

Chapter 23

Open Shortest Path First (OSPF)

Introduction	23-3
OSPF Features	23-3
Adjacency and Designated Routers	23-5
Link State Advertisements	23-6
OSPF Packet Types	23-7
OSPF States	23-8
OSPF Metrics	23-9
OSPF Auto Cost Calculation	23-9
Routing with OSPF	23-10
Addressless Interfaces	23-10
Using OSPF and RIP	23-11
Importing BGP routes into OSPF	23-11
OSPF On Demand Circuits	23-13
Configuration Examples	23-15
A Basic OSPF Network	23-15
An OSPF Network with Addressless PPP Links	23-16
An OSPF Network with Virtual Links	23-17
Command Reference	23-20
add ospf area	23-20
add ospf host	23-21
add ospf interface	23-22
add ospf neighbour	23-26
add ospf range	23-27
add ospf stub	23-28
delete ospf area	23-29
delete ospf host	23-29
delete ospf interface	23-30
delete ospf neighbour	23-31
delete ospf range	23-31
delete ospf stub	23-32
disable ospf	23-32
disable ospf debug	23-33
disable ospf interface	23-33
disable ospf log	23-34
enable ospf	23-35
enable ospf debug	23-35
enable ospf interface	23-36
enable ospf log	23-36
purge ospf	23-37
reset ospf	23-37
reset ospf counter	23-38

reset ospf interface	23-38
set ospf	23-39
set ospf area	23-41
set ospf host	23-42
set ospf interface	23-43
set ospf neighbour	23-46
set ospf range	23-47
set ospf stub	23-48
show ospf	23-49
show ospf area	23-51
show ospf debug	23-53
show ospf host	23-53
show ospf interface	23-55
show ospf lsa	23-59
show ospf neighbour	23-63
show ospf range	23-64
show ospf route	23-65
show ospf stub	23-67

Introduction

This chapter describes the Open Shortest Path First (OSPF) protocol, support for OSPF on the router, and how to configure the router to use OSPF as a routing protocol.

Some interface and port types mentioned in this chapter may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the *AR400 Series Router Hardware Reference*.

OSPF Features

Open Shortest Path First (OSPF) is an Interior Gateway Routing Protocol, based on Shortest Path First (SPF) or link-state technology. OSPF is defined in RFCs 1245–1247, 1253 and 1583. OSPF was designed specifically for the TCP/IP Internet environment, and supports the following features:

- Authentication of routing updates.
- Tagging of externally-derived routes.
- Fast response to topology changes with low overhead.
- Load sharing over meshed links.

In SPF-based routing protocols, each router maintains a database describing the Autonomous System's (AS) topology. Each router has an identical database. Each piece of this database describes a particular router and its current state, which includes the state of the interfaces, reachable neighbours, and other information. The router distributes this information about the Autonomous System by "flooding".

Each router runs the algorithm in parallel with other SPF routers, and from the internal database, constructs a tree of shortest paths with itself as the root. The tree contains a route to each destination in the Autonomous System. External routes are added to the tree as "leaves".

OSPF allows the grouping of networks into a set, called an *area*. The topology of an area is hidden from the rest of the Autonomous System. This technique minimizes the routing traffic required for the protocol. When multiple areas are used, each area has its own copy of the topological database.

Another feature of OSPF is that it allows IP subnets to be configured in a very flexible way. Each route distributed by OSPF has a destination and a mask. During the routing process, routes with the longest mask to a destination are used in preference to shorter masks. Host routes are also supported by OSPF; these are considered to be subnets with masks of all ones.

All OSPF protocol exchanges can be authenticated so that only trusted routers participate in the creation of the topology database, and hence the Autonomous System's routing. Authentication is disabled by default.

Externally derived routing data can be passed into the Autonomous System transparently. The externally derived routing information is kept separate from the OSPF protocol's link state data.

OSPF supports the following types of physical networks ([Table 23-1](#)):

Table 23-1: Physical networks supported by OSPF.

Network type	Description
Point-to-point	A network of two routers, one at either end of a single connection. The point-to-point interfaces can be set up as numbered or unnumbered interfaces.
Broadcast	A network with potentially more than two routers, and capable of sending a single physical message to all the routers. An example of this type of network is an Ethernet network.
Non-broadcast	A network with potentially more than two routers, but without a mechanism to send a single physical message to all the routers. Examples of these types of network are frame relay or X.25 networks.

The Autonomous System can be split into multiple areas. This means that routing within the Autonomous System takes place on two levels, depending on whether the route to the destination lies entirely within an area (intra-area routing) or in another area (inter-area routing). To link together multiple areas, OSPF uses the concept of a *backbone* that consists of networks and routers linking the other areas. These routers typically have interfaces to the backbone and to other areas. The backbone must be contiguous. *Virtual links* can be used to make the backbone contiguous. Virtual links are links configured between any two backbone routers through a non-backbone area. The backbone itself has all the properties of an area.

When a packet must be routed between two areas, the backbone is used. The packet is first routed to the router that is connected both to the originating area and to the backbone (such a router is called an *Area Border Router*). The packet is then routed through the backbone to another area border router acting for the destination area. The packet is finally routed through the destination area to the specific destination.

OSPF routers can be classified into four overlapping types — Internal routers, Area Border routers, Backbone routers, and Autonomous System (AS) routers ([Table 23-2](#)).

Table 23-2: OSPF router types

Router type	Description
Internal Router	Internal Routers route packets within a single area. The internal router can also be a backbone router if that router has no interfaces to other areas.
Area Border Router	Area border routers have interfaces in multiple areas, and route packets between these areas. Area border routers condense topological information before passing it to the backbone. This reduces the amount of routing information passed across the backbone.
Backbone router	A backbone router has an interface on the backbone area.
AS boundary router	AS boundary routers exchange routing information with other autonomous systems.

OSPF supports the concept of *stub* areas. External advertisements (external routing information) are not flooded into stub areas. Instead, a single default route is advertised by the Area Border Router. This feature reduces the number of routes the router needs to store, which may become critical if many external routes are known.

OSPF also supports Not-So-Stubby Areas. An NSSA is an optional type of Open Shortest Path First (OSPF) area. NSSAs are similar to the existing OSPF stub area configuration option but have the additional capability of importing AS external routes in a limited fashion. NSSAs are described in RFC1587, "The OSPF Not-So-Stubby Area (NSSA) Option".

Adjacency and Designated Routers

OSPF creates adjacencies between neighbouring routers. The reason for forming adjacencies is to exchange topological information. Not every router needs to become adjacent to every other router. Adjacencies are established and maintained with *hello* packets. These packets are sent periodically on all router interfaces. Bidirectional communication is determined by a router seeing itself listed in hello packets from its neighbours. On broadcast and non-broadcast multi-access networks, one of the routers becomes a *designated router*. This router performs the following additional tasks:

■ Network Links Advertisement

The designated router originates the network link state advertisement for the network.

■ Adjacency

The designated router becomes adjacent to all other routers on the network. Since the topological database is spread over adjacencies, the designated router coordinates the synchronization of the topological database on all the routers attached to the network.

The designated router for a broadcast network is determined dynamically via hello packets. On non-broadcast multi-access networks, static configuration information is used to initiate the search for a designated router. To help in dynamic fallover, OSPF also determines a backup designated router for a

network via hello packets. The backup designated router, like the designated router maintains an adjacency to all other routers on the network. If the designated router fails for any reason, the backup designated router takes over.

Link State Advertisements

Link state advertisements are records in the topological database. Routers may generate five different types of link state advertisements ([Table 23-3 on page 23-7](#)). Each type of link state advertisement describes a different set of features of the Autonomous System.

Link state advertisements *age* to a maximum age called *MaxAge* (3600 seconds) while stored in the topological database. When a link state advertisement reaches *MaxAge*, the router tries to flush it from the routing domain by reflooding the advertisement. A link state advertisement that has reached *MaxAge* is not used in further routing table calculations. The *MaxAge* link state advertisement is removed totally from the topological database when it is no longer contained on a neighbour link state retransmission list or none of the neighbours are in exchange or loading state. It is relatively rare for a link state advertisement to reach *MaxAge* because advertisements are usually replaced by more recent instances by normal refresh processes.

Table 23-3: OSPF link state advertisement types

Type	Meaning
Router Links	The router originates a router links advertisement for each area to which it belongs. The advertisement describes the collected states of the router's links to the area. This advertisement also indicates if the router is an area border router or an AS boundary router.
Network Links	A network link advertisement is originated for every transit multi-access network. This advertisement is originated by the designated router for the transit network, and describes all the OSPF routers fully adjacent to the designated router.
Summary Links	Summary Link advertisements describe a single route to a destination. The destinations described are external to the area but internal to the Autonomous System. Some condensing of routing information occurs when creating these summary link state advertisements.
AS Summary Links	These are like summary link advertisements but they describe routes to Autonomous System boundary routers.
AS External Links	AS external advertisements describe routes external to the Autonomous System.

OSPF Packet Types

The OSPF protocol runs directly over IP, using the assigned number 89. The protocol uses five different packet types ([Table 23-4](#)).

Table 23-4: OSPF packet types

Type	Purpose
Hello	Used to discover and maintain neighbours.
Database Description	Used to form adjacencies. The router summarises all its link state advertisements and passes this information, via database description packets to the router it is forming an adjacency with.
Link State Request	After the database description packets have been exchanged with a neighbour, the router may detect link state advertisements it requires to update or complete the topological database. Link state request packets are sent to the neighbour requesting these link state advertisements.
Link State Update	Used for transmission of link state advertisements between routers. This could be in response to a link state request packet or to flood a new or more recent link state advertisement.
Link State Acknowledgment	Used to make the flooding of link state advertisements reliable. Each link state advertisement received is explicitly acknowledged.

OSPF States

Neighbours can be in any of eight different states ([Table 23-5](#)). Similarly, the router's interfaces can be in one of seven different states ([Table 23-6 on page 23-8](#)).

Table 23-5: OSPF neighbour states

State	Meaning
Down	This is the initial state. No hello packets have been received from the neighbour recently or at all.
Attempt	This state applies to non-broadcast multi-access networks. The router is making a determined attempt to contact a statically configured neighbour. Hello packets are sent every HelloInterval.
Init	A hello packet has been seen from the neighbour, however the hello packet does not list the router as known.
Two-Way	This state is entered when the communication between two neighbours is bidirectional (the hello packet from the neighbour lists this router as a neighbour).
ExStart	This is the first step in creating an adjacency between two routers. The two routers decide which is going to control the exchange between them.
Exchange	In this state, the neighbours exchange database description packets. Each packet summarises the link state advertisements held by that router.
Loading	After all the database description information has been exchanged, the routers exchange link state advertisements required to update or complete each router's topological database thereby synchronising the two router's databases.
Full	This is the final state and the adjacency is complete. Reaching this state in itself may cause new instances of some link state advertisements, such as the network and router advertisements related to the two routers.

Table 23-6: OSPF interface states

State	Meaning
Down	The initial state. No traffic can be routed with the interface in this state.
Loopback	The router's interface to the network is looped back.
Waiting	Interfaces to broadcast and non-broadcast multi-access networks enter this state when they are started. In this state the router tries to determine the backup designated router. The router is not allowed to elect a backup or designated router while in the waiting state. This stops unnecessary changes in the designated router.
Point-to-point	The interface is operational and is connected to a point-to-point network or virtual link.
DROther	The interface to a broadcast or a non-broadcast multi-access network has not been selected as either the designated router or backup designated router for the network.
Backup	The interface to a broadcast or a non-broadcast multi-access network has been selected as the backup designated router for the network.
DR	The interface to a broadcast or a non-broadcast multi-access network has been selected as the designated router for the network.

OSPF Metrics

The metrics used by OSPF are not simple distance metrics, as used by RIP, but are measures of the bandwidth. Interface metrics should be set using the formula $10^8 / \text{InterfaceSpeed}$. This gives metrics such as 10 for Ethernet and 1562 for a 64 kbps serial line.

OSPF Auto Cost Calculation

OSPF interfaces automatically set the OSPF metric of an IP interface on the basis of the bandwidth of the interface, instead of the system administrator manually setting the OSPF metric. Automatic setting takes into account that the speed of an interface can change over time, when ports change link state or change speed via auto negotiation or manual setting. If metrics are manually set, some interfaces are preferred when they should not be because the network configuration dynamically changes.

Note that the interface speed used in the cost calculation is the average interface speed. For example, if the interface is a VLAN with two ports up, and one port has a speed of 10 and the other a speed of 100, then the metric will be 18.

To configure auto cost calculation:

1. Do not set the OSPF metric manually in the **add ip interface** command. If you have, remove the manual setting, using the command:

```
set ip interface=int ospfmetric=default
```

The **ospfmetric** parameter specifies the cost of crossing the logical interface, for OSPF. If **default** is specified the interface is restored to the default metric value. The setting of the OSPF metric to a value other than **default** provides a mechanism to provide a metric for an interface that is preferred over the OSPF automatic metric setting (if enabled via **set ospf autcost=on**).

2. Set **autocost** to on and change the reference bandwidth if necessary, using the command:

```
set ospf autcost=on [refbandwidth=10..10000]
```

The **autocost** parameter specifies whether or not the switch will assign OSPF interface metrics based on the available interface bandwidth. If an OSPF metric has been manually assigned using the **add ip interface ospfmetric=x** command, the manual metric setting will take priority over an automatic metric setting. The default is **off**.

The **refbandwidth** parameter specifies the reference bandwidth in megabits per second used for calculating the OSPF metric. The cost is calculated as **refbandwidth** / Interface Bandwidth. Using the default settings, the automatic cost calculation will result in an OSPF metric of 10 for a fast Ethernet (100M) interface. The **autocost** parameter must be set to **on** for the parameter **refbandwidth** to take effect. The default is 1000.

3. To check the settings, use the command:

```
show ospf
```

Routing with OSPF

To route an IP packet, the router looks up the routing table entry that best matches the destination of the packet. This entry contains the interface and nexthop router to forward the IP packet to its destination. The entry that best matches the destination is determined first by the path type ([Table 23-7 on page 23-10](#)), then the longest (most specific) network mask. At this point there may still be multiple routing entries to the destination; if so, then equi-cost multi-path routes exist to the destination. Such equi-cost routes are appropriately used to share the load to the destination.

Table 23-7: OSPF path types

Path Type	Meaning
INTRA	The route to the destination is within a single OSPF area.
INTER	The route to the destination is within the Autonomous system but spans more than one OSPF area.
EXT1	The route to the destination is via an AS router within the Autonomous system. This is an OSPF external route of Type 1. Type 1 external routes add the external metric as received by the AS router and the internal OSPF metric to the AS router to determine the final metric to the destination.
EXT2	This path type means that the route to the destination is via an AS router within the Autonomous system. This is an OSPF external route of Type 2. Type 2 external routes use two metrics to determine how to route traffic to the destination. The first metric is the internal OSPF metric to the AS router, the second metric is the EGP-derived external metric to the destination.

Addressless Interfaces

OSPF supports addressless interfaces on PPP links. There are a few restrictions, however, to the use of such addressless interfaces. If access to the router is required via ping or Telnet, then there must be at least one other interface with an assigned Internet address.



A router generally has at least one LAN interface, and this would usually have an assigned IP address.

A virtual link cannot be configured through an area where the last interface to the area border router is an addressless interface. The reason for this is that to create a virtual link, each end must have a real Internet address to send and receive OSPF packets that are sent as unicast packets. Except for these few restrictions it is prudent to use addressless interfaces on PPP links to save needless use of IP address space.

RFC 1583 provides additional support for addressless interfaces. Addressless interfaces are distinguished from each other by the *ifIndex* of the interface. This data is placed into router LSAs, and is flooded to all OSPF routers. This data is also used to provide next hop information when routes are calculated. The addressless interface index is displayed in the output of the **show ospf lsa** command on [page 23-59](#), and the output of the **show ip route** command on

page 14-206 of Chapter 14, Internet Protocol (IP). In the SHOW IP ROUTE command the next hop for OSPF routes that are down an addressless PPP interface is displayed as the ifIndex in dotted decimal notation. For example, if the addressless interface index for a PPP interface is 5, the next hop appears as 0.0.0.5.

Using OSPF and RIP

OSPF is an Internal Gateway Routing Protocol, and as such would normally have no mechanism to exchange routing information with other internal gateway routing protocols such as RIP. This implementation allows the bidirectional exchange of routing information with RIP. The main problems with such a routing exchange is that RIP metrics are based on a simple distance scheme (i.e. the number of routers in the path to the destination), while OSPF metrics are based on bandwidth. To handle incoming RIP packets, this implementation treats routes derived from RIP as it would other exterior routing information such as EGP routing information, and converts such routes into routes of type EXT1. The RIP metric is simply added to the internal OSPF metric. If the RIP metric is infinity the OSPF metric is similarly set to infinity. Exporting OSPF-derived routes out to RIP is more difficult. There is no easy way of converting the bandwidth metrics to distance metrics. The simplistic model used by this implementation is to use any OSPF metric below 8 as is, and to convert any metric above 8 to 8. OSPF metrics of infinity are converted to RIP infinity 16. This scheme would hence broadcast the OSPF-derived routes (and possibly OSPF external routes) with metrics of 8 and above, at a distance that is somewhat far away.

To import or export RIP use the command:

```
SET OSPF RIP={OFF|EXPORT|IMPORT|BOTH}
```

Then configure RIP as detailed in [Chapter 14, Internet Protocol \(IP\)](#).

Importing BGP routes into OSPF

This feature allows you to import routes from BGP into OSPF. BGP can learn thousands of routes, so it is important to consider the network impact of importing these routes. Routing devices in the OSPF domain may become overloaded if they store too many routes. You can prevent this by limiting the number of routes to be imported.



Do not enable the importing of BGP routes into OSPF unless you are sure about the consequences for the OSPF domain.

To enable importing BGP routes into OSPF, use the command:

```
SET OSPF BGPIMPORT=ON
```

There are two ways to limit the number of BGP routes imported into OSPF. One way is to specify a maximum number of routes with the command:

```
SET OSPF BGPLIMIT=1..4000
```

When the limit is reached, routes are no longer imported until existing ones are removed. Because they are BGP routes, BGP controls when the routes disappear. If you change the BGPLIMIT, the device may re-import BGP routes.

The other way to limit the imported routes is to configure a routing filter. This filter is used in conjunction with the BGPFILTER parameter in the SET OSPF command to control the passing of routing information in and out of the device. To configure a filter, use the ADD IP FILTER command:

```
ADD IP FILTER=filter-number {ACTION=INCLUDE|EXCLUDE}  
SOURCE=ipadd [SMASK=ipadd] [ENTRY=entry-number]
```

Use this filter to limit imported BGP routes with the command:

```
SET OSPF BGPFILTER=300..399
```

where the filter number is the previously configured filter.

Take care when configuring the IP filter. If the number of imported routes reaches the BGPLIMIT parameter, you may not have imported all the routes specified with the BGPFILTER parameter. If you change the filter, the device re-imports the BGP routes according to the new filter.

The order in which routes are added is arbitrary. This means that to have desired BGP routes advertised by OSPF, you must take care setting the ENTRY number for the route filter with the ADD IP ROUTE command. Assign a low entry number to a filter used to import preferred BGP routes. Alternatively, set the BGPLIMIT parameter above the total number of routes that BGP should add to the routing table.

Configuration example

This example supposes that you want to import the route 192.168.72.0 into the OSPF routing domain, but no other routes. This route is received on the gateway router as a BGP route. The following steps show the sequence of commands to use in this scenario.

1. Set up the IP filter:

```
ADD IP FILTER=300 SOURCE=192.168.72.0 SMASK=255.255.255.255  
ACTION=INCLUDE
```

2. Set up OSPF BGP import parameters:

```
SET OSPF BGPIMPORT=ON BGPFILTER=300 BGPLIMIT=1
```

3. Check that BGP has added the route to the IP route table:

```
SHOW IP ROUTE=192.168.72.0
```

The route should be visible in the output of the command.

4. Check that OSPF has imported the route:

```
SHOW OSPF LSA=192.168.72.0
```

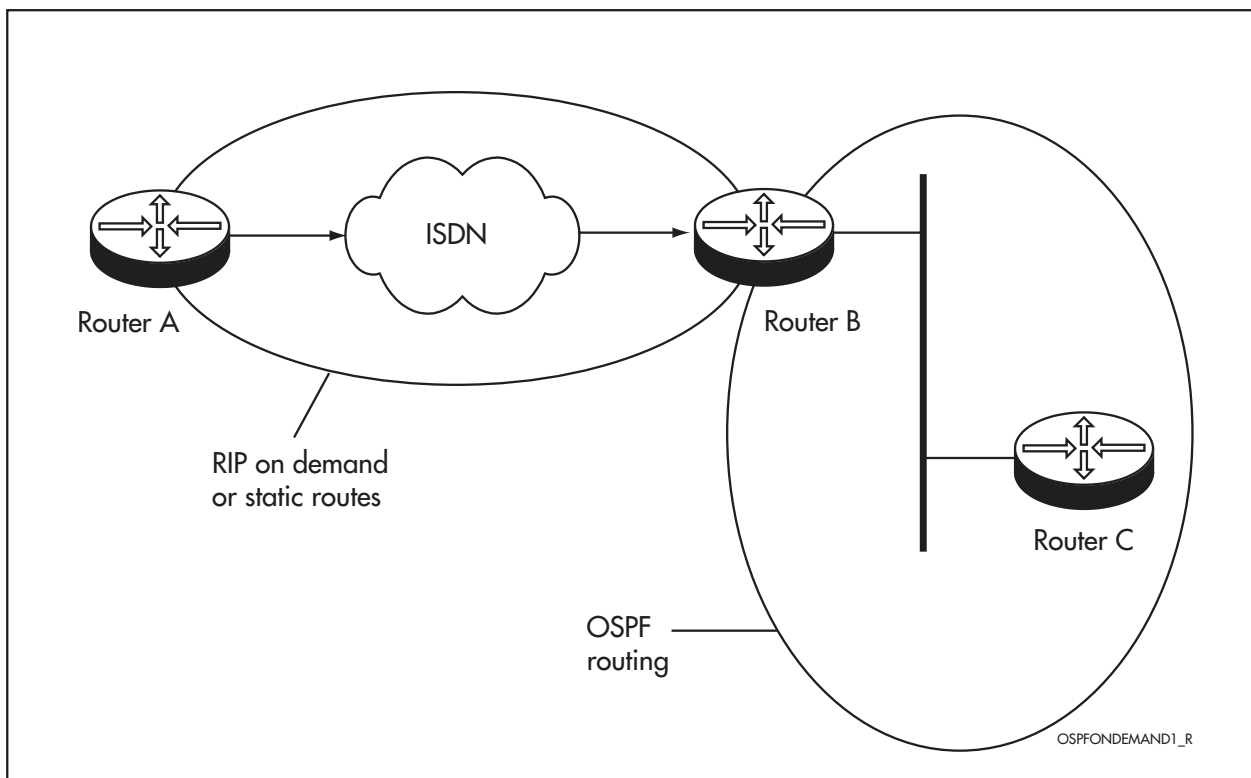
The output should show that there is an AS external LSA with this ID.

OSPF On Demand Circuits

OSPF on demand circuits allow data link connections to be closed when not carrying application traffic. It is used on cost-conscious networks, such as ISDN, X.25 and dial-up networks. If there is no traffic crossing the network, (either routing protocol traffic or application traffic), the data link connection is closed. When there is traffic to send, the data link connection is established, the data is sent, and the connection stays open until the link has been idle for a specified time. The data link connection is then closed to conserve cost and resources. [Figure 23-1 on page 23-13](#) and [Figure 23-2 on page 23-14](#) illustrate before and after OSPF on demand scenarios.

Some interface and port types mentioned in this section may not be supported on your router. The interface and port types that are available vary depending on your router's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the *AR400 Series Router Hardware Reference*.

Figure 23-1: Example of dial-on-demand ISDN before configuring OSPF on demand



Configuration Examples

The following examples show how to configure some common OSPF networks. Each example includes a brief description, a diagram of the desired network configuration, and the commands required to configure the network.

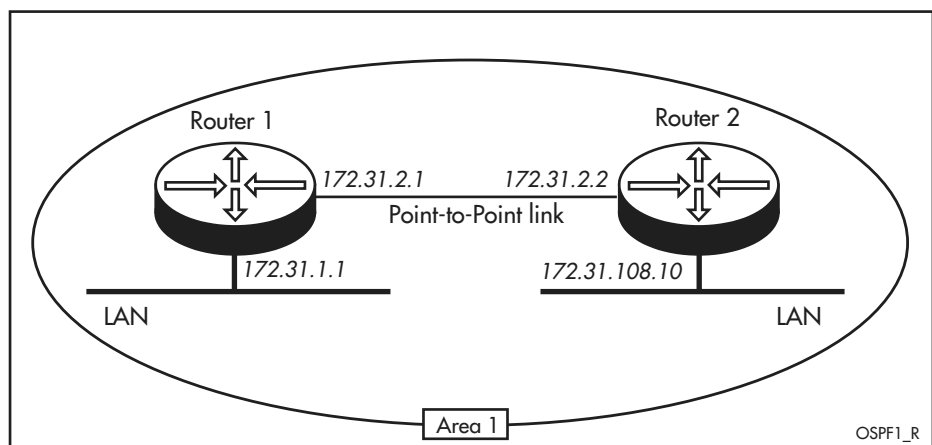
A Basic OSPF Network

The first example is a simple network of two routers connected together, each with its own local area network. The routers belong to a single class B network 172.31.0.0, which has further been subnetted using the subnet mask 255.255.255.0 (Figure 23-3 on page 23-15).

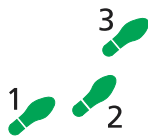


Some interface and port types mentioned in this example may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the AR400 Series Router Hardware Reference.

Figure 23-3: A basic OSPF network



See the description of the [add ospf interface command on page 23-22](#) for a more detailed explanation of each step.



To configure a basic OSPF network:

1. Configure the PPP and Ethernet interfaces on router 1.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=172.31.2.1 MASK=255.255.255.0
    OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.1.1 MASK=255.255.255.0
    OSPFMETRIC=1
```

2. Configure router 1 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```
ENABLE OSPF
```

```

ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=asecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret

```

3. Configure the PPP and Ethernet interfaces on router 2.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```

CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=172.31.2.2 MASK=255.255.255.0
    OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.108.10 MASK=255.255.255.0
    OSPFMETRIC=1

```

4. Configure router 2 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```

ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=csecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret

```

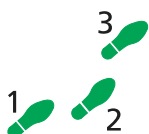
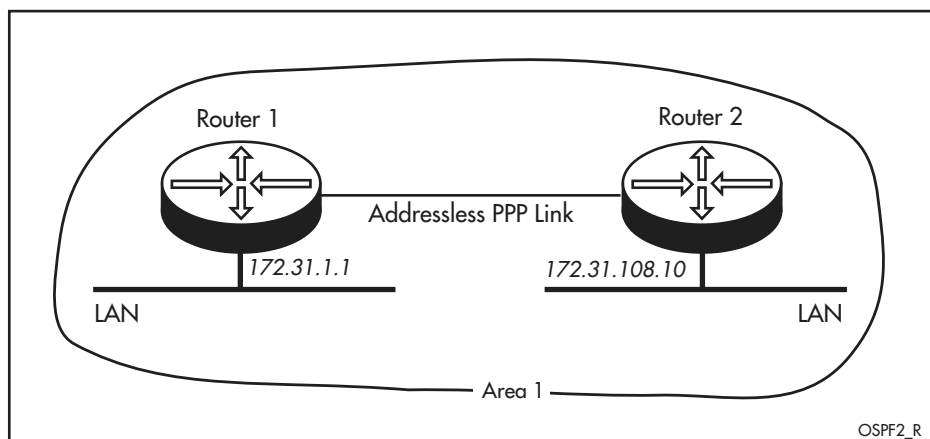
An OSPF Network with Addressless PPP Links

This example is similar to the first except that the PPP link has been replaced with an addressless PPP link (Figure 23-4 on page 23-16).



Some interface and port types mentioned in this example may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the AR400 Series Router Hardware Reference.

Figure 23-4: A basic OSPF network with an addressless PPP link



To configure an OSPF network with addressless PPP interfaces:

1. Configure the PPP and Ethernet interfaces on router 1.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface. Note that the PPP interface has no IP address:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=0.0.0.0 MASK=0.0.0.0 OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.1.1 MASK=255.255.255.0
    OSPFMETRIC=1
```

2. Configure router 1 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```
ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=asecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret
```

3. Configure the PPP and Ethernet interfaces on router 2.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface. Note that the PPP interface has no IP address:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INTERFACE=PPP0 IP=0.0.0.0 MASK=0.0.0.0 OSPFMETRIC=1
ADD IP INTERFACE=ETH0 IP=172.31.108.10 MASK=255.255.255.0
    OSPFMETRIC=1
```

4. Configure router 2 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```
ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=csecret
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=bsecret
```

An OSPF Network with Virtual Links

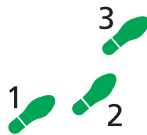
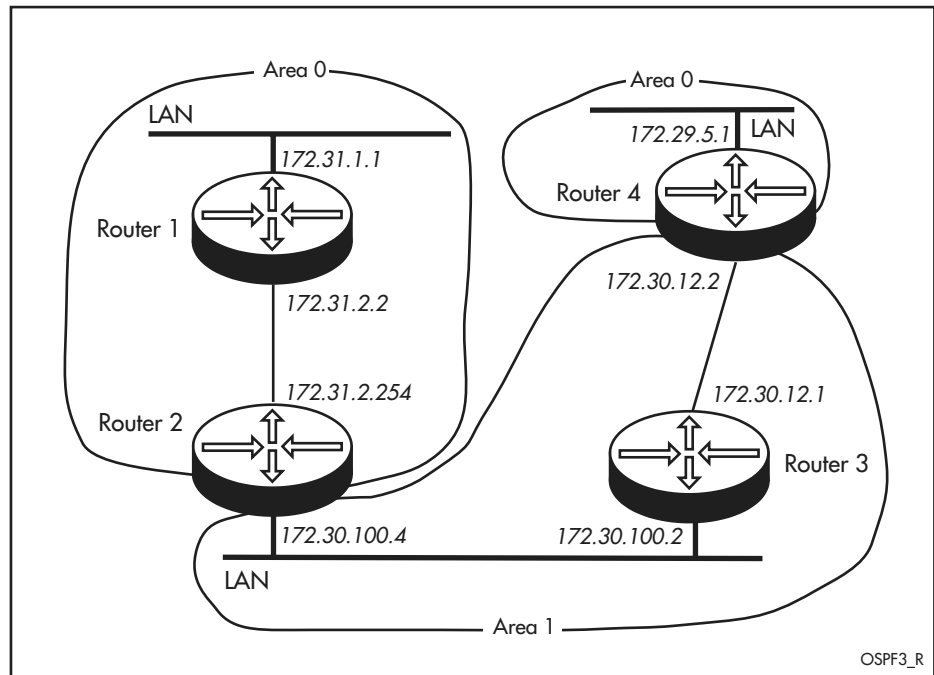
This example shows three routers forming a segmented backbone, and connected together via two routers in a transit area, using a virtual link. This configuration would join the two backbone areas together via the virtual link using area 1 as the transit area ([Figure 23-5 on page 23-18](#)).



Some interface and port types mentioned in this example may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the [AR400 Series Router Hardware Reference](#).

Note that for areas that are not backbone areas, the default setting for the STUBAREA parameter is ON. However, if an area is the transit area of a virtual link, STUBAREA must be set to OFF. Therefore in this example, STUBAREA is explicitly set to OFF for all definitions of area 0.0.0.1.

Figure 23-5: A OSPF network with a virtual link



To configure an OSPF network with virtual links:

1. Configure the PPP and Ethernet interfaces on router 1.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INT=PPP0 IP=172.31.2.2 MASK=255.255.255.0 OSPF=1
ADD IP INT=ETH0 IP=172.31.1.1 MASK=255.255.255.0 OSPF=1
```

2. Configure router 1 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```
ENABLE OSPF
ADD OSPF AREA=0.0.0.0 AUTHENTICATION=PASSWORD
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.0 MASK=255.255.0.0
ADD OSPF RANGE=172.29.0.0 AREA=0.0.0.0 MASK=255.255.255.0
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.0 PASSWORD=asecret
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.0 PASSWORD=secret
```

3. Configure the PPP and Ethernet interfaces on router 2.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```
CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INT=PPP0 IP=172.31.2.254 MASK=255.255.255.0 OSPF=1
ADD IP INT=ETH0 IP=172.30.100.4 MASK=255.255.255.0 OSPF=1
```

4. Configure router 2 as an OSPF router.

Create two OSPF areas, assign the IP interfaces to the areas, establish the virtual link and configure OSPF routing parameters. Explicitly assign the local router identification number and set the IP address of the virtual link to the IP address at the remote end of the link:

```

ENABLE OSPF
SET OSPF ROUTERID=2.2.2.2
ADD OSPF AREA=0.0.0.0 AUTHENTICATION=PASSWORD
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD STUBAREA=OFF
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.0 MASK=255.255.0.0
ADD OSPF RANGE=172.29.0.0 AREA=0.0.0.0 MASK=255.255.0.0
ADD OSPF RANGE=172.30.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.0 PASSWORD=asecret
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=bsecret
ADD OSPF INTERFACE=VIRT0 AREA=0.0.0.1 PASSWORD=esecret
VIRT=4.4.4.4

```

5. Configure the PPP and Ethernet interfaces on router 3.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```

CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INT=PPP0 IP=172.30.12.1 MASK=255.255.255.0 OSPF=1
ADD IP INT=ETH0 IP=172.30.100.2 MASK=255.255.255.0 OSPF=1

```

6. Configure router 3 as an OSPF router.

Create an OSPF area, assign the IP interfaces to the area, and configure OSPF routing parameters:

```

ENABLE OSPF
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD STUBAREA=OFF
ADD OSPF RANGE=172.30.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=csecret
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.1 PASSWORD=bsecret

```

7. Configure the PPP and Ethernet interfaces on router 4.

Create IP interfaces to use the PPP and Ethernet interfaces, and assign an OSPF metric to each IP interface:

```

CREATE PPP=0 OVER=SYN0
ENABLE IP
ADD IP INT=PPP0 IP=172.30.12.2 MASK=255.255.255.0 OSPF=1
ADD IP INT=ETH0 IP=172.29.5.1 MASK=255.255.255.0 OSPF=1

```

8. Configure router 4 as an OSPF router.

Create two OSPF areas, assign the IP interfaces to the areas, establish the virtual link and configure OSPF routing parameters:

```

ENABLE OSPF
SET OSPF ROUTERID=4.4.4.4
ADD OSPF AREA=0.0.0.0 AUTHENTICATION=PASSWORD
ADD OSPF AREA=0.0.0.1 AUTHENTICATION=PASSWORD STUBAREA=OFF
ADD OSPF RANGE=172.31.0.0 AREA=0.0.0.0 MASK=255.255.0.0
ADD OSPF RANGE=172.30.0.0 AREA=0.0.0.1 MASK=255.255.0.0
ADD OSPF RANGE=172.29.0.0 AREA=0.0.0.0 MASK=255.255.0.0
ADD OSPF INTERFACE=VIRT0 AREA=0.0.0.1 PASSWORD=esecret
VIRT=2.2.2.2
ADD OSPF INTERFACE=PPP0 AREA=0.0.0.1 PASSWORD=csecret
ADD OSPF INTERFACE=ETH0 AREA=0.0.0.0 PASSWORD=dsecret

```

Command Reference

This section describes the commands available to configure and monitor OSPF routing on the router. OSPF requires the IP module to be enabled and configured correctly. See [Chapter 14, Internet Protocol \(IP\)](#) for detailed descriptions of the commands required to enable and configure IP.

Some interface and port types mentioned in this chapter may not be supported on your router. The interface and port types that are available vary depending on your product's model, and whether an expansion unit (PIC, NSM) is installed. For more information, see the *AR400 Series Router Hardware Reference*.

The shortest valid command is denoted by capital letters in the Syntax section. See “[Conventions](#)” on page xcv of Preface in the front of this manual for details of the conventions used to describe command syntax. See [Appendix A, Messages](#) for a complete list of messages and their meanings.

add ospf area

Syntax `ADD OSPF AREA={BACKbone | area-number}
[AUTHentication={NONE | PASSword}] [STUBArea={ON | OFF | YES |
NO | NSSA | True | False}] [STUBMetric=0..16777215]
[SUMmary={SEND | NONE | OFF | NO | False}]`

where *area-number* is a 4-byte OSPF area number in dotted decimal notation

Description This command adds an OSPF area to the OSPF area table.

The AREA parameter specifies the area number, and is required; other parameters are optional. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must not already exist in the area table.

The AUTHENTICATION parameter specifies the type of authentication required for the area. If NONE is specified then no authentication is used on incoming OSPF packets. If PASSWORD is specified, a simple password up to eight characters is used to authenticate each incoming OSPF packet. The password is configured on a per-interface basis. The default is NONE.

The STUBAREA parameter specifies whether the router treats the area as a stub area. AS external advertisements are not flooded into or out of stub areas. The backbone cannot be configured as a stub area, nor can a virtual link be configured through a stub area. If AREA is set to 0.0.0.0 or BACKBONE, STUBAREA must be set to OFF. If AREA specifies the transit area of a virtual link, STUBAREA must be set to OFF. All routers within a particular area must have the same setting for STUBAREA. The values ON, YES and TRUE are equivalent. The values OFF, NO and FALSE are equivalent. The value NSSA specifies that the area is a Not-so-stubby-area (NSSA). External routes can be imported as type-7 advertisements in a NSSA. The default is OFF if AREA is set to 0.0.0.0 or BACKBONE, or ON if AREA is set to any other (non-backbone) value.

If the area has been configured as a stub area, and the router is to act as the area border router for the stub area, then the STUBMETRIC parameter specifies the metric (cost) of the default route as advertised by the router in the default summary link. The default is 1.

The SUMMARY parameter controls the generation of summary LSA's into stub areas. By default, the default (0.0.0.0) summary LSA is emitted into a stub area by an area border router. If SEND, summary LSA's from other areas are also emitted into the stub area. If NONE, the default (0.0.0.0) summary LSA is emitted into the stub area. If STUBAREA is set to NSSA, then the default is SEND, otherwise the default is NONE.

Examples To set up two areas on a router, with the first one being the backbone, use the commands:

```
add ospf are=0.0.0.0
add ospf are=0.0.0.1
```

To subsequently change area 1 into a stub area, use the command:

```
set ospf are=0.0.0.1 stuba=ON stubm=10
```

Because this router has multiple areas defined, it acts as an area border router and as such, the parameter STUBMETRIC must be defined when setting the area to a stub area. All other routers within area 1 should also have the STUBAREA parameter set to ON. They do not need to have a STUBMETRIC assigned.

Related Commands

- [add ospf range](#)
- [delete ospf area](#)
- [delete ospf range](#)
- [set ospf area](#)
- [set ospf range](#)
- [show ospf area](#)
- [show ospf range](#)

add ospf host

Syntax ADD OSPF HOS*t*=*ipadd* [MET*ric*=0..65535]

where *ipadd* is an IP address in dotted decimal notation

Description This command adds a static OSPF host route to the routing table.

OSPF allows host routes to be advertised to the local OSPF area. Such routes are advertised with a route mask of 255.255.255.255. Host routes are normally used for point-to-point networks where it is undesirable to run OSPF with IP hosts directly connected to the router.

The parameter HOST specifies the IP address of the host or point-to-point network. The IP address must fall within one of the OSPF ranges defined on the router. The host must not already exist in the routing table.

The parameter METRIC specifies the metric for the route to the host. The default is 1.

Examples Ethernet interface vlan1 has been configured, and an OSPF interface has been defined with an IP address of 172.30.1.1 and network mask 255.255.255.0 to be in area 0.0.0.1. To define a host 172.30.1.2 on a PPP link, use the command:

```
add ospf ho=172.30.1.2 met=1
```

Traffic for address 172.30.1.2 is directed down the PPP link instead of the Ethernet interface because the mask for the host LSA entry is 255.255.255.255 and is more specific than the Ethernet network mask of 255.255.255.0.

Related Commands

- [add ospf interface](#)
- [delete ospf host](#)
- [set ospf host](#)
- [show ospf host](#)
- [show ospf interface](#)

add ospf interface

Syntax ADD OSPF INTERface=*interface* AREa={BACKbone|*area-number*}
 [BOOST1=0..1023] [DEadinterval=2..2147483647]
 [DEMAND={ON|OFF|YES|NO|True|False}]
 [Hellointerval=1..65535] [PASSword=*password*]
 [POLLInterval=1..2147483647] [PRIOrity=0..255]
 [RXmtinterval=1..3600] [TRansitdelay=1..3600]
 [Virtuallink=*router-id*]

where:

- *interface* is a valid interface name.
- *area-number* is a four-byte OSPF area number in dotted decimal notation.
- *password* is a character string 1 to 8 characters long. Valid characters are any printable character. If *password* contains spaces, then it must be in double quotes.

Description This command adds an OSPF interface attached to the specified IP interface, or a unique OSPF virtual interface. Virtual interfaces are used for OSPF virtual links. To add an interface the associated area and its range or ranges must be defined first.

The INTERFACE parameter specifies the name of the OSPF interface to add, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

The interface must already exist. To see a list of all currently available interfaces, use the [show interface command on page 7-66 of Chapter 7, Interfaces](#).



*Disabled ghost OSPF interfaces exist for each IP interface that is attached to OSPF, for use with SNMP. These interfaces must be added to OSPF by using the **add ospf interface** command before they can be used by OSPF. Deleting the interface by using the **delete ospf interface** command on page 23-30 turns it back into a disabled ghost OSPF interface.*

Before the interface can be added, both the area and ranges for the area must be defined. A check is made to see if the interface is within one of the defined ranges for the area.



Addressless PPP links are the only exception to the range checking mechanism since there is no range to check them against.

The AREA parameter specifies the area to which the interface belongs. When defining a virtual link, the area number is the area number of the transit area used for the virtual link. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must already exist in the area table.

The BOOST1 parameter increases the type 1 metrics of all OSPF LSAs flooded out the interface by the value specified. Setting the value to anything other than 0 increases the LSA metrics by that amount. For example, setting the parameter in the router to BOOST1=2 boosts the metrics by 2, so an LSA in this router with a metric of 3 has a value of 5 when it is flooded out the interface. The default is 0.



This parameter represents a breakage in the OSPF specification, so should be used with extreme caution.

The DEADINTERVAL parameter specifies the interval in seconds after which no hello packets are received by a neighbour, the neighbour declares the router to be down. The timer is advertised in the hello packets. All routers on the same network where the interface is attached must have the same DEADINTERVAL timer. The value must be at least twice the value of the HELLOINTERVAL timer. The recommended multiplier is four. For example, if the HELLOINTERVAL timer is set to 10 seconds, then the DEADINTERVAL timer should be set to 40 seconds. The default is four times the value of the HELLOINTERVAL timer.

The DEMAND parameter specifies whether the interface connects to a demand circuit. Two routers connecting to the same common network segment need not agree on that segment's demand circuit status. This means that configuring one router does not require configuring other routers that connect to the same common network segment. If one router has been configured and the common network is a broadcast or non-broadcast multi-access (NBMA) network, the behaviour (e.g. sending, receiving hello packets) of the network remains the same, just as if the interface has not been configured as a demand circuit. If one router has been configured and the common network segment is a point-to-point link, the router on the other end may agree to treat the link as a demand circuit and the point-to-point network receives the full benefit. When broadcast and non-broadcast multi-access (NBMA) networks are declared as demand circuits (i.e. more than one router has the network configured as a demand circuit), routing update traffic is reduced but the periodic sending of hellos is

not, which requires that the data link connection remain constantly open. The default is OFF.

The HELLOINTERVAL parameter specifies the interval in seconds between hello packets transmitted over the interface. All routers on the network where the interface is attached must have the same HELLOINTERVAL timer. The value must be less than the value of the POLLINTERVAL timer. The default is 10.

The PASSWORD parameter specifies password used for authentication. A password is required if the authentication scheme for the area has been set to PASSWORD by using the [add ospf area command on page 23-20](#) or the [set ospf area command on page 23-41](#). The default is an empty (null) string.

The POLLINTERVAL timer defines the time in seconds at which hello packets are sent to neighbouring routers that are deemed to be inactive. The POLLINTERVAL timer is used on NBMA networks (Frame Relay and X.25) and point-to-point networks configured as OSPF on demand circuits. The value must be greater than the value of the HELLOINTERVAL timer. When the neighbour is in "Down" state, hellos are sent to the neighbour at the interval of POLLINTERVAL. The default is four times the value of the HELLOINTERVAL timer.

The PRIORITY parameter is used on multi-access networks to set the router priority. When two routers attached to a network attempt to become the designated router, the one with the highest priority takes precedence. If the priorities are the same then the router with the highest router identification number takes precedence. A router with a priority of zero is ineligible to become the designated router. Router priority can be configured only for routers attached to multi-access networks. The default is 1.

The RXMTINTERVAL parameter specifies the time interval, in seconds, between link state retransmissions, for adjacencies on the interface. The timer is also used when retransmitting database description and link state request packets. The value should be set well above the round trip time between the two routers. It should be set higher for slow serial and virtual links. A typical value is 5 seconds on a local area network. The default is 5.

The TRANSITDELAY parameter specifies the estimated time, in seconds, required to transmit a link state update packet over this interface. This time is added to any link state advertisement sent over the interface. The value of this parameter should take into account the transmission and propagation delays of the interface. This mechanism helps keep the link state advertisement timers synchronised on different routers. A typical value is 1 second on a local area network. The default is 1.

The VIRTUALLINK parameter specifies the router identification number for another area border router to be included in the backbone using a virtual link. Each end of the virtual link must be configured.

When the VIRTUALLINK parameter is added, it is always treated as a demand circuit. This is because when a virtual link's underlying physical path contains one or more demand circuits, periodic OSPF protocol exchanges over the virtual link would unnecessarily keep the underlying demand circuits open.



The `add ospf interface=interface virtuallink=router-id` command ignores the setting of the parameter `demand`. This means that if `demand` is set to `off`, the virtual link is still treated as a demand circuit.

*Also note that when configuring virtual links, the **area** parameter in the **add ospf interface** command is the transit area number used for the virtual link.*

Examples **Example:** To configure Ethernet interface 0 that has already been configured as an IP interface with IP address 172.31.1.1, the following commands are required:

For details on Ethernet interfaces in general, see [Chapter 7, Interfaces](#). For information on how to assign an Ethernet interface to the IP routing module, see [Chapter 14, Internet Protocol \(IP\)](#).

1. Assign an area number ('0.0.0.1' in this case) and add it to the area table.

```
add ospf are=0.0.0.1
```

2. Define the range of IP addresses to be associated with this area by specifying the IP address and subnet mask.

```
add ospf ran=172.31.0.0 mask=255.255.0.0 are=0.0.0.1
```

3. Associate the Ethernet interface with the area.

```
add ospf int=eth0 are=0.0.0.1
```

Example: This example defines an addressless (PPP) interface.

1. Assign a PPP interface to the IP routing module with an IP address of 0.0.0.0.

```
add ip int=ppp0 ip=0.0.0.0 mask=0.0.0.0 ospf=1
```

2. Assign an area number ('0.0.0.1' in this case) and add it to the area table.

```
add ospf are=0.0.0.1
```

3. Define the range of IP addresses to be associated with this area by specifying the IP address and subnet mask.

```
add ospf ran=172.31.0.0 mask=255.255.0.0 are=0.0.0.1
```

4. Associate the PPP interface with the area. The interface connects to the demand circuit.

```
add ospf int=PPP0 are=0.0.0.1 dem=on
```

Example: This example illustrates how to set up a virtual interface. Router1 is an area border router directly connected to the contiguous backbone and to area 1 (interface PPP0, IP address 172.30.2.2). Router2 is another area border in area 1 (interface PPP0, IP address 172.30.108.10). Area 1 is being used as the transit area for the virtual link.

For Router1:

1. Add the default backbone area number to the area table.

```
add ospf are=ba
```

2. Add the other area ('0.0.0.1') to the area table.

```
add ospf are=0.0.0.1
```

3. Assign a range of IP addresses to the backbone area.

```
add ospf ran=172.31.0.0 mask=255.255.0.0 are=ba
```

4. Assign a range of IP addresses to area 0.0.0.1.

```
add ospf ran=172.30.0.0 mask=255.255.0.0 are=0.0.0.1
```

5. Associate an Ethernet interface with the backbone area.

```
add ospf int=vlan1 are=ba
```

6. Associate the PPP interface with area 0.0.0.1.

```
add ospf int=ppp0 are=0.0.0.1
```

7. Allow access to area 0.0.0.1 using a virtual interface.

```
add ospf int=virt0 vi=172.30.108.10 are=0.0.0.1
```

For Router2:

1. Add the default backbone area number to the area table.

```
add ospf are=ba
```

2. Add the other area ('0.0.0.1') to the area table.

```
add ospf are=0.0.0.1
```

3. Assign a range of IP addresses to the backbone area.

```
add ospf ran=172.31.0.0 mask=255.255.0.0 are=ba
```

4. Assign a range of IP addresses to area 0.0.0.1.

```
add ospf ran=172.30.0.0 mask=255.255.0.0 are=0.0.0.1
```

5. Associate an Ethernet interface with the backbone area.

```
add ospf int=vlan1 are=ba
```

Related Commands

[add ospf area](#)
[add ospf range](#)
[delete ospf interface](#)
[disable ospf interface](#)
[enable ospf interface](#)
[reset ospf interface](#)
[set ospf area](#)
[set ospf interface](#)
[set ospf range](#)
[show ospf area](#)
[show ospf interface](#)
[show ospf range](#)

add ospf neighbour

Syntax ADD OSPF NEIghbour=*ipadd* PRIOrity=0..255

where *ipadd* is an IP address in dotted decimal notation

Description This command adds a non-broadcast multi-access neighbour and sets the neighbour parameters. On non-broadcast multi-access networks such as Frame Relay, the neighbours cannot be discovered by dynamic means. To overcome this problem, neighbours are configured statically. All parameters are required to add a neighbour.

Static OSPF neighbours should be defined on routers that are attached to an OSPF network and are eligible to become the *Designated Router* (DR) or *Backup Designated Router* (BDR) for that network. To be eligible to become the DR or

BDR for an OSPF network, a router must have at least one interface on the OSPF network with a non-zero priority. The priority of an OSPF interface is set with the **PRIORITY** parameter in the [add ospf interface command on page 23-22](#) or the [set ospf interface command on page 23-43](#). Any OSPF router connected to an OSPF network via an OSPF interface with a non-zero priority should be configured with static OSPF neighbours corresponding to all other OSPF routers attached to the OSPF network. OSPF routers that do not have an OSPF interface with a non-zero priority should not be configured with static OSPF neighbours.

The **NEIGHBOUR** parameter specifies the IP address of the neighbour. The IP address must fall within an IP address range associated with an OSPF interface. A neighbour with the specified IP address must not already exist in the neighbour table.

The **PRIORITY** parameter specifies the priority of the neighbour router. If the priority for the neighbour is set to zero then it is not initially considered eligible to become the designated router. The priority for the router itself is set in the interface priority.

Only a few OSPF routers in an NBMA network should be eligible to become the designated router.

Examples To define a neighbour with IP address 172.30.1.2, use the command:

```
add ospf nei=172.30.1.2 prio=1
```

Related Commands

- [add ospf interface](#)
- [delete ospf interface](#)
- [delete ospf neighbour](#)
- [set ospf interface](#)
- [set ospf neighbour](#)
- [show ospf interface](#)
- [show ospf neighbour](#)

add ospf range

Syntax `ADD OSPF RANGE=ipadd AREA={BACKbone|area-number}
[MASK=ipadd] [EFFECT={ADVERTISE|DONOTadvertise}]`

where:

- *ipadd* specifies an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command adds an OSPF range to an OSPF area. An OSPF area is defined as a list of IP address ranges. A IP address range is defined by an IP address and network mask pair. After an area has been created, the ranges that are to be active in the area must be defined. All the OSPF routers within an area must use the same set of ranges for the area.

The **AREA** parameter specifies the area number of the area to which the range is added. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword **BACKBONE**. The specified area must already exist in the area table.

The RANGE parameter specifies the base IP address of the range.

The MASK parameter specifies a mask used in combination with the base address to determine addresses that belong to the range. The value must be consistent with the value specified for the RANGE parameter. The default is the network mask for the address class of the IP address (e.g. 255.255.0.0 for a Class B address and 255.255.255.0 for a Class C address).

The range defined by the combination of RANGE and MASK must not overlap any other range defined on the router.

The EFFECT parameter controls the exporting of ranges into other areas by an area border router. This parameter is valid when the router is configured as an area border router, and can be used to control where the traffic into and out of an area for a particular network travels. If ADVERTISE, summary LSAs are created for the range. If DONOTADVERTISE, summary LSAs are not created for the range. The default is ADVERTISE.

Examples To add an IP address range of 172.30.0.0–172.30.255.255 to area 1, use the command:

```
add ospf ran=172.30.0.0 mask=255.255.0.0 are=0.0.0.1
```

Related Commands

- [delete ospf range](#)
- [set ospf range](#)
- [show ospf range](#)

add ospf stub

Syntax ADD OSPF STUB=*ipadd* MASK=*ipadd* [METRIC=0..65535]

where *ipadd* is an IP address in dotted decimal notation

Description This command adds a static non-OSPF network as a stub network to the OSPF routing table. This enables networks, such as an LAN with only one OSPF router, to be added as stub networks to OSPF without running OSPF on the interface to which the network is attached. The stub links are added to the router's LSA.

The STUB parameter specifies the base IP address of the stub network. The IP address must fall within one of the OSPF ranges defined on the router. The stub must not already exist in the routing table.

The MASK parameter specifies a mask used in combination with the base address to determine addresses that belong to the stub network. The value must be consistent with the value specified for the STUB parameter.

The METRIC parameter specifies the metric for the route to the stub network. The default is 1.

Examples Ethernet interface, vlan1 is attached to an Ethernet LAN with an IP subnet address of 172.30.1.0 and network mask 255.255.255.0. To add the LAN

attached to the Ethernet interface as a non-OSPF stub network, use the command:

```
add ospf stub=172.30.1.0 mask=255.255.255.0
```

Related Commands

- [add ospf host](#)
- [add ospf interface](#)
- [delete ospf stub](#)
- [set ospf stub](#)
- [show ospf stub](#)

delete ospf area

Syntax `DELEte OSPF AREa={BACKbone | area-number}`

where *area-number* is a 4-byte OSPF area number in dotted decimal notation

Description This command deletes an OSPF area from the OSPF area table.

The AREA parameter specifies the area number of the area to delete. The area must already exist in the area table. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

Examples To delete an OSPF area with the area number 0.0.0.1, use the command:

```
del ospf are=0.0.0.1
```

Related Commands

- [add ospf area](#)
- [add ospf range](#)
- [delete ospf range](#)
- [set ospf area](#)
- [set ospf range](#)
- [show ospf area](#)
- [show ospf range](#)

delete ospf host

Syntax `DELEte OSPF HOSt=ipadd`

where *ipadd* is an IP address in dotted decimal notation

Description This command deletes a static OSPF host route or all static OSPF host routes from the routing table.

OSPF allows host routes to be advertised to the local OSPF area. Such routes are advertised with a route mask of 255.255.255.255. Host routes are normally used for point-to-point networks where it is undesirable to run OSPF with IP hosts directly connected to the router.

The parameter HOST specifies the IP address of the host or point-to-point network to be deleted. The host must exist in the routing table.

Examples To delete the OSPF host with IP address 172.30.1.2, use the command:

```
del ospf ho=172.30.1.2
```

Related Commands [add ospf host](#)
[set ospf host](#)
[show ospf host](#)

delete ospf interface

Syntax `DELEte OSPF INTerface=interface`

where *interface* is a valid interface name

Description This command deletes an OSPF interface.

The INTERFACE parameter specifies the name of the OSPF interface to delete, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

To see a list of current valid interfaces, use the [show ospf interface command on page 23-55](#) or the [show interface command on page 7-66 of Chapter 7, Interfaces](#). An interface cannot be deleted if static neighbours exist that depend on the interface. Delete the static neighbours first, then delete the interface.

Disabled ghost OSPF interfaces exist for each IP interface that is attached to OSPF, for use with SNMP. These interfaces must be added to OSPF with the [add ospf interface command on page 23-22](#) before they can be used by OSPF. Deleting the interface with the [delete ospf interface command on page 23-30](#) turns it back into a disabled ghost OSPF interface.

Examples To delete OSPF interface ppp1, use the command:

```
del ospf int=ppp1
```

Related Commands [add ospf interface](#)
[disable ospf interface](#)
[enable ospf interface](#)
[reset ospf interface](#)
[set ospf interface](#)
[show ospf interface](#)

delete ospf neighbour

Syntax `DELeTe OSPF NEIghbour=ipadd`

where *ipadd* is an IP address in dotted decimal notation

Description This command deletes a non-broadcast multi-access neighbour.

The NEIGHBOUR parameter specifies the IP address of the neighbour. The neighbour with the specified IP address must exist in the neighbour table.

Examples To delete the neighbour with IP address 172.30.1.2, use the command:

```
del ospf nei=172.30.1.2
```

Related Commands [add ospf neighbour](#)
[set ospf neighbour](#)
[show ospf neighbour](#)

delete ospf range

Syntax `DELeTe OSPF RANge=ipadd`

where *ipadd* specifies an IP address in dotted decimal notation

Description This command deletes an OSPF range. An OSPF area is defined as a list of IP address ranges. A IP address range is defined by an IP address and network mask pair. All OSPF routers in an area must use the same set of ranges for the area.

The RANGE parameter specifies the base IP address of the range to be deleted. The specified range must already exist.

Examples To delete the range with a base IP address of 172.30.0.0, use the command:

```
del ospf ran=172.30.0.0
```

Related Commands [add ospf area](#)
[add ospf range](#)
[set ospf range](#)
[show ospf range](#)

delete ospf stub

Syntax `DELeTe OSPF STUB=ipadd MASK=ipadd`

where *ipadd* is an IP address in dotted decimal notation

Description This command deletes a static non-OSPF network as a stub network from the OSPF routing table. Networks, such as an LAN with only one OSPF router, can be added as stub networks to OSPF without running OSPF on the interface to which the network is attached. The stub links are added to the router's LSA.

The STUB parameter specifies the base IP address of the stub network. The IP address must fall within one of the OSPF ranges defined on the router. The stub must already exist in the routing table.

The MASK parameter specifies a mask used in combination with the base address to determine addresses that belong to the stub network. The value must be consistent with the value specified for the STUB parameter.

Examples To delete the stub network attached to Ethernet interface vlan1 with an IP subnet address of 172.30.1.0 and network mask 255.255.255.0, use the command:

```
del ospf stub=172.30.1.0 mask=255.255.255.0
```

Related Commands

- [add ospf stub](#)
- [delete ospf host](#)
- [delete ospf interface](#)
- [set ospf stub](#)
- [show ospf stub](#)

disable ospf

Syntax `DISAbLe OSPF`

Description This command disables OSPF routing. OSPF must currently be enabled. Networks and hosts that were reachable via OSPF are no longer accessible.

Examples To disable OSPF, use the command:

```
dis ospf
```

Related Commands

- [enable ospf](#)
- [show ospf](#)

disable ospf debug

Syntax `DISable OSPF DEBug={ALL|IFStAtE|NBRStAtE|PAcket|StAtE}`

Description This command disables the generation of OSPF debugging messages.

The DEBUG parameter specifies the debugging options to disable. If ALL, all debugging options are disabled. If IFSTATE, interface state debugging is disabled. If NBRSTATE, neighbour state debugging is disabled. If PACKET, OSPF packet debugging is disabled. If STATE, both interface and neighbour state debugging are disabled.

Examples To disable OSPF packet debugging, use the command:

```
dis ospf deb=pac
```

Related Commands [enable ospf debug](#)
[disable ospf log](#)
[enable ospf log](#)
[show ospf](#)

disable ospf interface

Syntax `DISable OSPF INTErface=interface`

where *interface* is a valid interface name

Description This command disables an OSPF interface. The interface along with areas assigned to it no longer participate in the OSPF routing protocol.

The INTERFACE parameter specifies the name of the OSPF interface to disable, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

To see a list of current valid interfaces, use the [show ospf interface](#) command on page 23-55 or the [show interface](#) command on page 7-66 of Chapter 7, [Interfaces](#).

Examples To disable OSPF interface ppp0, use the command:

```
dis ospf int=PPP0
```

Related Commands

- [add ospf interface](#)
- [delete ospf interface](#)
- [enable ospf interface](#)
- [reset ospf interface](#)
- [set ospf interface](#)
- [show ospf interface](#)

disable ospf log

Syntax DISable OSPF LOG

Description This command disables the logging of significant OSPF events to the router's logging facility. OSPF logging must currently be enabled. The events that are logged are listed in [Table 23-8 on page 23-34](#) and detailed in Appendix D of RFC 1247. Each OSPF log message is prefixed with the identifying code shown in [Table 23-8 on page 23-34](#). See RFC 1247 for a detailed description of the meaning of each message.

Table 23-8: OSPF log message codes

Code	Meaning
T1	Interface state change
T2	Neighbour state change
T3	Designated router change
T4	New LSA generated by router
T5	New LSA received
T6	Routing table change
C1	OSPF packet rejected due to header errors
C2	Hello packet rejected
C3	Other packet rejected due to Neighbour state being incorrect
C4	Database Description packet retransmitted
E1	Received LSA checksum incorrect
E2	Database LSA checksum incorrect
R1	Different instances of same LSA
R2	Different ages for 2 copies of LSA
R3	Received more recent self-originated LSA
R4	Received LSA Ack for unknown LSA
R5	Received older LSA
N1	Link state refresh timer gone off
N2	LSA aged to MaxAge
N3	MaxAge aged LSA has been flushed

Examples To disable OSPF logging, use the command:

```
dis ospf log
```

Related Commands [enable ospf log](#)
[show ospf](#)

enable ospf

Syntax ENABle OSPF

Description This command enables OSPF routing. OSPF must currently be disabled. OSPF interfaces form adjacencies, link state advertisements (LSAs) are exchanged, and the routing table is built by OSPF by using the Dijkstra algorithm.

Examples To enable OSPF, use the command:

```
ena ospf
```

Related Commands [disable ospf](#)
[show ospf](#)

enable ospf debug

Syntax ENABle OSPF DEBug={ALL|IFStAtE|NBRStAtE|PACket|StAtE}
 [DEtAil={BRIEf|HEADer|LSAFull|LSASummary}]

Description This command enables the generation of OSPF debugging messages.

The DEBUG parameter specifies the debugging options to enable. If ALL, all debug options are enabled. If IFSTATE is enabled, interface state debugging is enabled. If NBRSTATE, neighbour state debugging is enabled. Output from IFSTATE and NBRSTATE includes the interface or neighbour the state change relates to, the event that caused the state change, and the previous and current states of the interface or neighbour. If PACKET, OSPF packet debugging is enabled. The level of detail shown in packet debugging is set with the DETAIL parameter, but the output always contains the direction of the packet, the type of packet, the version of OSPF, the packet's source and destination, the router ID, area, length, checksum and authentication type. If STATE, both interface and neighbour state debugging are enabled.

The DETAIL parameter specifies the level of packet debugging. If BRIEF, a brief description about the contents of each packet is displayed as well as the OSPF header. If HEADER, the OSPF header for each packet is displayed. If LSAFULL, the details of the LSA are displayed as well as the OSPF header. If LSASUMMARY, Link State Advertisements (LSA) header information is displayed as well as the OSPF header. The default is HEADER.

Examples To enable all OSPF packet debugging and show details of the LSA and the OSPF header, use the command:

```
ena ospf deb=pac det=lsaf
```

Related Commands [disable ospf debug](#)
[disable ospf log](#)
[enable ospf log](#)
[show ospf](#)

enable ospf interface

Syntax ENABle OSPF INTerface=*interface*

where *interface* is a valid interface name

Description This command enables an OSPF interface. The interface along with areas assigned to it now participate in the OSPF routing protocol.

The INTERFACE parameter specifies the name of the OSPF interface to enable, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

To see a list of current valid interfaces, use the [show ospf interface command](#) on page 23-55 or the [show interface command](#) on page 7-66 of Chapter 7, Interfaces.

Examples To enable OSPF interface ppp0, use the command:

```
ena ospf int=ppp0
```

Related Commands [add ospf interface](#)
[delete ospf interface](#)
[disable ospf interface](#)
[reset ospf interface](#)
[set ospf interface](#)
[show ospf interface](#)

enable ospf log

Syntax ENABle OSPF LOG

Description This command enables the logging of significant OSPF events to the router's logging facility. OSPF logging must currently be disabled. The events that are logged are listed in [Table 23-8 on page 23-34](#) and detailed in Appendix D of RFC 1247. Each OSPF log message is prefixed with the identifying code shown in [Table 23-8 on page 23-34](#). See RFC 1247 for a detailed description of the meaning of each message.

Examples To enable OSPF logging, use the command:

```
ena ospf log
```

Related Commands [disable ospf log](#)
[show ospf](#)

purge ospf

Syntax PURge OSPF

Description This command purges all OSPF configuration information and resets global OSPF parameters to their defaults. The state of the OSPF routing (enabled or disabled) remains unchanged.

Examples To purge OSPF, use the command:

```
pur ospf
```

Related Commands [disable ospf](#)
[enable ospf](#)
[reset ospf](#)
[show ospf](#)

reset ospf

Syntax RESET OSPF

Description This command resets the OSPF routing software and re-initialises dynamic data structures. It does not make OSPF operational when it is incompletely or incorrectly configured. Nor does it reset OSPF counters; use the [reset ospf counter command on page 23-38](#) for this. A message is sent to the router's logging facility when one has been defined.

This command disrupts OSPF routing on the router. Networks and hosts that were reachable through the router are inaccessible while OSPF restarts.

Examples To reset OSPF, use the command:

```
reset ospf
```

Related Commands [disable ospf](#)
[enable ospf](#)
[purge ospf](#)
[reset ospf counter](#)
[reset ospf interface](#)
[show ospf](#)

reset ospf counter

Syntax RESET OSPF COUnter

Description This command resets all OSPF counters to their initial values.

Examples To reset all OSPF counters, use the command:

```
reset ospf cou
```

Related Commands

- [purge ospf](#)
- [reset ospf](#)
- [reset ospf interface](#)
- [show ospf](#)

reset ospf interface

Syntax RESET OSPF INTerface=*interface*

where *interface* is a valid interface name

Description This command resets an enabled OSPF interface. The OSPF interface is shut down, destroying all current routing information for networks attached to the interface. The interface is then restarted and the routing information is re-learned from the interface's network, effectively refreshing the routing database. The OSPF interface state machine is also restarted.

The INTERFACE parameter specifies the name of the OSPF interface to reset, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

To see a list of current valid interfaces, use the [show ospf interface command on page 23-55](#) or the [show interface command on page 7-66 of Chapter 7, Interfaces](#).

Examples To reset OSPF interface ppp0 that is currently enabled, use the command:

```
reset ospf int=ppp0
```

Related Commands

- [add ospf interface](#)
- [delete ospf interface](#)
- [disable ospf interface](#)
- [enable ospf interface](#)
- [set ospf interface](#)
- [show ospf interface](#)

set ospf

Syntax SET OSPF [ASExternal={ON|OFF|NSSA}] [BGPFilter={NONE|300..399}] [BGPImport={ON|OFF|True|False|YES|NO}] [BGPLimit=1..4000] [AUTOCOST={ON|OFF}] [DEFRoute={ON|OFF|True|False|YES|NO}] [TYPE={1|2}] [METRIC=0..16777215]] [DYNInterface={STUB|ASExternal|NONE|NO|OFF|False}] [REFBANDWIDTH=10..10000] [RIP={OFF|EXport|IMport|BOTH}] [ROuterid=*ipadd*] [PTPStub={ON|OFF|YES|NO|True|False}] [STATicexport=(YES|NO)]

where *ipadd* is an IP address in dotted decimal notation

Description This command sets general OSPF routing configuration parameters

The ASETERNAL parameter specifies whether the router acts as an Autonomous System boundary router. A router is said to be an Autonomous System (AS) boundary router when it has some interfaces in the OSPF AS and some interfaces that are not in the AS. Typically the router has some “external” routes in its routing table associated with the interfaces that are not in the AS. If ASETERNAL is set to ON, these external routes are advertised into the AS as type 5 LSAs for non-NSSAs and as type 7 LSAs for NSSAs. If ASETERNAL is set to NSSA, external routes will only be added to NSSAs as type 7 LSAs, which will be translated if appropriate to a type 5 LSA at an NSSA ABR. ASETERNAL should be set to NSSA if this device only uses NSSAs. If ASETERNAL is set to OFF, these external routes are not be advertised. The default is OFF.

The AUTOCOST parameter specifies whether or not the router will assign OSPF interface metrics based on the available interface bandwidth. If an OSPF metric has been manually assigned using the ADD IP INT=... OSPFMETRIC=x... command the manual metric setting will take priority over an automatic metric setting. If the OSPFMETRIC parameter has been specified for an interface, it must be restored to its defaults using the command ADD IP INT=... OSPFMETRIC=DEFAULT before an automatic metric can be applied. The default is OFF.

The BGPFILTER parameter specifies the route filter to use when importing BGP routes into OSPF. Route filters are created with the ADD IP FILTER command. If a route filter is defined, the entries for the filter include or exclude routes for importation. If routes have not been included by a previous entry, they are excluded from the import. If NONE is specified, no filters are defined so all routes from BGP are imported into OSPF. If you change the BGPFILTER, the device re-imports the BGP routes according to the new filter. The default is none.

The BGPIMPORT parameter specifies whether importing BGP routes into OSPF is enabled. If ON, TRUE or YES is specified, this feature is enabled. If OFF, FALSE or NO is specified, this feature is disabled. The default is OFF.



Do not enable the importing of BGP routes into OSPF unless you are sure about the consequences for the OSPF domain.

The BGPLIMIT parameter specifies the maximum number of BGP routes that can be imported into OSPF at a time. Once this limit is reached, importing

stops until existing routes are removed. If you change the BGPLIMIT, the device can re-import BGP routes. The default is 1000.

The DEFROUTE parameter specifies whether a default destination (0.0.0.0) AS external LSA should be generated by this router. This option can be used when it is not desirable to import all external routing information into an OSPF network as AS externals. This option should be used only on a router configured as an AS boundary router by using the command SET OSPF ASEXTERNAL=ON. The router must have routes in its routing table corresponding to the external routing information. This option should not be used if a static route has been defined on the router because the static route is automatically imported into OSPF. The default is OFF.

The TYPE parameter specifies the LSA type (type 1 or type 2) of the default destination AS external LSA to be generated, and is valid when DEFROUTE is also present. The default is 1 (type 1).

The METRIC parameter specifies the route metric of the default destination AS external LSA to be generated, and is valid when DEFROUTE is also present. The default is 1.

The DYNINTERFACE parameter controls the importation of dynamic interface route information. If STUB, dynamic interface routes are imported into the OSPF routing table as stub routes. If ASEXTERNAL, dynamic interface routes are imported into the OSPF routing table as AS external LSAs. If NONE, dynamic interface routes are not imported into the OSPF routing table. The values NO, OFF, and FALSE are synonyms for NONE. The default is NONE.

The REFBANDWIDTH parameter specifies the reference bandwidth in Mbit/s used for calculating the OSPF metric. The cost is calculated as $\text{REFBANDWIDTH} / \text{Interface Bandwidth (Mbit/s)}$. Using the default settings the automatic cost calculation will result in a OSPF metric of 1 for a fast Ethernet (100M) interface. The AUTOCOST parameter must be set to ON for the parameter REFBANDWIDTH to take effect. The range is 10 to 10000; the default is 1000.

The RIP parameter controls the import and export of RIP information. If EXPORT is specified, OSPF routes are exported as RIP routes. If IMPORT is specified, RIP information is imported into the OSPF routing table. If BOTH is specified, routing information is both imported from and exported to RIP. If RIP is set to OFF, there is no exchange of routing information between OSPF and RIP. The default is OFF.

The ROUTERID parameter specifies a 4-byte number that uniquely identifies the router in the autonomous system. One scheme for assigning router identification numbers is to choose the largest or smallest IP address assigned to the router. If ROUTERID is never set, the default is to use the highest interface IP address on the router.

The PTPSTUB parameter allows control over the formation of stub network links. The OSPF RFC states that whenever a numbered point to point link comes up, a stub network to the other end of the link should be added. Each stub network adds an extra link to the router's LSA. The extra link has no useful purpose, but does increase the LSA size. To limit the LSA size in cases where there are a large number of numbered point to point links, it may be desirable to stop generating stub networks. The default is TRUE, which means stub network links are created. Note that if PTPSTUB is set to FALSE, the router is not strictly compliant with the OSPF RFC but the non-compliance is minor and does not cause problems.



Changing the rip and asexternal parameters can temporarily disrupt the network's integrity.

The STATICEXPORT parameter specifies whether static routing information is exported by this router. If YES, static routes are included in routing exports. If NO, static routes are omitted. The default is YES.

Examples To assign a router the IP address 172.31.1.2 and disable the importing and exporting of RIP information, use the command:

```
set ospf ro=172.31.1.2 rip=off
```

Related Commands

- disable ospf debug
- disable ospf log
- enable ospf debug
- show ospf

set ospf area

Syntax SET OSPF AREA={BACKbone | *area-number*}
 [AUTHentication={NONE | PASSword}] [STUBArea={ON | OFF | YES | NO | NSSA | True | False}] [STUBMetric=0..16777215]
 [SUMmary={SEND | NONE | OFF | NO | FALSE}]

where *area-number* is a four-byte OSPF area number in dotted decimal notation

Description This command modifies the parameters of an existing OSPF area in the OSPF area table.

The AREA parameter specifies the area number, and is required; other parameters are optional. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must not already exist in the area table.

The AUTHENTICATION parameter specifies the type of authentication required for the area. If NONE is specified then no authentication is used on incoming OSPF packets. If PASSWORD is specified, a simple password up to eight characters is used to authenticate each incoming OSPF packet. The password is configured on a per-interface basis. The default is NONE.

The STUBAREA parameter specifies whether the router treats the area as a stub area. As external advertisements are not flooded into or out of stub areas. The backbone cannot be configured as a stub area, nor can a virtual link be configured through a stub area. If AREA is set to 0.0.0.0 or BACKBONE, STUBAREA must be set to OFF. If AREA specifies the transit area of a virtual link, STUBAREA must be set to OFF. All routers within a particular area must have the same setting for STUBAREA. The values ON, YES and TRUE are equivalent. The values OFF, NO and FALSE are equivalent. The value NSSA specifies that the area is a Not-so-stubby-area (NSSA). External routes can be imported as type-7 advertisements in a NSSA. The default is OFF if AREA is set to 0.0.0.0 or BACKBONE, or ON if AREA is set to any other (non-backbone) value.

If the area has been configured as a stub area, and the router is to act as the area border router for the stub area, then the STUBMETRIC parameter specifies the metric (cost) of the default route as advertised by the router in the default summary link. The default is 1.

The SUMMARY parameter controls the generation of summary LSA's into stub areas. By default, the default (0.0.0.0) summary LSA is emitted into a stub area by an area border router. If SEND, summary LSA's from other areas are also emitted into the stub area. If NONE, the default (0.0.0.0) summary LSA is emitted into the stub area. The values OFF, NO, and FALSE are synonyms for NONE. If STUBAREA is set to NSSA, then the default is SEND, otherwise the default is NONE.

Examples To change area 1 into a stub area, use the command:

```
set ospf are=0.0.0.1 stuba=ON stubm=10
```

Related Commands

- [add ospf area](#)
- [add ospf range](#)
- [delete ospf area](#)
- [delete ospf range](#)
- [set ospf range](#)
- [show ospf area](#)
- [show ospf range](#)

set ospf host

Syntax SET OSPF HOS*t*=*ipadd* MET*ric*=0..65535

where *ipadd* is an IP address in dotted decimal notation

Description This command changes the metric of a static OSPF host route in the routing table.

OSPF allows host routes to be advertised to the local OSPF area. Such routes are advertised with a route mask of 255.255.255.255. Host routes are normally used for point-to-point networks on which it is undesirable to run OSPF with IP hosts directly connected to the router.

The parameter HOST specifies the IP address of the host or point-to-point network to be modified. The host must exist in the routing table.

The parameter METRIC specifies the metric for the route to the host.

Examples To change the metric for OSPF host 172.30.1.2 to 5, use the command:

```
set ospf ho=172.30.1.2 met=5
```

Related Commands

- [add ospf host](#)
- [delete ospf host](#)
- [show ospf host](#)

set ospf interface

Syntax SET OSPF INTERface=*interface* [AREa={BACKbone|*area-number*}]
 [BOOST1=0...1023] [DEadinterval=2..2147483647]
 [DEMaND={ON|OFF|YES|NO|True|False}]
 [HELlointerval=1..65535] [PASSword=*password*]
 [POLLIinterval=1..2147483647] [PRIORity=0..255]
 [RXminterval=1..3600] [TRAnsitdelay=1..3600]
 [VIRtuallink=*router-id*]

where:

- *interface* is a valid interface name.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.
- *password* is a character string 1 to 8 characters long. Valid characters are any printable character. If *password* contains spaces, then it must be in double quotes.

Description This command modifies the parameters of an OSPF interface.

The INTERFACE parameter specifies the name of the OSPF interface to add, and must be a defined IP interface, or a valid virtual interface instance. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

To see a list of current valid interfaces, use the [show ospf interface command on page 23-55](#) or the [show interface command on page 7-66 of Chapter 7, Interfaces](#).

Disabled ghost OSPF interfaces exist for each IP interface that is attached to OSPF for use with SNMP. These interfaces must be added to OSPF with the [add ospf interface command on page 23-22](#) before OSPF can use them. Deleting the interface with the [delete ospf interface command on page 23-30](#) turns it back into a disabled ghost OSPF interface.



Addressless PPP links are the only exception to the range checking mechanism, since there is no range to check them against.

The AREA parameter specifies the area where the interface belongs. When defining a virtual link, the area number is the area number of the transit area used for the virtual link. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must already exist in the area table.

The BOOST1 parameter increases the type 1 metrics of all OSPF LSAs flooded out the interface by the value specified. Setting the value to anything other than 0 increases the LSA metrics by that amount. For example, setting the parameter in the router to BOOST1=2 boosts the metrics by 2, so an LSA in this

router with a metric of 3 has a value of 5 when it is flooded out the interface. The default is 0.



This parameter represents a breakage in the OSPF specification, so should be used with extreme caution.

The DEADINTERVAL parameter specifies the interval in seconds after which no hello packets are received by a neighbour, the neighbour declares the router to be down. The timer is advertised in the hello packets. Routers on the same network where the interface is attached must have the same DEADINTERVAL timer. The value must be at least twice the value of the HELLOINTERVAL timer. The recommended multiplier is four. For example, if the HELLOINTERVAL timer is set to 10 seconds, then the DEADINTERVAL timer should be set to 40 seconds. The default is four times the value of the HELLOINTERVAL timer.

The DEMAND parameter specifies whether the interface connects to a demand circuit. Two routers connecting to the same common network segment need not agree on that segment's demand circuit status. This means that configuring one router does not require configuring other routers that connect to the same common network segment. If one router has been configured and the common network is a broadcast or non-broadcast multi-access (NBMA) network, the behaviour (e.g. sending, receiving hello packets) of the network remains the same as if the interface has not been configured as a demand circuit. If one router has been configured and the common network segment is a point-to-point link, the router on the other end may agree to treat the link as a demand circuit and the point-to-point network receives the full benefit. When broadcast and non-broadcast multi-access (NBMA) networks are declared as demand circuits (i.e. more than one router has the network configured as a demand circuit), routing update traffic is reduced but the periodic sending of hellos is not, which requires that the data link connection remain constantly open. The values ON, YES, and TRUE are equivalent. The values OFF, NO, and FALSE are equivalent. The default is OFF.

The HELLOINTERVAL parameter specifies the interval in seconds between hello packets transmitted over the interface. Routers on the network to which the interface is attached must have the same HELLOINTERVAL timer. The value must be less than the value of the POLLINTERVAL timer. The default is 10.

The PASSWORD parameter specifies password used for authentication. A password is required if the authentication scheme for the area has been set to PASSWORD with the [add ospf area command on page 23-20](#) or the [set ospf area command on page 23-41](#). The default is an empty (null) string.

The POLLINTERVAL timer defines the time in seconds when hello packets are sent to neighbouring routers that are deemed to be inactive. The POLLINTERVAL timer is used on NBMA networks (Frame Relay, X.25) and point-to-point networks configured as OSPF on demand circuits. The value must be greater than the value of the HELLOINTERVAL timer. When the neighbour is in state "Down", hellos are sent to the neighbour at the interval of POLLINTERVAL. The default is four times the value of the HELLOINTERVAL timer.

The PRIORITY parameter is used on multi-access networks to set the router priority. When two routers attached to a network attempt to become the designated router, the one with the highest priority takes precedence. If the

priorities are the same then the router with the highest router identification number takes precedence. A router with a priority of zero is ineligible to become the designated router. Router priority can be configured only for routers attached to multi-access networks. The default is 1.

The RXMTINTERVAL parameter specifies the interval in seconds between link state retransmissions, for adjacencies on the interface. The timer is also used when retransmitting database description and link state request packets. The value should be set well above the round trip time between the two routers. It should be set higher for slow serial and virtual links. A typical value is 5 seconds on a local area network. The default is 5.

The TRANSITDELAY parameter specifies the estimated time in seconds that is required to transmit a link state update packet over this interface. This time is added to link state advertisements sent over the interface. The value of this parameter should take into account the transmission and propagation delays of the interface. This mechanism helps keep the link state advertisement timers synchronised on different routers. A typical value is 1 second on a local area network. The default is 1.

The VIRTUALLINK parameter specifies the router identification number for another area border router to be included in the backbone using a virtual link. Each end of the virtual link must be configured. This parameter is required when a virtual interface is added to OSPF.

When the VIRTUALLINK parameter is added, the DEMAND parameter is set to ON automatically. This means that virtual links are always treated as demand circuits. This is because when a virtual link's underlying physical path contains one or more demand circuits, periodic OSPF protocol exchanges over the virtual link would unnecessarily keep the underlying demand circuits open.



The `set ospf interface=interface virtuellink=router-id` command ignores the setting of the `demand` parameter. This means that if `demand` is set to `off`, the virtual link is still treated as a demand circuit.

Also note that when configuring virtual links, the `AREA` parameter in the `add ospf interface` command is the transit area number used for the virtual link.

Examples To set the HELLOINTERVAL to 20 and the DEADINTERVAL to 80 on OSPF interface ppp0, use the command:

```
set ospf int=ppp0 he=20 de=80
```

To set the OSPF interface PPP0 to a demand circuit over the point-to-point link, use the command:

```
set ospf int=ppp0 dem=on
```

Related Commands

`set ospf area`
`add ospf interface`
`add ospf range`
`delete ospf interface`
`disable ospf interface`
`enable ospf interface`
`reset ospf interface`
`set ospf area`
`set ospf range`

[show ospf area](#)
[show ospf interface](#)
[show ospf range](#)

set ospf neighbour

Syntax SET OSPF NEIghbour=*ipadd* PRIOrity=0..255

where *ipadd* is an IP address in dotted decimal notation

Description This command modifies the parameters of a non-broadcast multi-access neighbour. On non-broadcast multi-access networks such as Frame Relay, the neighbours cannot be discovered by dynamic means. To overcome this problem, neighbours are configured statically. All parameters are required to modify a neighbour.

Static OSPF neighbours should be defined on routers that are attached to an OSPF network and are eligible to become the *Designated Router* (DR) or *Backup Designated Router* (BDR) for that network. To be eligible to become the DR or BDR for an OSPF network, a router must have at least one interface on the OSPF network with a non-zero priority. The priority of an OSPF interface is set with the PRIORITY parameter of the [add ospf interface command on page 23-22](#) or the [set ospf interface command on page 23-43](#). Routers connected to an OSPF network via an OSPF interface with a non-zero priority should be configured with static OSPF neighbours corresponding to all other OSPF routers attached to the OSPF network. OSPF routers without an OSPF interface with a non-zero priority should not be configured with static OSPF neighbours.

The NEIGHBOUR parameter specifies the IP address of the neighbour. The IP address must fall within an IP address range associated with an OSPF interface. The specified neighbour must exist in the neighbour table.

The PRIORITY parameter specifies the priority of the neighbour router. If the priority for the neighbour is set to zero then it is not initially considered eligible to become the designated router. The priority for the router itself is set in the interface priority.

Examples To change the priority of the neighbour with IP address 172.30.1.2 to 45, use the command:

```
set ospf nei=172.30.1.2 prio=45
```

Related Commands [add ospf neighbour](#)
[delete ospf neighbour](#)
[show ospf neighbour](#)

set ospf range

Syntax SET OSPF RANGE=*ipadd* [AREA={BACKbone | *area-number*}]
[MASK=*ipadd*] [EFFECT={ADVERTISE | DONOTADVERTISE}]

where:

- *ipadd* specifies an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command modifies an OSPF range. An OSPF area is defined as a list of IP address ranges. A IP address range is defined by an IP address and network mask pair. After an area has been created, the ranges that are to be active in the area must be defined. All the OSPF routers within an area must use the same set of ranges.

The RANGE parameter specifies the base IP address of the range to modify.

The AREA parameter specifies the area number of the area to which the range belongs. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must already exist in the area table. If the area to which the range belongs changes, the interfaces that belong to the range also change.

The MASK parameter specifies a mask used in combination with the base address to determine addresses that belong to the range. The value must be consistent with the value specified for the RANGE parameter. The default is the network mask for the address class of the IP address (e.g. 255.255.0.0 for a Class B address and 255.255.255.0 for a Class C address).

The range defined by the combination of RANGE and MASK must not overlap any other range defined on the router. Either AREA or MASK must be specified.

The EFFECT parameter controls the exporting of ranges into other areas by an area border router. This parameter is valid when the router is configured as an area border router, and can be used to control where the traffic into and out of an area for a particular network travels. If ADVERTISE, summary LSAs are created for the range. If DONOTADVERTISE, summary LSAs are not created for the range. The default is ADVERTISE.

Examples To change an address range of 172.30.0.0–172.30.255.255 into an address range of 172.30.0.0–172.30.0.255, use the command:

```
set ospf ran=172.30.0.0 mask=255.255.255.0
```

Related Commands [add ospf range](#)
[delete ospf range](#)
[show ospf range](#)

set ospf stub

Syntax SET OSPF STUB=*ipadd* MASK=*ipadd* METRIC=0..65535

where *ipadd* is an IP address in dotted decimal notation

Description This command changes the metric of a static non-OSPF stub network in the OSPF routing table. Networks, such as an LAN with only one OSPF router, can be added as stub networks to OSPF without running OSPF on the interface to which the network is attached. The stub links are added to the router's LSA.

The STUB parameter specifies the base IP address of the stub network. The IP address must fall within one of the OSPF ranges defined on the router. The stub must not already exist in the routing table.

The MASK parameter specifies a mask used in combination with the base address to determine addresses that belong to the stub network. The value must be consistent with the value specified for the STUB parameter.

The METRIC parameter specifies the metric for the route to the stub network.

Examples Ethernet interface vlan1 is attached to an Ethernet LAN with an IP subnet address of 172.30.1.0 and network mask 255.255.255.0. To add the LAN attached to the Ethernet interface as a non-OSPF stub network, use the command:

```
add ospf stub=172.30.1.0 mask=255.255.255.0
```

The stub network is added to the OSPF routing table with a default metric of 1. To change the metric to 5, use the command:

```
set ospf stub=172.30.1.0 mask=255.255.255.0 met=5
```

Related Commands

- [add ospf stub](#)
- [delete ospf stub](#)
- [set ospf host](#)
- [set ospf interface](#)
- [show ospf stub](#)

show ospf

Syntax SHow OSPF

Description This command displays information about the general configuration of OSPF routing (Figure 23-6 on page 23-49, Table 23-9 on page 23-49). This display relates to the MIB group ospfGeneralGroup.

Figure 23-6: Example output from the **show ospf** command

```
Router ID ..... 123.234.143.231
OSPF module status ..... Enabled
Area border router status ..... Yes
AS boundary router status ..... Disabled
PTP stub network generation ..... Enabled
External LSA count ..... 10234
External LSA sum of checksums ... 1002345623
New LSAs originated ..... 10345
New LSAs received ..... 34500
RIP ..... Off
BGP importing:
  Enabled ..... Yes
  Import filter ..... 301
  Routes imported/limit ..... 214 / 4000
Export static routes ..... Yes
Dynamic interface support ..... None
Number of active areas ..... 10
Auto BW cost calculation ..... Enabled
Auto BW cost reference ..... 100
Logging ..... Disabled
Debugging ..... Disabled
AS external default route:
  Status ..... Disabled
  Type ..... 1
  Metric ..... 1
```

Table 23-9: Parameters in the output of the **show ospf** command

Parameter	Meaning
Router ID	Unique OSPF router identification number for this router.
OSPF module status	Whether OSPF routing is enabled.
Area border router status	Whether the router is acting as an area border router.
AS boundary router status	Whether the router is enabled to act as an autonomous system boundary router, one of "Enabled", "Disabled" or "NSSA".
PTP stub network generation	Whether stub network links are created when numbered point-to-point links come up.
External LSA count	Number of external link state advertisements in the topological database.
External LSA sum of checksums	32-bit checksum of the external link state advertisements. This checksum can be used to compare the topological databases on two different routers. When they have the same topology, the checksum is the same.

Table 23-9: Parameters in the output of the **show ospf** command

Parameter	Meaning
New LSAs originated	Number of new link state advertisements that have originated from this router.
New LSAs received	The number of link state advertisements received that are new or new instances of link state advertisements.
RIP	Whether RIP information is imported into or exported out of the OSPF routing domain; either "Off", "Import", "Export" or "Import/export".
BGP importing	Information about the importing of BGP routes into OSPF.
Enabled	Whether importing BGP routes into OSPF is enabled.
Import filter	IP filter number used to filter routes before they are imported into OSPF, or whether no filters are used.
Routes imported/limit	The number of BGP routes imported into OSPF, and the maximum number of routes that can be imported at a time.
Export static routes	Whether static routing information is exported to OSPF routing domain.
Dynamic interface support	Whether dynamic interface routes are imported into the OSPF routing table: Stub AS external None Undefined
Number of active areas	Number of OSPF areas defined on the router.
Auto BW cost calculation	Whether or not the router will assign OSPF interface metrics based on the available interface bandwidth.
Auto BW cost reference	The reference bandwidth in Mbit/s used for calculating the OSPF metric.
Logging	Whether OSPF logging is enabled or disabled.
Debugging	Whether OSPF debugging is enabled or disabled.
AS external default route	Information about the generation of a default destination (0.0.0.0) AS external LSA.
Status	Whether the generation of a default destination (0.0.0.0) AS external LSA is enabled or disabled.
Type	LSA type for the default destination (0.0.0.0) AS external LSA; either "1", "2", or "Undefined".
Metric	Metric for the default destination (0.0.0.0) AS external LSA.

Related Commands [set ospf](#)

show ospf area

Syntax `SHoW OSPF AREa [= {BAckbone | area-number}] [{FULl | SUMmary}]`

where *area-number* is a 4-byte OSPF area number in dotted decimal notation

Description This command displays OSPF area information. The AREA parameter specifies the area number. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE. The specified area must exist in the area table. If an area is not specified, a summary of all OSPF areas is displayed (Figure 23-7 on page 23-51, Table 23-10 on page 23-51). If an area is specified, detailed information about the specified area is displayed (Figure 23-8 on page 23-52, Table 23-11 on page 23-52). This display relates to the MIB entity ospfAreaTable.

The FULL and SUMMARY parameters override the default behaviour. The FULL parameter displays detailed information about the specified area or all areas. The SUMMARY parameter displays summary information about the specified area or all areas.

Figure 23-7: Example output from the **show ospf area** command

Area	State	Authentication	StubArea	StubMetric	Summary LSAs
Backbone	Active	Password	No	4	Send
0.0.0.1	Active	Password	Yes	5	None
0.0.0.2	Inactive	None	Yes	20001	None

Table 23-10: Parameters in the output of the **show ospf area** command

Parameter	Meaning
Area	Unique 32-bit number for the area, in dotted decimal notation.
State	Whether the area is active or inactive. This depends on having active ranges and interfaces defined for the area.
Authentication	Type of authentication for incoming OSPF packets to this area; either "None" or "Password".
StubArea	Whether the area imports external link state advertisements. This field relates to the MIB variable ospfImportASExtern.
StubMetric	If the area is a stub area, this is the default metric of the default summary link advertised into the area.
Summary LSAs	Whether summary LSAs other than the default (0.0.0.0) are emitted into the area; either "Send", "None" or "Undefined".

Figure 23-8: Example output from the **show ospf area** command for a specific area

```

Area 0.0.0.1:
  State ..... Active
  Authentication .... Password
  Stub area ..... No
  Stub cost ..... 1
  Summary LSAs ..... Send
  SPF runs ..... 23
  Area border router count ..... 3
  AS border router count ..... 2
  LSA count ..... 10
  LSA sum of checksums ..... 345bf

Ranges:
  Range 192.168.25.0:
    Mask ..... 255.255.255.0
  Range 192.168.250.0:
    Mask ..... 255.255.255.0

Interfaces:
  ppp23:
    Type ..... Point to point
    State ..... ptp
  eth0:
    Type ..... Broadcast
    State ..... otherDR

```

Table 23-11: Parameters in the output of the **show ospf area** command for a specific area

Parameter	Meaning
Area	Unique 32-bit number for the area, in dotted decimal notation.
State	Whether the area is active or inactive. This depends on having active ranges and interfaces defined for the area.
Authentication	Type of authentication for incoming OSPF packets to this area; either "None" or "Password".
Stub area	Whether the area imports external link state advertisements. This field relates to the MIB variable ospfImportASExtern.
Stub cost	If the area is a stub area, this is the default metric of the default summary link advertised into the area.
Summary LSAs	Whether summary LSAs other than the default (0.0.0.0) are emitted into the area; either "Send", "None" or "Undefined".
SPF runs	Number of times the intra-area routing table has been recalculated using the topological database.
Area border router count	Total number of area border routers reachable within the area.
AS border router count	Total number of Autonomous System boundary routers reachable within the area.
LSA count	Total number of link state advertisements in this area's topological database, excluding external LSAs.

Table 23-11: Parameters in the output of the **show ospf area** command for a specific area

Parameter	Meaning
LSA sum of checksums	32-bit checksum of the checksums of the area's link state advertisements. This checksum can be used to compare the topological databases on two different routers.
Ranges	Information about the ranges active for this area.
Range	Base IP address of a range.
Mask	Mask for a range.
Interfaces	Interfaces in use by the area.
Type	Interface type; either "Unknown", "Broadcast", "NBMA", "Point to Point" or "Virtual".
State	State of the interface; either "unknown", "down", "loopback", "waiting", "ptp", "DR", "backupDR" or "otherDR"

Examples To display a summary of all configured OSPF areas, use the command:

```
sh ospf are
```

To display detailed information about all configured OSPF areas, use the command:

```
sh ospf are ful
```

Related Commands

- [add ospf area](#)
- [add ospf range](#)
- [delete ospf area](#)
- [delete ospf range](#)
- [reset ospf counter](#)
- [set ospf area](#)
- [set ospf range](#)
- [show ospf range](#)

show ospf debug

Syntax SHow OSPF DEBug

Description This command displays internal debugging information for the OSPF routing module and should only be used under the direction of a technical support engineer.

show ospf host

Syntax SHow OSPF HOsT [=ipadd] [AREa={BAckbone | area-number}]

where:

- *ipadd* is an IP address in dotted decimal notation.

- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command displays information about statically configured OSPF host routes (Figure 23-9 on page 23-54, Table 23-12 on page 23-54). This display relates to the MIB entity ospfHostTable.

The HOST parameter specifies the OSPF host route to display. Host routes whose base IP addresses match the specified IP address are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple host routes. For example, the value 172.16.0.0 matches (and displays) all OSPF host routes whose base address begins with 172.16.

The AREA parameter specifies the area for which host route information is to be displayed. Host routes associated with the specified area are displayed. Wildcard addresses with zeros in the right-hand position may be used to match multiple areas. For example, the value 172.16.0.0 matches (and displays) OSPF host routes associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

Figure 23-9: Example output from the **show ospf host** command

IP address	Mask	State	Area	Metric	TOS	Type
192.188.150.2	255.255.255.255	Inactive	0.0.0.24	20000	0	Stat
192.188.250.235	255.255.255.255	Active	123.125.230.156	10	0	Stat
192.188.125.240	255.255.255.255	Active	0.0.0.1	1	0	Stat

Table 23-12: Parameters in the output of the **show ospf host** command

Parameter	Meaning
IP address	The IP address of the host or point-to-point network.
Mask	The mask for the host route.
State	Whether the host route entry is active or inactive. If active, it is being advertised via the router LSA.
Area	The area number of the area containing the host.
Metric	The metric to be advertised for the host.
TOS	The type of service of the route to the host.
Type	Whether the type of host route entry is permanent static or dynamic.

Examples To display all OSPF host routes, use the command:

```
SHOW OSPF HOST
```

To display information for all host routes from 172.30.0.0 to 172.30.255.255 in area 0.0.0.3, use the command:

```
SHOW OSPF HOST=172.30.0.0 AREA=0.0.0.3
```

Related Commands

- [add ospf host](#)
- [delete ospf host](#)
- [set ospf host](#)

show ospf interface

Syntax `SHoW OSPF INTErface [=interface] [AREa={BACKbone |
area-number}] [IPaddress=ipadd] [{FULL | SUMmary}]`

where:

- *interface* is a valid interface name.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.
- *ipadd* is an IP address in dotted decimal notation.

Description This command displays information about OSPF interfaces. If an interface is not specified, summary information for all OSPF interfaces attached to OSPF is displayed ([Figure 23-10 on page 23-56](#), [Table 23-13 on page 23-56](#)). If an interface is given, detailed information about the specified OSPF interface is displayed ([Figure 23-11 on page 23-57](#), [Table 23-14 on page 23-57](#)). This display relates to the MIB entity ospflfTable.

The INTERFACE parameter specifies a valid interface already assigned and configured. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

Disabled ghost OSPF interfaces exist for each IP interface that is attached to OSPF for use with SNMP. These interfaces must be added to OSPF with the [add ospf interface command on page 23-22](#) before OSPF can use them. Deleting the interface with the [delete ospf interface command on page 23-30](#) turns it back into a disabled ghost OSPF interface.

The AREA parameter specifies the area for which interface information is to be displayed. Interfaces associated with the specified area are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple areas. For example, the value 172.16.0.0 matches (and displays) OSPF interfaces associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

The IPADDRESS parameter specifies the IP address for which interface information is to be displayed. Interfaces with the specified address are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple interfaces. For example, the value 172.16.0.0 matches (and displays) all OSPF interfaces with addresses beginning 172.16.

The parameters FULL and SUMMARY can override the default behaviour. The FULL parameter displays detailed information about the specified interface or all interfaces. The SUMMARY parameter displays summary information about the specified interface or all interfaces.

Figure 23-10: Example output from the **show ospf interface** command

Iface	Status	Area	State	Designated rtr / Virtual nbr	Backup DR / Transit area
eth0	Enabled	0.0.0.1	otherDR	192.168.250.254	192.168.250.253
fr0	Enabled	Backbone	DR	192.168.0.3	192.168.0.4
ppp23	Disabled	0.0.0.1	ptp	-	-
virt0	Enabled	Backbone	ptp	192.168.250.5	0.0.0.1

Table 23-13: Parameters in the output of the **show ospf interface** command

Parameter	Meaning
Iface	Interface name.
Status	Whether the administrative status of the interface is enabled.
Area	Area with which the interface is associated.
State	The state of the interface: Unknown Down Loopback Waiting Ptp DR BackupDR OtherDR
Designated rtr	Current designated router for a broadcast or non-broadcast multi-access network, or "None" if a designated router has not yet been selected.
Backup DR	Current backup designated router for a broadcast or non-broadcast multi-access network, or "None" if a backup designated router has not yet been selected.
Virtual nbr	Router identification number of the virtual neighbour for virtual interfaces.
Transit area	Transit area used for virtual interfaces.

Figure 23-11: Example output from the **show ospf interface** command for a specific interface

```

vlan1:
  Status ..... Enabled
  Area ..... Backbone
  IP address ..... 192.168.250.1
  IP net mask ..... 255.255.255.0
  IP network number ..... 192.168.250.0
  Type ..... broadcast
  OSPF on demand ..... ON (OFF)
  State ..... otherDR
  Router priority ..... 5
  Transit delay ..... 1 second
  Retransmit interval ..... 5 seconds
  Hello interval ..... 10 seconds
  Router dead interval ..... 40 seconds
  Poll interval ..... 120 seconds
  Interface events ..... 1
  Password ..... Charlie1
  Demand circuit ..... ON
  Designated router ..... 192.168.250.254
  Backup designated router ..... 192.168.250.253
  Metric boost 1 ..... 0

```

Table 23-14: Parameters in the output of the **show ospf interface** command for a specific interface

Parameter	Meaning
Status	Whether the administrative status of the interface is enabled.
Area	Area with which the interface is associated.
Addressless index	Addressless interface index for addressless interfaces.
IP address	IP address assigned to the interface when the interface is not an addressless interface. This is defined by the IP interface where OSPF is attached.
IP net mask	IP network mask for the associated IP interface, if the interface is not an addressless interface.
IP network number	IP network address for the interface when the interface is not an addressless interface. The network address is determined from the IP address and network mask.
IP OSPF metric	Cost of transmitting a packet across the interface, expressed in the link state metric.
Type	Type of network associated with the interface; either "Broadcast", "NBMA" (non-broadcast multi-access), "Point-to-Point", "Unknown", or "Virtual".
OSPF on demand	Whether the interface is configured as a demand circuit. If the interface is a virtual interface, the parameter is always on. For a point-to-point interface, the status of the demand circuit after negotiation with the remote end is displayed within the parenthesis.

Table 23-14: Parameters in the output of the **show ospf interface** command for a specific interface (continued)

Parameter	Meaning
State	State of the interface: Unknown Down Loopback Waiting Ptp DR BackupDR OtherDR
Router priority	Router priority for the interface. A value of zero means the router is not eligible to become the designated router on the network associated with the interface.
Interface transit delay	Estimated time in seconds to transmit a link state advertisement over the interface.
Retransmit interval	Seconds between retransmissions of link state advertisement, database description, and link state request packets.
Hellointerval	Seconds between hello packets transmitted from the interface. This value must be the same for all routers attached to a common network.
Router dead interval	Seconds advertised by this router after which it should be considered as down if another router on the network has not heard from this router. This value must be the same for all routers attached to a common network.
Poll interval	On non-broadcast multi-access networks, the time in seconds when hello packets are sent to neighbouring routers that are deemed to be inactive. This should be set to a larger value than the hello interval timer.
Interface events	Number of times the interface has changed its OSPF interface state, or the number of times an error has occurred.
Password	Authentication key, if the area is set to authentication PASSWORD. This password is a security measure; be careful who sees it. This field is empty if no password is defined.
Demand circuit	Whether the interface connects to a demand circuit. If the interface is a virtual interface, the parameter is always on.
Designated router	Current designated router for a broadcast or non-broadcast multi-access network, or "None" if a designated router has not yet been selected.
Backup designated router	Current backup designated router for a broadcast or non-broadcast multi-access network, or "None" if a backup designated router has not yet been selected.
Virtual neighbour	Identification number for the virtual neighbour when the interface is a virtual interface.
Transit area	Transit area used when the interface is a virtual interface.

Examples To display summary information for all OSPF interfaces, use the command:

```
sh ospf int
```

To display detailed information for all OSPF interfaces, use the command:

```
sh ospf int ful
```

To display detailed information for OSPF interface ppp0, use the command:

```
sh ospf int=ppp0
```

Related Commands

- [add ospf interface](#)
- [delete ospf interface](#)
- [set ospf interface](#)
- [reset ospf counter](#)

show ospf lsa

Syntax `SHoW OSPF LSA=link-id [AREa={BACKbone | area-number}]`
`[{FULl | SUMmary}] [TYpe={ASBrsummary | ASExternal | ASNSSA |`
`ASSummary | IPsummary | SUMmary | NETwork | ROUTer}]`

where:

- *link-id* is an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command displays the current link state advertisements within the topological database. This display relates to the MIB entity ospfLsdbTable.

The display is split into two sections, link state advertisements by area, and for if the area is not a stub area, the external link state advertisements.

The LSA parameter specifies the unique ID of the network link, or link state identifier, associated with the LSA to display. Only LSAs whose link state identifiers match the specified link state identifier are displayed. If a link state identifier is not specified, summary information about all LSAs is displayed (Figure 23-12 on page 23-60, Table 23-15 on page 23-60). If a link state identifier is specified, detailed information about the specified LSA is displayed (Figure 23-13 on page 23-62, Table 23-16 on page 23-64). Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple LSAs. For example, the value 172.16.0.0 matches (and displays) all LSAs whose link state identifier begins with 172.16.

The AREA parameter specifies the area for which LSA information is to be displayed. LSAs associated with the specified area are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple areas. For example, the value 172.16.0.0 matches (and displays) LSAs associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

The FULL and SUMMARY parameters override the default behaviour. The FULL parameter displays detailed information about the specified LSA or all

LSAs. The SUMMARY parameter displays summary information about the specified LSA or all LSAs.

The TYPE parameter specifies the type of link state advertisements to display. If ROUTER is specified, only router link state advertisements are displayed. If NETWORK is specified, only network link state advertisements are displayed. If IPSUMMARY or SUMMARY is specified, only summary IP advertisements are displayed. If ASBRSUMMARY or ASSUMMARY is specified, only autonomous system border router summary links are displayed. If ASETERNAL is specified, only autonomous system external links are displayed. The ASETERNAL parameter is not valid if AREA has been specified.

Figure 23-12: Example output from the **show ospf lsa summary** command

Type	LS ID	Router ID	Sequence	Age	Len	Csum

Area 0.0.0.0:						
Router	172.28.2.8	172.28.2.8	80000001	401	36	cd27
Summary	172.30.0.0	172.28.2.8	80000001	384	28	fcd2
Area 0.0.0.1:						
Router	172.28.2.8	172.28.2.8	800000a6	381	36	482b
Router	172.28.2.9	172.28.2.9	80000096	*6	36	de4a
Router	172.28.10.4	172.28.10.4	80000093	387	36	aadc
Summary	172.28.0.0	172.28.2.8	80000024	391	28	c6ea
AsNssa	192.32.0.0	172.30.2.4	80000005	392	36	72f9
External:						
AsExternal	0.0.0.0	172.28.2.8	80000001	383	36	b1d4
AsExternal	172.16.0.0	172.28.2.8	80000001	383	36	4741
AsExternal	172.20.0.0	172.28.2.8	80000001	383	36	e644
AsExternal	172.21.0.0	172.28.2.8	80000001	383	36	da4f
AsExternal	172.23.0.0	172.28.2.8	80000001	383	36	ff1
AsExternal	172.24.0.0	172.28.2.8	80000001	383	36	72d9
AsExternal	172.26.0.0	172.28.2.8	80000001	383	36	218f
AsExternal	172.27.0.0	172.28.2.8	80000001	383	36	ba6d

Table 23-15: Parameters in the output of the **show ospf lsa summary** command

Parameter	Meaning
Type	Type of link state advertisement.
LS ID	The link state advertisement identification field and its contents are specific to the type of link state advertisement. This field identifies the piece of the routing domain being described by the advertisement.
RouterID	Router identification number of the OSPF router that originated the link state advertisement.
Sequence	Sequence number of the link state advertisement. The sequence number is a 32-bit signed integer. It starts with the value 0x80000001 and increments by one up to 0x7FFFFFFF.
Age	Age of the link state advertisement. The maximum age for any link state advertisement is 3600 seconds. If the age field has a "*", it means the LSA is a DoNotAge LSA.

Table 23-15: Parameters in the output of the **show ospf lsa summary** command

Parameter	Meaning
Len	Length of the LSA in bytes, including the 20 byte LSA header.
Csum	Checksum of the complete link state advertisement, except the age field. This can be used to compare two instances of the same link state advertisement.

Figure 23-13: Example output from the **show ospf lsa full** command

Type	LS ID	Router ID	Sequence	Age	Len	Csum

Area backbone:						
Router	1.1.1.1	1.1.1.1	8000008e	34	36	9c42
Options: --B Number of links: 1						
Link 1: Type: Transit ID: 192.168.3.4 Data: 192.168.3.1						
TOS 0 metric: 1 Number of other metrics: 0						
Router	2.2.2.2	2.2.2.2	80000114	28	36	50fe
Options: --B Number of links: 1						
Link 1: Type: Transit ID: 192.168.3.4 Data: 192.168.3.2						
TOS 0 metric: 1 Number of other metrics: 0						
Router	4.4.4.4	4.4.4.4	800000f7	26	36	0f4b
Options: --B Number of links: 1						
Link 1: Type: Transit ID: 192.168.3.4 Data: 192.168.3.4						
TOS 0 metric: 1 Number of other metrics: 0						
Network	192.168.3.4	4.4.4.4	80000002	26	36	5365
Network Mask: 255.255.255.0						
Attached router: 4.4.4.4						
Attached router: 1.1.1.1						
Attached router: 2.2.2.2						
Summary	192.168.1.0	1.1.1.1	80000004	1208	28	9456
Network Mask: 255.255.255.0						
TOS: 0 Metric: 1						
Summary	192.168.2.0	2.2.2.2	80000005	147	28	697b
Network Mask: 255.255.255.0						
TOS: 0 Metric: 1						
Summary	192.168.4.0	4.4.4.4	80000004	1580	28	19c2
Network Mask: 255.255.255.0						
TOS: 0 Metric: 1						
Area 3.3.3.3:						
Router	4.4.4.4	4.4.4.4	8000000c	1342	36	fc47
Options: --B Number of links: 1						
Link 1: Type: Transit ID: 192.168.4.4 Data: 192.168.4.4						
TOS 0 metric: 1 Number of other metrics: 0						
Router	5.5.5.5	5.5.5.5	80000013	83	36	ad87
Options: --- Number of links: 1						
Link 1: Type: Transit ID: 192.168.4.4 Data: 192.168.4.5						
TOS 0 metric: 1 Number of other metrics: 0						
Network	192.168.4.4	4.4.4.4	80000004	1338	32	8031
Network Mask: 255.255.255.0						
Attached router: 4.4.4.4						
Attached router: 5.5.5.5						
Summary	192.168.1.0	4.4.4.4	80000005	41	28	429a
Network Mask: 255.255.255.0						
TOS: 0 Metric: 2						
Summary	192.168.2.0	4.4.4.4	80000001	14	28	3fa0
Network Mask: 255.255.255.0						
TOS: 0 Metric: 2						
Summary	192.168.3.0	4.4.4.4	80000004	1560	28	24b8
Network Mask: 255.255.255.0						
TOS: 0 Metric: 1						
AsNssa	192.32.0.0	172.30.2.4	80000005	392	36	72f9
Network Mask: 255.255.255.0 Options: --N---						
TOS: 0 Metric: E1- 2 Foward: 192.30.5.2 Tag: 00000000						

```

External:
  AsExternal  202.49.72.0      5.5.5.5      80000004      83   36   12e2
    Network Mask: 255.255.255.0  Options: ----- NSSA Translated: N
      TOS: 0  Metric: E1-      2  Foward: 0.0.0.0      Tag: 00000000

  AsNssa      192.30.0.0      172.30.2.4      80000004      392  36   1f52
    Network Mask: 255.255.255.0  Options: ----- NSSA Translated: Y
      TOS: 0      Metric:  E1-      2  Foward: 192.30.5.2  Tag: 00000000
-----

```

Examples To display all LSAs for the backbone area, use the command:

```
sh ospf lsa are=ba
```

show ospf neighbour

Syntax SHow OSPF NEIghbour [=ipadd] [INTERface=interface]

where:

- *ipadd* is an IP address in dotted decimal notation.
- *interface* is a valid interface name.

Description This command displays the OSPF static NBMA neighbours ([Figure 23-14 on page 23-64](#), [Table 23-16 on page 23-64](#)). If a neighbour is specified, only information about the specified neighbour is displayed. This display relates to the MIB entity ospfNbrTable.

The INTERFACE parameter specifies a valid interface already assigned and configured. Valid interfaces are:

- eth (e.g. eth0)
- PPP (e.g. ppp0)
- VLAN (e.g. vlan1)
- FR (e.g. fr0)
- virtual interface (e.g. virt9)

The NEIGHBOUR parameter specifies the IP address for which neighbour information is to be displayed. Neighbours with the specified address are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple neighbours. For example, the value 172.16.0.0 matches (and displays) all OSPF neighbours with addresses beginning 172.16.

The INTERFACE parameter specifies the interface for which neighbour information is to be displayed. Neighbours associated with the specified interface are displayed.

Figure 23-14: Example output from the **show ospf neighbour** command

IP address	State	Interface	Router ID	Priority	LSRxmtQ	Type
192.168.67.1	full	eth0	10.34.5.78	10	23	Dyn
192.168.200.12	full	fr0	0.0.0.5	5	0	Stat
192.168.234.123	full	fr0	124.123.234.143	255	1034	Stat

Table 23-16: Parameters in the output of the **show ospf neighbour** command

Parameter	Meaning
IP address	The IP address of the neighbour.
State	Neighbour state.
Interface	Interface associated with the neighbour.
Router ID	Neighbour's assigned OSPF router identification number.
Priority	The priority currently being advertised by the neighbour in its hello packets.
LSRetransQ	Current length of the link state retransmission queue.
Type	Whether the entry is dynamically learned or statically defined.

Related Commands

- [add ospf neighbour](#)
- [delete ospf neighbour](#)
- [reset ospf counter](#)
- [set ospf neighbour](#)

show ospf range

Syntax `SHoW OSPF RANge [= ipadd] [AREa={BACKbone | area-number}]`

where:

- *ipadd* specifies an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command displays information about the OSPF ranges that have been defined ([Figure 23-15 on page 23-65](#), [Table 23-17 on page 23-65](#)). This display relates to the MIB entity ospfAreaRangeTable. The range table shows which ranges have been defined in which areas.

The RANGE parameter specifies the OSPF range or ranges to display. Ranges whose base IP address matches the specified range are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple ranges. For example, the value 172.16.0.0 matches (and displays) all OSPF ranges whose base address begins with 172.16.

The AREA parameter specifies the area for which range information is to be displayed. Ranges associated with the specified area are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match

multiple areas. For example, the value 172.16.0.0 matches (and displays) OSPF ranges associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

Figure 23-15: Example output from the **show ospf range** command

Base IP address	State	Mask	Area	Effect
10.0.0.0	Active	255.0.0.0	0.0.0.1	Advertise
192.168.10.0	Inactive	255.255.255.0	10.34.143.234	Advertise
192.168.123.240	Active	255.255.255.240	123.234.243.125	Advertise

Table 23-17: Parameters in the output of the **SHOW OSPF RANGE** command

Parameter	Meaning
Base IP address	Base IP address of the network or subnet for the range.
State	Whether the range is active or inactive. A range is active if it is attached to an active area
Mask	Subnet mask for the network or subnet.
Area	Area to which the range is attached.
Effect	Whether the range is advertised to other areas via a summary LSA.

Examples To display OSPF range information for all ranges whose base address begins with 172.16, use the command:

```
sh ospf ran=172.16.0.0
```

To display OSPF range information for all areas numbered 192.168.10.0 to 192.168.10.255, use the command:

```
sh ospf ran are=192.168.10.0
```

Related Commands

- [add ospf range](#)
- [delete ospf range](#)
- [set ospf area](#)

show ospf route

Syntax `SHoW OSPF ROUte [=ipadd] [AREa={BACKbone | area-number}]`
`[TYpe={AB | ASbr}]`

where:

- *ipadd* specifies an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command displays the current state of all OSPF internal routes within the OSPF module (Figure 23-16 on page 23-66, Table 23-18 on page 23-66). The

display has two sections: the Area Border Router (AB) routes within particular areas, and the Autonomous System Boundary Router (ASBR) routes, if the area is not a stub area.

The ROUTE parameter specifies the unique ID of the route to be displayed. If a route is not specified, all OSPF routes matching the other criteria are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple routes. For example, the value 172.16.0.0 matches (and displays) OSPF routes whose address begins with 172.16.

The AREA parameter specifies the area for which route information is to be displayed. Routes associated with the specified area are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple areas. For example, the value 172.16.0.0 matches (and displays) OSPF routes associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

The TYPE parameter specifies the type of route to display. If AB is specified, Area Border Router routes are displayed. If ASBR is specified, Autonomous System Boundary Router routes are displayed.

Figure 23-16: Example output from the **show ospf route** command

OSPF Routes					
Destination DLCI/Circ.	Mask Type	Policy	NextHop Protocol	Interface Metrics	Age Preference

Area backbone AB routes:					
1.1.1.1	255.255.255.255		192.168.3.1	fr0	0
20	ospfAB	0	ospf	1	10
2.2.2.2	255.255.255.255		192.168.3.2	fr0	0
22	ospfAB	0	ospf	1	10
ASBR routes:					
5.5.5.5	255.255.255.255		192.168.4.5	eth0	0
-	ospfAS	0	ospf	1	10

Table 23-18: Parameters in the output of the **show ospf route** command

Parameter	Meaning
Destination	Router ID of the BA router or ASBR router to which this route points.
DLCI/Circ.	Frame Relay or X25T circuit that the route uses
Mask	Mask for the route. Should always be 255.255.255.255.
Type	Whether the route is ospfAB (AB route) or ospfAS (ASBR route).
Policy	Forwarding policy of the route; always 0.
NextHop	Forwarding address of the next hop for this route, or 0.0.0.0 if the destination is directly attached.
Protocol	Protocol of the route; always "ospf".
Interface	Interface with which the route is associated.
Metrics	Metrics (costs) associated with the route.

Table 23-18: Parameters in the output of the **show ospf route** command (continued)

Parameter	Meaning
Age	Age of the route in seconds.
Preference	Forwarding preference of the route. This is related to the route's OSPF path type. 10 for Intra Area routes and 11 for Inter area routes.

Examples To display information about all OSPF routes, use the command:

```
sh ospf rou
```

To display OSPF routes whose base address begins with 172.16, use the command:

```
sh ospf rou=172.16.0.0
```

To display OSPF range information for all areas numbered 192.168.10.0 to 192.168.10.255, use the command:

```
sh ospf rou are=192.168.10.0
```

Related Commands [show ospf area](#)
[show ospf interface](#)
[show ospf range](#)

show ospf stub

Syntax `SHoW OSPF STUB [=ipadd] [AREa={BACKbone | area-number}]`

where:

- *ipadd* is an IP address in dotted decimal notation.
- *area-number* is a 4-byte OSPF area number in dotted decimal notation.

Description This command displays information about statically configured non-OSPF stub network routes ([Figure 23-17 on page 23-68](#), [Table 23-19 on page 23-68](#)).

The STUB parameter specifies the stub network or networks to display. Only stub networks whose base IP address matches the specified IP address are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple stub networks. For example, the value 172.16.0.0 matches (and displays) all OSPF stub networks whose base address begins with 172.16.

The AREA parameter specifies the area for which stub network information is to be displayed. Stub networks associated with the specified area are displayed. Wildcard addresses with zeros (0) in the right-hand position(s) may be used to match multiple areas. For example, the value 172.16.0.0 matches (and displays) OSPF stub networks associated with areas whose area number begins with 172.16. The area number 0.0.0.0 is reserved for the backbone area, and can be used interchangeably with the keyword BACKBONE.

Figure 23-17: Example output from the **show ospf stub** command

IP address	Mask	State	Area	Metric	TOS	Type
192.168.150.2	255.255.255.255	Active	Backbone	5	0	Stat
192.168.8.0	255.255.255.0	Active	Backbone	4	0	Stat

Table 23-19: Parameters in the output of the **show ospf stub** command

Parameter	Meaning
IP address	The IP address of the host or point-to-point network.
Mask	The mask for the stub network.
State	Whether the stub network is active or inactive. When a stub network is active, it is advertised via the router LSA.
Area	The area number of the area containing the stub network.
Metric	The metric to be advertised for the stub network.
TOS	The type of service of the route to the stub network.
Type	Whether the stub network entry is permanent static or dynamic.

Examples To display all OSPF stub networks, use the command:

```
sh ospf stub
```

To display information for all stub networks from 172.30.0.0 to 172.30.255.255 in area 0.0.0.3, use the command:

```
sh ospf stub=172.30.0.0 are=0.0.0.3
```

Related Commands

- [add ospf stub](#)
- [delete ospf stub](#)
- [set ospf stub](#)