OSPFv3 Protocol

bintec-Dm 816-I

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Chapter 1 Introduction

1.1 OSPFv3 Protocol: Introduction

This chapter describes how to use the Open Shortest Path First version 3 protocol (OSPFv3), which is an Interior Gateway Protocol (IGP) designed to support IPv6. Our router supports two different IGPs in order to build the IPv6 routing table. These protocols are OSPFv3 and RIPng.

OSPFv3 is a *per-link* protocol, i.e., a *link* is a medium by which nodes can communicate at the link layer. OSPFv3 uses special *hello* messages broadcast on all OSPFv3-enabled interfaces to detect neighboring routers that are also using the routing protocol.

Once a neighbor has been discovered, the two routers will compare the information in the *hello* messages to see whether they have compatible configurations. The neighbor router tries to form an adjacency, meaning routers have to synchronize their *link-state* databases to ensure they have identical OSPFv3 routing information.

Neighboring routers use LSAs (*Link State Advertisements*) to share link-state, cost and other information. Each router receiving LSAs from a neighbor sends a copy of it to all OSPFv3-enabled interfaces so that all routers have identical *LSA* databases. When this occurs, we say that the network converges.

1.1.1 Differences between OSPFv3 and OSPFv2

Much of OSPFv3 is identical to OSPFv2. Here are some of the ways in which the latest version of the OSPF protocol differs from its predecessor:

- OSPFv3 supports the IPv6 address size.
- In the *LSAs*, the addresses are expressed as a prefix and a prefix length instead of as an address and mask.
- The router ID and the area ID are 32-bit addresses that have nothing to do with IPv6 addresses.
- OSPFv3 uses IPv6 *link-local* addresses to discover neighbors.
- Authentication has been removed from the OSPFv3 protocol.
- Some types of *LSAs* have been re-defined.
- Neighboring routers on a common *link* are identified by a router ID.

1.1.2 Hello Packet

Hello packets are sent at regular intervals on all OSPFv3-enabled interfaces. The transmission interval for these packets is set per interface. This packet contains information about the originating interface and router, including the cost of the link, the *hello* interval and some of the originating router's capabilities.

When an OSPFv3 router receives a *hello* packet, it will check to see if the parameters listed in the *hello* packet match the values configured on the receiving interface. When two interfaces are compatible, they are considered neighbors and are added to the neighbor table.

The *hello* packet also contains a list of Router IDs of interfaces with which the originating router has already communicated. If the receiving router sees its own Router ID in this list, bidirectional communication is established between the two interfaces.

Hello packets are also used to determine whether a particular interface is still available. If no *hello* message is received within a certain interval (*dead-interval*), the neighbor is removed from the neighbor table.

1.1.3 Neighbors and Adjacency

Two OSPFv3-enabled interfaces must have compatible configurations before they can be considered neighbors. When the first *hello* packet is received from a new neighbor, the neighbor is added to the receiving interface's neighbor table in the initial state. Following this, a one-way communication is established and the neighbor's state changes to a *two-way* state. Next come the *start* and *exchange* states, where the two interfaces exchange their *LSA* databases. Once this exchange is complete, the neighbor's state changes to *full*.

Neighbor adjacencies in OSPFv3 are established by exchanging *Database Description, Link State Request* and *Link State Update* packets.

- *Database Description*. This contains the *LSA* headers from the neighbor's *link-state* database. The router receiving this packet checks the information against its own *LSA* database to see whether the *LSAs* are new or require updating.

- *Link State Request*. A router in receipt of a *Database Description* sends this packet to request any *LSAs* it needs information about.
- *Link State Update*. This is sent in response to a *Link State Request* and contains the requested *LSA* information.

Once this process is complete, the adjacency has been established.

1.1.4 Designated Routers

If the entire *LSA* database for all OSPFv3-enabled interfaces was sent in a network with lots of routers, it would create a lot of repeated information. Therefore, OSPFv3 uses *Designated Routers* (DR) to control the *LSA* information exchange and handle *LSA* distribution. If a problem arises with the DR, then the *Backup Designated Router* (BDR) assumes the role of the DR. The process of selecting the DR/BDR is the same as in OSPFv2.

The DR and BDR are selected based on the information in the *hello* packet. The process is as follows. When an interface sends a *hello* packet, it sets the priority field and the DR and BDR fields if it knows which routers have been selected to fulfill these roles.

The routers follow an election procedure based on which routers declare themselves to be DR and BDR in the *hello* packet, and on the priority field of said packet. If several routers have the same priority at the end of the election process, the routers with the highest Router IDs are chosen as the DR and BDR.

There must be a DR for each area. A router might be the DR on an interface in one area and not on a different interface belonging to another area.

1.1.5 Areas

An area is a logical division of links. You can assign areas to interfaces so that each interface belongs to a different area. Areas are identified through an identifier known as the *area ID*. The identifier is a 32-bit IP address in x.x.x.x. format.

When there are multiple areas, a *backbone* area (0.0.0.0.) must be configured.

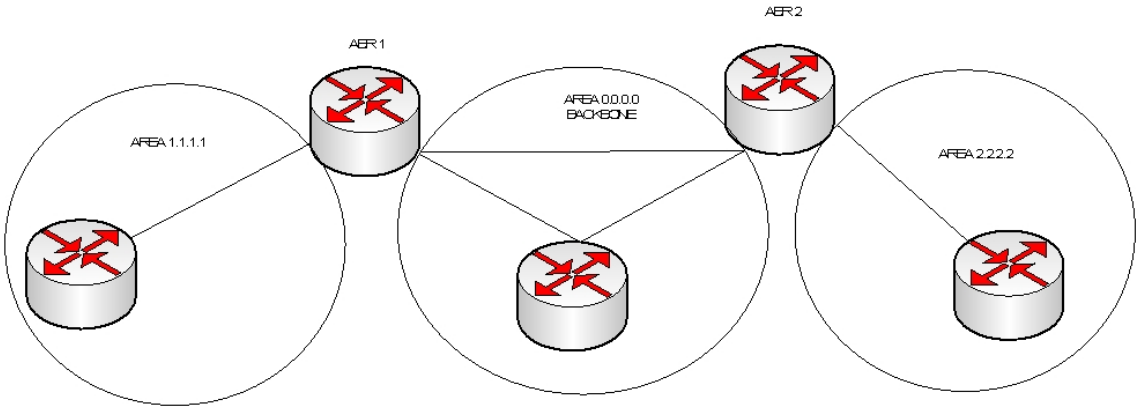

Fig. 1: Different areas in an OSFPv3 network.

Area Border Routers (ABR) have a separate *LSA* database for each area they connect to. These routers send *inter-area-prefix LSAs* from a connected area to the *backbone*. The *backbone* summarizes the information so that it can be sent to other areas.

OSPFv3 also defines another type of router called an *Autonomous System Boundary Router* (ASBR). These devices connect an area to another autonomous system, thereby allowing routes from other routing protocols (such as RIPng) to be redistributed in the area.

1.1.5.1 Stub Areas

Stub areas limit the amount of external routing information sent through an area. This area type does not allow external *LSAs* (*AS-External-LSAs*).

Instead of using external *LSAs*, a stub area supports using a default route for traffic that has to pass through the *backbone* to an external autonomous system.

1.1.6 LSAs

OSPFv3 uses the information provided in *LSAs* to build its routing table.

There are several different *LSA* types in OSPFv3:

Name	Description
Router-LSA	Sent by all routers to describe the link status and link cost of a router. It does not include prefix information. It is an *area-local scope* LSA.
Network-LSA	Sent by a link's DR to describe the link status of all routers, including the DR.
Inter-Area-Prefix-LSA	Sent by an ABR to describe routes to IPv6 prefixes in other areas.
Inter-Area-Router-LSA	Sent by an ABR to describe routes to ASBRs in other areas.
AS-External-LSA	Generated by an ASBR to describe routes to a destination outside the autonomous system (AS). Each *LSA* contains a route to an IPv6 prefix. It is an *autonomous-system scope* LSA.
NSSA-LSA	Generated by an ASBR inside a NSSA to describe routes to a destination outside the AS that may or may not be propagated outside the NSSA. This is not implemented.
Link-LSA	Sent by all the routers for each physical link they are attached to. It contains the *link-local* address of the router's interface and the IPv6 prefixes to assign to the link. It is a *link-local scope* LSA.
Intra-Area-Prefix-LSA	Sent by all the routers to advertise one or more IPv6 prefixes that are associated with a local address, a *stub* network segment or a transition network segment.

The *LSAs* are stored in a database containing all the OSPFv3 network *LSAs*. The protocol uses this database to calculate the best route to each destination and advertise the routing table with the best routes to each destination.

When an *LSAs* reaches its maximum age (*MaxAge*), it is deleted from the database. The database is updated every 30 minutes to prevent valid *LSAs* from being removed.

1.1.7 Redistributing routes

You can control which routes to redistribute using *route-maps*. For example, you can configure *route-maps* with an access list so that those that match are simply passed or marked with a specific metric.

You associate the *route-map* with the route type you want to redistribute in the configuration.

For further information on how to configure *route-maps* in IPv6, please see the *bintec-Dm764-I Route Mapping* manual.

Chapter 2 Configuration

2.1 OSPFv3: Global Configuration

This chapter describes the commands to use to configure the OSPFv3 protocol. To access the OSPFv3 configuration area, enter the following commands:

```
*config
Config>protocol ospfv3
-- OSPFv3 protocol user configuration --
OSPFv3 config>
```

Within the OSPFv3 menu, you will find the following configuration commands:

Command	Function
? (help)	Lists the available commands or their options.
area	Configures OSPFv3 area parameters.
distance	Allows you to set the OSPFv3 administrative distance.
no	Allows you to delete parts of this configuration.
redistribute	Configures the redistribution (importation) of routes from other protocols towards OSPFv3.
router-id	Router identifier.
vrf	Configures OSPFv3 in a *routing/forwarding* domain in a Virtual Private Network (VPN).
exit	Exits the OSPFv3 configuration process.

Command history:

Release	Modification
11.01.09	The *vrf* command was introduced as of version 11.01.09

2.1.1 ? (HELP)

Use the **?** (HELP) command to list the commands available at the current prompt. You can also use this command after a specific command to list the available options.

Syntax:

```
OSPFv3 config>?
```

Example:

```
OSPFv3 config>?
  area            OSPF area parameters
  distance        Administrative distance
  no              Negate a command or set its defaults
  redistribute    Redistribute information from another routing protocol
  router-id       Router ID
  vrf             OSPFv3 in a VPN Routing/Forwarding instance
  exit
OSPFv3 config>
```

Command history:

Release	Modification
11.01.09	The *vrf* command was introduced as of version 11.01.09

2.1.2 AREA

This command allows you to configure parameters for the different areas that will be configured on the interfaces.

Syntax:

```
OSPFv3 config>area ?
  <a.b.c.d>    OSPF area ID in IP address format
OSPFv3 config>area <a.b.c.d> ?
  range    Summarize routes matching address/mask (border routers only)
  stub     Specify a stub area
OSPFv3 config>area <a.b.c.d> range ?
  <a::b/l>    Ipv6 prefix
OSPFv3 config>area <a.b.c.d> range <a::b/l> ?
  advertise       Advertise this range
  no-advertise    Do not advertise this range
OSPFv3 config>area <a.b.c.d> ?
  range    Summarize routes matching address/mask (border routers only)
  stub     Specify a stub area
OSPFv3 config>area <a.b.c.d> stub
```

<a.b.c.d>	This is the OSPF area address. This is a 32-bit address identifying the area. Identifier 0.0.0.0 is reserved for the *backbone*.
range	This controls the routes advertised across area boundaries. That is, only a single route is advertised for each address range.
<a::b/l>	Describes this set of IPv6 addresses that are within this range.
advertise	Option allowing the specified address range to be advertised.
no-advertise	Option preventing the specified address range to be advertised.
stub	Indicates that this area is a *stub* area.

Example “range”:

```
OSPFv3 config>area 1.2.3.4 ?
  range    Summarize routes matching address/mask (border routers only)
  stub     Specify a stub area
OSPFv3 config>area 1.2.3.4 range ?
  <a::b/l>    Ipv6 prefix
OSPFv3 config>area 1.2.3.4 range 2001:db8:5678::/64 ?
  advertise       Advertise this range
  no-advertise    Do not advertise this range
OSPFv3 config>area 1.2.3.4 range 2001:db8:5678::/64 advertise
OSPFv3 config>
```

Example “stub”:

```
OSPFv3 config>area 1.2.3.4 ?
  range    Summarize routes matching address/mask (border routers only)
  stub     Specify a stub area
OSPFv3 config>area 1.2.3.4 stub
OSPFv3 config>
```

2.1.3 DISTANCE

This command allows you to configure the administrative distance of OSPFv3-learned routes. The administrative distance is used to determine the preferred route. The lower the administrative distance, the more preferable the route.

Syntax:

```
OSPFv3 config>distance ?
  <1..254>    Value in the specified range
  ospf        OSPF distance
OSPFv3 config>
```

Option	Function
<1..254>	Sets the default administrative distance for all routes obtained through OSPFv3. The default administrative distance for OSPFv3 is 150. The default value is used in OSPFv3 routes that haven't been configured with an explicit administrative distance using the commands listed below.
ospf	Sets the administrative distance for all the selected routes (*external, inter-area, intra-area*) obtained through OSPFv3. This value prevails over the default value.

Example “distance”:

```
OSPFv3 config>distance 100
```

This example specifies that the default administrative distance for all OSPFv3-learned routes is 100.

Syntax “distance ospf”:

Assigns an administrative distance to a specific route type selected from among the following OSPFv3-learned routes:

```
OSPFv3 config>distance ospf ?
  external      External type 5 and type 7 routes
  inter-area    Inter-area routes
  intra-area    Intra-area routes
OSPFv3 config>distance ospf external ?
  <1..254>    Value in the specified range
OSPFv3 config>
```

Example “distance ospf”:

```
OSPFv3 config>distance ospf external 200
```

Sets an administrative distance of 200 for all OSPFv3 external routes.

2.1.4 NO

Allows you to delete OSPFv3 information from the router’s configuration memory or to configure default values.

Syntax:

```
OSPFv3 config>no ?
  area            OSPF area parameters
  distance        Administrative distance
  no              Negate a command or set its defaults
  redistribute    Redistribute information from another routing protocol
  router-id       Router ID
OSPFv3 config>no
```

Example:

```
OSPFv3 config>no distance 100
```

Eliminates the default administrative distance configured in the OSPFv3 protocol.

2.1.5 REDISTRIBUTE

The **REDISTRIBUTE** command is used to redistribute routes from one routing domain to another.

Syntax:

```
OSPFv3 config>redistribute ?
  bgp          BGP routes
  connected    Connected routes
  ripng        RIPng routes
  static       Static routes
OSPFv3 config>redistribute connected ?
  route-map    Route map reference
  <cr>
OSPFv3 config>
```

bgp	Enables redistribution of all *BGP*-learned routes.
connected	Enables redistribution of all directly connected routes.
static	Enables redistribution of all the static routes.
ripng	Enables redistribution of all *RIPng*-learned routes.
route-map	(Optional) The route map that is interrogated to filter the importation of routes from the source protocol to the current protocol. If none is specified, all routes are redistributed.

Example 1:

```
OSPFv3 config>redistribute connected
```

This example causes all directly connected routes to be redistributed.

Example 2:

```
OSPFv3 config>redistribute connected route-map routemap1
```

This example causes all directly connected routes that match routemap1 to be redistributed.

2.1.6 ROUTER-ID

Sets the router identifier. This identifier is written in an IPv4-address format and must be unique in the autonomous system.

Syntax:

```
OSPFv3 config>router-id ?
  <a.b.c.d>    Ipv4 format
OSPFv3 config>
```

Example:

```
OSPFv3 config>router-id 5.5.5.5
```

This sets the device identifier (router-id) to 5.5.5.5.

2.1.7 VRF

Configures the OSPFv3 protocol in a routing/forwarding domain in Virtual Private Networks (VPNs). For more information, please see the bintec-**Dm775-I VRF** Lite Facility manual.

This menu contains the same configuration commands as in the main VRF.

```
OSPFv3 config>vrf v1

-- OSPFv3 protocol user configuration for a VRF --
OSPFv3 vrf config>?
  area            OSPF area parameters
  distance        Administrative distance
  no              Negate a command or set its defaults
  redistribute    Redistribute information from another routing protocol
  router-id       Router ID
  exit
```

Command history:

Release	Modification
11.01.09	This command was introduced as of version 11.01.09

2.1.8 EXIT

Use the **EXIT** command to return to the previous prompt level.

Syntax:

```
OSPFv3 config>exit
```

Example:

```
OSPFv3 config>exit
Config>
```

2.2 Configuring the OSPFv3 protocol per interface

This chapter describes the per-interface commands for configuring the OSPFv3 protocol. Given that each interface is associated with a VRF, you don't need to specify it. To access the per-interface OSPFv3 configuration environment, enter the following commands:

```
*config

Config>network ethernet0/0
-- Ethernet Interface User Configuration --
ethernet0/0 config>ipv6 ospfv3 ?
  area                  Set the OSPF area ID
  cost                  Interface cost
  dead-interval         Interval after which a neighbor is declared dead
  hello-interval        Time between HELLO packets
  instance              Instance ID
  mtu                   Interface MTU
  mtu-ignore            Ignores the MTU in DBDesc packets
  passive               No adjacency will be formed on this interface
  priority              Router priority
  retransmit-interval   Time between retransmitting lost link state
                        advertisements
  transmit-delay        Link state transmit delay
ethernet0/0 config>
```

The per-interface OSPFv3 configuration commands are:

Command	Function
? (HELP)	Lists the available commands or their options.
AREA	Sets the area to which the interface belongs.
COST	Sets the cost of said interface.
DEAD-INTERVAL	Sets the time interval after which a neighbor is declared dead.
HELLO-INTERVAL	Sets the time interval for sending HELLO messages.
INSTANCE	Sets the OSPFv3 protocol instance number.
MTU	Sets the MTU value.
MTU-IGNORE	Ignores the *Data Base Description* packets' mtu.
PASSIVE	Sets the interface as passive with respect to the sending of updates.
PRIORITY	Sets the priority to be the *Designated Router*.
RETRANSMIT-INTERVAL	Sets the number of seconds between *LSA* retransmissions for adjacencies.
TRANSMIT-DELAY	Sets the number of seconds needed to transmit a *Link State Update*.

2.2.1 ? (HELP)

Use the **?** (HELP) command to list the commands available at the current prompt. You can also use this command after a specific command to list the available options.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 ?
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 ?
  area                  Set the OSPF area ID
  cost                  Interface cost
  dead-interval         Interval after which a neighbor is declared dead
  hello-interval        Time between HELLO packets
  instance              Instance ID
  mtu                   Interface MTU
  mtu-ignore            Ignores the MTU in DBDesc packets
  passive               No adjacency will be formed on this interface
  priority              Router priority
  retransmit-interval   Time between retransmitting lost link state
```

```
                        advertisements
  transmit-delay        Link state transmit delay
```

2.2.2 AREA

The **AREA** command sets the area ID for an interface. This is an IPv4 address identifier. A value of 0.0.0.0 signals that the area is a backbone area.

If this command is not configured, OSPFv3 will not be enabled on the interface.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 area ?
  <a.b.c.d>    Ipv4 format
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 area 0.0.0.0
```

Area 0.0.0.0 (*backbone*) is configured for the ethernet0/0 interface.

2.2.3 COST

The **COST** command sets the interface output metric. The cost is specified as an integer between 1 and 65535. The default value is 1.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 cost ?
  <1..65535>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 cost 5
```

This example configures a cost of 5 on the ethernet0/0 interface.

2.2.4 DEAD-INTERVAL

The **DEAD-INTERVAL** command configures the amount of time that can elapse without receiving a router's *hello* packets before the router's neighbors will declare it down. This time must be the same on all routers connected to an area. The default value is four times the hello-interval.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 dead-interval ?
  <1..65535>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 dead-interval 50
```

This example configures a *dead-interval* of 50 seconds on the ethernet0/0 interface.

The *dead-interval* value must always be more than the *hello-interval*, or it will be impossible to form adjacencies.

2.2.5 HELLO-INTERVAL

The **HELLO-INTERVAL** command configures the length of time in seconds between *hello* packets. This must be an integer between 1 and 65535. The default value is 10 seconds. This time should be the same for all routers attached to a common network.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 hello-interval ?
  <1..65535>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 hello-interval 10
```

This example configures a *hello-interval* of 10 seconds on the ethernet0/0 interface.

When configuring a *hello-interval*, the *dead-interval* changes automatically to four times the *hello-interval*, provided the *dead-interval* is not already configured.

2.2.6 INSTANCE

The **INSTANCE** command allows you to determine the protocol instance identifier on this interface. For devices in an area to interoperate, they must have the same instance. The default value is 0.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 instance ?
  <0..255>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 instance 1
```

Sets the instance of the ethernet0/0 interface in the area where it is configured to 1.

2.2.7 MTU

The **MTU** command allows you to configure a maximum MTU on this interface for the OSPFv3 protocol. The default value is 1500 bytes.

*Syntax:*l

```
ethernet0/0 config>ipv6 ospfv3 mtu ?
  <1..65535>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 mtu 1400
```

Sets an MTU value of 1400 bytes on the ethernet0/0 interface.

2.2.8 MTU-IGNORE

If the **MTU-IGNORE** command is configured, the mtu in the *Data Base Description* packets will be ignored.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 mtu-ignore ?
  <cr>
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 mtu-ignore
```

2.2.9 PASSIVE

The **PASSIVE** command indicates that this interface is passive in the OSPFv3 protocol, i.e., it does not permit adjacencies with its neighbors.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 passive
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 passive
```

This example configures the ethernet0/0 interface to be passive with respect to OSPFv3.

2.2.10 PRIORITY

Configures the interface priority to use in the *designated-router* election. The default value is 1.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 priority ?
  <0..255>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 priority 120
```

This example configures a priority of 120 on the ethernet0/0 interface for the area where it is configured.

2.2.11 RETRANSMIT-INTERVAL

The **RETRANSMIT-INTERVAL** command sets the amount of time between *LSA* retransmissions. The default value is 5.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 retransmit-interval
  <1..65535>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 retransmit-interval 30
```

This example configures a retransmission interval of 30 seconds on the ethernet0/0 interface for the area where it is configured.

2.2.12 TRANSMIT-DELAY

The **TRANSMIT-DELAY** command sets the number of seconds required to transmit a *link-state update* packet. This value must be between 1 and 3600 and the default value is 1 second.

Syntax:

```
ethernet0/0 config>ipv6 ospfv3 transmit-delay ?
  <1..3600>    Value in the specified range
```

Example:

```
ethernet0/0 config>ipv6 ospfv3 transmit-delay 60
```

This example configures a transmit delay of 60 seconds on the ethernet0/0 interface.

Chapter 3 Monitoring

3.1 Monitoring Commands

This chapter describes the commands for monitoring the OSPFv3 protocol. To access the OSPFv3 monitoring environment, enter the following commands:

```
*monitor
Console Operator
+protocol ospfv3
-- OSPFv3 protocol monitor --
OSPFv3+
```

You perform OSPFv3 monitoring using the following commands:

```
OSPFv3+?
  border-routers    Display Border and Boundary router information
  database          Display Link state database
  interface         Display OSPFv3 interface information
  linkstate         Display linkstate routing table
  neighbors         Neighbor list
  redistribute      Redistributing external information
  route             Display route table
  vrf               OSPFv3 in a VPN Routing/Forwarding instance
  exit
```

Command	Function
? (HELP)	Lists the available commands or their options.
BORDER-ROUTERS	Displays information on the routers.
DATABASE	Displays the *link-state* database.
INTERFACE	Displays OSPFv3 information for this interface.
LINKSTATE	Displays the *link-state* routing table.
NEIGHBORS	Lists the neighbors.
REDISTRIBUTE	Displays the external information that is redistributed.
ROUTE	Displays the OSPFv3 routing table.
VRF	Selects another VRF instance where the OSPFv3 protocol is monitored.
EXIT	Exits the OSPFv3 monitoring process.

Command history:

Release	Modification
11.01.09	The *vrf* command was introduced as of version 11.01.09

3.1.1 ? (HELP)

Use the **?** (HELP) command to list the commands available at the prompt where you are working. You can also use this command after a specific command to list the available options.

Syntax:

```
OSPFv3+?
```

Example:

```
OSPFv3+?
  border-routers    Display Border and Boundary router information
  database          Display Link state database
  interface         Display OSPFv3 interface information
  linkstate         Display linkstate routing table
  neighbors         Neighbor list
  redistribute      Redistributing external information
  route             Display route table
```

```
  vrf               OSPFv3 in a VPN Routing/Forwarding instance
  exit
```

Command history:

Release	Modification
11.01.09	The *vrf* command was introduced as of version 11.01.09

3.1.2 BORDER-ROUTERS

Use this command to monitor the network routers. It displays information about them.

Syntax:

```
OSPFv3+border-routers ?
  <a.b.c.d>    Specify Router-ID in IPv4 format
  detail       Display details
  <cr>
OSPFv3+border-routers
```

If you do not select an option, the command will display summarized information on all the routers in the network.

Example:

```
OSPFv3+border-routers
Router-ID       Rtr-Bits Options        Path-Type  Area            Via
1.1.1.1         ------E- --|R|-|--|E|V6 Inter-Area 3.3.3.3         ethernet0/0.59
2.2.2.2         ------E- --|R|-|--|E|V6 Intra-Area 3.3.3.3         internal
3.3.3.3         ------EB DC|R|-|--|E|V6 Intra-Area 3.3.3.3         ethernet0/0.59
4.4.4.4         ------E- --|R|-|--|E|V6 Inter-Area 3.3.3.3         ethernet0/0.59
5.5.5.5         ------E- --|R|-|--|E|V6 Inter-Area 3.3.3.3         ethernet0/0.59
6.6.6.6         ------E- --|R|-|--|E|V6 Inter-Area 3.3.3.3         ethernet0/0.59
OSPFv3+
```

The information displayed is as follows:

router-id	32-bit address that identifies the router.
rtr-bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
path-type	Type of route: intra-area, inter-area or external.
area	Area through which the router was discovered.
via	Interface through which the router was discovered.

3.1.2.1 <a.b.c.d>

If a router is selected, detailed information on this particular router is displayed.

Syntax:

```
OSPFv3+border-routers ?
  <a.b.c.d>    Specify Router-ID in IPv4 format
  detail       Display details
  <cr>
OSPFv3+border-routers
```

Example:

```
OSPFv3+border-routers 3.3.3.3
Destination: 3.3.3.3
Destination type: Router
Installed Time: 01:34:51 ago
  Changed Time: 01:34:51 ago
Associated Area: 3.3.3.3
Path Type: Intra-Area
```

```
LS Origin: Router Id: 0.0.0.0 Adv: 3.3.3.3
Options: DC|R|-|--|E|V6
Router Bits: ------EB
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 1
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59
OSPFv3+
```

The information displayed is as follows:

destination	Displays the destination identifier.
destination type	Type of destination: router, network, *linkstate*, address range, dropped or unknown.
installed time	Time elapsed since being installed in the device.
changed time	Time elapsed since the last change in state.
associated area	Area through which this was learned.
path type	Type of route: intra-area, inter-area or external.
ls origin	Link state through which this has been learnt. Displays information on the identifier (*id*) and the advertising router (*adv*).
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
router bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).
metric type	Type of metric: none, type 1 (type 1 external route) or type 2 (type 2 external route). The metric varies according to the type.
metric	Metric that the route has.
nexthop	Next hop through which the router can be reached.

3.1.2.2 DETAIL

The **DETAIL** option makes a detailed list of all routers in the network. The same information shown in the previous option is shown for each router.

Syntax:

```
OSPFv3+border-routers detail ?
  <cr>
OSPFv3+
```

Example:

```
OSPFv3+border-routers detail
Destination: 1.1.1.1
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Inter-Area
LS Origin: Inter-Router Id: 1.1.1.1 Adv: 3.3.3.3
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 0 Metric: 3
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 2.2.2.2
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Intra-Area
```

```
LS Origin: Router Id: 0.0.0.0 Adv: 2.2.2.2
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 0
Nexthop:
  ::1 0

Destination: 3.3.3.3
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Intra-Area
LS Origin: Router Id: 0.0.0.0 Adv: 3.3.3.3
Options: DC|R|-|--|E|V6
Router Bits: ------EB
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 1
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 4.4.4.4
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Inter-Area
LS Origin: Inter-Router Id: 4.4.4.4 Adv: 3.3.3.3
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 0 Metric: 2
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 5.5.5.5
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Inter-Area
LS Origin: Inter-Router Id: 5.5.5.5 Adv: 3.3.3.3
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 0 Metric: 2
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 6.6.6.6
Destination type: Router
Installed Time: 01:37:05 ago
  Changed Time: 01:37:05 ago
Associated Area: 3.3.3.3
Path Type: Inter-Area
LS Origin: Inter-Router Id: 6.6.6.6 Adv: 3.3.3.3
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 0 Metric: 3
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

OSPFv3+
```

3.1.3 DATABASE

This command displays the *LSA* database

Syntax:

```
OSPFv3+database ?
  as-external     External link states
  detail          Display Link state database
  inter-prefix    Inter-prefix link states
  inter-router    Inter-router link states
  intra-prefix    Inter-area link states
  link            Link link states
  network         Network link states
  router          Router link states
  unknown         Unknown link states
  <cr>
OSPFv3+database
```

The *detail* option displays detailed information on all the *LSAs*, while the other options give you the ability to filter when listing the *LSAs*

Example:

```
OSPFv3+database

        Area Scoped Link State Database (Area 3.3.3.3)

Type          AdvRouter        Age   SeqNum LSId            Duration
Router        2.2.2.2           493 800000b9 0.0.0.0         00:08:12
Router        3.3.3.3           100 800000b6 0.0.0.0         00:01:38
Network       3.3.3.3           346 80000002 0.0.0.23        00:05:44
Inter-Prefix 3.3.3.3            100 800000a2 0.0.0.0         00:01:38
Inter-Prefix 3.3.3.3            100 800000a2 0.0.0.1         00:01:38
Inter-Prefix 3.3.3.3            100 800000a2 0.0.0.3         00:01:38
Inter-Prefix 3.3.3.3            100 80000040 0.0.0.10        00:01:38
Inter-Prefix 3.3.3.3           1597 8000001d 0.0.0.11        00:26:35
Inter-Prefix 3.3.3.3           1597 8000001d 0.0.0.12        00:26:35
Inter-Prefix 3.3.3.3           1597 8000001d 0.0.0.13        00:26:35
Inter-Router 3.3.3.3           1597 800000a7 1.1.1.1         00:26:35
Inter-Router 3.3.3.3           1597 800000a7 4.4.4.4         00:26:35
Inter-Router 3.3.3.3            100 800000a2 5.5.5.5         00:01:38
Inter-Router 3.3.3.3            100 800000a6 6.6.6.6         00:01:38
Intra-Prefix 3.3.3.3            346 80000002 0.0.3.255       00:05:44

        Interface Scoped Link State Database (Interface ethernet0/0.59 in Area 3.3.3.3)

Type          AdvRouter        Age   SeqNum LSId            Duration
Link          2.2.2.2           493 800000b3 0.0.0.6         00:08:12
Link          3.3.3.3           100 800000a2 0.0.0.23        00:01:38

        AS Scoped Link State Database

Type          AdvRouter        Age   SeqNum LSId            Duration
AS-External   1.1.1.1          1567 800000b4 0.0.0.0         00:26:03
AS-External   1.1.1.1          1567 800000b4 0.0.0.1         00:26:03
AS-External   2.2.2.2           493 800000b3 0.0.0.0         00:08:12
AS-External   2.2.2.2           493 800000b3 0.0.0.1         00:08:12
AS-External   4.4.4.4           610 800000b5 0.0.0.0         00:10:07
AS-External   5.5.5.5           615 800000b5 0.0.0.0         00:10:12
AS-External   5.5.5.5           615 800000b5 0.0.0.1         00:10:12
AS-External   6.6.6.6           613 800000b5 0.0.0.0         00:10:09
```

The following information on the *LSAs* is displayed when listing them.

type	Type of *LSA*.
advRouter	Advertising Router.
age LSA	Lifetime in seconds.

seqNum	Sequence number.
lsid	Link state identifier.
duration	Length of time the *LSA* has been installed.

3.1.3.1 DETAIL

The **DETAIL** command shows each *LSA* in detail. The displayed information varies according to the type of *LSA* being shown.

Example:

```
OSPFv3+database detail
        Area Scoped Link State Database (Area 3.3.3.3)

LS Age:  876 LSType: Router
Link State ID: 0.0.0.0
Advertising Router: 2.2.2.2
LS Sequence Number: 0x800000b9
CheckSum: 0xa989 Length: 40
    Bits: ------E- Options: --|R|-|--|E|V6
    Type: Transit-Network Metric: 1
    Interface ID: 0.0.0.6
    Neighbor Interface ID: 0.0.0.23
    Neighbor Router ID: 3.3.3.3
…
LS Age:  996 LSType: AS-External
Link State ID: 0.0.0.0
Advertising Router: 6.6.6.6
LS Sequence Number: 0x800000b5
CheckSum: 0x9ed7 Length: 36
     Bits: E--
     Metric:     8
     Prefix Options: --|--|--|--
     Referenced LSType: 0
     Prefix: 2001:db8::6161::/64
```

All the *LSAs* have the following information in common:

LS Age	*LSA* lifetime in seconds.
LS Type	Type of *LSA*.
Link State ID	*LSA* identifier.
Advertising Router	Identifier for the router advertising the *LSA*.
LS Sequence Number	Sequence number.
Checksum	Checksum.
Length	*LSA* length.

Subsequently, depending on the type of *LSA*, different information is displayed. Below you can see the various types of *LSAs*, together with specific information on each type.

Router:

Example:

```
LS Age:  876 LSType: Router
Link State ID: 0.0.0.0
Advertising Router: 2.2.2.2
LS Sequence Number: 0x800000b9
CheckSum: 0xa989 Length: 40
    Bits: ------E- Options: --|R|-|--|E|V6
    Type: Transit-Network Metric: 1
    Interface ID: 0.0.0.6
    Neighbor Interface ID: 0.0.0.23
    Neighbor Router ID: 3.3.3.3
```

Information displayed for a *Router LSA*:

bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).

options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether or not this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
type	Type of network: point-to-point, transition, stub or *virtual link*.
metric	Metric.
neighbor interface id	Neighbor interface identifier.
neighbor router id	Neighbor router identifier.

Network:

Example:

```
LS Age:  729 LSType: Network
Link State ID: 0.0.0.23
Advertising Router: 3.3.3.3
LS Sequence Number: 0x80000002
CheckSum: 0x7858 Length: 32
     Options: DC|R|-|--|E|V6
     Attached Router: 3.3.3.3
     Attached Router: 2.2.2.2
```

Information displayed for a *Network LSA*:

options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
attached router	Identifier of the router connected to this network.

Inter-prefix:

Example:

```
LS Age:  483 LSType: Inter-Prefix
Link State ID: 0.0.0.0
Advertising Router: 3.3.3.3
LS Sequence Number: 0x800000a2
CheckSum: 0x7b66 Length: 36
     Metric: 1
     Prefix Options: --|--|--|--
     Prefix: 2001:db8:3333::/64
```

Information displayed for an *Inter-prefix LSA* :

metric	Metric.
prefix options	Prefix options: P (*Propagate,* for NSSA areas), MC (*Multicast*), LA (*local Address*), NU (*No Unicast*).
prefix	Prefix contained in the *LSA*.

Inter-router:

Example:

```
LS Age: 1980 LSType: Inter-Router
Link State ID: 1.1.1.1
Advertising Router: 3.3.3.3
LS Sequence Number: 0x800000a7
CheckSum: 0x84e5 Length: 32
     Options: --|R|-|--|E|V6
     Metric: 2
     Destination Router ID: 1.1.1.1
```

Information displayed for an *Inter-router LSA* :

options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
metric	Metric.
destination router id	Destination router identifier.

Intra-prefix:

Example:

```
LS Age:  729 LSType: Intra-Prefix
Link State ID: 0.0.3.255
Advertising Router: 3.3.3.3
LS Sequence Number: 0x80000002
CheckSum: 0x6403 Length: 56
     Number of Prefix: 2
     Reference: Network Id: 0.0.0.23 Adv: 3.3.3.3
     Prefix Options: --|--|--|--
     Prefix: 2001:db8:cccc::/64
     Prefix Options: --|--|--|--
     Prefix: 2001:db8:2222::/64
```

Information displayed for an *Intra-prefix LSA*:

number of prefix	Number of prefixes the *LSA* contains.
reference	Type of link state.
id	Identifier of the router interface advertising the *LSA*.
adv	Identifier of the router that has advertised the *LSA*.
prefix options	Prefix options: P (*Propagate,* for NSSA areas), MC (*Multicast*), LA (*local Address*), NU (*No Unicast*).
prefix	Prefix contained in the *LSA*.

Link:

Example:

```
LS Age:  876 LSType: Link
Link State ID: 0.0.0.6
Advertising Router: 2.2.2.2
LS Sequence Number: 0x800000b3
CheckSum: 0x0958 Length: 56
     Priority: 1 Options: --|R|-|--|E|V6
     LinkLocal Address: fe80::2a0:26ff:fe00:338
     Number of Prefix: 1
     Prefix Options: --|--|--|--
     Prefix: 2001:db8:2222::/64
```

Information displayed for a *Link LSA*:

priority	Priority.
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
link-local Address	*Link-local* address.
number of prefix	Number of prefixes in the *LSA*.
prefix options	Prefix options: P (*Propagate,* for NSSA areas), MC (*Multicast*), LA (*local Address*), NU (*No Unicast*).
prefix	Prefix contained in the *LSA*.

AS-External:

Example:

```
LS Age:  150 LSType: AS-External
Link State ID: 0.0.0.0
Advertising Router: 1.1.1.1
LS Sequence Number: 0x800000b5
CheckSum: 0xc006 Length: 36
     Bits: ---
     Metric:     0
     Prefix Options: --|--|--|--
     Prefix: 2001:db8:cccc:dddd::/64
```

Information displayed for an *AS-External LSA*:

bits	Bits for the type of route: E (indicates that the router is type 2 external), F *Forwarding address*) and T (*Route Tag External* , not supported).
metric	Metric.
prefix options	Prefix options: P (*Propagate,* for NSSA areas), MC (*Multicast*), LA (*local Address*), NU (*No Unicast*).
prefix	Prefix contained in the *LSA*.

3.1.3.2 FILTERING THROUGH TYPE

Filtering through type is carried out by selecting one of the types shown as an option.

Syntax:

```
OSPFv3+database ?
  as-external     External link states
  detail          Display Link state database
  inter-prefix    Inter-prefix link states
  inter-router    Inter-router link states
  intra-prefix    Inter-area link states
  link            Link link states
  network         Network link states
  router          Router link states
  unknown         Unknown link states
  <cr>
```

Example:

```
OSPFv3+database link
database link

        Interface Scoped Link State Database (Interface ethernet0/0.59 in Area 3.3.3.3)

Type         AdvRouter        Age   SeqNum LSId            Duration
Link         2.2.2.2           126 800000b4 0.0.0.6         00:02:06
Link         3.3.3.3          1533 800000a2 0.0.0.23        00:25:31

OSPFv3+
```

3.1.4 INTERFACE

This command displays information about interfaces that run OSPFv3.

Syntax:

```
OSPFv3+interface ?
  <interface>    Interface name
  <cr>
```

If you select a particular interface, only information for the selected interface is displayed. In the example below, all the interfaces are shown, but information is only given for those running OSPFv3.

Example:

```
OSPFv3+interface
ethernet0/0 is down, type BROADCAST
   Interface ID: 1
   OSPF not enabled on this interface
ethernet0/0.59 is up, type BROADCAST
  Interface ID: 6
  Link-local address is:  fe80::2a0:26ff:fe00:338
  Internet Address:
    inet6: 2001:db8:2222::1/64
  Instance ID 1, Interface MTU 1500 (autodetect: 1500)
  MTU mismatch detection: enabled
  Area ID 3.3.3.3, Cost 1
  DR: 3.3.3.3 BDR: 2.2.2.2
  State BDR, Transmit Delay 1 sec, Priority 1
  Timer intervals configured:
    Hello 10, Dead 40, Retransmit 5
```

```
  Number of Interface scoped LSAs is 2
ethernet0/1 is down, type BROADCAST
   Interface ID: 2
   OSPF not enabled on this interface
internal is down, type LOOPBACK
   Interface ID: 65535
   OSPF not enabled on this interface
OSPFv3+
```

The information displayed is as follows:

interface state	Whether the interface is *up* or *down*.
link-local address	*Link-local* interface address.
interface ID	Interface identifier.
internet address	IPv6 addresses configured on this interface.
area ID	Area identifier.
instance ID	OSPFv3 instance on this interface.
router ID	32-bit address that identifies the router.
interface MTU	MTU on this interface.
MTU mismatch detection	If the MTU does not match, the interface ignores it.
network type	Type of network: *loopback*, *broadcast*, point-to-point or unknown.
DR	Displays the *Designated Router.*
BDR	Displays the *Backup Designated Router*
state	State the interface is in.
transmit delay	Transmission delay.
priority	Priority to elect the *Designated Router*.
timer intervals	Shows the configured time intervals.
scoped LSAs	Number of *LSAs* belonging to this scope.

3.1.5 LINKSTATE

Displays the routing table formed by the LS messages in the link.

Syntax:

```
OSPFv3+linkstate ?
  detail     Display details
  network    Display network entry
  router     Display router entry
  <cr>
OSPFv3+
```

Example:

```
OSPFv3+linkstate

        SPF Result in Area 3.3.3.3

Type    Router-ID       LS ID           Rtr-Bits Options        Cost
Router  2.2.2.2         0.0.0.0         ------E- --|R|-|--|E|V6 0
Router  3.3.3.3         0.0.0.0         ------EB DC|R|-|--|E|V6 1
Network 3.3.3.3         0.0.0.23        -------- DC|R|-|--|E|V6 1

OSPFv3+
```

The meaning of each field is as follows:

type	Type of *linkstate.*
router-id	32-bit address that identifies the router.
ls id	*linkstate* identifier.
rtr-bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N

	(indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
cost	Cost assigned to the route.

3.1.5.1 DETAIL

Provides detailed information on all the *linkstates.*

Syntax:

```
OSPFv3+linkstate detail ?
  <cr>
OSPFv3+
```

Example:

```
OSPFv3+linkstate detail

        SPF Result in Area 3.3.3.3
Destination: 2.2.2.2
Destination type: Linkstate
Installed Time: 01:03:05 ago
  Changed Time: 01:03:05 ago
Associated Area: 0.0.0.0
Path Type: Intra-Area
LS Origin: Router Id: 0.0.0.0 Adv: 2.2.2.2
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 0
Nexthop:
  ::1 0

Destination: 3.3.3.3
Destination type: Linkstate
Installed Time: 01:03:05 ago
  Changed Time: 01:03:05 ago
Associated Area: 0.0.0.0
Path Type: Intra-Area
LS Origin: Router Id: 0.0.0.0 Adv: 3.3.3.3
Options: DC|R|-|--|E|V6
Router Bits: ------EB
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 1
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 3.3.3.3
Destination type: Linkstate
Installed Time: 01:03:05 ago
  Changed Time: 01:03:05 ago
Associated Area: 0.0.0.0
Path Type: Intra-Area
LS Origin: Network Id: 0.0.0.23 Adv: 3.3.3.3
Options: DC|R|-|--|E|V6
Router Bits: --------
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 1
Nexthop:
  :: ethernet0/0.59

OSPFv3+
```

The following information is displayed in detail:

destination	Displays the destination identifier.
destination type	Type of destination: router, network, *linkstate*, range of addresses, dropped, or unknown.

installed time	Time elapsed since being installed in the device.
changed time	Time elapsed since the last change in state.
associated area	Area through which this was learned.
path type	Type of route: intra-area, inter-area or external.
ls origin	Link state through which this has been learned. Displays information on the identifier (*id*) and the advertising router (*adv*).
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N (indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
router bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).
metric type	Type of metric: none, type 1 (type 1 external route) or type 2 (type 2 external route). The metric varies according to the type.
metric	Metric that the route has.
nexthop	Next hop through which the router can be reached.

3.1.5.2 NETWORK

This displays a *network linkstate*. You need to enter the *LSA router id* and its *linkstate id.*

Syntax:

```
OSPFv3+linkstate network ?
  <a.b.c.d>    Specify router ID in IPv4 format
OSPFv3+linkstate network <a.b.c.d> ?
  <a.b.c.d>    Specify link state ID in IPv4 format
OSPFv3+linkstate network <a.b.c.d> <a.b.c.d> ?
  <cr>
OSPFv3+
```

Example:

```
OSPFv3+linkstate network 3.3.3.3 0.0.0.23

        SPF Result in Area 3.3.3.3

Destination: 3.3.3.3
Destination type: Linkstate
Installed Time: 00:03:30 ago
  Changed Time: 00:03:30 ago
Associated Area: 0.0.0.0
Path Type: Intra-Area
LS Origin: Network Id: 0.0.0.23 Adv: 3.3.3.3
Options: DC|R|-|--|E|V6
Router Bits: --------
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 1
Nexthop:
  :: ethernet0/0.59

OSPFv3+
```

The information displayed here is the same as described in the previous section.

3.1.5.3 ROUTER

This displays a *router linkstate* in detail.

Syntax:

```
OSPFv3+linkstate router ?
  <a.b.c.d>    Specify router-ID in IPv4 format
OSPFv3+
```

Example:

```
OSPFv3+ linkstate router 2.2.2.2

        SPF Result in Area 3.3.3.3

Destination: 2.2.2.2
Destination type: Linkstate
Installed Time: 00:03:35 ago
  Changed Time: 00:03:35 ago
Associated Area: 0.0.0.0
Path Type: Intra-Area
LS Origin: Router Id: 0.0.0.0 Adv: 2.2.2.2
Options: --|R|-|--|E|V6
Router Bits: ------E-
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 0
Nexthop:
  ::1 0
OSPFv3+
```

The information displayed here is the same as that described previously.

3.1.6 NEIGHBORS

The NEIGHBORS command displays OSPFv3 neighbor information related to the device.

Syntax:

```
OSPFv3+neighbors ?
  detail        Show detailed neighbor information
  dr            Show neighbor DR choice information
  <cr>
```

Example:

```
OSPFv3+neighbors
Neighbor ID     Pri    Deadtime    State/IfState         Duration  Ifc[State]
100.100.100.112   1    00:00:32     Full/DR              00:26:24  ethernet0/0.606[BDR]
100.100.100.212   1    00:00:39     Full/DR              00:26:34  ethernet0/0.605[BDR]
```

The meaning of each field is as follows:

Neighbor ID	Neighbor router ID.
Pri	Router priority for Designated Router (DR) election. A router priority of 0 is never picked as the DR or Backup DR.
DeadTime	Time (in hh:mm:ss) that elapses before OSPFv3 declares the neighbor dead.
State	The state between the device and the neighbor. The state can be one of the following: *Down, Attempt, Init, Twoway, ExStart, ExChange, Loading, Full* .
IfState	The interface through which the router is connected to the neighbor. The state of the interface can be one of the following: *DR, BDR, DROther, PointToPoint.*
Duration	Time (in hh:mm:ss) the OSPFv3 neighbor has been up.
Ifc	Name of the interface that connects to this neighbor.
State	The state of the interface. This state can be one of the following: *None, Down, Loopback, Waiting, PointToPoint, DROther, BDR, DR*

3.1.6.1 DR

Provides information about DR selection (obtained from neighbors).

Syntax:

```
OSPFv3+neighbors dr ?
  <cr>
```

Example:

```
OSPFv3+neighbors dr
Router ID          State/Duration    DR              BDR             Ifc[State]
```

```
100.100.100.112     Full/00:58:39    100.100.100.112 100.100.100.111  ethernet0/0.606[BDR]
100.100.100.212     Full/00:58:45    100.100.100.212 100.100.100.111  ethernet0/0.605[BDR]
```

The meaning of each field is as follows:

Router ID	Neighbor router ID.
State	The state between the device and the neighbor. The state can be one of the following: *Down, Attempt, Init, Twoway, ExStart, ExChange, Loading, Full* .
Duration	Time (in hh:mm:ss) the OSPFv3 neighbor has been up.
DR	Neighbor ID belonging to the Designated Router (DR).
BDR	Neighbor ID belonging to the Backup Designated Router (BDR).
Ifc	Name of the interface that connects to this neighbor.
State	The state of the interface. This state can be one of the following: *None, Down, Loopback, Waiting, PointToPoint, DROther, BDR, DR*

3.1.6.2 DETAIL

Provides OSPFv3 detailed neighbor information.

Syntax:

```
OSPFv3+neighbors detail ?
  <cr>
```

Example:

```
OSPFv3+neighbors detail
 Neighbor 100.100.100.232
    Area 0.0.0.0 via interface ethernet0/0.606
    Interface ID: 5 Link-local address: fe80::2a0:26ff:febe:0
    Neighbor priority is 1,  State Full for a duration of 00:09:59
    DR is 100.100.100.212 BDR is 100.100.100.232
    DbDesc status: Slave SeqNum: 0xe
 Neighbor 100.100.100.37
    Area 0.0.0.0 via interface ethernet0/0.605
    Interface ID: 4 Link-local address: fe80::2a0:26ff:feb9:8d50
    Neighbor priority is 1,  State Full for a duration of 07:17:28
    DR is 100.100.100.37 BDR is 100.100.100.212
    DbDesc status: Master SeqNum: 0x2c
```

The meaning of each field is as follows:

Neighbor	Neighbor router ID.
Area	Area and interface through which the OSPFv3 neighbor is known.
Interface ID	Number that uniquely identifies an interface on a router.
Link-local address	Link local address of the interface.
Neighbor priority	Router priority of neighbor and neighbor state.
State	The state between the device and the neighbor. The state can be the following: *Down, Attempt, Init, Twoway, ExStart, ExChange, Loading, Full* .
DR is	Neighbor ID of the Designated Router.
BDR is	Neighbor ID of the Backup Designated Router.
DbDesc status	Database Description status. The status can be the following: *Master, Slave.*
SeqNum	Database Description Sequence Number.

3.1.7 REDISTRIBUTE

The **REDISTRIBUTE** command displays external routes that are redistributed by OSPFv3 on this device.

Syntax:

```
OSPFv3+redistribute ?
  <cr>
```

Example:

```
OSPFv3+redistribute
```

```
Redistributing External Routes from:
    0: connected
    2: static
Total 2 routes
Type  Route                           Cost  Interface
S     2001:db8::2222::/64                0  ethernet0/0
S     2001:db8::2323::/64                0  ethernet0/0.59
```

Where, first of all, the number of routes for each type of redistributed route and the total number of redistributed routes are displayed. Subsequently, each route is shown in a table together with its type, cost and the interface through which it can be reached.

3.1.8 ROUTE

The **ROUTE** command shows an OSPFv3 routing table.

Syntax:

```
OSPFv3+route ?
  detail        Display route table details
  external-1    Display type 1 external routers
  external-2    Display type 2 external routers
  inter-area    Display inter-area routers
  intra-area    Display intra-area routers
  summary       Summary of route table
  <cr>
OSPFv3+route
```

Where each command shows the following information:

detail	Displays detailed information on each route.
external-1	Displays type 1 external routes.
external-2	Displays type 2 external routes.
inter-area	Displays *inter-area* routes.
intra-area	Displays *intra-area* routes.
summary	Displays a summary on the types of routes received.

Example:

```
OSPFv3+route
Types: ? - Unknown, R - Router, N - Network, D - Discard, L - Linkstate, A - AddressRange
       ?? - Unknown, O - Intra-Area, OI - Inter-Area, OE1 - External-1, OE2 - External-2

Type   Route                          NextHop                   Interface          Duration
*N OE1 ::/0                           fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:1111::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OE1 2001:db8:1111:1111::/64        fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N O   2001:db8:2222::/64             ::                        ethernet0/0.59     3d23:36:47
*N OI  2001:db8:3333::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:4444::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OE1 2001:db8:4444:4444::/64        fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:5555::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OE1 2001:db8:5555:5555::/64        fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OE2 2001:db8:6161:6161::/64        fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:6666::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:aaaa::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N OI  2001:db8:bbbb::/64             fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
*N O   2001:db8:cccc::/64             ::                        ethernet0/0.59     3d23:36:48
*N OE1 2001:db8:cccc:dddd::/64        fe80::215:63ff:feee:2120  ethernet0/0.59     3d23:36:47
OSPFv3+
```

Where the following information is given for each route:

- Type of route.
- Route.
- Next hop.
- Output interface.

- Length of time it has been active for.

3.1.8.1 DETAIL

This command displays detailed route information.

Syntax:

```
OSPFv3+route detail ?
  <cr>
```

Example:

```
OSPFv3+route detail
Destination: ::/0
Destination type: Network
Installed Time: 00:18:54 ago
  Changed Time: 00:18:54 ago
Associated Area: 3.3.3.3
Path Type: External-1
LS Origin: AS-External Id: 0.0.0.0 Adv: 5.5.5.5
Options: --|-|-|--|-|--
Router Bits: --------
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 2
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59

Destination: 2001:db8:1111::/64
Destination type: Network
Installed Time: 00:18:54 ago
  Changed Time: 00:18:54 ago
Associated Area: 3.3.3.3
Path Type: Inter-Area
LS Origin: Inter-Prefix Id: 0.0.0.13 Adv: 3.3.3.3
Options: --|-|-|--|-|--
Router Bits: --------
Prefix Options: --|--|--|--
Metric Type: 0 Metric: 3
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59
…
Destination: 2001:db8:cccc:dddd::/64
Destination type: Network
Installed Time: 00:18:54 ago
  Changed Time: 00:18:54 ago
Associated Area: 3.3.3.3
Path Type: External-1
LS Origin: AS-External Id: 0.0.0.0 Adv: 1.1.1.1
Options: --|-|-|--|-|--
Router Bits: --------
Prefix Options: --|--|--|--
Metric Type: 1 Metric: 3
Nexthop:
  fe80::215:63ff:feee:2120 ethernet0/0.59
```

Where each field provides information on:

destination	Displays the destination identifier.
destination type	Type of destination: router, network, *linkstate*, range of addresses, dropped, or unknown.
installed time	Time elapsed since being installed in the device.
changed time	Time elapsed since the last change in state.
associated area	Area through which this was learned.
path type	Type of route: intra-area, inter-area or external.
ls origin	Link state through which this has been learned. Displays information on the identifier (*id*) and the advertising router (*adv*).
options	Router options: DC (*Demand Circuit*), R (indicates that this is an active router), N

	(indicates whether this router is in an NSSA area), x (obsolete), E (indicates how the *as-external-lsas* are advertised) and V6 (if this router is active, it is included in the IPv6 routing).
router bits	Router properties: W (obsolete bit previously used for *multicast*), V (this may or may not be a *virtual link* end point), E (this may or may not be an ASBR) and B (this may or may not be an ABR).
metric type	Type of metric: none, type 1 (type 1 external route) or type 2 (type 2 external route). The metric varies according to the type.
metric	Metric that the route has.
nexthop	Next hop through which the router can be reached.

3.1.8.2 EXTERNAL-1 / EXTERNAL-2 / INTER-AREA / INTRA-AREA

The other options allow you to filter the routing table based on route type.

Syntax:

```
OSPFv3+route ?
  detail        Display route table details
  external-1    Display type 1 external routers
  external-2    Display type 2 external routers
  inter-area    Display inter-area routers
  intra-area    Display intra-area routers
  summary       Summary of route table
  <cr>
```

Example:

```
OSPFv3+route inter-area
Types: ? - Unknown, R - Router, N - Network, D - Discard, L - Linkstate, A - AddressRange
       ?? - Unknown, O - Intra-Area, OI - Inter-Area, OE1 - External-1, OE2 - External-2

Type   Route                          NextHop                   Interface          Duration
*N OI  2001:db8:1111::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:3333::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:4444::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:5555::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:6666::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:aaaa::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
*N OI  2001:db8:bbbb::/64             fe80::215:63ff:feee:2120  ethernet0/0.59    3d23:36:47
```

In this example, only the *inter-area* routes are shown.

3.1.8.3 SUMMARY

The **ROUTE SUMMARY** command displays a summary of the OSPFv3 routes.

Syntax:

```
OSPFv3+route summary ?
  <cr>
```

Example:

```
OSPFv3+route summary
Number of OSPFv3 routes: 15
Number of Intra-Area routes: 2
Number of Inter-Area routes: 7
Number of External-1 routes: 5
Number of External-2 routes: 1
```

3.1.9 VRF

Monitors the OSPFv3 protocol in a routing/forwarding domain in Virtual Private Networks (VPNs). For more information, please see the bintec-**Dm775-I VRF** Lite Facility manual.

This menu contains the same monitoring commands as the main VRF.

```
OSPFv3+vrf v1
```

```
-- OSPFv3 protocol monitor for a VRF --

OSPFv3 vrf+?
  border-routers    Display Border and Boundary router information
  database          Display Link state database
  interface         Display OSPFv3 interface information
  linkstate         Display linkstate routing table
  neighbors         Neighbor list
  redistribute      Redistributing external information
  route             Display route table
  exit
```

Command history:

Release	Modification
11.01.09	The *vrf* command was introduced as of version 11.01.09

3.1.10 EXIT

Use the **EXIT** command to return to the previous prompt level.

Syntax:

```
OSPFv3+exit
```

Example:

```
OSPFv3+exit
+
```

Chapter 4 Example

4.1 Example Scenario

In our example, we will use the scenario shown below. We have six devices in different areas performing different roles.

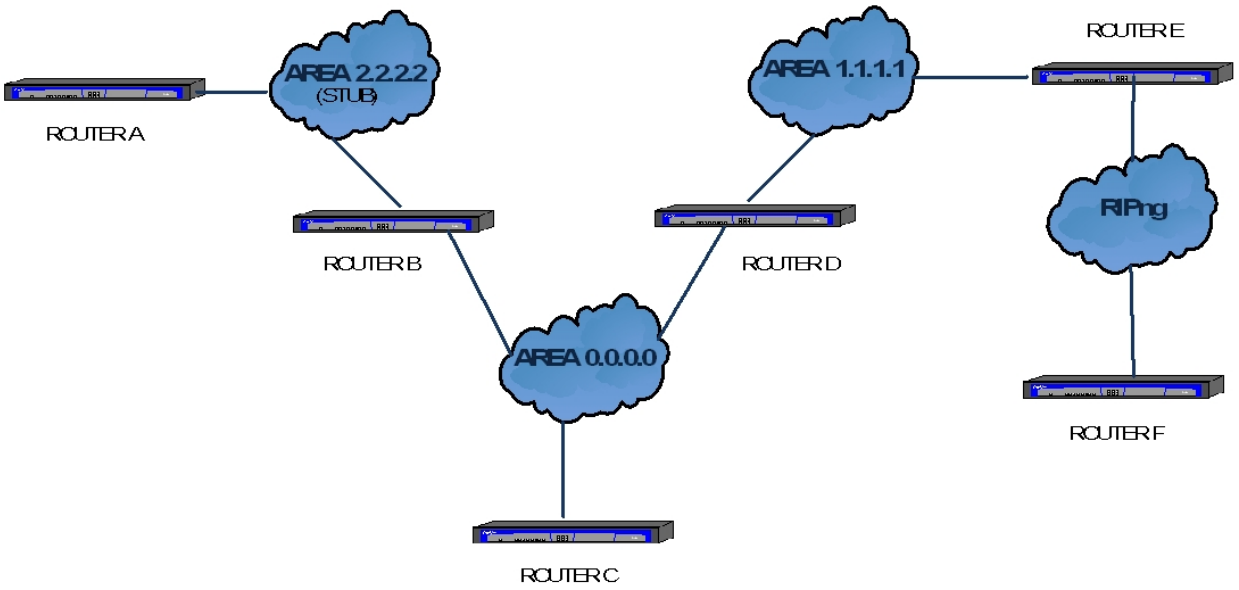

Fig. 2: OSPFv3 network: Example.

To begin with, an OSPFv3 network cannot do without a *backbone* area (area 0.0.0.0). We have three connected devices (B, C and D) in this area, two of which (the ones that are connected to other areas, i.e., routers B and D) are *Area Border Routers* (ABR). The role of these devices is to interconnect several areas and report any changes that occur in these areas to the rest of the network.

Area 2.2.2.2 is configured as a *stub* area, which means external routes cannot be redistributed in its interior. Therefore router A's routing table does not contain either type 1 or type 2 *external* routes.

We have two connected devices in area 1.1.1.1. One (router D), which we have already seen, is the ABR belonging to area 0.0.0.0, and another (router E) that acts as an *Autonomous System Border Router* (ASBR), which redistribute routes from other protocols, redistributes RIPng routes learned from router F.

4.2 Configuring the devices

ROUTER A:

This device does not redistribute its static routes (2001:db8:1111:1111::/64) nor those that do not belong to any area (2001:db8:cccc:dddd::/64), as these are external routes. It belongs to area 2, which is a *stub* area.

```
   log-command-errors
   no configuration
   set hostname RouterA
   set inactivity-timer disabled
   add device eth-subinterface ethernet0/0 57
;
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.166 255.255.254.0
;
      ipv6 enable
      ipv6 address 2001:db8:cccc:dddd::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 priority 255
      ipv6 nd ra suppress
   exit
```

```
;
;
   network ethernet0/0.57
; -- Ethernet Subinterface Configuration --
      ipv6 enable
      ipv6 address 2001:db8:1111::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 area 2.2.2.2

;
      ipv6 ospfv3 priority 255
      encapsulation dot1q 58
;
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:1111:1111::/64 interface ethernet0/0
      unicast-routing
   exit
;
;
   protocol ospfv3
; -- OSPFv3 protocol user configuration --
      area 2.2.2.2 stub
;
      redistribute static
      redistribute connected
      router-id 1.1.1.1
   exit
;
   dump-command-errors
   end
```

ROUTER B:

Router B belongs to two areas; the *backbone* and area 2.2.2.2, which is a *stub* area. In this area, the DR is Router A as it has a higher priority.

```
   log-command-errors
   no configuration
   set hostname RouterB
   set inactivity-timer disabled
   add device eth-subinterface ethernet0/0 58
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.168 255.255.254.0
;
      ipv6 enable
      ipv6 address 2001:db8:2222::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 area 0.0.0.0
;
      ipv6 ospfv3 priority 5
      ipv6 nd ra suppress
   exit
;
   network ethernet0/0.58
; -- Ethernet Subinterface Configuration --
      ipv6 enable
      ipv6 address 2001:db8:aaaa::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 priority 10
      ipv6 ospfv3 area 2.2.2.2
;
```

```
      ipv6 nd ra suppress
      encapsulation dot1q 58
;
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:2222:2222::/64 interface ethernet0/0
      unicast-routing
   exit
;
;
   protocol ospfv3
; -- OSPFv3 protocol user configuration --
      area 2.2.2.2 stub
;
      redistribute static
      redistribute connected
      router-id 2.2.2.2
   exit
;
   dump-command-errors
   end
```

ROUTER C:

This device only belongs to the *backbone*. It is the elected DR as it has a priority of 100. It redistributes *static* and *connected* routes.

```
   log-command-errors
   no configuration
   set hostname RouterC
   set inactivity-timer disabled
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.167 255.255.254.0
;
      ipv6 enable
      ipv6 address 2001:db8:3333::1/64
      ipv6 ospfv3 area 0.0.0.0
;
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 priority 100
      ipv6 nd ra suppress
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:3333:3333::/64 interface ethernet0/0
      unicast-routing
   exit
;
;
   protocol ospfv3
; -- OSPFv3 protocol user configuration --
     redistribute static
     redistribute connected
     router-id 3.3.3.3
   exit
;
   dump-command-errors
   end
```

ROUTER D:

Router D is the ABR between areas 0.0.0.0 and 1.1.1.1. It redistributes *static* and *connected* routes.

```
   log-command-errors
   no configuration
   set hostname RouterD
   set inactivity-timer disabled
   add device eth-subinterface ethernet0/0 59
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.169 255.255.254.0
;
      ipv6 enable
      ipv6 address 2001:db8:4444::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 area 0.0.0.0
;
      ipv6 ospfv3 priority 10
      ipv6 nd ra suppress
   exit
;
;
   network ethernet0/0.57
; -- Ethernet Subinterface Configuration --
      ipv6 enable

      ipv6 address 2001:db8:bbbb::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 area 1.1.1.1
;
      ipv6 ospfv3 priority 10
      ipv6 nd ra suppress
      encapsulation dot1q 57
;
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:5555:5555::/64 interface ethernet0/0
      route ::/0 interface ethernet0/0
      unicast-routing
   exit
;
;
   protocol ospfv3
; -- OSPFv3 protocol user configuration --
      redistribute static
      redistribute connected
      router-id 4.4.4.4
   exit
;
   dump-command-errors
   end
```

ROUTER E:

Router E belongs to area 1.1.1.1, but is also an ASBR as it receives routes from the RIPng protocol in one of its subinterfaces. This device redistributes *static, connected* and *ripng* routes.

It also has a *route-map* configured for static routes. This means that only those routes that *match* the “rmbintec” *route map* are redistributed, besides changing their metric to 8.

It is also the DR in area 1.1.1.1, as it has maximum priority, 255.

```
   log-command-errors
```

```
   no configuration
   set hostname RouterE
   set inactivity-timer disabled
   add device eth-subinterface ethernet0/0 57
   add device eth-subinterface ethernet0/0 60
   feature ipv6-access-list
; -- IPv6 Access Lists user configuration --
      access-list albintec
         entry 1 permit
         entry 1 source address 2001:db8:5151:5151::/64
;
         entry 2 deny
;
      exit
;
   exit
;
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.170 255.255.254.0
;
   exit
;
;
   network ethernet0/0.57
; -- Ethernet Subinterface Configuration --
      ipv6 enable
      ipv6 address 2001:db8:5555::1/64
      ipv6 ospfv3 instance 1
      ipv6 ospfv3 area 1.1.1.1
;
      ipv6 ospfv3 priority 255
      ipv6 nd ra suppress
      encapsulation dot1q 57
;
   exit
;
   network ethernet0/0.60
; -- Ethernet Subinterface Configuration --
      ipv6 enable
      ipv6 ripng enable
      ipv6 ripng passive
      encapsulation dot1q 60
;
   exit
;
   feature route-map
; -- Route maps user configuration --
      route-map "rmbintec"
         entry 1 default
         entry 1 permit
         entry 1 match ipv6 address albintec
         entry 1 set metric 8
;
         entry 2 default
         entry 2 deny
;
      exit
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:5151:5151::/64 interface ethernet0/0
      route 2001:db8:5555:5555::/64 interface ethernet0/0.57
```

```
      unicast-routing
   exit
;
;
   protocol ospfv3
; -- OSPFv3 protocol user configuration --
     redistribute static route-map rmbintec
     redistribute connected
     redistribute ripng
     router-id 5.5.5.5
   exit
;
   dump-command-errors
   end
```

ROUTER F:

The task of router F is to provide Router E with routes from another routing protocol (another IGP), which in this case is RIPng.

```
   log-command-errors
   no configuration
   set hostname RouterF
   set inactivity-timer disabled
   add device eth-subinterface ethernet0/0 60
   set data-link x25 serial0/1
;
   network ethernet0/0
; -- Ethernet Interface User Configuration --
      ip address 192.168.213.171 255.255.254.0
;
   exit
;
;
   network ethernet0/0.60
; -- Ethernet Subinterface Configuration --
      ipv6 enable
      ipv6 address 2001:db8:eeee::1/64
      ipv6 ripng enable
      ipv6 nd ra suppress
      encapsulation dot1q 60
;
   exit
;
;
   protocol ipv6
; -- IPv6 user configuration --
      route 2001:db8:efef:efef::/64 interface ethernet0/0
      unicast-routing
   exit
;
;
   protocol ripng
; -- RIPng protocol user configuration --
      redistribute static
      redistribute connected
   exit
;
   dump-command-errors
   end
```