1. Configuration Example

Here’s an example of configuring router ID 0.0.0.1 for Router-1 and auto mode router ID for Router-2.

6.1.1. Topology Setup

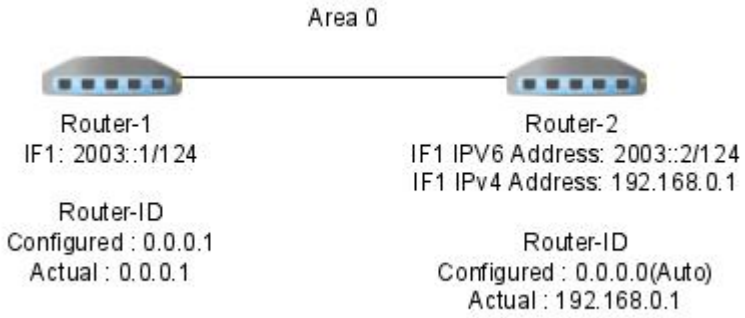


Figure 8. OSPF router ID example

6.1.2. Via CLI

Use the 'router-id' command in OSPF router configuration mode to set the OSPF router ID. Use the 'no' form to restore the setting to default algorithm.

Syntax

- router-id <router_id>
- no router-id

Parameter

- <router_id>: OSPF router-id in IPv4 address format (A.B.C.D). Notice that the router ID should be unique in the Autonomous System and value '0.0.0.0' is invalid since it is reserved for the default algorithm. If there is one or more fully adjacent neighbors in the current OSPF area, the new router ID will take effect after restarting the OSPF process (using 'clear ipv6 ospf process'.)

Default

No OSPF router ID is configured. The default algorithm will choose the largest IPv4 address assigned to the router.

Table 1. Configure OSPF Router ID

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# router ospf6	Enable OSPF and enter OSPF router configuration mode.
3	Router-1: Configure Router ID 0.0.0.1 (config-router)# router-id 0.0.0.1 Router-2: Apply default algorithm (Auto) (config-router)# no router-id	Configure the OSPF router ID.

TIP Use the 'show ipv6 ospf' command to verify the setting. See also General/Area Status via CLI.

6.1.3. Via Web

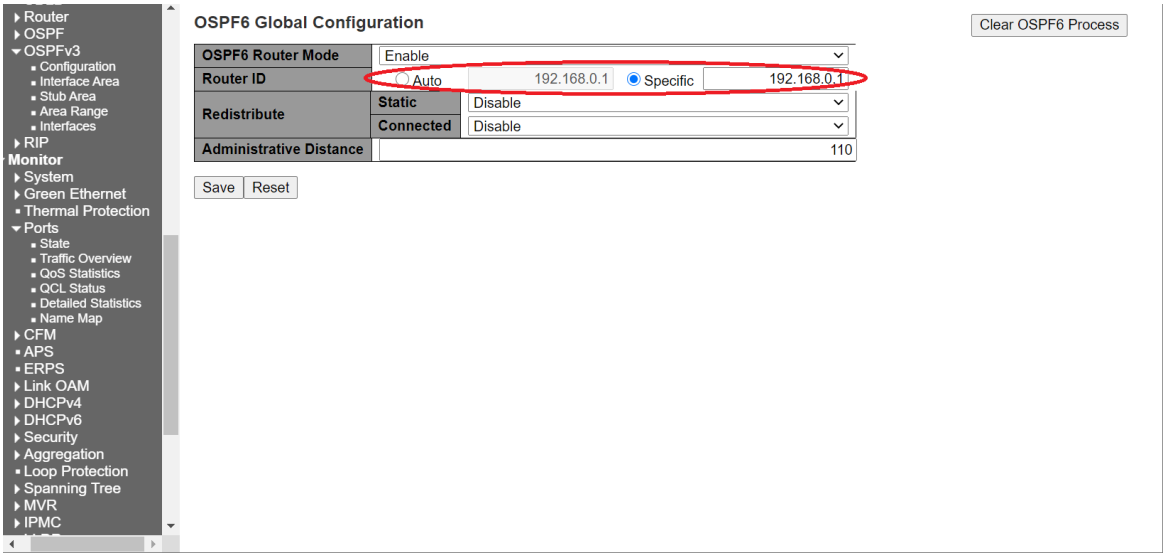


Figure 9. Configure OSPFv3 router ID via Web

TIP Use the 'OSPFv3 Status' web page to verify the setting. See also General/Area Status via Web.

7. OSPF Interface

7.1. OSPF Passive Interface

When an interface is configured as a passive interface, transmission of OSPF routing updates is suppressed. Therefore, the interface does not establish adjacencies (no OSPF Hellos). The subnet of all interfaces (both passive and active) is advertised by the OSPF router.

7.1.1. Configuration Example

The following example configures VLAN 32 as a passive interface.

7.1.1.1. Via CLI

Use the 'ipv6 ospf passive' command in VLAN interface configuration mode to suppress OSPF routing updates on a specific interface.

Syntax

- ipv6 ospf passive
- no ipv6 ospf passive

Default

No Passive interface is configured

Example

Configure OSPF passive interface through CLI.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# interface vlan 32	Enable VLAN configuration mode.
3	(config-if-vlan)# ipv6 ospf passive	Mark VLAN 32 as a passive interface.

7.1.1.2. Via Web

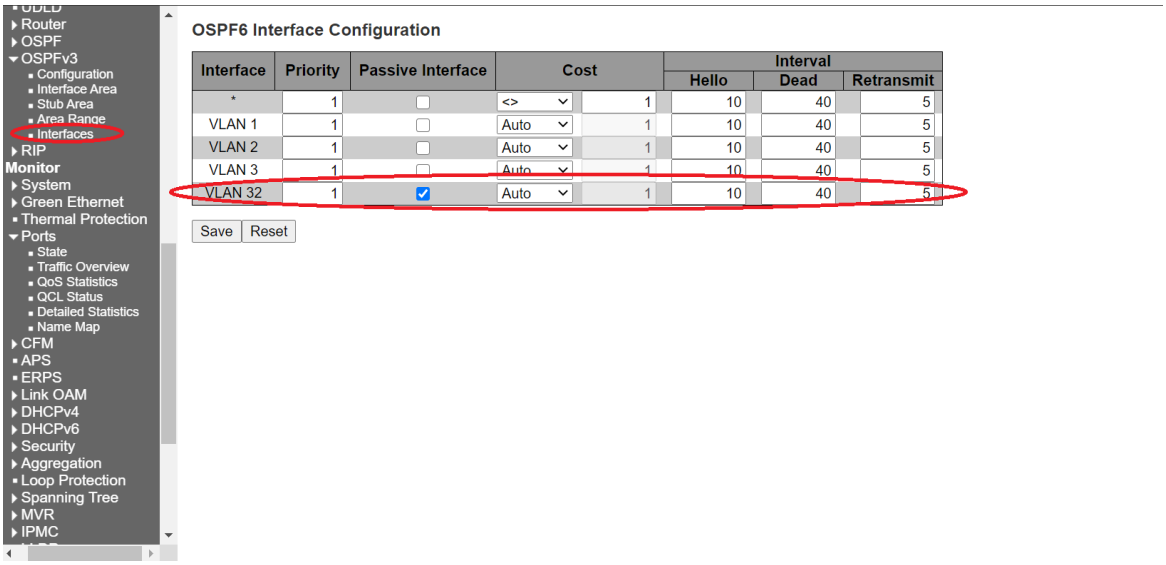


Figure 10. Configure OSPF passive interface via Web

TIP

Use the 'OSPFv3 Status' web page to verify the current settings. See also Interface Status via Web.

7.2. Interface Parameter Tuning

This section describes additional parameters allowing for fine-tuning interfaces to fit real network situations.

7.2.1. OSPF Interface Router Priority

The Designated Router is elected by the Hello protocol. A router's Hello packet contains its Router Priority, which is configurable on a per-interface basis. The router with the highest priority will be more eligible to become DR.

The router priority is an integer value from 0 to 255 with a default value of 1.

NOTE When the router priority is set to zero, this router will be ineligible to become the Designated Router (DR) or Backup Designated Router (BDR).

7.2.2. OSPF Interface Cost

The OSPF interface cost is a link state metric. The lower the cost, the more likely the interface is to be used for forwarding data traffic.

The cost value is used in the router LSAs' metric field and used in the Shortest Path First (SPF) calculation.

The interface cost is an integer value from 0 to 255 with a default value of 1.

7.2.3. OSPF Hello Interval and Dead Interval

If a router does not receive a hello packet from a neighbor within the dead interval, it will declare the neighbor to be down. Reception of a hello packet resets the timer.

Both the hello interval and the dead interval must be the same within the network. They are both included in Hello packets, and if - upon reception - the values don’t match the configured values, the Hello packet is dropped, so no neighborship will be formed.

TIP It is common practice to set the dead interval to four times the hello interval.

7.2.4. OSPF Interface Retransmit Interval

The retransmit interval determines the time until retransmitting a database description packet or a link-state request when the previous packet has not been acknowledged. If a router sends a link-state advertisement (LSA) to its neighbor without acknowledgement within the retransmit interval, the LSA will be sent again.

The retransmit-interval is an integer value from 3 to 65535 with a default value of 5 seconds.

7.2.5. Configuration Examples

This section provides a series of examples for tuning the OSPF interface parameters.

7.2.5.1. Via CLI

7.2.5.1.1. OSPF Interface Router Priority

Use the 'ipv6 ospf priority' command in VLAN interface configuration mode to set the router priority for that VLAN interface.

Use the 'no' form to restore the setting to default.

Syntax

- ipv6 ospf priority <0-255>
- no ipv6 ospf priority

Parameters

- <0-255>: User-specified router priority for the interface.

Default

The default router priority value is 1.

7.2.5.1.2. OSPF Interface Cost

Use the 'ipv6 ospf cost' command in VLAN interface configuration mode to set the cost value for that VLAN interface. The cost value is assigned to router LSAs' metric field and used in the Shortest Path First (SPF) calculation.

Use the 'no' form to remove the setting.

Syntax

- ipv6 ospf cost <1-65535>
- no ipv6 ospf cost

Parameters

- <1-65535>: Link state metric for the interface. This is used in the Shortest Path First (SPF) algorithm.

Default

The default is no user-specified cost value. The cost is calculated by the OSPF process.

7.2.5.1.3. OSPF Interface Dead Interval

Use the 'ipv6 ospf dead-interval' command in VLAN interface configuration mode to set the dead interval value (in seconds) for the interface.

Use the 'no' form to restore the setting to default value.

Syntax

- ipv6 ospf dead-interval <1-65535>
- no ipv6 ospf dead-interval

Parameters

- <1-65535>: Number of seconds to wait until the neighbor is assumed to be dead. The timer is restarted whenever a hello packet is received from the neighbor.

Default

The default dead-interval value is 40 seconds.

NOTE

The configuration of dead-interval should be used with caution.

Although the benefit of smaller dead intervals is faster detection of neighbor removals, the downside is higher CPU (and network) utilizations, which in turn may impact routing performance and other CPU activities.

7.2.5.1.4. OSPF Interface Hello Interval

Use the 'ipv6 ospf hello-interval' command in VLAN interface configuration mode to set the hello interval value for the interface.

Use the 'no' form to restore the setting to default value.

Syntax

- ipv6 ospf hello-interval <1-65535>
- no ipv6 ospf hello-interval

Parameters

- <1-65535>: The time interval (in seconds) between hello packets.

Default

The default hello interval is 10 seconds.

7.2.5.1.5. OSPF Interface Retransmit Interval

Use the 'ipv6 ospf retransmit-interval' command in VLAN interface configuration mode to set the retransmit interval value for the interface.

Use the 'no' form to restore the setting to default value.

Syntax

- ipv6 ospf retransmit-interval <3-65535>
- no ipv6 ospf retransmit-interval

Parameters

- <3-65535>: The time interval (in seconds) to wait before retransmitting a database description packet or a link-state request when it has not been acknowledged.

Usage Guidelines

Be aware that the value of retransmit-interval should be greater than the expected round-trip delay between any two routers on the attached network. The configuration should also consider needless LSA retransmissions.

> **NOTE** It is recommended to use the same retransmit interval on neighboring routers in order to avoid unnecessary LSA retransmissions.

Default

The default retransmit-interval value is 5 seconds.

Examples

Configure various OSPF interface parameters via CLI.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# interface vlan 32	Enter VLAN interface configuration mode.
3	(config-if-vlan)# ipv6 ospf priority 8	Set the priority to be used to elect the DR for a network. The OSPF router with the highest router priority becomes the designated router.
4	(config-if-vlan)# ipv6 ospf cost 1	Specify the cost of sending packets from the interface. The lower the cost, the more likely the interface is to be used to forward data traffic.
5	(config-if-vlan)# ipv6 ospf dead-interval 10	Set the number of seconds during which the router must receive at least one Hello packet from a neighbor without declaring it down.
6	(config-if-vlan)# ipv6 ospf hello-interval 20	Set the interval - in seconds - between transmission of Hello packets.
7	(config-if-vlan)# ipv6 ospf retransmit-interval 20	Set the interval between retransmission of an LSA in case no acknowledgment has been received.

TIP Use the 'show ipv6 ospf interface' command to verify the current settings. See also Interface Status via CLI.

7.2.5.2. Via Web

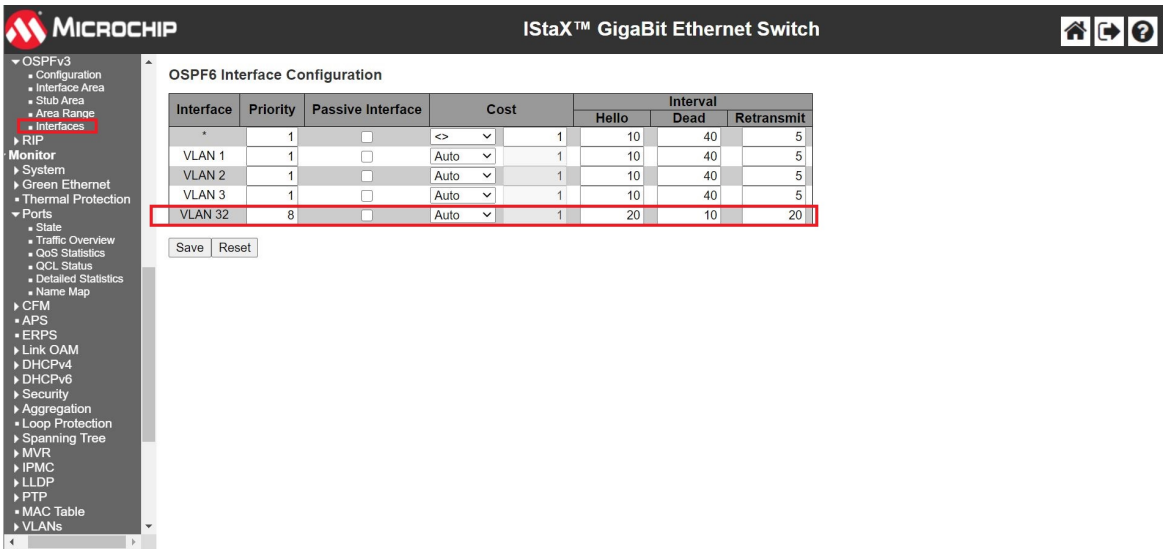


Figure 11. Configure OSPF interface parameters via Web

TIP

Use the 'OSPF Status' web page to verify the current settings. See also Interface Status via Web.

8. OSPF Stub Areas

OSPF stub areas are shielded from external routes, so AS-external LSAs are not flooded into/through it. This reduces the link-state database size and therefore the memory and CPU utilisations.

To further reduce the memory and CPU consumptions, an area can be configured as a totally stubby area, where also inter-area-prefix LSAs (Type 0x2003) except for the default route are blocked.

For a stub area or totally stubby area to reach any destination not reachable by an intra-area or inter-area path, the stub area’s ABR must advertise a default route into the stub or totally stubby area via inter area LSAs..

NOTE

- All routers in a stub area must be configured as stub routers. Otherwise the neighboring routers will refuse to accept Hello packets.
- All routers in a totally stubby area must be configured as stub routers and only the ABR needs to be configured as a totally stubby router.
- An ASBR cannot be placed inside a stub area or a totally stubby area.

The figure below shows an example of a stub area.

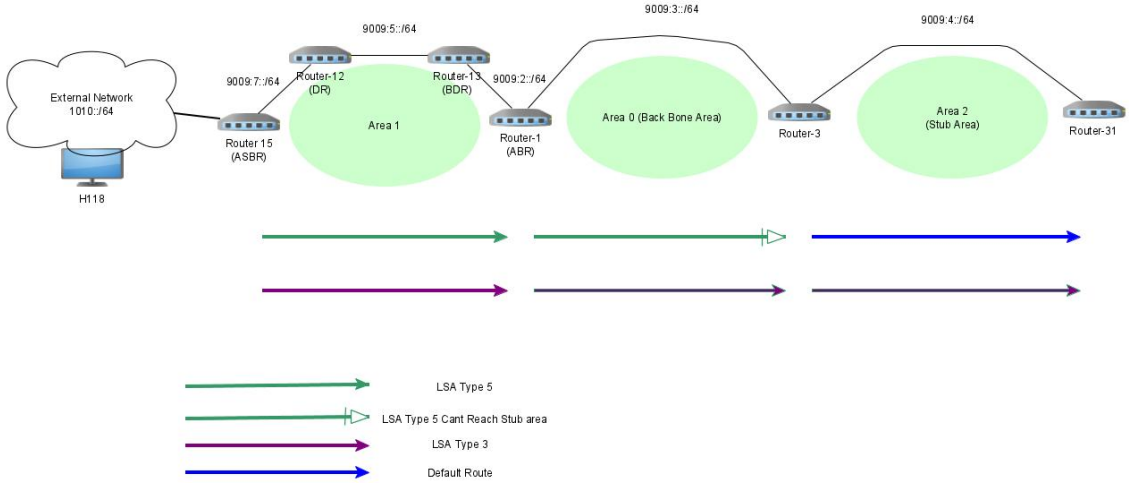


Figure 12. OSPF Stub Area Example

Router-15 is an ASBR connected to external network which is `1010::/64`, so it originates AS-external-LSAs to advertise the external network information. All ABRs must flood these LSAs into the area they attach. Finally, all routers have the external route. For example, the route entries in router-31 are:

```
Codes: C - connected, S - static, O - OSPF,
       * - selected route, D - DHCP installed route

O* 1010::/64 [110/20] via Router-3
O* 9009:7::/64 [110/100] via Router-3
O* 9009:5::/64 [110/100] via Router-3
O* 9000:2::/64 [110/100] via Router-3
O* 9009:3::/64 [110/100] via Router-3
C* 9009:4::/64 [110/100] is directly connected
```

On the other hand, once area 3 is configured as stub area, Router-3 doesn't flood AS-external-LSAs into area 3 because it is an ABR for stub area 3. Meanwhile, it also advertises a default route into the stub area. In this example, the route entries in Router-31 are:

```
Codes: C - connected, S - static, O - OSPF,
       * - selected route, D - DHCP installed route

O* ::/0 [110/100] via Router-3
O* 9009:7::/64 [110/100] via Router-3
O* 9009:5::/64 [110/100] via Router-3
O* 9000:2::/64 [110/100] via Router-3
O* 9009:3::/64 [110/100] via Router-3
C* 9009:4::/64 [110/100] is directly connected
```

The figure below shows an example of a totally stubby area.

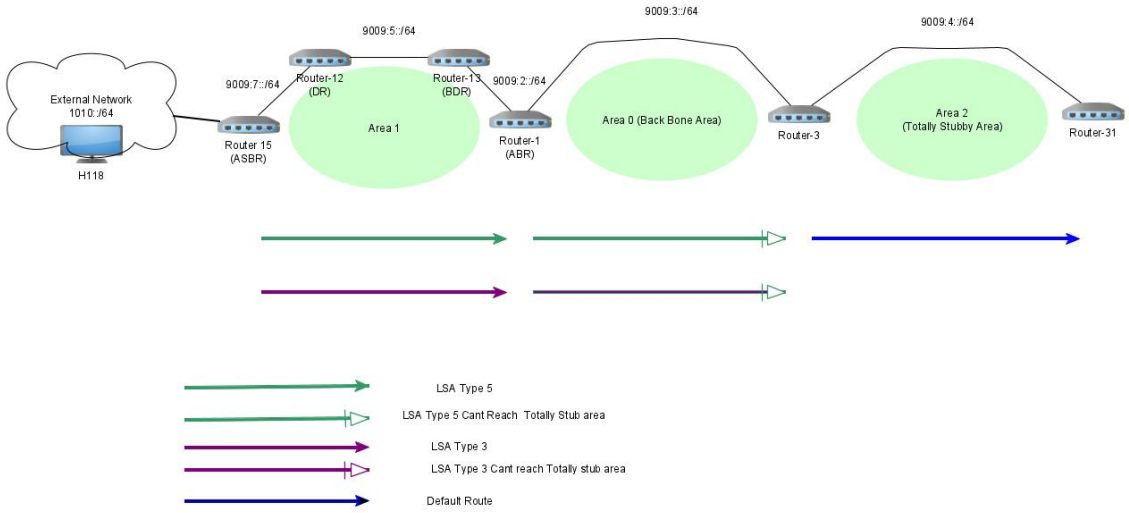


Figure 13. OSPF Totally Stubby Area Example

This topology is almost the same as the above except Router-3 is configured as a totally stubby router, area 2 is a totally stubby area. Compared to the stub area, the totally stubby area not only blocks AS-external-LSAs, but also summary-LSAs. So the area doesn't get any routes from other areas except for the default route from Router-2. The route entries in Router-31 are:

```
Codes: C - connected, S - static, O - OSPF,
       * - selected route, D - DHCP installed route

O* ::/0 [110/100] via Router-3
C* 9009:4::/64 [110/100] is directly connected
```

8.1. Stub Area Configuration Example

The following example configures area 2 as a stub area or totally stubby area.

8.1.1. Via CLI

Use the 'area stub' command in OSPF router configuration mode to configure a stub or totally stubby area.

Use the 'no' form to restore the setting.

Syntax

- area <area_id> stub [no-summary]
- no area <area_id> stub [no-summary]

Parameters

- <area_id>: Area ID.
- stub: Configure the area as stub or totally stubby area.
- no-summary: Configure the area as totally stubby area. Leave out to configure as a stub area.

Default

Area is neither a stub nor a totally stubby area.

Examples

Configure OSPF stub area via CLI

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# router ospf6	Enable the OSPF routing process and enter the OSPF router configuration mode.
3	Example 1: Configure Router-3. Set area 2 as a stub area. (config-router)# area 0.0.0.2 stub Example 2: Configure Router-3. Set area 2 as a totally stubby area. (config-router)# area 0.0.0.2 stub no-summary	Notice that the 'no-summary' option is required on ABR (Router-3) only.
4	Configure Router-31. Set area 2 as a stub area. (config-router)# area 0.0.0.2 stub	Configure area 2 as a stub area. All routers in a stub area must be configured as stub routers. Otherwise the neighboring routers will refuse to accept OSPF hello packets.

TIP

Use the 'show ipv6 ospf' command to verify the current settings. See also General/Area Status via CLI.

8.1.2. Via Web

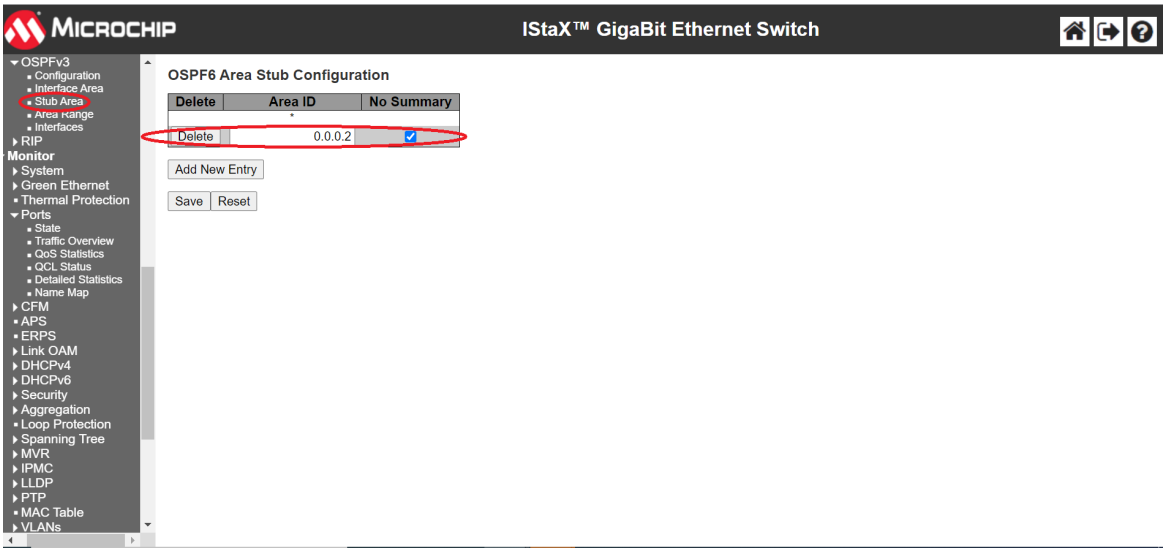


Figure 14. Configure OSPF stub area via Web

TIP

Use the 'OSPF Status' web page to verify the current settings. See also General/Area Status via Web.

9. OSPF Area Range

In an OSPF domain, each ABR maintains separate link-state databases and advertises the summarized routes to other areas. The reasoning behind OSPF area ranges is to reduce the number of routes advertised through summary-LSAs (Type 3), thereby reducing the size of LSDB in neighboring areas.

When a route matches a configured area range, only the area range is advertised. In addition, it is possible to filter out the entire advertisement of that range.

An area range may also come with a user-specified cost.

NOTE

The software will detect overlapping address ranges and deny applying the configuration.

9.1. Configuration Example

Here’s an example where ABR is configured to summarize the following networks in area 1 into a single range, namely 2000::/16, 2001::/16 2002::/16, 2003::/16.

9.1.1. Topology Setup

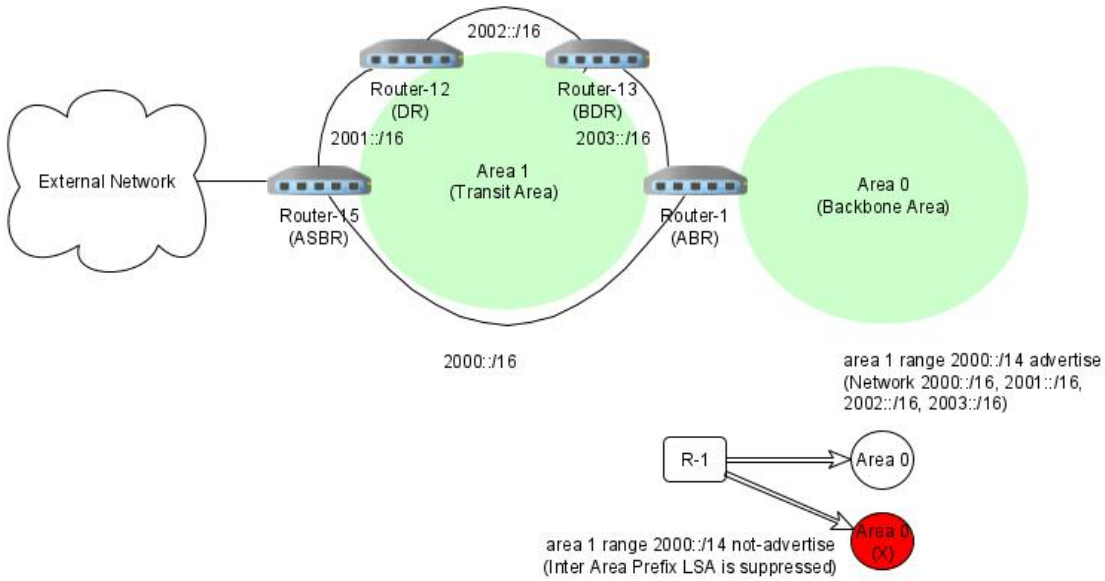


Figure 15. OSPF area range topology

9.1.2. Via CLI

Use the 'area range' command in router configuration mode to summarize or suppress ranges. Use the 'no' form to remove the setting.

Syntax

- area <area_id> range <ipv6_subnet> [advertise | not-advertise] [cost <0-16777215>]
- no area <area_id> range <ipv6_subnet> [advertise | not-advertise] [cost <0-16777215>]

Parameters

- <area_id>: Area ID.
- <ipv6_subnet>: User-specified address range.
- advertise: Summarize intra-area paths from the address range in one Inter-Area-Prefix LSA (Type 0x2003) and advertise to other areas (this is default if not directly specified).
- not-advertise: The intra-area paths from the address range are not advertised to other areas.
- cost <cost>: User-specified cost (or metric) for this summary route.

Default

No area range is configured. 'advertise' is default if not specified. If 'cost' is not specified, the advertised cost for the summarized route will become the maximum metric among the routes the command summarizes.

Usage Guidelines

The area range command is used only with ABRs and only router-LSAs (Type 0x2001) and network-LSAs (Type 0x2002) can be summarized.

AS-external-LSAs (Type 0x4005) cannot be summarized because the scope is OSPF AS.

The NSSA-LSAs(Type 0x2007) cannot be summarized as this feature is not supported yet.

Example

Configure OSPF route range via CLI.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# router ospf6	Enable OSPF routing and enter OSPF router configuration mode.
3	(config-router)# area 1 range 2000::/14	Summarize intra-area paths on the ABR.

TIP

Use the 'show ipv6 ospf' command to verify the current settings. See also General/Area Status via CLI.

9.1.3. Via Web

Figure 16. Configure OSPF area range via Web

TIP

Use the 'OSPF Status' web page to verify the current settings. See also General/Area Status via Web.

10. OSPF Administrative Distance

The administrative distance (AD) is used to rank multiple routes for the same destination which are available via different routing protocols. The lower administrative distance value takes the higher preference. By default, the administrative distance value for OSPF and RIP is set to 110 and 120, respectively, which means that OSPF routes have precedence over RIP routes to the same destination.

10.1. Configuration Example

The following example shows how to configure the OSPF administrative distance value to 100.

10.1.1. Via CLI

Use the 'distance' command in router configuration mode to configure the OSPF administrative distance.

Use the 'no' form to restore to the default setting.

Syntax

- distance <1-255>
- no distance

Parameters

- <1-255>: User-specified administrative metric value for the OSPF routing protocol.

Default

The default administrative distance value is 110.

Examples

Configure OSPF administrative distance via CLI

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# router ospf6	Enable the OSPF routing process and enter the OSPF router configuration mode.
3	(config-router)# distance 100	Configure OSPF administrative distance value to 100.

10.1.2. Via Web

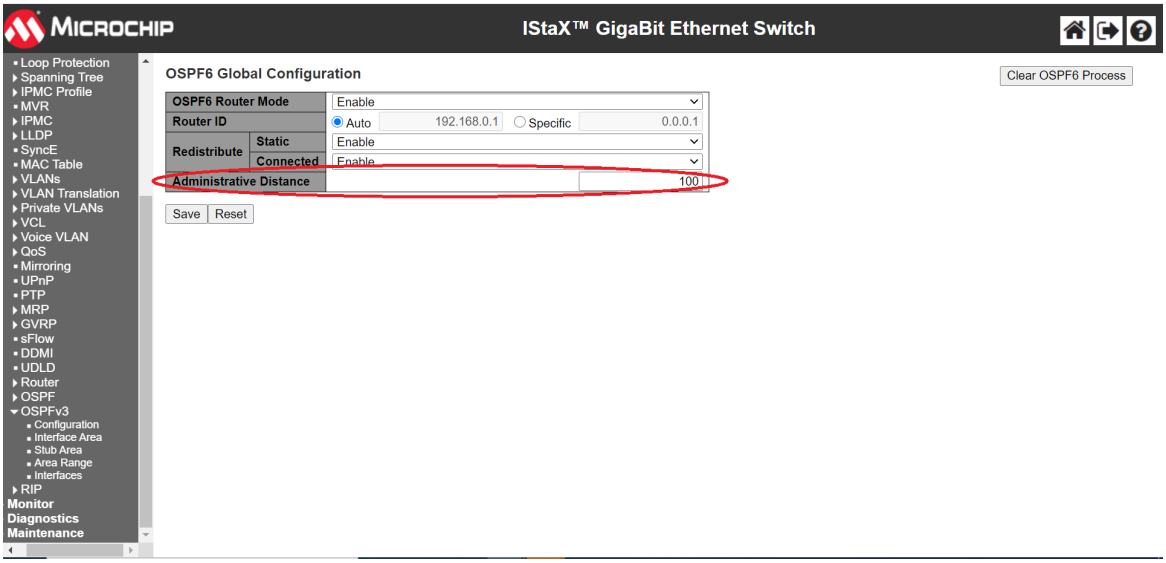


Figure 17. Configure OSPF administrative distance via Web

11. OSPF Route Redistribution

OSPF route redistribution is a means to advertise routes coming from other domains (e.g. RIP and BGP) to an OSPF domain. Use of this feature effectively makes the router an ASBR.

In the current implementation, only the following "other domains" are supported:

- **Static routes**
- **Interfaces that don’t have OSPF enabled**

Redistributed routes are transmitted into the OSPF domain with Type 5 External LSAs provided the area accepts external routes.

11.1. Configuration Example

The following example shows how to configure an OSPF router to redistribute route information into the OSPF domain.

11.1.1. Via CLI

11.1.1.1. Route redistribution

Use the 'redistribute' command in OSPF router configuration mode to enable route redistribution to the OSPF domain. The redistributed routes are transmitted with the AS-external-LSAs (Type 0x4005 LSAs).

Use the 'no' form to remove the setting.

Syntax

- redistribute {static | connected}
- no redistribute {static | connected}

Parameters

- {static | connected}: The OSPF redistributed route protocol type. The 'static' argument is used to redistribute static routes (those configured with the 'ip route' command).
  The 'connected' argument is used to redistribute the local interfaces that are not OSPF enabled.

Default

No route redistribution is configured.

Example

Configure OSPF route redistribution for connnected interfaces via CLI. Assume there are two IP interfaces on the device. One is on VLAN 10 and the other is on VLAN 11 and only VLAN 10 participates in the OSPF domain, i.e. VLAN 11 doesn’t.

For the connected interface VLAN 11, the following configuration will cause the connected route of VLAN 11 to be distributed into the OSPF domain given by VLAN 10.

Step	Command	Description
1	# configure terminal	Enter global configuration mode.
2	(config)# vlan 10,11	Create VLAN 10 and 11.
3	(config)# interface vlan 10	Enter VLAN 10 interface configuration mode.
4	(config-if-vlan)# ipv6 address 2000::1/124	Set IP address on VLAN 10.
5	(config-if-vlan)# interface vlan 11	Enter VLAN 11 interface configuration mode.
6	(config-if-vlan)# ipv6 address 2001::1/124	Set IP address on VLAN 11.
7	(config-if-vlan)# interface GigabitEthernet 1/10	Enter GigabitEthernet 1/10 interface configuration mode.
8	(config-if)# switchport access vlan 10	Join VLAN 10.
9	(config-if-vlan)# interface GigabitEthernet 1/11	Enter GigabitEthernet 1/11 interface configuration mode
10	(config-if)# switchport access vlan 11	Join VLAN 11.
11	(config-if)# router ospf6	Enable the OSPF routing process and enter OSPF router configuration mode.

Step	Command	Description
12	(config-router)# interface vlan 10 area 0.0.0.0	Add vlan 10 to area 0.0.0.0
13	(config-router)# redistribute connected	Redistribute connected route information into OSPF domain.
14	(config-router)# redistribute static	Redistribute static route information into OSPF domain.

TIP Use the 'show ipv6 ospf' command to verify the current settings. See also General/Area Status via CLI.

11.1.2. Via Web

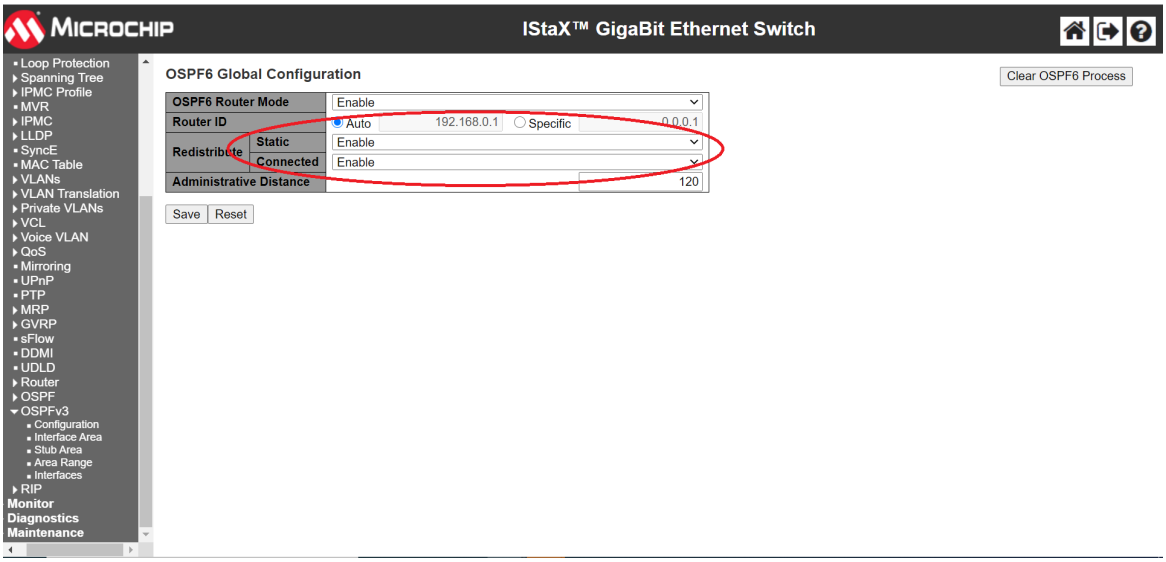


Figure 18. Configure OSPF route redistribution via Web

TIP Use the 'OSPF Status' web page to verify the current settings. See also General/Area Status via Web.

12. Clear IPv6 OSPF Process

In a few specific cases, the OSPF routing process may need to restart.

For example, when the OSPF Router ID is re-configured, the OSPF process must be restarted for this to take effect.

12.1. Via CLI

Use the 'clear ipv6 ospf process' command in privileged execution mode to reset the OSPF routing process. The original OSPF database will be cleared before the latest configuration gets applied.

Syntax

- clear ipv6 ospf process

Example

Clear ipv6 ospf process via CLI.

Index	Command	Description
1	# clear ipv6 ospf process	Restart the OSPF routing process.

TIP Use the 'show ipv6 ospf' command to verify the current settings. See also [General/Area status via CLI].

12.1.1. Via Web

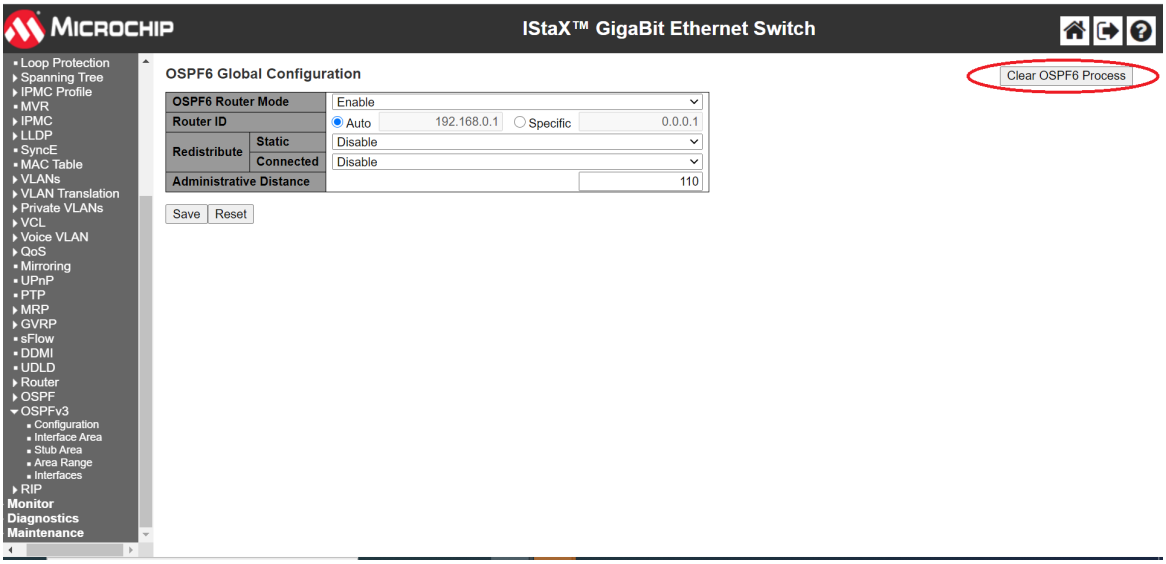


Figure 19. Clear ipv6 ospf process via Web

TIP Use the 'OSPF Status' web page to verify the current settings. See also [General status via Web].

13. OSPF Status

13.1. General/Area Status

13.1.1. General/Area Status via CLI

Use the 'show ipv6 ospf' command in global execution mode to show the general OSPF and area information.

Syntax

- show ipv6 ospf

Examples

```
# show ipv6 ospf
Routing Process, with ID 192.168.0.1
 Initial SPF schedule delay 200 msecs
 Minimum hold time between two consecutive SPFs 400 msecs
 Maximum wait time between two consecutive SPFs 10000 msecs
 SPF algorithm last executed 00:54:42 ago
 Number of areas in this router is 3
    Area BACKBONE(0.0.0.0)
        Number of interfaces in this area is 1
        SPF algorithm executed 11 times
        Number of LSA 6

    Area ID: 0.0.0.1
        Number of interfaces in this area is 1
        SPF algorithm executed 10 times
        Number of LSA 5

    Area ID: 0.0.0.2
        Number of interfaces in this area is 0
        SPF algorithm executed 0 times
        Number of LSA 2
        Area ranges are
            2000::/124 Passive DoNotAdvertise
```

13.1.2. General/Area Status via Web

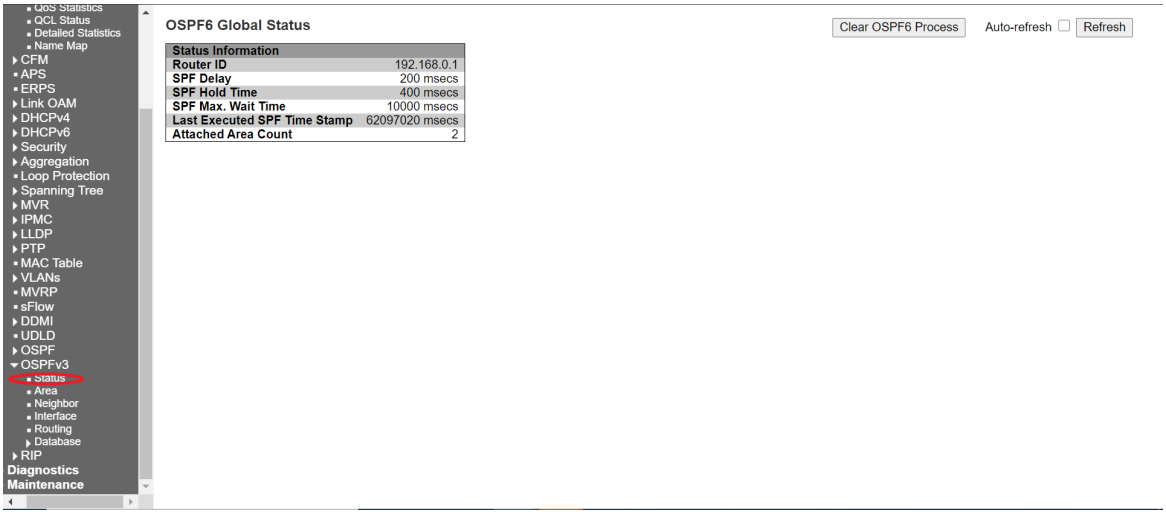


Figure 20. OSPF general status

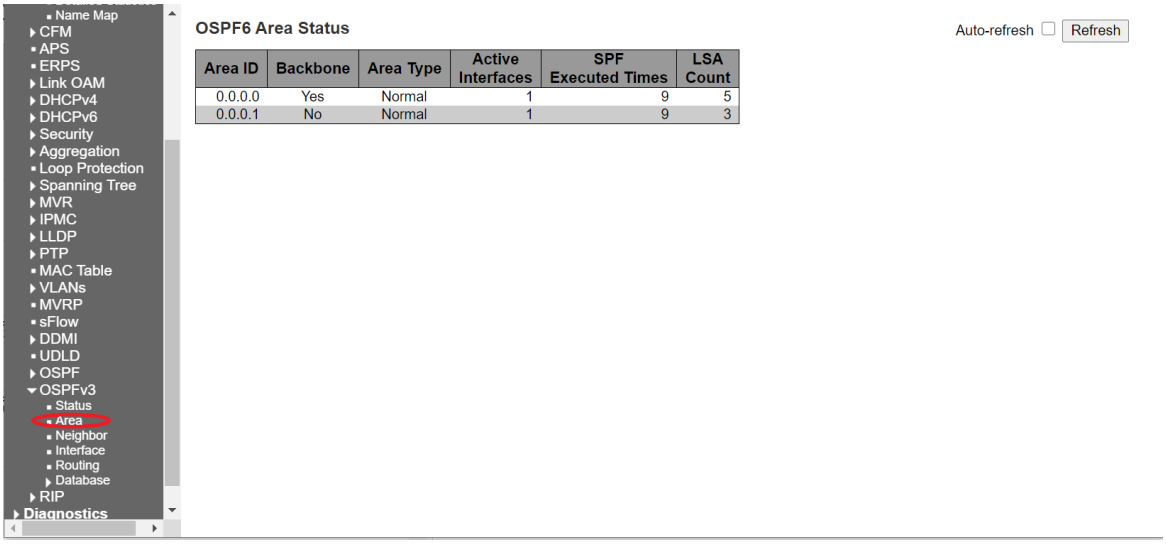


Figure 21. OSPF area status

13.2. Neighbor Status

13.2.1. Neighbor Status via CLI

Use the 'show ipv6 ospf neighbor' command in global execution mode to show all OSPF neighbor information.

Syntax

- show ipv6 ospf neighbor [detail]

Parameters

- [detail]: Show detailed information of each neighbor.

Examples

```
# show ipv6 ospf neighbor
Neighbor ID      Pri  State              Dead Time   Address
Interface
3.3.3.3          1    FULL/BDR           39.935sec   fe80::25d:73ff:fe13:ca77 VLAN 2
192.0.0.2        1    FULL/BDR           31.179sec   fe80::1                  VLAN 3
# show ipv6 ospf neighbor detail
Neighbor 3.3.3.3, interface address fe80::25d:73ff:fe13:ca77
    In the area 0.0.0.0 via interface VLAN 2
    Neighbor priority is 1, State is FULL
    DR ID is 192.168.0.1    BDR ID is 3.3.3.3
    Dead timer due in 36.711 sec

Neighbor 192.0.0.2, interface address fe80::1
    In the area 0.0.0.1 via interface VLAN 3
    Neighbor priority is 1, State is FULL
    DR ID is 192.168.0.1    BDR ID is 192.0.0.2
    Dead timer due in 37.954 sec

#
```

13.2.2. Neighbor status via Web

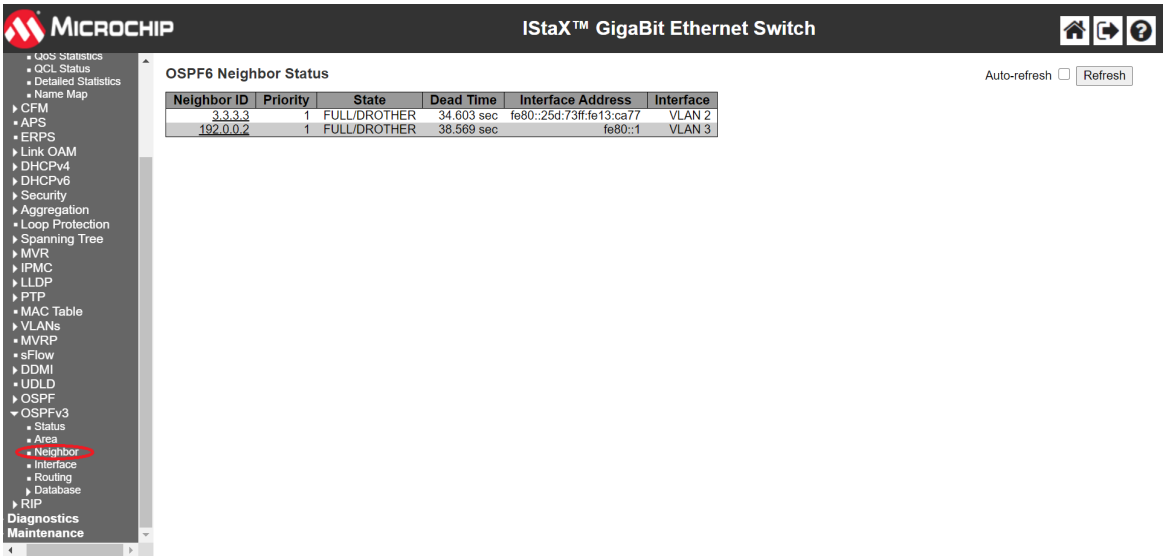


Figure 22. OSPF neighbor status

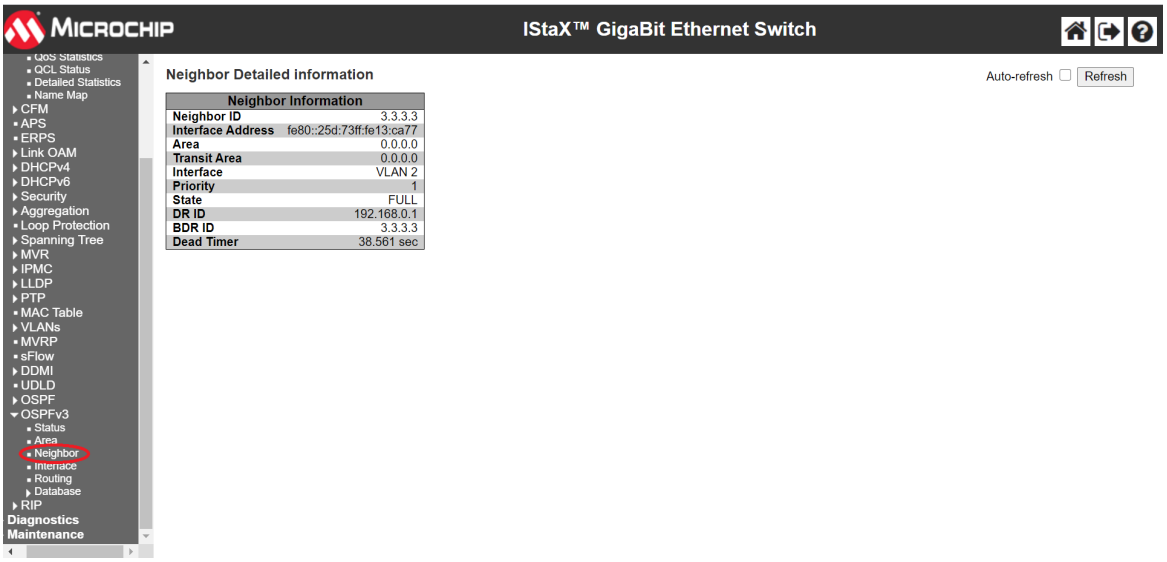


Figure 23. OSPF neighbor detail status

13.3. Interface Status

13.3.1. Interface Status via CLI

Use the 'show ipv6 ospf interface' command in global execution mode to show specific OSPF interface information. By default, it shows all OSPF interfaces. 'VLAN is down' is shown when OSPF is not running on this interface until the interface is up.

Syntax

- show ipv6 ospf interface [vlan <vlan_list>]

Parameters

- <vlan_list>: The VLAN list can be a single VLAN ID, a range of VLAN IDs (e.g. 20-25), a list of VLAN IDs (e.g. 1,3) or a combination (e.g. 1,3,20-25).

Examples

```
# show ipv6 ospf interface vlan 2,3
VLAN 2 is up
  Internet Address fe80::201:c1ff:fe00:cf70/64, Area 0.0.0.0
  Router ID 0.0.0.1, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.0.1
  Backup Designated router (ID) 3.3.3.3
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5

VLAN 3 is up
  Internet Address fe80::201:c1ff:fe00:cf70/64, Area 0.0.0.1
  Router ID 0.0.0.1, Cost: 10
  Transmit Delay is 1 sec, State DR, Priority 1
  Designated Router (ID) 192.168.0.1
  Backup Designated router (ID) 192.0.0.2
  Timer intervals configured, Hello 10, Dead 40, Retransmit 5
```

13.3.2. Interface Status via Web

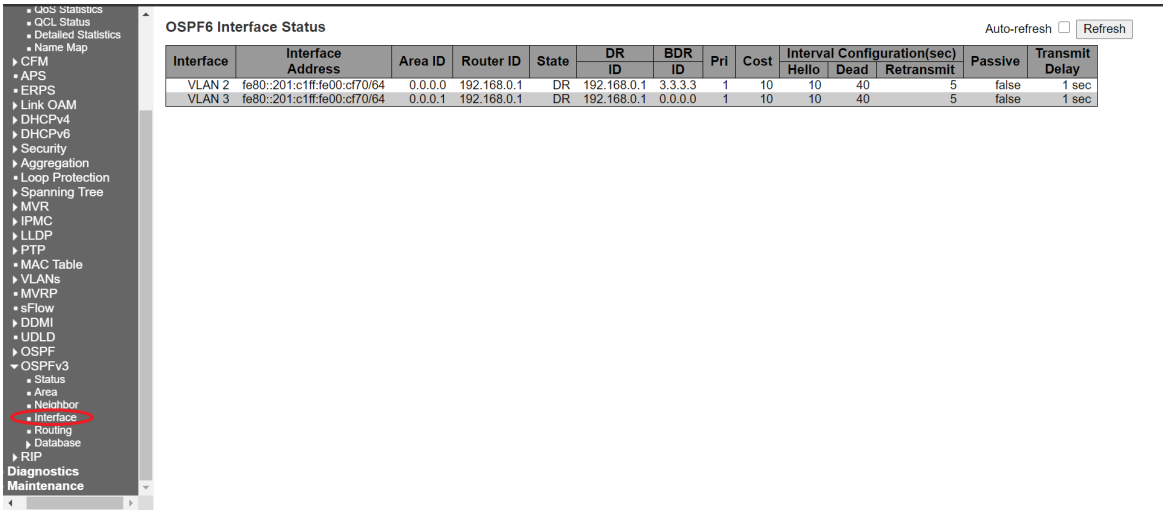


Figure 24. OSPF interface status

13.4. Route Status

13.4.1. Route Status via CLI

Use the 'show ipv6 route' command in global execution mode to show information about all routes.

Syntax

- show ipv6 route

Examples

```
# show ipv6 route
Codes: C - connected, S - static, O - OSPF
```

```
       * - FIB route

C* 2003::/124 is directly connected, VLAN 2, 03:16:47
O  2003::/124 [110/10] is directly connected, VLAN 2, 03:16:06
C* 2004::/124 is directly connected, VLAN 3, 02:18:02
O  2004::/124 [110/10] is directly connected, VLAN 3, 02:18:02
O* 2005::/124 [110/11] via fe80::25d:73ff:fe13:ca77, VLAN 2, 03:15:55
C* fe80::/64 is directly connected, VLAN 1, 03:16:41
 *           is directly connected, VLAN 2, 03:16:47
 *           is directly connected, VLAN 3, 02:18:02
```

`Connected` : Specifies the route was learned as a result of configuring the interface
`Static` : Specifies the route was explicitly configured using the 'ipv6 route' command
`OSPF` : Specifies the route was learned through OSPF
`DHCP` : DHCP installed route

13.4.2. Route Status via Web

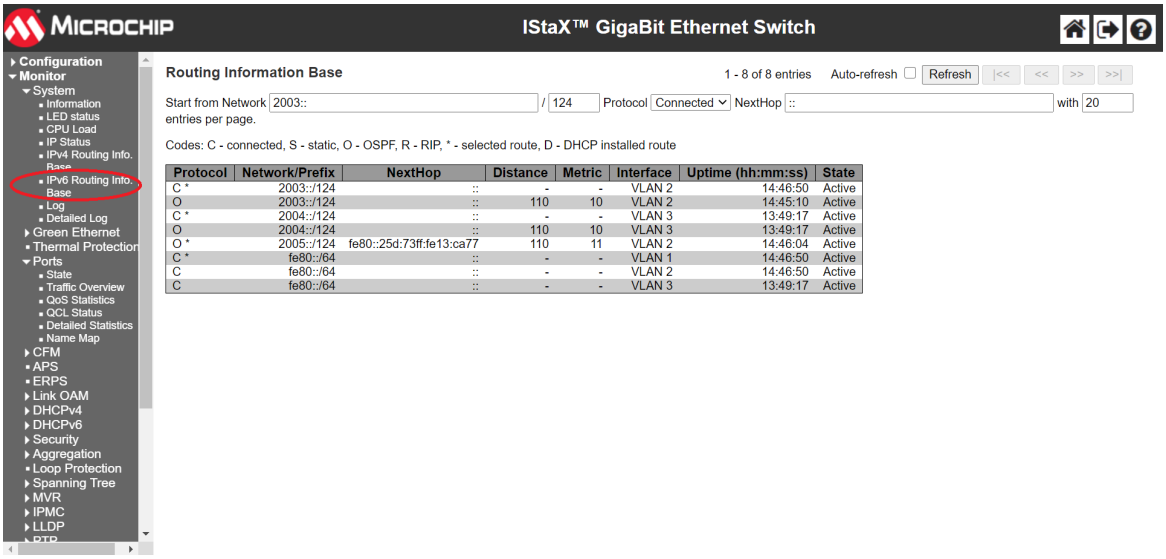


Figure 25. Route status

13.5. OSPF Route Status

13.5.1. OSPF Route Status via CLI

Use the 'show ipv6 ospf route' command in global execution mode to show information about all routes learned from OSPF. Compared to Route Status, the user is able to get more detailed OSPF routing information such as the routes area location: intra-area, inter-area or the outside of the AS. It also tells users how to reach the ABRs or ASBRs.

Syntax

- show ipv6 ospf route

Examples

```
# show ipv6 ospf route

            OSPF6 Router with ID (192.168.0.1)

    Codes: i - Intra-area Router Path, I - Inter-area Router Path

    Intra-area Route List

    2003::/124, Intra, cost 10, area 0.0.0.0, Connected
                  VLAN 2
    2004::/124, Intra, cost 10, area 0.0.0.1, Connected
                  VLAN 3
```

13.5.2. OSPF Route Status via Web

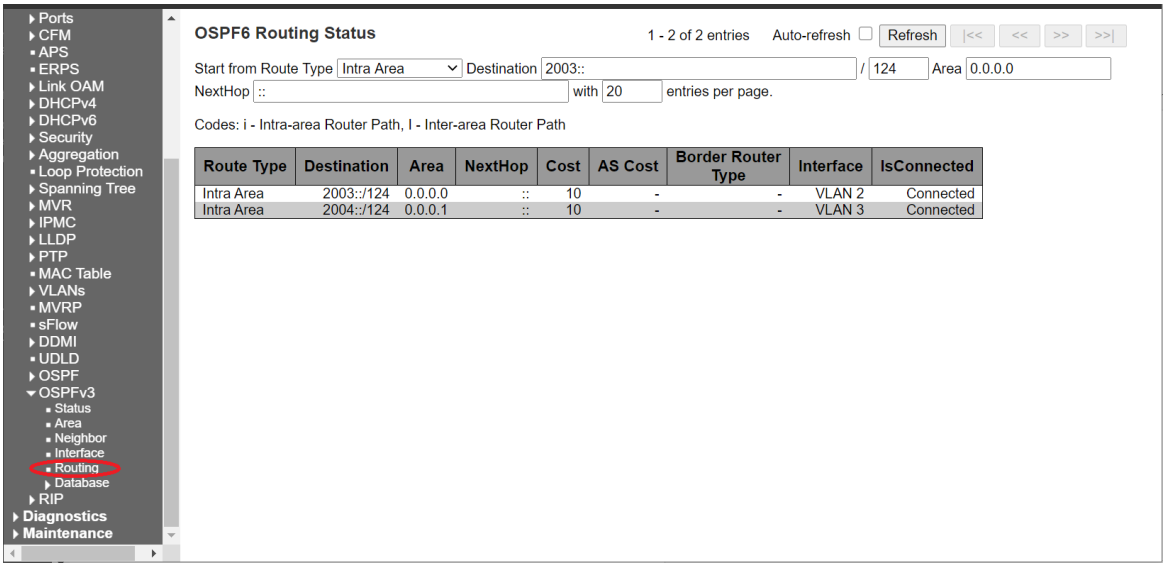


Figure 26. OSPF route status

13.6. OSPF Database Status

13.6.1. OSPF General database

13.6.1.1. OSPF General database via CLI

Use the "show ipv6 ospf database" command in global configuration mode to show information about all LSAs available in the database.

Syntax

- show ipv6 ospf database

Examples

```
# show ipv6 ospf database

            OSPF6 Router with ID (192.168.0.1)

                Link Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
0.0.0.5         192.168.0.1     417         0x80000193
0.0.0.38        3.3.3.3         438         0x80000003

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
0.0.0.0         0.0.0.0         462         0x80000002
0.0.0.0         3.3.3.3         178         0x80001414
0.0.0.0         192.168.0.1     417         0x80000003

                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
0.0.0.5         192.168.0.1     417         0x80000002

                Inter Area Prefix Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
0.0.0.2         192.168.0.1     405         0x80000002
0.0.0.3         192.168.0.1     405         0x80000002
0.0.0.4         192.168.0.1     405         0x80000002
0.0.0.5         192.168.0.1     405         0x80000002
0.0.0.6         192.168.0.1     405         0x80000002

                Inter Area Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
1.0.0.1         192.168.0.1     405         0x80000002

                Intra Area Prefix Link States (Area 0.0.0.0)

Link ID         ADV Router      Age         Seq#
0.0.0.0         3.3.3.3         178         0x8000000c
0.0.0.5         192.168.0.1     417         0x80000002

                Link Link States (Area 0.0.0.1)

Link ID         ADV Router      Age         Seq#
0.0.0.0         192.0.0.2       1078        0x80000009
0.0.0.6         192.168.0.1     445         0x80000003

                Router Link States (Area 0.0.0.1)
```

```
Link ID         ADV Router      Age         Seq#
0.0.0.0         0.0.0.0         462         0x80000002
0.0.0.0         1.0.0.1         538         0x80000002
0.0.0.0         192.0.0.2       538         0x80000002
0.0.0.0         192.168.0.1     405         0x80000003

                Net Link States (Area 0.0.0.1)

Link ID         ADV Router      Age         Seq#
0.0.0.6         192.168.0.1     405         0x80000002

                Inter Area Prefix Link States (Area 0.0.0.1)

Link ID         ADV Router      Age         Seq#
0.0.0.1         1.0.0.1         538         0x80000002
0.0.0.1         192.168.0.1     357         0x80000004
0.0.0.2         1.0.0.1         538         0x80000002
0.0.0.2         192.168.0.1     412         0x80000003
0.0.0.3         1.0.0.1         538         0x80000002
0.0.0.4         1.0.0.1         538         0x80000002
0.0.0.5         1.0.0.1         538         0x80000002

                Inter Area Router Link States (Area 0.0.0.1)

Link ID         ADV Router      Age         Seq#
3.3.3.3         192.168.0.1     412         0x80000002

                Intra Area Prefix Link States (Area 0.0.0.1)

Link ID         ADV Router      Age         Seq#
0.0.0.1         1.0.0.1         528         0x8000000a
0.0.0.2         1.0.0.1         528         0x8000000a
0.0.0.3         1.0.0.1         528         0x8000000a
0.0.0.4         1.0.0.1         528         0x8000000a
0.0.0.5         1.0.0.1         528         0x8000000a
0.0.0.6         192.168.0.1     405         0x80000002

                AS External Link States

Link ID         ADV Router      Age         Seq#
0.0.0.1         1.0.0.1         398         0x80000003
0.0.0.2         1.0.0.1         398         0x80000003
0.0.0.3         1.0.0.1         398         0x80000003
0.0.0.4         1.0.0.1         398         0x80000003
0.0.0.5         1.0.0.1         398         0x80000003
```

13.6.1.2. OSPF General Database via Web

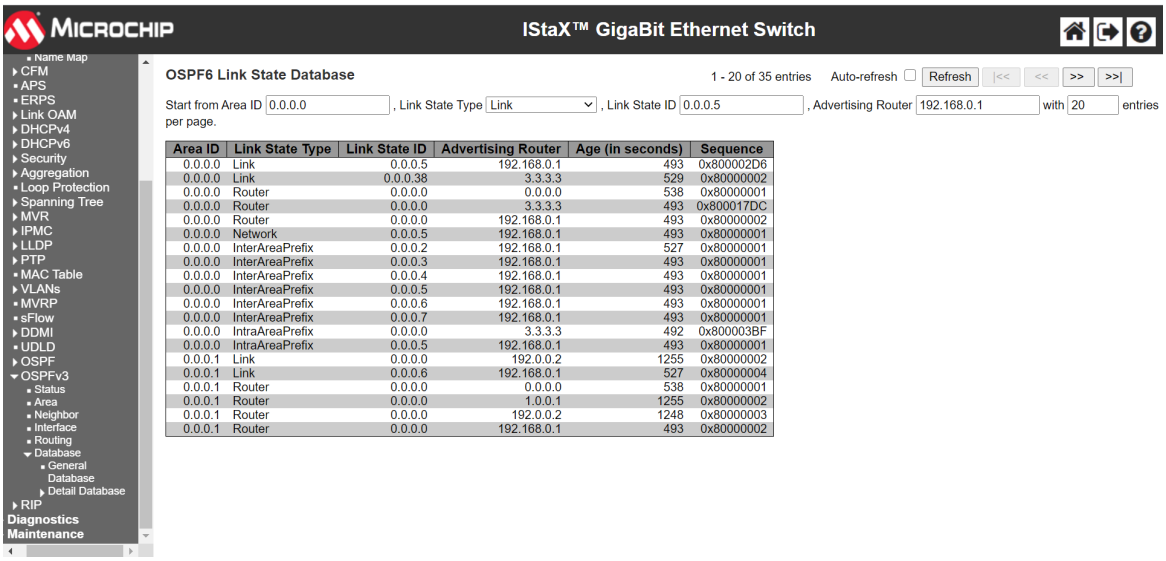


Figure 27. OSPF General Database

13.6.2. OSPF Detail database

13.6.2.1. OSPF Detail database via CLI

Use the command "show ipv6 ospf database {router|network|inter-prefix|inter-router|external|link|intra-prefix}" to display detailed information of all the LSAs available in the database.

Syntax

- show ipv6 ospf database {router|network|inter-prefix|inter-router|external|link|intra-prefix}

Examples

```
# show ipv6 ospf database router

            OSPF6 Router with ID (192.168.0.1)

                Router Link States (Area 0.0.0.0)

  LS age: 79
  Options: 0x13 -|R|-|--|E|V6
  LS Type: router-LSA
  Link State ID: 0.0.0.0
  Advertising Router: 0.0.0.0
  LS Seq Number: 0x8000000e
  Checksum: 0x170d
  Length: 24

   Number of Links: 0

  LS age: 1300
  Options: 0x33 DC|R|-|--|E|V6
  LS Type: router-LSA
```

```
Link State ID: 0.0.0.0
Advertising Router: 3.3.3.3
LS Seq Number: 0x8000141e
Checksum: 0x5ecb
Length: 40

 Number of Links: 1

  Link connected to: a Transit Network
   (Link ID) Net: 0.0.0.5
   (Link Data) : 192.168.0.1
    metrics: 1

LS age: 34
Options: 0x13 -|R|-|--|E|V6
LS Type: router-LSA
Link State ID: 0.0.0.0
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000f
Checksum: 0xc760
Length: 40

 Number of Links: 1

  Link connected to: a Transit Network
   (Link ID) Net: 0.0.0.5
   (Link Data) : 192.168.0.1
    metrics: 10


              Router Link States (Area 0.0.0.1)

LS age: 79
Options: 0x13 -|R|-|--|E|V6
LS Type: router-LSA
Link State ID: 0.0.0.0
Advertising Router: 0.0.0.0
LS Seq Number: 0x8000000e
Checksum: 0x170d
Length: 24

 Number of Links: 0

LS age: 156
Options: 0x13 -|R|-|--|E|V6
LS Type: router-LSA
Link State ID: 0.0.0.0
Advertising Router: 1.0.0.1
LS Seq Number: 0x8000000e
Checksum: 0xd96f
Length: 40

 Number of Links: 1

  Link connected to: another Router (point-to-point)
```

```
     (Link ID) Net: 0.0.0.1
     (Link Data) : 192.0.0.2
      metrics: 1

  LS age: 156
  Options: 0x13 -|R|-|--|E|V6
  LS Type: router-LSA
  Link State ID: 0.0.0.0
  Advertising Router: 192.0.0.2
  LS Seq Number: 0x8000000e
  Checksum: 0x299f
  Length: 56

   Number of Links: 2

    Link connected to: another Router (point-to-point)
     (Link ID) Net: 0.0.0.1
     (Link Data) : 1.0.0.1
      metrics: 1

    Link connected to: a Transit Network
     (Link ID) Net: 0.0.0.6
     (Link Data) : 192.168.0.1
      metrics: 1

  LS age: 22
  Options: 0x13 -|R|-|--|E|V6
  LS Type: router-LSA
  Link State ID: 0.0.0.0
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000f
  Checksum: 0xe73e
  Length: 40

   Number of Links: 1

    Link connected to: a Transit Network
     (Link ID) Net: 0.0.0.6
     (Link Data) : 192.168.0.1
      metrics: 10


# show ipv6 ospf database network

            OSPF6 Router with ID (192.168.0.1)

                Net Link States (Area 0.0.0.0)

  LS age: 85
  Options: 0x33 DC|R|-|--|E|V6
  LS Type: network-LSA
  Link State ID: 0.0.0.5
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0xbd58
```

```
  Length: 32



               Net Link States (Area 0.0.0.1)

  LS age: 73
  Options: 0x13 -|R|-|--|E|V6
  LS Type: network-LSA
  Link State ID: 0.0.0.6
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0xc0bd
  Length: 32



# show ipv6 ospf database link

            OSPF6 Router with ID (192.168.0.1)

                Link Link States (Area 0.0.0.0)

  LS age: 102
  Options: 0x13 -|R|-|--|E|V6
  LS Type: Link-LSA
  Link State ID: 0.0.0.5
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000019f
  Checksum: 0xa747
  Length: 64

   Number of Links: 1

    Prefix Address : 2003::
    Prefix Length: 124
    Prefix Options: 0

  LS age: 1622
  Options: 0x33 DC|R|-|--|E|V6
  LS Type: Link-LSA
  Link State ID: 0.0.0.38
  Advertising Router: 3.3.3.3
  LS Seq Number: 0x8000000d
  Checksum: 0x3e3e
  Length: 64

   Number of Links: 1

    Prefix Address : 2003::
    Prefix Length: 124
    Prefix Options: 0


               Link Link States (Area 0.0.0.1)
```

```
  LS age: 764
  Options: 0x13 -|R|-|--|E|V6
  LS Type: Link-LSA
  Link State ID: 0.0.0.0
  Advertising Router: 192.0.0.2
  LS Seq Number: 0x80000015
  Checksum: 0x31f4
  Length: 64

   Number of Links: 1

    Prefix Address : 2004::2
    Prefix Length: 124
    Prefix Options: 1

  LS age: 130
  Options: 0x13 -|R|-|--|E|V6
  LS Type: Link-LSA
  Link State ID: 0.0.0.6
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000f
  Checksum: 0xe19c
  Length: 64

   Number of Links: 1

    Prefix Address : 2004::
    Prefix Length: 124
    Prefix Options: 0


# show ipv6 ospf database intra-prefix

            OSPF6 Router with ID (192.168.0.1)

                Intra Area Prefix Link States (Area 0.0.0.0)

  LS age: 1388
  LS Type: intra-area-prefix-LSA
  Link State ID: 0.0.0.0
  Advertising Router: 3.3.3.3
  LS Seq Number: 0x80000016
  Checksum: 0x64ca
  Length: 52

   Number of Prefixes: 1

    Prefix Address : 2005::
    Prefix Length: 124
    Prefix Options: 0

  LS age: 122
  LS Type: intra-area-prefix-LSA
  Link State ID: 0.0.0.5
```

```
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000e
Checksum: 0x3042
Length: 52

 Number of Prefixes: 1

  Prefix Address : 2003::
  Prefix Length: 124
  Prefix Options: 0


              Intra Area Prefix Link States (Area 0.0.0.1)

LS age: 234
LS Type: intra-area-prefix-LSA
Link State ID: 0.0.0.1
Advertising Router: 1.0.0.1
LS Seq Number: 0x80000016
Checksum: 0x2c5f
Length: 44

 Number of Prefixes: 1

  Prefix Address : 2000::
  Prefix Length: 64
  Prefix Options: 0

LS age: 234
LS Type: intra-area-prefix-LSA
Link State ID: 0.0.0.2
Advertising Router: 1.0.0.1
LS Seq Number: 0x80000016
Checksum: 0x3c4d
Length: 44

 Number of Prefixes: 1

  Prefix Address : 2000:0:0:1::
  Prefix Length: 64
  Prefix Options: 0

LS age: 234
LS Type: intra-area-prefix-LSA
Link State ID: 0.0.0.3
Advertising Router: 1.0.0.1
LS Seq Number: 0x80000016
Checksum: 0x4c3b
Length: 44

 Number of Prefixes: 1

  Prefix Address : 2000:0:0:2::
  Prefix Length: 64
  Prefix Options: 0
```

```
  LS age: 234
  LS Type: intra-area-prefix-LSA
  Link State ID: 0.0.0.4
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x80000016
  Checksum: 0x5c29
  Length: 44

   Number of Prefixes: 1

    Prefix Address : 2000:0:0:3::
    Prefix Length: 64
    Prefix Options: 0

  LS age: 234
  LS Type: intra-area-prefix-LSA
  Link State ID: 0.0.0.5
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x80000016
  Checksum: 0x6c17
  Length: 44

   Number of Prefixes: 1

    Prefix Address : 2000:0:0:4::
    Prefix Length: 64
    Prefix Options: 0

  LS age: 110
  LS Type: intra-area-prefix-LSA
  Link State ID: 0.0.0.6
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x541a
  Length: 52

   Number of Prefixes: 1

    Prefix Address : 2004::
    Prefix Length: 124
    Prefix Options: 1


# show ipv6 ospf database inter-prefix

            OSPF6 Router with ID (192.168.0.1)

                Inter Area Prefix Link States (Area 0.0.0.0)

  LS age: 125
  Options: 0 -|-|-|--|-|--
  LS Type: inter-area-prefix-LSA
  Link State ID: 0.0.0.2
  Advertising Router: 192.168.0.1
```

```
LS Seq Number: 0x8000000e
Checksum: 0xe26e
Length: 36

      Prefix 2000::/64
      Metric: 12

LS age: 125
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.3
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000e
Checksum: 0xea64
Length: 36

      Prefix 2000:0:0:1::/64
      Metric: 12

LS age: 125
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.4
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000e
Checksum: 0xf25a
Length: 36

      Prefix 2000:0:0:2::/64
      Metric: 12

LS age: 125
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.5
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000e
Checksum: 0xfa50
Length: 36

      Prefix 2000:0:0:3::/64
      Metric: 12

LS age: 125
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.6
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000e
Checksum: 0x346
Length: 36

      Prefix 2000:0:0:4::/64
      Metric: 12
```

```
              Inter Area Prefix Link States (Area 0.0.0.1)

LS age: 259
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.1
Advertising Router: 1.0.0.1
LS Seq Number: 0x8000000e
Checksum: 0x5c01
Length: 36

      Prefix 2000:0:0:5::/64
      Metric: 100

LS age: 77
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.1
Advertising Router: 192.168.0.1
LS Seq Number: 0x80000010
Checksum: 0xb654
Length: 44

      Prefix 2003::/124
      Metric: 10

LS age: 259
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.2
Advertising Router: 1.0.0.1
LS Seq Number: 0x8000000e
Checksum: 0x64f6
Length: 36

      Prefix 2000:0:0:6::/64
      Metric: 100

LS age: 132
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.2
Advertising Router: 192.168.0.1
LS Seq Number: 0x8000000f
Checksum: 0xcc3b
Length: 44

      Prefix 2005::/124
      Metric: 11

LS age: 259
Options: 0 -|-|-|--|-|--
LS Type: inter-area-prefix-LSA
Link State ID: 0.0.0.3
```

```
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x6cec
  Length: 36

        Prefix 2000:0:0:7::/64
        Metric: 100

  LS age: 259
  Options: 0 -|-|-|--|-|--
  LS Type: inter-area-prefix-LSA
  Link State ID: 0.0.0.4
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x74e2
  Length: 36

        Prefix 2000:0:0:8::/64
        Metric: 100

  LS age: 259
  Options: 0 -|-|-|--|-|--
  LS Type: inter-area-prefix-LSA
  Link State ID: 0.0.0.5
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x7cd8
  Length: 36

        Prefix 2000:0:0:9::/64
        Metric: 100


# show ipv6 ospf database inter-router

            OSPF6 Router with ID (192.168.0.1)

                Inter Area Router Link States (Area 0.0.0.0)

  LS age: 209
  Options: 0x13 -|R|-|--|E|V6
  LS Type: inter-area-router-LSA
  Link State ID: 1.0.0.1
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x5848
  Length: 32

        Destination id: 1.0.0.1
        Metric: 11


                Inter Area Router Link States (Area 0.0.0.1)

  LS age: 216
```

```
  Options: 0x33 DC|R|-|--|E|V6
  LS Type: inter-area-router-LSA
  Link State ID: 3.3.3.3
  Advertising Router: 192.168.0.1
  LS Seq Number: 0x8000000e
  Checksum: 0x1954
  Length: 32

        Destination id: 3.3.3.3
        Metric: 10


# show ipv6 ospf database external

            OSPF6 Router with ID (192.168.0.1)

                AS External Link States

  LS age: 213
  Options: 0 -|-|-|--|-|--
  LS Type: AS-external-LSA
  Link State ID: 0.0.0.1
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000f
  Checksum: 0xe0cc
  Length: 36

        Prefix: 2000:0:0:a::/64
        Metric: 1000
        Forward Address: ::

  LS age: 213
  Options: 0 -|-|-|--|-|--
  LS Type: AS-external-LSA
  Link State ID: 0.0.0.2
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000f
  Checksum: 0xe8c2
  Length: 36

        Prefix: 2000:0:0:b::/64
        Metric: 1000
        Forward Address: ::

  LS age: 213
  Options: 0 -|-|-|--|-|--
  LS Type: AS-external-LSA
  Link State ID: 0.0.0.3
  Advertising Router: 1.0.0.1
  LS Seq Number: 0x8000000f
  Checksum: 0xf0b8
  Length: 36

        Prefix: 2000:0:0:c::/64
        Metric: 1000
```

```
      Forward Address: ::

LS age: 213
Options: 0 -|-|-|--|-|--
LS Type: AS-external-LSA
Link State ID: 0.0.0.4
Advertising Router: 1.0.0.1
LS Seq Number: 0x8000000f
Checksum: 0xf8ae
Length: 36

      Prefix: 2000:0:0:d::/64
      Metric: 1000
      Forward Address: ::

LS age: 213
Options: 0 -|-|-|--|-|--
LS Type: AS-external-LSA
Link State ID: 0.0.0.5
Advertising Router: 1.0.0.1
LS Seq Number: 0x8000000f
Checksum: 0x1a4
Length: 36

      Prefix: 2000:0:0:e::/64
      Metric: 1000
      Forward Address: ::
```

13.6.2.2. OSPF Detail Database via Web

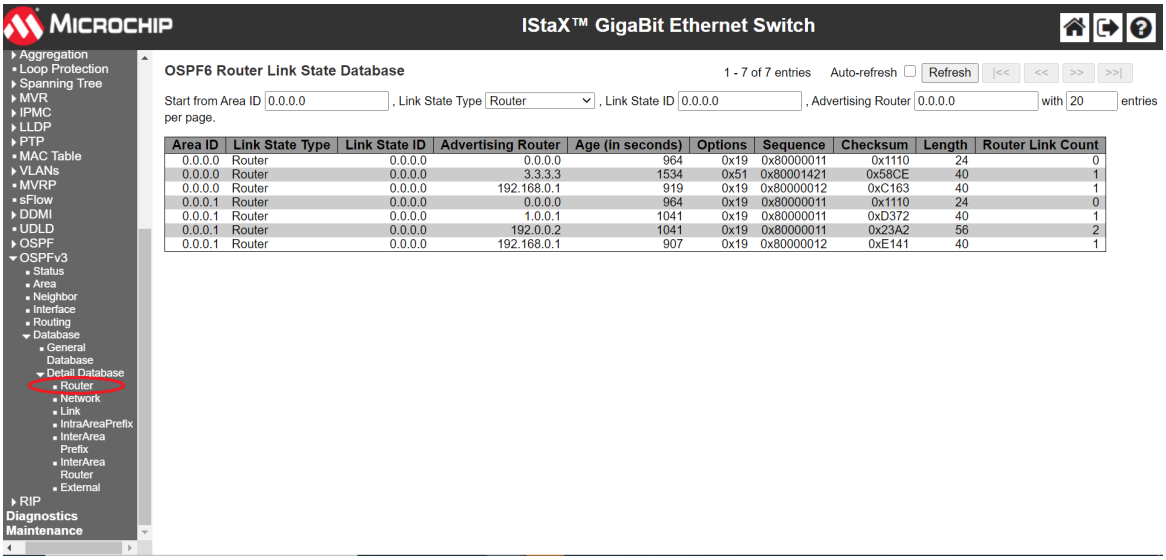
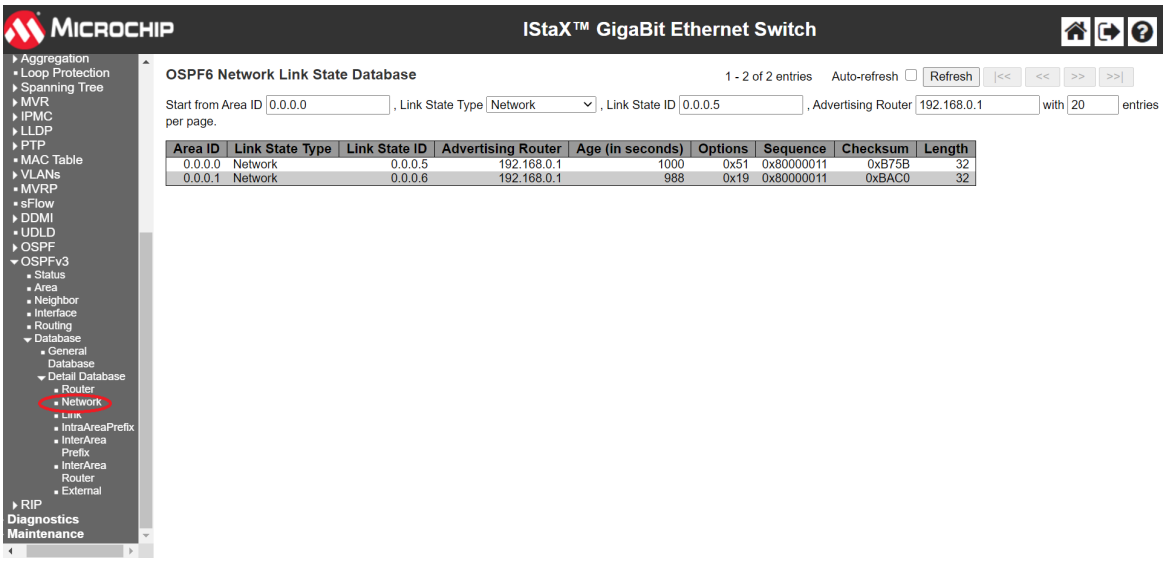
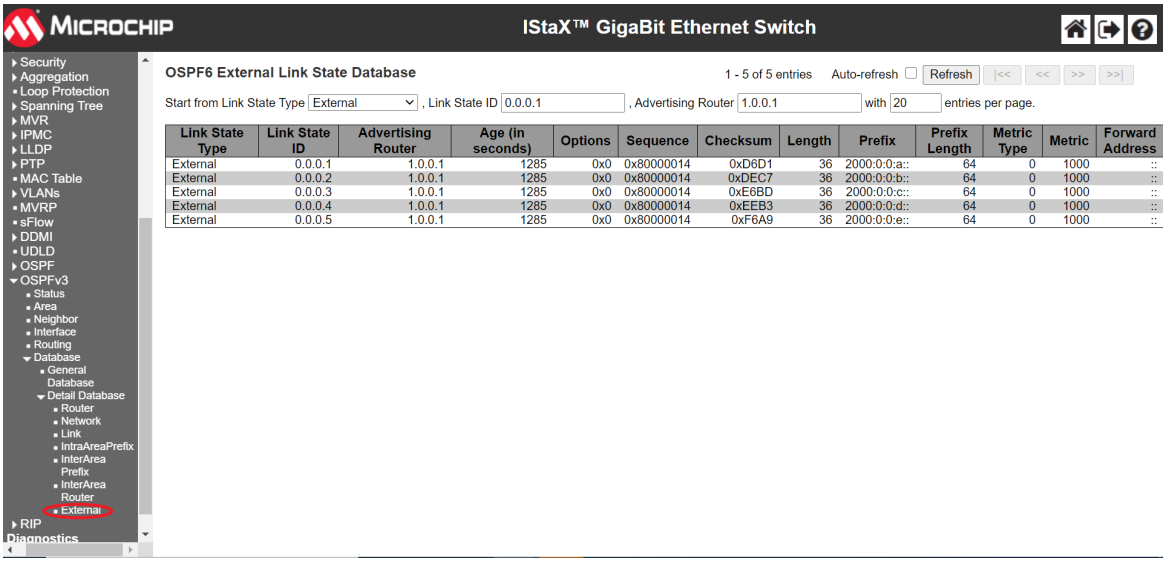
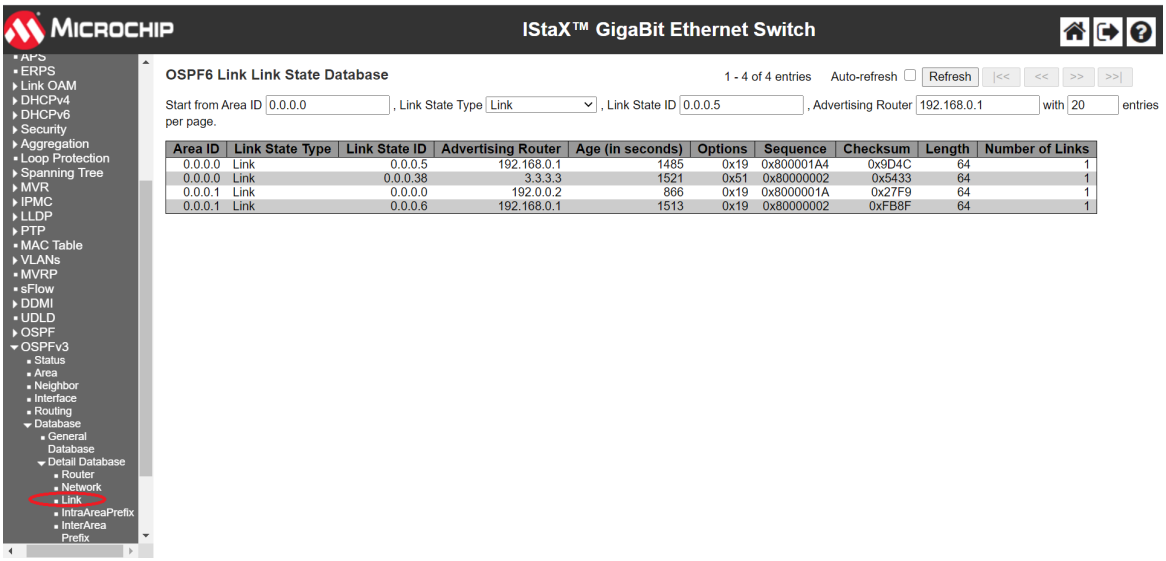
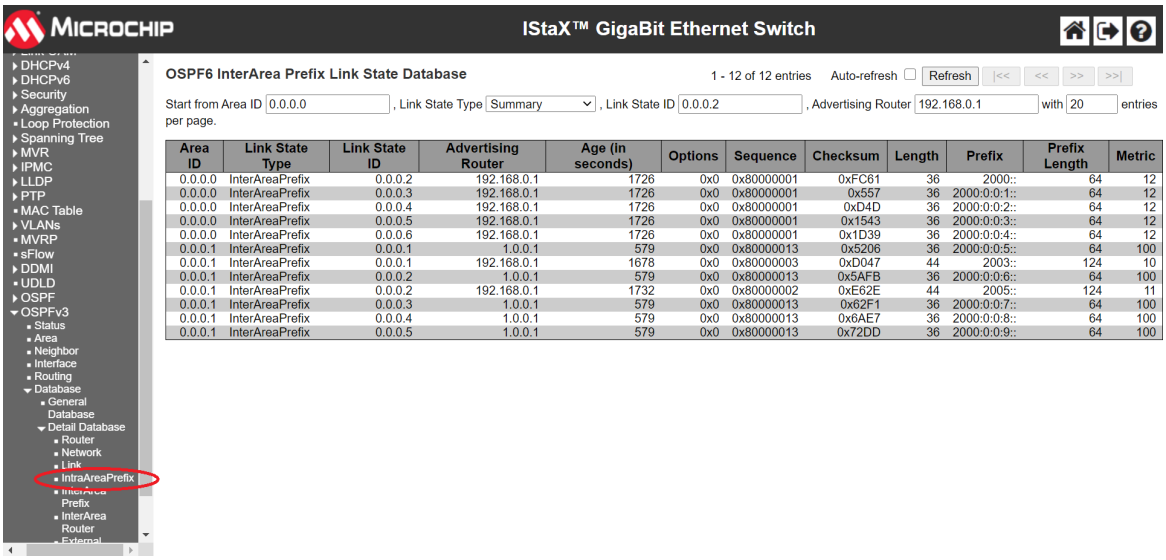


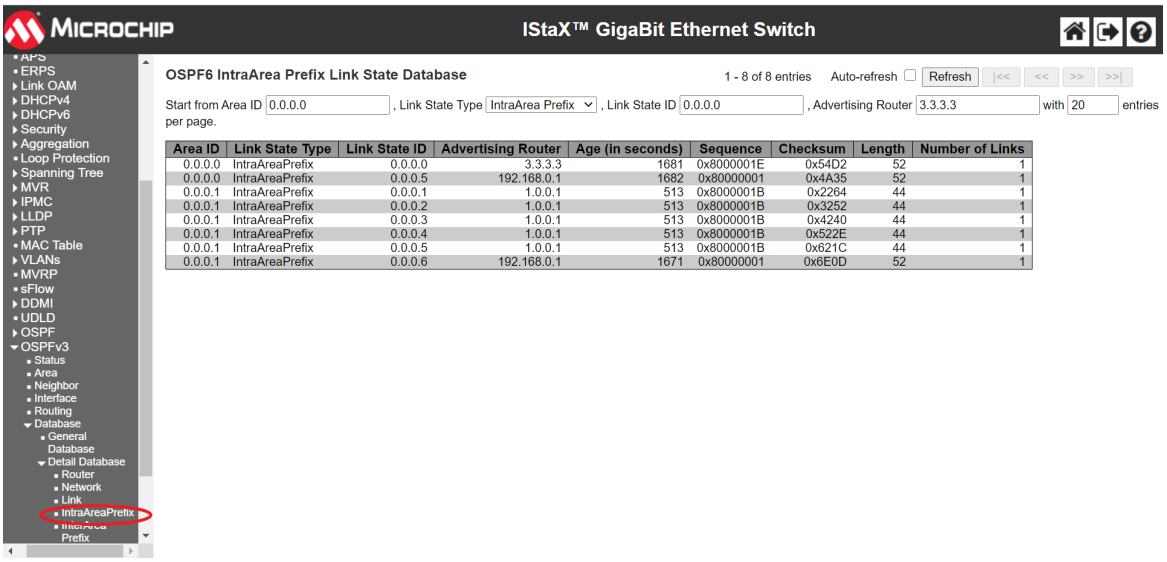
Figure 28. OSPF Detail Database

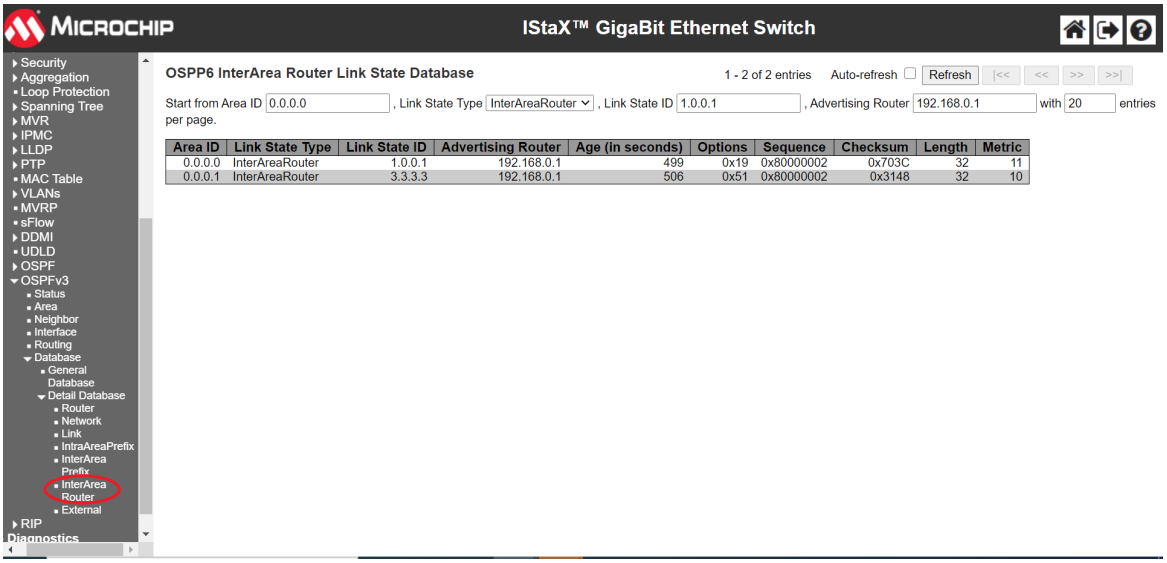



MICROCHIP
IStaX™ GigaBit Ethernet Switch
Security
Aggregation
Loop Protection
Spanning Tree
MVR
IPMC
LLDP
PTP
MAC Table
VLANs
MVRP
sFlow
DDMI
UDLD
OSPF
OSPFv3
Status
Area
Neighbor
Interface
Routing
Database
General Database
Detail Database
Router
Network
Link
IntraAreaPrefix
InterArea Prefix
InterArea Router
External
RIP
Diagnostics
OSPF6 External Link State Database
1 - 5 of 5 entries
Auto-refresh
Refresh
Start from Link State Type External , Link State ID 0.0.0.1 , Advertising Router 1.0.0.1 with 20 entries per page.
Link State Type | Link State ID | Advertising Router | Age (in seconds) | Options | Sequence | Checksum | Length | Prefix | Prefix Length | Metric Type | Metric | Forward Address
External 0.0.0.1 1.0.0.1 1285 0x0 0x80000014 0xD6D1 36 2000:0:0:a:: 64 0 1000 ::
External 0.0.0.2 1.0.0.1 1285 0x0 0x80000014 0xDEC7 36 2000:0:0:b:: 64 0 1000 ::
External 0.0.0.3 1.0.0.1 1285 0x0 0x80000014 0xE6BD 36 2000:0:0:c:: 64 0 1000 ::
External 0.0.0.4 1.0.0.1 1285 0x0 0x80000014 0xEEB3 36 2000:0:0:d:: 64 0 1000 ::
External 0.0.0.5 1.0.0.1 1285 0x0 0x80000014 0xF6A9 36 2000:0:0:e:: 64 0 1000 ::


MICROCHIP
IStaX™ GigaBit Ethernet Switch
APS
ERPS
Link OAM
DHCPv4
DHCPv6
Security
Aggregation
Loop Protection
Spanning Tree
MVR
IPMC
LLDP
PTP
MAC Table
VLANs
MVRP
sFlow
DDMI
UDLD
OSPF
OSPFv3
Status
Area
Neighbor
Interface
Routing
Database
General Database
Detail Database
Router
Network
Link
IntraAreaPrefix
InterArea Prefix
OSPF6 Link Link State Database
1 - 4 of 4 entries
Auto-refresh
Refresh
Start from Area ID 0.0.0.0 , Link State Type Link , Link State ID 0.0.0.5 , Advertising Router 192.168.0.1 with 20 entries per page.
Area ID | Link State Type | Link State ID | Advertising Router | Age (in seconds) | Options | Sequence | Checksum | Length | Number of Links
0.0.0.0 Link 0.0.0.5 192.168.0.1 1485 0x19 0x800001A4 0x9D4C 64 1
0.0.0.0 Link 0.0.0.38 3.3.3.3 1521 0x51 0x80000002 0x5433 64 1
0.0.0.1 Link 0.0.0.0 192.0.0.2 866 0x19 0x8000001A 0x27F9 64 1
0.0.0.1 Link 0.0.0.6 192.168.0.1 1513 0x19 0x80000002 0xFB8F 64 1


MICROCHIP
IStaX™ GigaBit Ethernet Switch
DHCPv4
DHCPv6
Security
Aggregation
Loop Protection
Spanning Tree
MVR
IPMC
LLDP
PTP
MAC Table
VLANs
MVRP
sFlow
DDMI
UDLD
OSPF
OSPFv3
Status
Area
Neighbor
Interface
Routing
Database
General Database
Detail Database
Router
Network
Link
IntraAreaPrefix
InterArea Prefix
InterArea Router
External
OSPF6 InterArea Prefix Link State Database
1 - 12 of 12 entries
Auto-refresh
Refresh
Start from Area ID 0.0.0.0 , Link State Type Summary , Link State ID 0.0.0.2 , Advertising Router 192.168.0.1 with 20 entries per page.
Area ID | Link State Type | Link State ID | Advertising Router | Age (in seconds) | Options | Sequence | Checksum | Length | Prefix | Prefix Length | Metric
0.0.0.0 InterAreaPrefix 0.0.0.2 192.168.0.1 1726 0x0 0x80000001 0xFC61 36 2000:: 64 12
0.0.0.0 InterAreaPrefix 0.0.0.3 192.168.0.1 1726 0x0 0x80000001 0x557 36 2000:0:0:1:: 64 12
0.0.0.0 InterAreaPrefix 0.0.0.4 192.168.0.1 1726 0x0 0x80000001 0xD4D 36 2000:0:0:2:: 64 12
0.0.0.0 InterAreaPrefix 0.0.0.5 192.168.0.1 1726 0x0 0x80000001 0x1543 36 2000:0:0:3:: 64 12
0.0.0.0 InterAreaPrefix 0.0.0.6 192.168.0.1 1726 0x0 0x80000001 0x1D39 36 2000:0:0:4:: 64 12
0.0.0.1 InterAreaPrefix 0.0.0.1 1.0.0.1 579 0x0 0x80000013 0x5206 36 2000:0:0:5:: 64 100
0.0.0.1 InterAreaPrefix 0.0.0.1 192.168.0.1 1678 0x0 0x80000003 0xD047 44 2003:: 124 10
0.0.0.1 InterAreaPrefix 0.0.0.2 1.0.0.1 579 0x0 0x80000013 0x5AFB 36 2000:0:0:6:: 64 100
0.0.0.1 InterAreaPrefix 0.0.0.2 192.168.0.1 1732 0x0 0x80000002 0xE62E 44 2005:: 124 11
0.0.0.1 InterAreaPrefix 0.0.0.3 1.0.0.1 579 0x0 0x80000013 0x62F1 36 2000:0:0:7:: 64 100
0.0.0.1 InterAreaPrefix 0.0.0.4 1.0.0.1 579 0x0 0x80000013 0x6AE7 36 2000:0:0:8:: 64 100
0.0.0.1 InterAreaPrefix 0.0.0.5 1.0.0.1 579 0x0 0x80000013 0x72DD 36 2000:0:0:9:: 64 100





14. Appendices

14.1. Unsupported List

The following lists features not supported in the current WebStaX OSPF software.

- **No support for multiple OSPF processes/instances**
- **No support for VRF**
- **No support for Policy-Based Routing**
- **No support for ECMP**
- **No support for tunnels**
- **No support for VRRP**
- **No support for virtual links**
- **No support for NSSA**

14.2. Configuration Considerations

There is no standard OSPF guidelines for the maximum number of routers in an area or number of neighbors in a network segment. The OSPF process load can be very heavy under a large and complicated network. The following limitations need to be considered when a switch device is placed in an OSPF domain.

Topic	**Maximum Support**
OSPF processes/instances	1
OSPF interfaces	128
Ingress packet throttling for OSPF control packets	1000 Frames/Second
Hardware routing entries	Varies with platform

14.3. OSPF Commands on Cisco Layer 3 Switch Product (3650/3750)

The following table lists OSPF commands on a Cisco Layer 3 switch product alongside with the corresponding WebStaX CLI commands.

Feature	**Cisco**	**WebStaX (- means the same command)**
IP routing	• ipv6 routing	• ip routing
OSPF process	• [no] router ospfv3 **process-id [vrf vrf-name]** • clear ipv6 ospf	• [no] router ospf6 • clear ipv6 ospf process
OSPF interface area	• [no] ipv6 ospf process-id area area_id **(in interface configuration mode)**	• [no] interface vlan vlan_id area area_id **(in router configuration mode)**
OSPF router ID	• [no] router-id ip-address	• -
OSPF passive interface	• [no] passive-interface {default | vlan <vid_list>} **(in router configuration mode)**	• [no] ipv6 ospf passive **(in VLAN interface configuration mode)**

Feature	Cisco	WebStaX (- means the same command)
OSPF interface parameters tuning	• [no] ipv6 ospf priority number-value • [no] ipv6 ospf cost interface-cost • [no] ipv6 ospf dead-interval seconds • [no] ipv6 ospf hello-interval seconds • [no] ipv6 ospf retransmit-interval seconds	• - • - • - • - • -
OSPF stub area	• [no] area area-id stub [no-summary]	• -
OSPF area range	• [no] area area-id range ipv6-subnet [advertise | not-advertise] **[cost cost]**	• [no] area area-id range ipv6-subnet [advertise | not-advertise]
OSPF route redistribution	• [no] redistribute {connected | static | **bgp** | **eigrp** | **isis** | **iso-igrp** | **maximum-prefix** | **mobile** | **odr** | **ospf** | **ospfv3** | **rip** | **vrf** } **[process-id] {level-1 | level-1-2 | level-2} [as-number]** [metric {metric-value | **transparent**}] [metric-type type-value] **[match {internal | external 1 | external 2}] [tag tag-value] [route-map map-tag] [subnets]**	• [no] redistribute {static | connected}
OSPF administrative distance	• [no] distance <1-255>	• -
OSPF status	• show ipv6 ospf **[process-id]** • show ipv6 ospf neighbor [detail] • show ipv6 ospf **[process-id]** interface [type number]	• show ipv6 ospf • - • show ipv6 ospf interface [vlan <vlan_list>]

14.4. Known Issues

14.4.1. Link Metric

The link metric value does not match the actual link speed, because VLAN interfaces represent L2 broadcast domains, which may include more than one physical port. So if, for example, the VLAN domain consists of a 100M, a 1G and a 10G port, what would be the correct metric for that VLAN interface? We leave the question unanswered and report it as a known issue for now.

14.5. Frequently Asked Questions

14.5.1. Why does the OSPF Adjacency State Continuously Switch Between 'ExStart' and 'Exchange'?

This situation may be due to the CPU being too busy to handle the OSPF database description packets arriving from its neighbors.

A possible solution to this is to increase the retransmit interval value to prevent a neighboring switch from retransmitting the packets while the switch is currently handling the previous. The following table lists recommended retransmission intervals as a function of number of OSPF neighbors.

Use command 'show system cpu status' to check the current CPU load and 'show ipv6 ospf neighbor' for the neighbor status.

Number of OSPF neighbors	Retransmit interval suggestion
12	5
24	10
36	15
50	20

15. References

1. RS1191-OSPFv3.adoc
2. RFC 5340 https://www.ietf.org/rfc/rfc5340.txt
3. Cisco OSPF Configuration Guide https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/iproute_ospf/configuration/xe-3se/3650/iro-xe-3se-3650-book.pdf