Configuring OSPF with CLI

This section provides information to configure Open Shortest Path First (OSPF) using the command line interface.

Topics in this section include:

OSPF Configuration Guidelines

Configuration planning is essential to organize routers, backbone, non-backbone, stub, NSSA areas, and transit links. OSPF provides essential defaults for basic protocol operability. You can configure or modify commands and parameters. OSPF is not enabled by default.

The minimal OSPF parameters which should be configured to deploy OSPF are:

- Router ID

  Each router running OSPF must be configured with a unique router ID. The router ID is used by both OSPF and BGP routing protocols in the routing table manager.

  When configuring a new router ID, protocols will not automatically be restarted with the new router ID. Shut down and restart the protocol to initialize the new router ID.

- OSPF Instance

  OSPF instances must be defined when configuring multiple instances and/or the instance being configured is not the base instance.

- An area

  At least one OSPF area must be created. An interface must be assigned to each OSPF area.

- Interfaces

  An interface is the connection between a router and one of its attached networks. An interface has state information associated with it, which is obtained from the underlying lower level protocols and the routing protocol itself. An interface to a network has associated with it a single IP address and mask (unless the network is an unnumbered point-to-point network). An interface is sometimes also referred to as a link.

Basic OSPF Configuration

This section provides information to configure OSPF and OSPF3 as well as configuration examples of common configuration tasks.

The minimal OSPF parameters that need to be configured are:

- A router ID - If a *router-id* is not configured in the `config>router` context, the router's system interface IP address is used.
- One or more areas.
- Interfaces (`interface "system"`).

Following is an example of a basic OSPF configuration:

```
ALA-A>config>router>ospf# info
----------------------------------------------
            area 0.0.0.0
                interface "system"
                exit
            exit
            area 0.0.0.20
                nssa
                exit
                interface "to-104"
                    priority 10
                exit
            exit
            area 0.0.1.1
            exit
----------------------------------------------
ALA-A>config>router>ospf#
A:ALA-48>config>router>ospf3# info
----------------------------------------------
            asbr
            overload
            timers
                lsa-arrival 50000
            exit
            export "OSPF-Export"
            area 0.0.0.0
                interface "system"
                exit
            exit
            area 0.0.0.20
                nssa
                exit
                interface "SR1-2"
                exit
            exit
            area 0.0.0.25
                stub
                    default-metric 5000
                exit
            exit
```

Configuring the Router ID

The router ID uniquely identifies the router within an AS. In OSPF, routing information is exchanged between autonomous systems, groups of networks that share routing information. It can be set to be the same as the loopback (system interface) address. Subscriber services also use this address as far-end router identifiers when service distribution paths (SDPs) are created. The router ID is used by both OSPF and BGP routing protocols. A router ID can be derived by:

- Defining the value in the `config>router` *router-id* context.

- Defining the system interface in the `config>router>interface` *ip-int-name* context (used if the router ID is not specified in the `config>router` *router-id* context).

- Inheriting the last four bytes of the MAC address.

- On the BGP protocol level, a BGP router ID can be defined in the **config>router>bgp router-id** context and is only used within BGP.

- Defining a router ID when creating an OSPF instance `config>router>ospf [instance-id][router-id]`

When configuring a new router ID, protocols are not automatically restarted with the new router ID. The next time a protocol is (re) initialized the new router ID is used. An interim period of time can occur when different protocols use different router IDs. To force the new router ID, issue the `shutdown` and `no shutdown` commands for each protocol that uses the router ID or restart the entire router.

It is possible to configure an SR OS node to operate with an IPv6 only BOF and no IPv4 system interface address. When configured in this manner, the operator must explicitly define IPv4 router IDs for protocols such as OSPF and BGP as there is no mechanism to derive the router ID from an IPv6 system interface address.

The following displays a router ID configuration example:

```
A:ALA-B>config>router# info
#----------------------------------------
# IP Configuration
#----------------------------------------
        interface "system"
            address 10.10.10.104/32
        exit
        interface "to-103"
            address 10.0.0.104/24
            port 1/1/1
        exit
        autonomous-system 100
        router-id 10.10.10.104
...
#----------------------------------------
A:ALA-B>config>router#
```

Configuring OSPF Components

Use the CLI syntax displayed below for:

Configuring OSPF Parameters

The following displays a basic OSPF configuration example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
            asbr
            overload
            overload-on-boot timeout 60
            traffic-engineering
            export "OSPF-Export"
            graceful-restart
                helper-disable
            exit
----------------------------------------------
A:ALA-49>config>router>ospf# ex
```

Configuring OSPF3 Parameters

Use the following CLI syntax to configure OSPF3 parameters:

CLI Syntax:
```
config>router# ospf3
    asbr
    export policy-name [policy-name...(upto 5 max)]
    external-db-overflow limit seconds
    external-preference preference
    overload [timeout seconds]
    overload-include-stub
    overload-on-boot [timeout seconds]
    preference preference
    reference-bandwidth bandwidth-in-kbps
    router-id ip-address
    no shutdown
    timers
        lsa-arrival lsa-arrival-time
        lsa-generate max-lsa-wait
        spf-wait max-spf-wait [spf-initial-wait [spf-second-
        wait]]
```

The following displays an OSPF3 configuration example:

```
A:ALA-48>config>router>ospf3# info
----------------------------------------------
        asbr
        overload
        timers
            lsa-arrival 50000
        exit
        export "OSPF-Export"
----------------------------------------------
A:ALA-48>config>router>ospf3#
```

OSFP also supports the concept of multi-instance OSPFv2 and OSPFv3 which allows separate instances of the SOPF protocols to run independently within the SR-OS router.

Separate instances are created by adding a different instance ID as the optional parameter to the config>router>ospf and config>router>ospf3 commands. When this is done a separate OSPF instance is created which maintains separate link state databases for each instance.

Configuring an OSPF or OSPF3 Area

An OSPF area consists of routers configured with the same area ID. To include a router in a specific area, the common area ID must be assigned and an interface identified.

If your network consists of multiple areas you must also configure a backbone area (0.0.0.0) on at least one router. The backbone is comprised of the area border routers and other routers not included in other areas. The backbone distributes routing information between areas. The backbone is considered to be a participating area within the autonomous system. To maintain backbone connectivity, there must be at least one interface in the backbone area or have a virtual link configured to another router in the backbone area.

The minimal configuration must include an area ID and an interface. Modifying other command parameters are optional.

Use the following CLI syntax to configure an OSPF or OSPF3 area:

CLI Syntax:
```
ospf ospf-instance
ospf3
  area area-id
    area-range ip-prefix/mask [advertise|not-advertise]
    blackhole-aggregate
```

The following displays an OSPF area configuration example:

```
A:ALA-A>config>router>ospf# info
----------------------------------------------
        area 0.0.0.0
        exit
        area 0.0.0.20
        exit
----------------------------------------------
ALA-A>config>router>ospf#A:
```

Configuring a Stub Area

Configure stub areas to control external advertisements flooding and to minimize the size of the topological databases on an area's routers. A stub area cannot also be configured as an NSSA.

By default, summary route advertisements are sent into stub areas. The **no** form of the summary command disables sending summary route advertisements and only the default route is advertised by the ABR. This example retains the default so the command is not entered.

If this area is configured as a transit area for a virtual link, then existing virtual links of a non-stub or NSSA area are removed when its designation is changed to NSSA or stub.

Stub areas for OSPF3 are configured the same as OSPF stub areas.

Use the following CLI syntax to configure virtual links:

CLI Syntax:
```
ospf
ospf3
        area area-id
        stub
        default-metric metric
        summaries
```

The following displays a stub configuration example:

```
ALA-A>config>router>ospf>area># info
----------------------------------------------
...
        area 0.0.0.0
        exit
        area 0.0.0.20
            stub
            exit
        exit
...
----------------------------------------------
ALA-A>config>router>ospf#
```

The following displays a stub configuration example:

```
ALA-A>config>router>ospf>area># info
----------------------------------------------
...
        area 0.0.0.0
        exit
        area 0.0.0.20
            stub
            exit
        exit
...
----------------------------------------------
```

```
ALA-A>config>router>ospf#


A:ALA-48>config>router>ospf3>area# info
----------------------------------------------
                stub
                    default-metric 5000
                exit
----------------------------------------------
A:ALA-48>config>router>ospf3>area#
```

Configuring a Not-So-Stubby Area

You must explicitly configure an area to be a Not-So-Stubby Area (NSSA) area. NSSAs are similar to stub areas in that no external routes are imported into the area from other OSPF areas. The major difference between a stub area and an NSSA is an NSSA has the capability to flood external routes it learns throughout its area and by an area border router to the entire OSPF domain. An area cannot be both a stub area and an NSSA.

If this area is configured as a transit area for a virtual link, then existing virtual links of a non-stub or NSSA area are removed when its designation is changed to NSSA or stub.

Use the following CLI syntax to configure stub areas:

CLI Syntax: ```
ospf ospf-instance
ospf3
        area area-id
    nssa
        area-range ip-prefix/mask [advertise|not-advertise]
        originate-default-route [type-7]
        redistribute-external
        summaries
```

The following displays an NSSA configuration example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------
        asbr
        overload
        overload-on-boot timeout 60
        traffic-engineering
        export "OSPF-Export"
        graceful-restart
            helper-disable
        exit
        area 0.0.0.0
        exit
        area 0.0.0.20
            stub
            exit
        exit
        area 0.0.0.25
            nssa
            exit
        exit
----------------------------------------
A:ALA-49>config>router>ospf#
```

The following displays a OSPF3 NSSA configuration example:

```
A:ALA-48>config>router>ospf3# info
----------------------------------------------
        asbr
        overload
        timers
            lsa-arrival 50000
        exit
        export "OSPF-Export"
        area 0.0.0.0
        exit
        area 0.0.0.20
            stub
            exit
        exit
        area 0.0.0.25
            nssa
            exit
        exit
        area 4.3.2.1
        exit
----------------------------------------------
A:ALA-48>config>router>ospf3#
```

Configuring a Virtual Link

The backbone area (area 0.0.0.0) must be contiguous and all other areas must be connected to the backbone area. If it is not practical to connect an area to the backbone then the area border routers must be connected via a virtual link. The two area border routers will form a point-to-point-like adjacency across the transit area. A virtual link can only be configured while in the area 0.0.0.0 context.

The `router-id` parameter specified in the `virtual-link` command must be associated with the virtual neighbor, that is, enter the virtual neighbor's router ID, not the local router ID. The transit area cannot be a stub area or an NSSA.
Use the following CLI syntax to configure stub areas:

CLI Syntax: ```
ospf ospf-instance
        area area-id
      virtual-link router-id transit-area area-id
         authentication-key [authentication-key|hash-key]
            [hash]
         authentication-type [password|message-digest]

         dead-interval seconds
         hello-interval seconds
         message-digest-key key-id md5 [key|hash-key]
            [hash|hash2]
         retransmit-interval seconds
         transit-delay
         no shutdown
```

The following displays a virtual link configuration example:

```
A:ALA-49>config>router>ospf# info
--------------------------------------------
         asbr
         overload
         overload-on-boot timeout 60
         traffic-engineering
         export "OSPF-Export"
         graceful-restart
             helper-disable
         exit
         area 0.0.0.0
             virtual-link 1.2.3.4 transit-area 1.2.3.4
                 hello-interval 9
                 dead-interval 40
             exit
         exit
         area 0.0.0.20
             stub
             exit
         exit
         area 0.0.0.25
```

```
                        nssa
                        exit
                    exit
                    area 1.2.3.4
                    exit
        ----------------------------------------------
        A:ALA-49>config>router>ospf#
```

The following displays an OSPF3 virtual link configuration example:

```
A:ALA-48>config>router>ospf3# info
----------------------------------------------
            asbr
            overload
            timers
                lsa-arrival 50000
            exit
            export "OSPF-Export"
            area 0.0.0.0
                virtual-link 4.3.2.1 transit-area 4.3.2.1
                exit
            exit
            area 0.0.0.20
                stub
                exit
            exit
            area 0.0.0.25
                nssa
                exit
            exit
            area 4.3.2.1
            exit
----------------------------------------------
A:ALA-48>config>router>ospf3#
```

Configuring an Interface

In OSPF, an interface can be configured to act as a connection between a router and one of its attached networks. An interface includes state information that was obtained from underlying lower level protocols and from the routing protocol itself. An interface to a network is associated with a single IP address and mask (unless the network is an unnumbered point-to-point network). If the address is merely changed, then the OSPF configuration is preserved.

The `passive` command enables the passive property to and from the OSPF interface where passive interfaces are advertised as OSPF interfaces but do not run the OSPF protocol. By default, only interface addresses that are configured for OSPF are advertised as OSPF interfaces. The passive parameter allows an interface to be advertised as an OSPF interface without running the OSPF protocol. When enabled, the interface will ignore ingress OSPF protocol packets and not transmit any OSPF protocol packets.

An interface can be part of more than one area, as specified in RFC5185. To do this, add the keyword **secondary** when creating the interface.

Use the following CLI syntax to configure an OSPF interface:

CLI Syntax:
```
ospf ospf-instance
    area area-id
  interface ip-int-name
    advertise-subnet
    authentication-key [authentication-key|hash-key]
        [hash|hash2]
    authentication-type [password|message-digest]
    bfd-enable
    dead-interval seconds
    hello-interval seconds
    interface-type {broadcast|point-to-point}
    message-digest-key key-id md5 [key|hash-
        key][hash|hash2]
    metric metric
    mtu bytes
    passive
    priority number
    retransmit-interval seconds
    no shutdown
    transit-delay seconds
```

The following displays an interface configuration example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
        asbr
        overload
        overload-on-boot timeout 60
```

```
            traffic-engineering
            export "OSPF-Export"
            graceful-restart
                helper-disable
            exit
            area 0.0.0.0
                virtual-link 1.2.3.4 transit-area 1.2.3.4
                    hello-interval 9
                    dead-interval 40
                exit
                interface "system"
                exit
            exit
            area 0.0.0.20
                stub
                exit
                interface "to-103"
                exit
            exit
            area 0.0.0.25
                nssa
                exit
            exit
            area 1.2.3.4
            exit
          area 4.3.2.1
                interface "SR1-3"
                exit
            exit
            area 4.3.2.1
                interface "SR1-3" secondary
                exit
            exit
----------------------------------------------
A:ALA-49>config>router>ospf# area 0.0.0.20
```

The following displays an interface configuration:

```
A:ALA-48>config>router>ospf3# info
----------------------------------------------
            asbr
            overload
            timers
                lsa-arrival 50000
            exit
            export "OSPF-Export"
            area 0.0.0.0
                virtual-link 4.3.2.1 transit-area 4.3.2.1
                exit
                interface "system"
                exit
            exit
            area 0.0.0.20
                stub
                exit
                interface "SR1-2"
                exit
            exit
```

```
           area 0.0.0.25
               nssa
               exit
           exit
           area 4.3.2.1
           exit


       ---------------------------------------------
       A:ALA-48>config>router>ospf3#
```

Configuring Authentication

This section includes the following topics:

Overview

The use of protocol authentication is recommended to protect against malicious attack on the communications between routing protocol neighbors. These attacks could aim to either disrupt communizations or to inject incorrect routing information into the systems routing table. The use of authentication keys can help to protect the routing protocols from these types of attacks.

Authentication must be explicitly configured and can be done so through two separate mechanisms. First is configuration of an explicit authentication key and algorithm through the use of the authentication and authentication-type commands. The second method is through the use of the authentication keychain mechanism. Both mechanisms are described in the following sections.

Configuring Authentication Keys and Algorithms

The following authentication commands can be configured on the interface level or the virtual link level:

- `authentication-key` — Configures the password used by the OSPF interface or virtual-link to send and receive OSPF protocol packets on the interface when simple password authentication is configured.

- `authentication-type` — Enables authentication and specifies the type of authentication to be used on the OSPF interface, either password or message digest.

- `message-digest-key` — Use this command when `message-digest` keyword is selected in the `authentication-type` command. The Message Digest 5 (MD5) hashing algorithm is used for authentication. MD5 is used to verify data integrity by creating a 128-bit message digest from the data input. It is unique to that specific data.

An special checksum is included in transmitted packets and are used by the far-end router to verify the packet by using an authentication key (a password). Routers on both ends must use the same MD5 key.

MD5 can be configured on each interface and each virtual link. If MD5 is enabled on an interface, then that interface accepts routing updates only if the MD5 authentication is accepted. Updates that are not authenticated are rejected. A router accepts only OSPF packets sent with the same `key-id` value defined for the interface.

When the hash parameter is not used, non-encrypted characters can be entered. Once configured using the `message-digest-key` command, then all keys specified in the command are stored in encrypted format in the configuration file using the `hash` keyword. When using the `hash` keyword the password must be entered in encrypted form. Hashing cannot be reversed. Issue the `no message-digest-key key-id` command and then re-enter the command *without* the `hash` parameter to configure an unhashed key.

The following CLI commands are displayed to illustrate the key authentication features. These command parameters can be defined at the same time interfaces and virtual-links are being configured. See and .

Use the following CLI syntax to configure authentication:

CLI Syntax: `ospf ospf-instance`

```
            area area-id
         interface ip-int-name
             authentication-key [authentication-key|hash-key]
                 [hash]
             authentication-type [password|message-digest]
             message-digest-key key-id md5 key [hash]
         virtual-link router-id transit-area area-id
             authentication-key [authentication-key|hash-key]
                 [hash]
             authentication-type [password|message-digest]
             message-digest-key key-id md5 key [hash]
```

The following displays authentication configuration examples:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
            asbr
            overload
            overload-on-boot timeout 60
            traffic-engineering
            export "OSPF-Export"
            graceful-restart
                helper-disable
            exit
            area 0.0.0.0
                virtual-link 1.2.3.4 transit-area 1.2.3.4
                    hello-interval 9
                    dead-interval 40
                exit
                interface "system"
                exit
            exit
            area 0.0.0.20
                stub
                exit
                interface "to-103"
                exit
            exit
            area 0.0.0.25
```

```
                nssa
                exit
            exit
            area 0.0.0.40
                interface "test1"
                    authentication-type password
                    authentication-key "3WErEDozxyQ" hash
                exit
            exit
            area 1.2.3.4
            exit
-----------------------------------------------
A:ALA-49>config>router>ospf#

A:ALA-49>config>router>ospf# info
-----------------------------------------------
            asbr
            overload
            overload-on-boot timeout 60
            traffic-engineering
            export "OSPF-Export"
            graceful-restart
                helper-disable
            exit
            area 0.0.0.0
                virtual-link 10.0.0.1 transit-area 0.0.0.1
                    authentication-type message-digest
                    message-digest-key 2 md5 "Mi6BQAFi3MI" hash
                exit
                virtual-link 1.2.3.4 transit-area 1.2.3.4
                    hello-interval 9
                    dead-interval 40
                exit
                interface "system"
                exit
            exit
            area 0.0.0.1
            exit
            area 0.0.0.20
                stub
                exit
                interface "to-103"
                exit
            exit
            area 0.0.0.25
                nssa
                exit
            exit
            area 0.0.0.40
                interface "test1"
                    authentication-type password
                    authentication-key "3WErEDozxyQ" hash
                exit
            exit
            area 1.2.3.4
            exit
-----------------------------------------------
A:ALA-49>config>router>ospf#
```

Configuring Authentication using Keychains

The use of authentication mechanism is recommended to protect against malicious attack on the communications between routing protocol neighbors. These attacks could aim to either disrupt communications or to inject incorrect routing information into the systems routing table. The use of authentication keys can help to protect the routing protocols from these types of attacks. In addition, the use of authentication keychains provides the ability to configure authentication keys and make changes to them without affecting the state of the routing protocol adjacencies.

To configure the use of an authentication keychain within OSFP, use the following steps:

1. Configure an authentication keychain within the config>system>security context. The configured keychain must include at least on valid key entry, using a valid authentication algorithm for the OSPF protocol.

2. Associate the configure authentication keychain within OSPF. Authentication keychains can be used to specify the authentication key and algorithm on a per interface basis within the configuration for the OSPF protocol.

For a key entry to be valid, it must include a valid key, the current system clock value must be within the begin and end time of the key entry, and the algorithm specified in the key entry must be supported by the OSPF protocol.

The OSPF protocol supports the following algorithms:

- clear text password
- MD5
- HMAC-SHA-1-96
- HMAC-SHA-1
- HMAC-SHA-256

Keychain Error handling:

- If a keychain exists but there are no active key entries with an authentication type that is valid for the associated protocol, then inbound protocol packets will not be authenticated and discarded and no outbound protocol packets will be sent.

- If keychain exists, but the last key entry has expired, a log entry will be raised indicating that all keychain entries have expired. The OSPF protocol requires that the protocol continue to authenticate inbound and outbound traffic using the last valid authentication key.

Assigning a Designated Router

A designated router is elected according to the priority number advertised by the routers. When a router starts up, it checks for a current designated router. If a designated router is present, then the router accepts that designated router, regardless of its own priority designation. When a router fails, then new designated and backup routers are elected according their priority numbers.

The **priority** command is only used if the interface is a broadcast type. The designated router is responsible for flooding network link advertisements on a broadcast network to describe the routers attached to the network. A router uses hello packets to advertise its priority. The router with the highest priority interface becomes the designated router. A router with priority 0 is not eligible to be a designated router or a backup designated router. At least one router on each logical IP network or subnet must be eligible to be the designated router. By default, routers have a priority value of 1.

Use the following CLI syntax to configure the designated router:

CLI Syntax: `ospf` *ospf-instance*
       `area` *area-id*
     `interface` *ip-int-name*
       `priority` *number*

The following displays a priority designation example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
        asbr
        overload
        overload-on-boot timeout 60
        traffic-engineering
        export "OSPF-Export"
        graceful-restart
            helper-disable
        exit
        area 0.0.0.0
            virtual-link 10.0.0.1 transit-area 0.0.0.1
                authentication-type message-digest
                message-digest-key 2 md5 "Mi6BQAFi3MI" hash
            exit
            virtual-link 1.2.3.4 transit-area 1.2.3.4
                hello-interval 9
                dead-interval 40
            exit
            interface "system"
            exit
        exit
        area 0.0.0.1
        exit
        area 0.0.0.20
            stub
            exit
            interface "to-103"
```

```
                exit
            exit
            area 0.0.0.25
                nssa
                exit
                interface "if2"
                    priority 100
                exit
            exit
            area 0.0.0.40
                interface "test1"
                    authentication-type password
                    authentication-key "3WErEDozxyQ" hash
                exit
            exit
            area 1.2.3.4
            exit
----------------------------------------------
A:ALA-49>config>router>ospf#
```

Configuring Route Summaries

Area border routers send summary (type 3) advertisements into a stub area or NSSA to describe the routes to other areas. This command is particularly useful to reduce the size of the routing and Link State Database (LSDB) tables within the stub or NSSA.

By default, summary route advertisements are sent into the stub area or NSSA. The `no` form of the `summaries` command disables sending summary route advertisements and, in stub areas, the default route is advertised by the area border router.

The following CLI commands are displayed to illustrate route summary features. These command parameters can be defined at the same time stub areas and NSSAs are being configured. See Configuring a Stub Area on page 304 and Configuring a Not-So-Stubby Area on page 306.

Use the following CLI syntax to configure a route summary:

CLI Syntax:
```
ospf ospf-instance
        area area-id
    stub
        summaries
    nssa
        summaries
```

The following displays a stub route summary configuration example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
        asbr
        overload
        overload-on-boot timeout 60
        traffic-engineering
        export "OSPF-Export"
        graceful-restart
            helper-disable
        exit
        area 0.0.0.0
            virtual-link 10.0.0.1 transit-area 0.0.0.1
                authentication-type message-digest
                message-digest-key 2 md5 "Mi6BQAFi3MI" hash
            exit
            virtual-link 1.2.3.4 transit-area 1.2.3.4
                hello-interval 9
                dead-interval 40
            exit
            interface "system"
            exit
        exit
        area 0.0.0.1
        exit
        area 0.0.0.20
            stub
```

```
                exit
                interface "to-103"
                exit
            exit
            area 0.0.0.25
                nssa
                exit
                interface "if2"
                    priority 100
                exit
            exit
            area 0.0.0.40
                interface "test1"
                    authentication-type password
                    authentication-key "3WErEDozxyQ" hash
                exit
            exit
            area 1.2.3.4
            exit
----------------------------------------------
A:ALA-49>config>router>ospf#

A:ALA-48>config>router>ospf3# info
----------------------------------------------
            asbr
            overload
            timers
                lsa-arrival 50000
            exit
            export "OSPF-Export"
            area 0.0.0.0
                virtual-link 4.3.2.1 transit-area 4.3.2.1
                exit
                interface "system"
                exit
            exit
            area 0.0.0.20
                stub
                exit
                interface "SR1-2"
                exit
            exit
            area 0.0.0.25
                nssa
                exit
            exit
            area 4.3.2.1
            exit
----------------------------------------------
A:ALA-48>config>router>ospf3#
```

Configuring Route Preferences

A route can be learned by the router from different protocols, in which case, the costs are not comparable. When this occurs the preference value is used to decide which route is installed in the forwarding table if several protocols calculate routes to the same destination. The route with the lowest preference value is selected

Different protocols should not be configured with the same preference, if this occurs the tiebreaker is per the default preference table as defined in Table 5. If multiple routes are learned with an identical preference using the same protocol, the lowest cost route is used.

Table 5:   Route Preference Defaults by Route Type

Route Type	Preference	Configurable
Direct attached	0	No
Static routes	5	Yes
OSPF internal	10	Yes[a]
IS-IS level 1 internal	15	Yes
IS-IS level 2 internal	18	Yes
OSPF external	150	Yes
TMS	167	No
IS-IS level 1 external	160	Yes
IS-IS level 2 external	165	Yes
BGP	170	Yes

a. Preference for OSPF internal routes is configured with the **preference** command.

If multiple routes are learned with an identical preference using the same protocol and the costs (metrics) are equal, then the decision of what route to use is determined by the configuration of the **ecmp** in the **config>router** context.

The following CLI commands are displayed to illustrate route preference features. The command parameters can be defined at the same time you are configuring OSPF. See Configuring OSPF Components on page 301.

Use the following CLI syntax to configure a route preference:

CLI Syntax: `ospf` *ospf-instance*
            `ospf3`
                    `preference` *preference*
                    `external-preference` *preference*

The following displays a route preference configuration example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------
        asbr
        overload
        overload-on-boot timeout 60
        traffic-engineering
        preference 9
        external-preference 140
        export "OSPF-Export"
        graceful-restart
            helper-disable
        exit
        area 0.0.0.0
            virtual-link 10.0.0.1 transit-area 0.0.0.1
                authentication-type message-digest
                message-digest-key 2 md5 "Mi6BQAFi3MI" hash
            exit
            virtual-link 1.2.3.4 transit-area 1.2.3.4
                hello-interval 9
                dead-interval 40
            exit
            interface "system"
            exit
        exit
        area 0.0.0.1
        exit
        area 0.0.0.20
            stub
            exit
            interface "to-103"
            exit
        exit
        area 0.0.0.25
            nssa
            exit
            interface "if2"
                priority 100
            exit
        exit
        area 0.0.0.40
            interface "test1"
                authentication-type password
                authentication-key "3WErEDozxyQ" hash
            exit
        exit
        area 1.2.3.4
        exit
```

The following displays a route preference configuration example:

```
A:ALA-48>config>router>ospf3# info
---------------------------------------------
        asbr
        overload
        timers
            lsa-arrival 50000
        exit
        preference 9
        external-preference 140
        export "OSPF-Export"
        area 0.0.0.0
            virtual-link 4.3.2.1 transit-area 4.3.2.1
            exit
            interface "system"
            exit
        exit
        area 0.0.0.20
            stub
            exit
            interface "SR1-2"
            exit
        exit
        area 0.0.0.25
            nssa
            exit
        exit
        area 4.3.2.1
        exit
---------------------------------------------
A:ALA-48>config>router>ospf3#
```

OSPF Configuration Management Tasks

This section discusses the following OSPF configuration management tasks:

Modifying a Router ID

Since the router ID is defined in the `config>router` context, not in the OSPF configuration context, the protocol instance is not aware of the change. Re-examine the plan detailing the router ID. Changing the router ID on a device could cause configuration inconsistencies if associated values are not also modified.

After you have changed a router ID, manually shut down and restart the protocol using the `shutdown` and `no shutdown` commands in order for the changes to be incorporated.

Use the following CLI syntax to change a router ID number:

CLI Syntax: `config>router# router-id router-id`

The following displays a NSSA router ID modification example:

```
A:ALA-49>config>router# info
----------------------------------------
IP Configuration
----------------------------------------
        interface "system"
            address 10.10.10.104/32
        exit
        interface "to-103"
            address 10.0.0.103/24
            port 1/1/1
        exit
        autonomous-system 100
        router-id 10.10.10.104
----------------------------------------
A:ALA-49>config>router#


ALA-48>config>router# info
----------------------------------------
IP Configuration
----------------------------------------
        interface "system"
            address 10.10.10.103/32
```

```
        exit
        interface "to-104"
            address 10.0.0.104/24
            port 1/1/1
        exit
        autonomous-system 100
        router-id 10.10.10.103
----------------------------------------
ALA-48>config>router#
```

Deleting a Router ID

You can modify a router ID, but you cannot delete the parameter. When the `no router router-id` command is issued, the router ID reverts to the default value, the system interface address (which is also the loopback address). If a system interface address is not configured, then the last 32 bits of the chassis MAC address is used as the router ID.

Modifying OSPF Parameters

You can change or remove existing OSPF parameters in the CLI or NMS. The changes are applied immediately.

The following example displays an OSPF modification in which an interface is removed and another interface added.

Example:
```
config>router# ospf 1
config>router>ospf# area 0.0.0.20
config>router>ospf>area# no interface "to-103"
config>router>ospf>area# interface "to-HQ
config>router>ospf>area>if$ priority 50
config>router>ospf>area>if# exit
config>router>ospf>area# exit
```

The following example displays the OSPF configuration with the modifications entered in the previous example:

```
A:ALA-49>config>router>ospf# info
----------------------------------------------
            asbr
            overload
            overload-on-boot timeout 60
            traffic-engineering
            preference 9
            external-preference 140
            export "OSPF-Export"
            graceful-restart
                helper-disable
            exit
            area 0.0.0.0
                virtual-link 10.0.0.1 transit-area 0.0.0.1
                    authentication-type message-digest
                    message-digest-key 2 md5 "Mi6BQAFi3MI" hash
                exit
                virtual-link 1.2.3.4 transit-area 1.2.3.4
                    hello-interval 9
                    dead-interval 40
                exit
                interface "system"
                exit
            exit
            area 0.0.0.1
            exit
            area 0.0.0.20
                stub
                exit
                interface "to-HQ"
                    priority 50
                exit
            exit
            area 0.0.0.25
```

```
                        nssa
                        exit
                        interface "if2"
                            priority 100
                        exit
                exit
                area 0.0.0.40
                        interface "test1"
                            authentication-type password
                            authentication-key "3WErEDozxyQ" hash
                        exit
                exit
                area 1.2.3.4
                        exit
        ---------------------------------------------
        A:ALA-49>config>router>ospf#
```