

# Brocade 5600 vRouter OSPF Configuration Guide

Supporting Brocade 5600 vRouter 4.2R1

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# Contents

---

|  |           |
|--|-----------|
| <b>Preface</b> .....   | <b>7</b>  |
| Document conventions.....                                    | 7         |
| Text formatting conventions.....                             | 7         |
| Command syntax conventions.....                              | 7         |
| Notes, cautions, and warnings.....                           | 8         |
| Brocade resources.....                                       | 8         |
| Contacting Brocade Technical Support.....                    | 8         |
| Brocade customers.....                                       | 8         |
| Brocade OEM customers.....                                   | 9         |
| Document feedback.....                                       | 9         |
| <b>About This Guide</b> .....                                | <b>11</b> |
| <b>OSPF Configuration</b> .....                              | <b>13</b> |
| OSPF overview.....   | 13        |
| Supported standards.....                                     | 13        |
| Configuring OSPF.....  | 13        |
| Basic OSPF configuration.....                                | 14        |
| Verifying the OSPF configuration.....                        | 16        |
| Excluding addresses from being broadcast.....                | 16        |
| <b>OSPF Commands</b> .....                                   | <b>19</b> |
| monitor protocol ospf background.....                        | 21        |
| monitor protocol ospf disable database-timer rate-limit..... | 22        |
| monitor protocol ospf disable events.....                    | 23        |
| monitor protocol ospf disable ifsm.....                      | 24        |
| monitor protocol ospf disable lsa.....                       | 25        |
| monitor protocol ospf disable n fsm.....                     | 26        |
| monitor protocol ospf disable nsm.....                       | 27        |
| monitor protocol ospf disable packet all.....                | 28        |
| monitor protocol ospf disable packet dd.....                 | 29        |
| monitor protocol ospf disable packet detail.....             | 30        |
| monitor protocol ospf disable packet hello.....              | 31        |
| monitor protocol ospf disable packet ls-ack.....             | 32        |
| monitor protocol ospf disable packet ls-request.....         | 33        |
| monitor protocol ospf disable packet ls-update.....          | 34        |
| monitor protocol ospf disable packet rcv.....                | 35        |
| monitor protocol ospf disable packet send.....               | 36        |
| monitor protocol ospf disable route.....                     | 37        |
| monitor protocol ospf enable database-timer.....             | 38        |
| monitor protocol ospf enable events.....                     | 39        |
| monitor protocol ospf enable ifsm.....                       | 40        |
| monitor protocol ospf enable lsa.....                        | 41        |
| monitor protocol ospf enable n fsm.....                      | 42        |
| monitor protocol ospf enable nsm.....                        | 43        |
| monitor protocol ospf enable packet all.....                 | 44        |
| monitor protocol ospf enable packet dd.....                  | 45        |
| monitor protocol ospf enable packet detail.....              | 46        |

|   |     |
|---|-----|
| monitor protocol ospf enable packet hello.....  | 47  |
| monitor protocol ospf enable packet ls-ack.....                                       | 48  |
| monitor protocol ospf enable packet ls-request.....                                   | 49  |
| monitor protocol ospf enable packet ls-update.....                                    | 50  |
| monitor protocol ospf enable packet recv.....   | 51  |
| monitor protocol ospf enable packet send.....   | 52  |
| monitor protocol ospf enable route.....   | 53  |
| protocols ospf.....   | 54  |
| protocols ospf area <area-id>.....  | 55  |
| protocols ospf area <area-id> area-type nssa <action>.....                            | 56  |
| protocols ospf area <area-id> area-type stub <action>.....                            | 58  |
| protocols ospf area <area-id> authentication <type>.....                              | 59  |
| protocols ospf area <area-id> network <ipv4net>.....                                  | 61  |
| protocols ospf area <area-id> range <ipv4net> not-advertise.....                      | 62  |
| protocols ospf area <area-id> virtual-link <ipv4> authentication <method>.....        | 63  |
| protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>.....       | 65  |
| protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>.....      | 67  |
| protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>..... | 69  |
| protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>.....         | 71  |
| protocols ospf auto-cost reference-bandwidth <bandwidth>.....                         | 73  |
| protocols ospf default-information originate.....                                     | 74  |
| protocols ospf default-metric <metric>.....   | 76  |
| protocols ospf distance.....  | 77  |
| protocols ospf distribute-list <list-number>.....                                     | 79  |
| protocols ospf log.....   | 81  |
| protocols ospf log events.....  | 83  |
| protocols ospf log ifsm.....  | 85  |
| protocols ospf log lsa.....   | 86  |
| protocols ospf log n fsm.....   | 88  |
| protocols ospf log nsm.....   | 89  |
| protocols ospf log packet.....  | 90  |
| protocols ospf log rib.....   | 92  |
| protocols ospf log route.....   | 93  |
| protocols ospf neighbor <ipv4>.....   | 95  |
| protocols ospf overflow database external limit <number> recovery <time>.....         | 96  |
| protocols ospf overflow database hard limit <number>.....                             | 97  |
| protocols ospf overflow database soft limit.....                                      | 98  |
| protocols ospf parameters.....  | 99  |
| protocols ospf passive-interface.....   | 101 |
| protocols ospf passive-interface-exclude.....   | 102 |
| protocols ospf redistribute bgp.....  | 104 |
| protocols ospf redistribute connected.....  | 106 |
| protocols ospf redistribute kernel.....   | 108 |
| protocols ospf redistribute <protocol> <options>.....                                 | 110 |
| protocols ospf redistribute rip.....  | 112 |
| protocols ospf redistribute static.....   | 114 |
| protocols ospf refresh timers <value>.....  | 116 |
| protocols ospf summary-address <address> <action>.....                                | 117 |
| show ip ospf.....   | 118 |
| show ip ospf border-routers.....  | 119 |

|   |            |
|---|------------|
| show ip ospf database.....  | 120        |
| show ip ospf interface.....   | 122        |
| show ip ospf neighbor.....  | 123        |
| show ip ospf route.....   | 124        |
| show ip route ospf.....   | 125        |
| show monitoring protocols ospf.....   | 126        |
| <b>OSPF Area Commands.....</b>  | <b>127</b> |
| protocols ospf area <area-id>.....  | 128        |
| protocols ospf area <area-id> area-type normal.....                                   | 129        |
| protocols ospf area <area-id> area-type nssa <action>.....                            | 130        |
| protocols ospf area <area-id> area-type stub <action>.....                            | 132        |
| protocols ospf area <area-id> authentication <type>.....                              | 133        |
| protocols ospf area <area-id> network <ipv4net>.....                                  | 135        |
| protocols ospf area <area-id> range <ipv4net> not-advertise.....                      | 136        |
| protocols ospf area <area-id> virtual-link <ipv4> authentication <method>.....        | 137        |
| protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>.....       | 139        |
| protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>.....      | 141        |
| protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>..... | 143        |
| protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>.....         | 145        |
| <b>OSPF Interface Commands.....</b>   | <b>147</b> |
| interfaces <interface> <interface-name> ip ospf.....                                  | 148        |
| interfaces <interface> <interface-name> ip ospf authentication <text>.....            | 149        |
| interfaces <interface> <interface-name> ip ospf bandwidth <bandwidth>.....            | 151        |
| interfaces <interface> <interface-name> ip ospf cost <cost>.....                      | 152        |
| interfaces <interface> <interface-name> ip ospf dead-interval <interval>.....         | 154        |
| interfaces <interface> <interface-name> ip ospf hello-interval <interval>.....        | 156        |
| interfaces <interface> <interface-name> ip ospf mtu-ignore.....                       | 158        |
| interfaces <interface> <interface-name> ip ospf network <type>.....                   | 160        |
| interfaces <interface> <interface-name> ip ospf priority <priority>.....              | 162        |
| interfaces <interface> <interface-name> ip ospf retransmit-interval <interval>.....   | 164        |
| interfaces <interface> <interface-name> ip ospf transmit-delay <delay>.....           | 166        |
| <b>Supported Interface Types.....</b>   | <b>169</b> |
| <b>List of Acronyms.....</b>  | <b>171</b> |



# Preface

---

- Document conventions..... 7
- Brocade resources..... 8
- Contacting Brocade Technical Support..... 8
- Document feedback..... 9

## Document conventions

The document conventions describe text formatting conventions, command syntax conventions, and important notice formats used in Brocade technical documentation.

## Text formatting conventions

Text formatting conventions such as boldface, italic, or Courier font may be used in the flow of the text to highlight specific words or phrases.

| Format             | Description   |
|--------------------|---|
| <b>bold text</b>   | Identifies command names<br>Identifies keywords and operands<br>Identifies the names of user-manipulated GUI elements |
| <i>italic text</i> | Identifies text to enter at the GUI<br>Identifies emphasis<br>Identifies variables                                    |
| Courier font       | Identifies document titles<br>Identifies CLI output<br>Identifies command syntax examples                             |

## Command syntax conventions

Bold and italic text identify command syntax components. Delimiters and operators define groupings of parameters and their logical relationships.

| Convention         | Description   |
|--------------------|---|
| <b>bold text</b>   | Identifies command names, keywords, and command options.  |
| <i>italic text</i> | Identifies a variable.  |
| value              | In Fibre Channel products, a fixed value provided as input to a command option is printed in plain text, for example, <b>--show</b> WWN.  |
| [ ]                | Syntax components displayed within square brackets are optional.  |
| { x   y   z }      | Default responses to system prompts are enclosed in square brackets.<br>A choice of required parameters is enclosed in curly brackets separated by vertical bars. You must select one of the options. |
| x   y              | In Fibre Channel products, square brackets may be used instead for this purpose.<br>A vertical bar separates mutually exclusive elements.   |
| < >                | Nonprinting characters, for example, passwords, are enclosed in angle brackets.   |

| Convention | Description   |
|------------|---|
| ...        | Repeat the previous element, for example, <i>member{member...}</i> .  |
| \          | Indicates a "soft" line break in command examples. If a backslash separates two lines of a command input, enter the entire command at the prompt without the backslash. |

## Notes, cautions, and warnings

Notes, cautions, and warning statements may be used in this document. They are listed in the order of increasing severity of potential hazards.

### NOTE

A Note provides a tip, guidance, or advice, emphasizes important information, or provides a reference to related information.

### ATTENTION

An Attention statement indicates a stronger note, for example, to alert you when traffic might be interrupted or the device might reboot.



### CAUTION

A Caution statement alerts you to situations that can be potentially hazardous to you or cause damage to hardware, firmware, software, or data.



### DANGER

*A Danger statement indicates conditions or situations that can be potentially lethal or extremely hazardous to you. Safety labels are also attached directly to products to warn of these conditions or situations.*

## Brocade resources

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You can download additional publications supporting your product at [www.brocade.com](http://www.brocade.com). Select the Brocade Products tab to locate your product, then click the Brocade product name or image to open the individual product page. The user manuals are available in the resources module at the bottom of the page under the Documentation category.

To get up-to-the-minute information on Brocade products and resources, go to [MyBrocade](http://MyBrocade). You can register at no cost to obtain a user ID and password.

Release notes are available on [MyBrocade](http://MyBrocade) under Product Downloads.

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|---|---|---|
| Preferred method of contact for non-urgent issues: <ul style="list-style-type: none"> <li>• <a href="#">My Cases</a> through MyBrocade</li> <li>• <a href="#">Software downloads</a> and licensing tools</li> <li>• <a href="#">Knowledge Base</a></li> </ul> | Required for Sev 1-Critical and Sev 2-High issues: <ul style="list-style-type: none"> <li>• Continental US: 1-800-752-8061</li> <li>• Europe, Middle East, Africa, and Asia Pacific: +800-AT FIBREE (+800 28 34 27 33)</li> <li>• For areas unable to access toll free number: +1-408-333-6061</li> <li>• <a href="#">Toll-free numbers</a> are available in many countries.</li> </ul> | <a href="mailto:support@brocade.com">support@brocade.com</a><br>Please include: <ul style="list-style-type: none"> <li>• Problem summary</li> <li>• Serial number</li> <li>• Installation details</li> <li>• Environment description</li> </ul> |

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- Brocade provides backline support for issues that cannot be resolved by the OEM/Solution Provider.
- Brocade Supplemental Support augments your existing OEM support contract, providing direct access to Brocade expertise. For more information, contact Brocade or your OEM.
- For questions regarding service levels and response times, contact your OEM/Solution Provider.

## Document feedback

To send feedback and report errors in the documentation you can use the feedback form posted with the document or you can e-mail the documentation team.

Quality is our first concern at Brocade and we have made every effort to ensure the accuracy and completeness of this document. However, if you find an error or an omission, or you think that a topic needs further development, we want to hear from you. You can provide feedback in two ways:

- Through the online feedback form in the HTML documents posted on [www.brocade.com](http://www.brocade.com).
- By sending your feedback to [documentation@brocade.com](mailto:documentation@brocade.com).

Provide the publication title, part number, and as much detail as possible, including the topic heading and page number if applicable, as well as your suggestions for improvement.



# About This Guide

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This guide describes how to configure OSPF on the Brocade vRouter (referred to as a virtual router, vRouter, or router in the guide).



# OSPF Configuration

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- [OSPF overview](#).....13
- [Supported standards](#).....13
- [Configuring OSPF](#).....13

## OSPF overview

OSPF is a dynamic routing protocol that uses a link-state algorithm (Dijkstra), as opposed to protocols (such as RIP) that use a distance-vector algorithm. It is an interior gateway protocol (IGP) and operates in a single autonomous system (AS).

### NOTE

OSPF uses both link-state algorithm (Dijkstra) within an area and distance vector algorithms across areas.

In OSPF, each router advertises the state of its own links, or connections, in a link-state advertisement (LSA), which it then multicasts to other routers on the network. In addition, each router uses the LSAs that it receives from other routers to construct a directed graph with itself as the root representing the network topology.

To build its routing table, the router applies Dijkstra's Shortest Path First algorithm within an area to find the best path through the graph to each network in the topology that is within the area. This "shortest path tree" becomes the basis of the routing table. OSPF is hierarchical. In OSPF, the network is divided into "areas." Within each area, routers possess only local routing information. Routing information about other areas is calculated by using distance vector protocol and forming summarized routes. This reduces the amount of network topology information that routers have to generate and maintain, making OSPF a good choice for larger networks.

## Supported standards

The Brocade Communications Systems, Inc. implementation of OSPF complies with the following standard:

- RFC 2328: OSPF Version 2

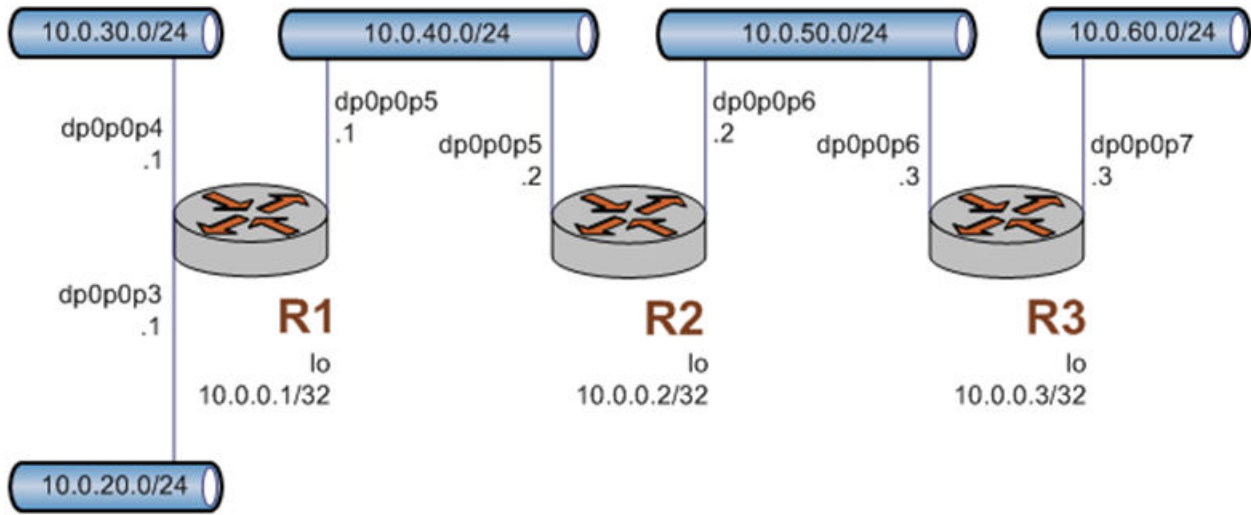
## Configuring OSPF

This section presents the following topics:

- [Basic OSPF configuration](#) on page 14
- [Verifying the OSPF configuration](#) on page 16

This section presents an example configuration of OSPF. The example is based on the following reference diagram.

FIGURE 1 OSPF configuration diagram



### Basic OSPF configuration

In this section, you configure OSPF on the routers that are labeled R1, R2, and R3 in the OSPF configuration diagram. The routers advertise their routes on the 10.0.40.0/24 and 10.0.50.0/24 networks.

For this example, it is assumed that you have already configured the router interfaces, including the loopback interfaces (lo); only the steps that are required to implement OSPF are shown.

**NOTE**

Setting the router-id, loopback interface, and redistribution of router area are not mandatory requirements for basic OSPF configuration.

To create a basic OSPF configuration, perform the following steps in configuration mode.

TABLE 1 Configuring random early detection (RED)

| Step | Step   | Command   |
|------|--|---|
| R1   | Set the identifier of the OSPF router to that of the loopback address. | <pre>vyatta@R1# set protocols ospf parameters router-id 10.0.0.1</pre>  |
| R1   | Advertise to the 10.0.40.0/24 network.                                 | <pre>vyatta@R1# set protocols ospf area 0.0.0.0 network 10.0.40.0/24</pre>  |
| R1   | Commit the configuration.  | <pre>vyatta@R1# commit</pre>  |
| R1   | Display the configuration.   | <pre>vyatta@R1# show protocols ospf {   area 0.0.0.0 {     network 10.0.40.0/24   }   parameters {     router-id 10.0.0.1   }   {     connected {     }   } }</pre> |

TABLE 1 Configuring random early detection (RED) (continued)

| Step | Step   | Command  |
|------|--|--|
|      |  | <pre> } } </pre>   |
| R2   | Set the identifier of the OSPF router to that of the loopback address. | <pre> vyatta@R2# set protocols ospf parameters router-id 10.0.0.2 </pre>   |
| R2   | Advertise to the 10.0.40.0/24 network.                                 | <pre> vyatta@R2# set protocols ospf area 0.0.0.0 network 10.0.40.0/24 </pre>   |
| R2   | Advertise to the 10.0.50.0/24 network.                                 | <pre> vyatta@R2# set protocols ospf area 0.0.0.0 network 10.0.50.0/24 </pre>   |
| R2   | Redistribute connected routes to OSPF.                                 | <pre> vyatta@R2# set protocols ospf redistribute connected </pre>  |
| R2   | Commit the configuration.  | <pre> vyatta@R2# commit </pre>   |
| R2   | Display the configuration.   | <pre> vyatta@R2# show protocols ospf {   area 0.0.0.0 {     network 10.0.40.0/24     network 10.0.50.0/24   }   parameters {     router-id 10.0.0.2   }   {     connected {     }   } } </pre> |
| R3   | Set the identifier of the OSPF router to that of the loopback address. | <pre> vyatta@R3# set protocols ospf parameters router-id 10.0.0.3 </pre>   |
| R3   | Advertise the 10.0.50.0/24 network.                                    | <pre> vyatta@R3# set protocols ospf area 0.0.0.0 network 10.0.50.0/24 </pre>   |
| R3   | Redistribute connected routes to OSPF.                                 | <pre> vyatta@R3# set protocols ospf redistribute connected </pre>  |
| R3   | Commit the configuration.  | <pre> vyatta@R3# commit </pre>   |
| R3   | Display the configuration.   | <pre> vyatta@R3# show protocols ospf {   area 0.0.0.0 {     network 10.0.50.0/24   }   parameters {     router-id 10.0.0.3   }   redistribute {     connected {     }   } } </pre>             |

## Verifying the OSPF configuration

The following operational mode commands can be used to verify the OSPF configuration.

### R3: show ip route

The following example shows the output of the **show ip route** command for router R3.

#### Verifying OSPF on R3: "show ip route"

```
vyatta@R3:~$ show ip route
Codes: K - kernel route, C - connected, S - static, R - RIP, O - OSPF,
       I - ISIS, B - BGP, > - selected route, * - FIB route
O>* 10.0.0.1/32 [110/20] via 10.0.50.2, eth5, 00:04:21
O>* 10.0.0.2/32 [110/20] via 10.0.50.2, eth5, 00:03:31
C>* 10.0.0.3/32 is directly connected, lo
O>* 10.0.20.0/24 [110/20] via 10.0.50.2, eth5, 03:06:06
O>* 10.0.30.0/24 [110/20] via 10.0.50.2, eth5, 03:07:39
O>* 10.0.40.0/24 [110/20] via 10.0.50.2, eth5, 03:07:40
O 10.0.50.0/24 [110/10] is directly connected, eth5, 03:07:45
C>* 10.0.50.0/24 is directly connected, eth5
C>* 10.0.60.0/24 is directly connected, eth6
C>* 127.0.0.0/8 is directly connected, lo
vyatta@R3:~$
```

The output shows that routes to 10.0.0.1/32, 10.0.0.2/32, 10.0.20.0/24, 10.0.30.0/24, and 10.0.40.0/24 have been learned through OSPF (and are the selected routes). In addition, packets to those networks are forwarded from eth5 to 10.0.50.2. The 10.0.0.3/32, 10.0.50.0/24 and 10.0.60.0/24 networks are directly connected to R3. Directly connected routes are always preferred over OSPF discovered routes.

### R3: ping 10.0.20.1

Using the **ping** command from R3, confirm that hosts on remote networks can be reached. In this case, ping an IP address on R1. Example 1-3 shows this ping.

#### Verifying OSPF on R3: "ping 10.0.20.1"

```
vyatta@R3:~$ ping 10.0.20.1
PING 10.0.20.1 (10.0.20.1) 56(84) bytes of data.
64 bytes from 10.0.20.1: icmp_seq=1 ttl=63 time=5.75 ms
64 bytes from 10.0.20.1: icmp_seq=2 ttl=63 time=1.74 ms
64 bytes from 10.0.20.1: icmp_seq=3 ttl=63 time=1.40 ms
^C
--- 10.0.20.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2002ms
rtt min/avg/max/mdev = 1.405/2.966/5.751/1.974 ms
vyatta@R3:~$
```

This ping confirms that the OSPF configuration is working and that you can reach a remote network.

## Excluding addresses from being broadcast

To filter routers between different areas, but not within the same area, you must exclude addresses from being broadcast.

Topology: Two vRouters are attached to core routers through a separate network from the vRouters. The core routers share area 0. Each vRouter has publicly routed networks and a 192.168.*n.n* network that is used for VRRP.

To exclude addresses from being broadcast across an area in the given topology, the router must broadcast connected routes and exclude the 192.168.*n.n* network from being broadcast into area 0. You can do this by using the **distribute-list** command to configure the router (the Autonomous System Boundary Router (ASBR)) that is redistributing connected.



Another method to exclude addresses from being broadcast across areas is by using the **protocols ospf summary-address** command. You must apply the **summary-address** keywords to external routes redistributed into OSPF. The Area Border Router (ABR) applies the **summary-address** configuration to *external*/Link-State Advertisements (LSAs) when redistributing into other areas.

The **range** keyword works only between two different OSPF areas. You must apply this command to the LSAs that are exchanged between OSPF areas.

Both the **summary-address** and **range** commands only work across areas. If all routers are in the same area, then the **summary-address** or **range** commands do not work.

To exclude addresses from being broadcast from routers within a single area.

- If all routers are in the same area, you can apply **distribution-list** filters to the ingress interface if you configure import policy, or to the egress if you configure export policy by using the **protocols ospf distribute-list list-number** command.
- To use route-maps to filter routes while redistributing routes, use the **protocols ospf redistribute connected route-map route-map** command.

The **redistribute connected** configuration redistributes all the connected routes to an OSPF peer. The **route-map** configuration points to either an access list or a prefix list which is set to deny 192.168.*n.n*, but permits everything else.



# OSPF Commands

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|   |    |
|---|----|
| • monitor protocol ospf background.....   | 21 |
| • monitor protocol ospf disable database-timer rate-limit.....                          | 22 |
| • monitor protocol ospf disable events.....   | 23 |
| • monitor protocol ospf disable ifsm.....   | 24 |
| • monitor protocol ospf disable lsa.....  | 25 |
| • monitor protocol ospf disable nfsm.....   | 26 |
| • monitor protocol ospf disable nsm.....  | 27 |
| • monitor protocol ospf disable packet all.....   | 28 |
| • monitor protocol ospf disable packet dd.....  | 29 |
| • monitor protocol ospf disable packet detail.....                                      | 30 |
| • monitor protocol ospf disable packet hello.....                                       | 31 |
| • monitor protocol ospf disable packet ls-ack.....                                      | 32 |
| • monitor protocol ospf disable packet ls-request.....                                  | 33 |
| • monitor protocol ospf disable packet ls-update.....                                   | 34 |
| • monitor protocol ospf disable packet recv.....  | 35 |
| • monitor protocol ospf disable packet send.....  | 36 |
| • monitor protocol ospf disable route.....  | 37 |
| • monitor protocol ospf enable database-timer.....                                      | 38 |
| • monitor protocol ospf enable events.....  | 39 |
| • monitor protocol ospf enable ifsm.....  | 40 |
| • monitor protocol ospf enable lsa.....   | 41 |
| • monitor protocol ospf enable nfsm.....  | 42 |
| • monitor protocol ospf enable nsm.....   | 43 |
| • monitor protocol ospf enable packet all.....  | 44 |
| • monitor protocol ospf enable packet dd.....   | 45 |
| • monitor protocol ospf enable packet detail.....                                       | 46 |
| • monitor protocol ospf enable packet hello.....  | 47 |
| • monitor protocol ospf enable packet ls-ack.....                                       | 48 |
| • monitor protocol ospf enable packet ls-request.....                                   | 49 |
| • monitor protocol ospf enable packet ls-update.....                                    | 50 |
| • monitor protocol ospf enable packet recv.....   | 51 |
| • monitor protocol ospf enable packet send.....   | 52 |
| • monitor protocol ospf enable route.....   | 53 |
| • protocols ospf.....   | 54 |
| • protocols ospf area <area-id>.....  | 55 |
| • protocols ospf area <area-id> area-type nssa <action>.....                            | 56 |
| • protocols ospf area <area-id> area-type stub <action>.....                            | 58 |
| • protocols ospf area <area-id> authentication <type>.....                              | 59 |
| • protocols ospf area <area-id> network <ipv4net>.....                                  | 61 |
| • protocols ospf area <area-id> range <ipv4net> not-advertise.....                      | 62 |
| • protocols ospf area <area-id> virtual-link <ipv4> authentication <method>.....        | 63 |
| • protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>.....       | 65 |
| • protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>.....      | 67 |
| • protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>..... | 69 |
| • protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>.....         | 71 |
| • protocols ospf auto-cost reference-bandwidth <bandwidth>.....                         | 73 |
| • protocols ospf default-information originate.....                                     | 74 |
| • protocols ospf default-metric <metric>.....   | 76 |
| • protocols ospf distance.....  | 77 |

- protocols ospf distribute-list <list-number>.....79
- protocols ospf log.....81
- protocols ospf log events.....83
- protocols ospf log ifsm.....85
- protocols ospf log lsa.....86
- protocols ospf log nsm.....88
- protocols ospf log nsm.....89
- protocols ospf log packet.....90
- protocols ospf log rib.....92
- protocols ospf log route.....93
- protocols ospf neighbor <ipv4>.....95
- protocols ospf overflow database external limit <number> recovery <time>.....96
- protocols ospf overflow database hard limit <number>.....97
- protocols ospf overflow database soft limit.....98
- protocols ospf parameters.....99
- protocols ospf passive-interface.....101
- protocols ospf passive-interface-exclude.....102
- protocols ospf redistribute bgp.....104
- protocols ospf redistribute connected.....106
- protocols ospf redistribute kernel.....108
- protocols ospf redistribute <protocol> <options>.....110
- protocols ospf redistribute rip.....112
- protocols ospf redistribute static.....114
- protocols ospf refresh timers <value>.....116
- protocols ospf summary-address <address> <action>.....117
- show ip ospf.....118
- show ip ospf border-routers.....119
- show ip ospf database.....120
- show ip ospf interface.....122
- show ip ospf neighbor.....123
- show ip ospf route.....124
- show ip route ospf.....125
- show monitoring protocols ospf.....126

## monitor protocol ospf background

Starts or stops background monitoring of all enabled OSPF monitor commands.

### Syntax

```
monitor protocol ospf background { start | stop }
```

### Parameters

**start**

Starts background monitoring.

**stop**

Stops background monitoring.

### Modes

Operational mode

### Usage Guidelines

Use this command to start or stop background monitoring of all enabled OSPF monitor commands.

## monitor protocol ospf disable database-timer rate-limit

Disables the generation of debug messages that are related to the OSPF database timer.

### Syntax

```
monitor protocol ospf disable database-timer rate-limit
```

### Parameters

**rate-limit**

Disables the debugging of the timer.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to the OSPF database timer.

## monitor protocol ospf disable events

Disables the generation of debug messages that are related to OSPF events.

### Syntax

```
monitor protocol ospf disable events [ abr | asbr | lsa | nssa | os | router | vlink ]
```

### Parameters

**abr**

Disables debugging of area border router (ABR) events.

**asbr**

Disables debugging of autonomous system boundary router (ASBR) events.

**lsa**

Disables debugging of link-state advertisement (LSA) events.

**nssa**

Disables debugging of not-so-stubby area (NSSA) events.

**os**

Disables debugging of OS-interaction events.

**router**

Disables debugging of other router events.

**vlink**

Disables debugging of virtual-link events.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF events.

## monitor protocol ospf disable ifsm

Disables the generation of debug messages that are related to OSPF IFSM events.

### Syntax

```
monitor protocol ospf disable ifsm [ events | status | timers ]
```

### Command Default

OSPF IFSM event debugging is disabled.

### Parameters

**events**

Disables debugging of IFSM events.

**status**

Disables debugging of IFSM status.

**timers**

Disables debugging of IFSM timers.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF Interface Finite State Machine (IFSM).



## monitor protocol ospf disable lsa

Disables the generation of debug messages that are related to OSPF LSAs.

### Syntax

```
monitor protocol ospf disable lsa [ flooding | generate | install | maxage | refresh ]
```

### Command Default

When used with no option, this command disables debugging for all OSPF LSA activity.

### Parameters

**flooding**

Disables debugging of OSPF LSA flood events.

**generate**

Disables debugging of OSPF LSA generation.

**install**

Disables debugging of OSPF LSA installation.

**maxage**

Disables debugging of maximum-age-related OSPF LSA processing.

**refresh**

Disables debugging of OSPF LSA refreshes.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF link-state advertisements (LSAs).

## monitor protocol ospf disable nfsm

Disables the generation of debug messages that are related to OSPF NFSMs.

### Syntax

```
monitor protocol ospf disable nfsm [ events | status | timers ]
```

### Command Default

OSPF NFSM debugging is disabled.

### Parameters

**events**

Disables debugging of OSPF NFSM events.

**status**

Disables debugging of OSPF NFSM status.

**timers**

Disables debugging of OSPF NFSM timers.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF Neighbor State Machines (NFSMs).

## monitor protocol ospf disable nsm

Disables the generation of debug messages that are related to OSPF NSM.

### Syntax

```
monitor protocol ospf disable nsm [ interface | redistribute ]
```

### Command Default

OSPF NSM debugging is disabled.

### Parameters

#### **interface**

Disables debugging of OSPF NSM interface events.

#### **redistribute**

Disables debugging of OSPF NSM redistribute events.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages related to the OSPF NSM.

## monitor protocol ospf disable packet all

Disables the generation of debug messages that are related to all OSPF packets.

### Syntax

```
monitor protocol ospf disable packet all [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for all OSPF packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for all OSPF packets, both sent and received.

**recv**

Disables debug messages for all received OSPF packets.

**detail**

Disables detailed debug messages for all received OSPF packets.

**send**

Disables debug messages for all transmitted OSPF packets.

**detail**

Disables detailed debug messages for all transmitted OSPF packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to all OSPF packets.

## monitor protocol ospf disable packet dd

Disables the generation of debug messages that are related to OSPF DD packets.

### Syntax

```
monitor protocol ospf disable packet dd [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for OSPF DD packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for OSPF DD packets, both sent and received.

**recv**

Disables debug messages for received OSPF DD packets.

**detail**

Disables detailed debug messages for received OSPF DD packets.

**send**

Disables debug messages for transmitted OSPF DD packets.

**detail**

Disables detailed debug messages for transmitted OSPF DD packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF Database Description (DD) packets.

## monitor protocol ospf disable packet detail

Disables the generation of debug messages that are related to OSPF detailed packets.

### Syntax

```
monitor protocol ospf disable packet detail
```

### Command Default

Debug messages are disabled for OSPF detailed packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF detailed packets.

## monitor protocol ospf disable packet hello

Disables the generation of debug messages that are related to OSPF hello packets.

### Syntax

```
monitor protocol ospf disable packet hello [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for OSPF hello packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for OSPF hello packets, both sent and received.

**recv**

Disables debug messages for received OSPF hello packets.

**detail**

Disables detailed debug messages for received OSPF hello packets.

**send**

Disables debug messages for transmitted OSPF hello packets.

**detail**

Disables detailed debug messages for transmitted OSPF hello packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF hello packets.

## monitor protocol ospf disable packet ls-ack

Disables the generation of debug messages that are related to OSPF LS Ack packets.

### Syntax

```
monitor protocol ospf disable packet ls-ack [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for OSPF LS Ack packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for OSPF LS Ack packets, both sent and received.

**recv**

Disables debug messages for received OSPF LS Ack packets.

**detail**

Disables detailed debug messages for received OSPF LS Ack packets.

**send**

Disables debug messages for transmitted OSPF LS Ack packets.

**detail**

Disables detailed debug messages for transmitted OSPF LS Ack packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages related to OSPF link-state acknowledgment (LS Ack) packets.



## monitor protocol ospf disable packet ls-request

Disables the generation of debug messages that are related to OSPF LSR packets.

### Syntax

```
monitor protocol ospf disable packet ls-request [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for OSPF LSR packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for OSPF LSR packets, both sent and received.

**recv**

Disables debug messages for received OSPF LSR packets.

**detail**

Disables detailed debug messages for received OSPF LSR packets.

**send**

Disables debug messages for transmitted OSPF LSR packets.

**detail**

Disables detailed debug messages for transmitted OSPF LSR packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF link-state request (LSR) packets.

## monitor protocol ospf disable packet ls-update

Disables the generation of debug messages that are related to OSPF LSU packets.

### Syntax

```
monitor protocol ospf disable packet ls-update [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are disabled for OSPF LSU packets at a medium level of detail.

### Parameters

**detail**

Disables detailed debug messages for OSPF LSU packets, both sent and received.

**recv**

Disables debug messages for received OSPF LSU packets.

**detail**

Disables detailed debug messages for received OSPF LSU packets.

**send**

Disables debug messages for transmitted OSPF LSU packets.

**detail**

Disables detailed debug messages for transmitted OSPF LSU packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF link-state update (LSU) packets.

## monitor protocol ospf disable packet rcv

Disables the generation of debug messages that are related to OSPF received packets.

### Syntax

```
monitor protocol ospf disable packet rcv
```

### Command Default

Debug messages are disabled for OSPF received packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF received packets.

## monitor protocol ospf disable packet send

Disables the generation of debug messages that are related to OSPF sent packets.

### Syntax

```
monitor protocol ospf disable packet send
```

### Command Default

Debug messages are disabled for OSPF sent packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF sent packets.

## monitor protocol ospf disable route

Disables the generation of debug messages that are related to OSPF route calculations.

### Syntax

```
monitor protocol ospf disable route [ ase | ia | install | spf ]
```

### Command Default

Debug messages are disabled for OSPF route calculations.

### Parameters

**ase**

Disables detailed debugging of OSPF external route calculations.

**ia**

Disables detailed debugging of OSPF interarea route calculations.

**install**

Disables detailed debugging of OSPF route installation.

**spf**

Disables detailed debugging of OSPF Shortest Path First calculation.

### Modes

Operational mode

### Usage Guidelines

Use this command to disable the generation of debug messages that are related to OSPF route calculations.

## monitor protocol ospf enable database-timer

Enables the generation of debug messages that are related to the OSPF database timer.

### Syntax

```
monitor protocol ospf enable database-timer [ rate-limit ]
```

### Parameters

**rate-limit**

Enables debugging of the timer.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to the OSPF database timer.

## monitor protocol ospf enable events

Enables the generation of debug messages that are related to OSPF events.

### Syntax

```
monitor protocol ospf enable events [ abr | asbr | lsa | nssa | os | router | vlink ]
```

### Parameters

|               |   |
|---------------|---|
| <b>abr</b>    | Enables debugging of Area Border Router (ABR) events.                 |
| <b>asbr</b>   | Enables debugging of Autonomous System Boundary Router (ASBR) events. |
| <b>lsa</b>    | Enables debugging of link-state advertisement (LSA) events.           |
| <b>nssa</b>   | Enables debugging of not-so-stubby area (NSSA) events.                |
| <b>os</b>     | Enables debugging of OS-interaction events.                           |
| <b>router</b> | Enables debugging of other router events.                             |
| <b>vlink</b>  | Enables debugging of virtual-link events.                             |

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF events.

## monitor protocol ospf enable ifsm

Enables the generation of debug messages that are related to OSPF IFSM events.

### Syntax

```
monitor protocol ospf enable ifsm [ events | status | timers ]
```

### Parameters

**events**

Enables debugging of IFSM events.

**status**

Enables debugging of IFSM status.

**timers**

Enables debugging of IFSM timers.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF Interface Finite State Machine (IFSM) events.



## monitor protocol ospf enable lsa

Enables the generation of debug messages that are related to OSPF LSAs.

### Syntax

```
monitor protocol ospf enable lsa [ flooding | generate | install | maxage | refresh ]
```

### Command Default

When used with no option, this command enables debugging for all OSPF LSA activity.

### Parameters

**flooding**

Enables debugging of OSPF LSA flood events.

**generate**

Enables debugging of OSPF LSA generation.

**install**

Enables debugging of OSPF LSA installation.

**maxage**

Enables debugging of maximum-age processing that is related to OSPF LSAs.

**refresh**

Enables debugging of OSPF LSA refreshes.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF LSAs.

## monitor protocol ospf enable nfsm

Enables the generation of debug messages that are related to OSPF NFSMs.

### Syntax

```
monitor protocol ospf enable nfsm [ events | status | timers ]
```

### Parameters

**events**

Enables debugging of OSPF NFSM events.

**status**

Enables debugging of OSPF NFSM status.

**timers**

Enables debugging of OSPF NFSM timers.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF Neighbor Finite State Machine (NFSM) events.

## monitor protocol ospf enable nsm

Enables the generation of debug messages that are related to OSPF NSM events.

### Syntax

```
monitor protocol ospf enable nsm [ interface | redistribute ]
```

### Parameters

**interface**

Enables debugging of OSPF NSM interface events.

**redistribute**

Enables debugging of OSPF NSM redistribute events.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF Network Services Module (NSM) events.

## monitor protocol ospf enable packet all

Enables the generation of debug messages that are related to all OSPF packets.

### Syntax

```
monitor protocol ospf enable packet all [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for all OSPF packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for all OSPF packets, both sent and received.

**recv**

Generates debug messages for all received OSPF packets.

**detail**

Generates detailed debug messages for all received OSPF packets.

**send**

Generates debug messages for all transmitted OSPF packets.

**detail**

Generates detailed debug messages for all transmitted OSPF packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to all OSPF packets.

## monitor protocol ospf enable packet dd

Enables the generation of debug messages that are related to OSPF DD packets.

### Syntax

```
monitor protocol ospf enable packet dd [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for OSPF DD packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for OSPF DD packets, both sent and received.

**recv**

Generates debug messages for received OSPF DD packets.

**detail**

Generates detailed debug messages for received OSPF DD packets.

**send**

Generates debug messages for transmitted OSPF DD packets.

**detail**

Generates detailed debug messages for transmitted OSPF DD packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF Database Description (DD) packets. OSPF DD packets provide a summary (digest) of each link-state advertisement in the link-state databases. OSPF routers exchange these packets to keep data synchronized.

## monitor protocol ospf enable packet detail

Enables the generation of debug messages that are related to OSPF detailed packets.

### Syntax

```
monitor protocol ospf enable packet detail
```

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF detailed packets.

## monitor protocol ospf enable packet hello

Enables the generation of debug messages that are related to OSPF hello packets.

### Syntax

```
monitor protocol ospf enable packet hello [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for OSPF hello packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for OSPF hello packets, both sent and received.

**recv**

Generates debug messages for received OSPF hello packets.

**detail**

Generates detailed debug messages for received OSPF hello packets.

**send**

Generates debug messages for transmitted OSPF hello packets.

**detail**

Generates detailed debug messages for transmitted OSPF hello packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF hello packets. OSPF hello packets are sent at intervals to discover neighbors and ensure that neighbors can be reached. Hello packets include information about certain OSPF timers, the designated router, the backup designated router (BDR), and known neighbors.

## monitor protocol ospf enable packet ls-ack

Enables the generation of debug messages that are related to OSPF LSA Ack packets.

### Syntax

```
monitor protocol ospf enable packet ls-ack [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for OSPF LS Ack packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for OSPF LS Ack packets, both sent and received.

**recv**

Generates debug messages for received OSPF LS Ack packets.

**detail**

Generates detailed debug messages for received OSPF LS Ack packets.

**send**

Generates debug messages for transmitted OSPF LS Ack packets.

**detail**

Generates detailed debug messages for transmitted OSPF LS Ack packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF link-state acknowledgment (LSA) packets. LS Ack packets are sent to OSPF neighbors to acknowledge receipt of a link-state advertisement packet from a neighbor.



## monitor protocol ospf enable packet ls-request

Enables the generation of debug messages that are related to OSPF LSR packets.

### Syntax

```
monitor protocol ospf enable packet ls-request [ detail | recv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for OSPF LSR packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for OSPF LSR packets, both sent and received.

**recv**

Generates debug messages for received OSPF LSR packets.

**detail**

Generates detailed debug messages for received OSPF LSR packets.

**send**

Generates debug messages for transmitted OSPF LSR packets.

**detail**

Generates detailed debug messages for transmitted OSPF LSR packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF link-state request (LSR) packets. After exchanging Database Description packets, neighboring OSPF routers determine which link-state advertisements (LSAs) are missing from the local link-state database. The local router sends an LSR packet to the neighbor to request the missing LSAs.

## monitor protocol ospf enable packet ls-update

Enables the generation of debug messages that are related to OSPF LSU packets.

### Syntax

```
monitor protocol ospf enable packet ls-update [ detail | rcv [ detail ] | send [ detail ] ]
```

### Command Default

Debug messages are generated for OSPF LSU packets at a medium level of detail.

### Parameters

**detail**

Generates detailed debug messages for OSPF LSU packets, both sent and received.

**rcv**

Generates debug messages for received OSPF LSU packets.

**detail**

Generates detailed debug messages for received OSPF LSU packets.

**send**

Generates debug messages for transmitted OSPF LSU packets.

**detail**

Generates detailed debug messages for transmitted OSPF LSU packets.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF link-state update (LSU) packets. LSU packets send any required link-state advertisements updates to an OSPF neighbor.

## monitor protocol ospf enable packet recv

Enables the generation of debug messages that are related to received OSPF packets.

### Syntax

```
monitor protocol ospf enable packet recv
```

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to received OSPF packets.

## monitor protocol ospf enable packet send

Enables the generation of debug messages that are related to OSPF sent packets.

### Syntax

```
monitor protocol ospf enable packet send
```

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF sent packets.

## monitor protocol ospf enable route

Enables the generation of debug messages that are related to OSPF route calculations.

### Syntax

```
monitor protocol ospf enable route [ ase | ia | install | spf ]
```

### Parameters

**ase**

Enables detailed debugging of OSPF external route calculations.

**ia**

Enables detailed debugging of OSPF interarea route calculations.

**install**

Enables detailed debugging of OSPF route installation.

**spf**

Enables detailed debugging of OSPF Shortest Path First calculation.

### Modes

Operational mode

### Usage Guidelines

Use this command to enable the generation of debug messages that are related to OSPF route calculations.

## protocols ospf

Enables the OSPF routing protocol on the router.

### Syntax

```
set protocols ospf
delete protocols ospf
show protocols ospf
```

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf
}
```

### Usage Guidelines

Use this command to enable the Open Shortest Path First (OSPF) routing protocol on the system.

Use the **set** form of this command to enable the OSPF routing protocol.

Use the **delete** form of this command to disable the OSPF routing protocol and remove all OSPF configuration.

Use the **show** form of this command to display the configuration of the OSPF routing protocol.

## protocols ospf area <area-id>

Defines an OSPF area.

### Syntax

**set** protocols ospf area *area-id*

**delete** protocols ospf area *area-id*

**show** protocols ospf area *area-id*

### Parameters

*area-id*

The identifier of the OSPF area that is being created, expressed either as an IP address or a decimal value.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id
  }
}
```

### Usage Guidelines

Use this command to create an area within an OSPF Autonomous System (AS).

Use the **set** form of this command to create an OSPF area.

Use the **delete** form of this command to remove an OSPF area.

Use the **show** form of this command to display an OSPF area.

## protocols ospf area <area-id> area-type nssa <action>

Designates an OSPF area as an NSSA.

### Syntax

```
set protocols ospf area area-id area-type nssa [ default-cost cost | [ default-information-originate [ metric 0-16777214 | metric-type { 1 | 2 } ] ] no-summary | translate { always | candidate } }
```

```
delete protocols ospf area area-id area-type nssa [ default-cost cost | default-information-originate [ metric 0-16777214 | metric-type { 1 | 2 } ] ] no-summary | translate { always | candidate } }
```

```
show protocols ospf area area-id area-type nssa
```

### Command Default

By default, summary routes are generated into the area, and only Type 7 LSAs from the candidate NSSA ABR are translated.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**default-cost** *cost*

Sets the administrative cost, or metric, that applies to the default route in the specified OSPF area. The cost ranges from 0 through 6777215.

**default-information-originate**

Distributes the default route into an NSSA area.

**metric:** The OSPF default metric.

**metric-type:** Specifies the OSPF metric type on how cost is calculated for default routes. The metric type is either of the following:

- 1: Adds internal cost to external cost.
- 2: Uses only external cost.

The default type is 2.

**no-summary**

Prevents route summaries from being generated into the area.

**translate**

Directs the NSSA ABR when to translate Type 7 LSAs into Type 5 AS-External-LSAs. The direction is either of the following:

**always:** Always translates Type 7 LSAs into Type 5 AS-External-LSAs.

**candidate:** Translates only Type 7 LSAs from the candidate NSSA ABR.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
```



```

area area-id {
  area-type {
    nssa {
      default-cost cost
      default-information-originate
      metric 0-16777214
      metric-type 1-2
      no-summary
      translate {
        always
        candidate
      }
    }
  }
}

```

## Usage Guidelines

Use this command to designate an OSPF area as a not-so-stubby area.

Type 5 AS-External-LSAs are not allowed in stubby areas, but Type 7 LSAs may be translated into Type 5 LSAs by the not-so-stubby (NSSA) area border router and may traverse the NSSA in this manner. Interarea routes are not allowed.

Use the **set** form of this command to set the OSPF area type to not-so-stubby.

Use the **delete** form of this command to designate an OSPF area.

Use the **show** form of this command to display an area type configuration.

## protocols ospf area <area-id> area-type stub <action>

Designates an OSPF area as a stub area.

### Syntax

```
set protocols ospf area area-id area-type stub { default-cost cost | no-summary }
delete protocols ospf area area-id area-type stub [ default-cost | no-summary ]
show protocols ospf area area-id area-type stub [ default-cost ]
```

### Command Default

By default, summary routes are generated into the area.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**default-cost** *cost*

Sets the administrative cost, or metric, that applies to the default route in the specified OSPF area. The cost ranges from 0 through 6777215.

**no-summary**

Prevents route summaries from being generated into the area.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      area-type {
        stub {
          default-cost cost
          no-summary
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to designate an OSPF area as a stub area. No Type 5 AS-External-LSAs are allowed into a stub area.

Use the **set** form of this command to set the OSPF area type to stub.

Use the **delete** form of this command to remove area type configuration.

Use the **show** form of this command to display an area type configuration.

## protocols ospf area <area-id> authentication <type>

Sets the authentication type of an OSPF area.

### Syntax

```
set protocols ospf area area-id authentication { plaintext | md5 }
delete protocols ospf area area-id authentication [ plaintext | md5 ]
show protocols ospf area area-id authentication
```

### Command Default

The authentication is plain text.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**plaintext**

Specifies that passwords are sent through the network in plain text.

**md5**

Specifies the MD5 authentication key to use as input to the MD5 hashing algorithm. This key must be the same on both the sending and receiving systems.

A hash value is sent through the network, computed from the password in the OSPF packet and the password, by using the Message Digest algorithm.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      authentication
      plaintext
      md5
    }
  }
}
```

### Usage Guidelines

Use this command to set the authentication type of an OSPF area.

In plain-text authentication, passwords are sent through the network in plain text. In MD5 authentication, the system uses the Message Digest 5 (MD5) algorithm to compute a hash value from the contents of the OSPF packet and the password. The hash value and the MD5 key are included in the transmitted packet, and the receiving system (configured with the same password) calculates its own hash function, which must match.

Use the **set** form of this command to set the authentication type of an OSPF area.

Use the **delete** form of this command to remove the authentication type of an OSPF area.

Use the **show** form of this command to display the authentication type of an OSPF area.

## protocols ospf area <area-id> network <ipv4net>

Sets the network address of an OSPF area.

### Syntax

```
set protocols ospf area area-id network ipv4net
delete protocols ospf area area-id network [ipv4net]
show protocols ospf area area-id network
```

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4net*

Multinode. A network to use for the specified OSPF area. The format is *ip-address/prefix*.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      network ipv4net
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to set the network address of an OSPF area.

Use the **delete** form of this command to delete the network address of an OSPF area.

Use the **show** form of this command to display the network address of an OSPF area.

## protocols ospf area <area-id> range <ipv4net> not-advertise

Directs the router to summarize routes that match a prefix range.

### Syntax

**set** protocols ospf area *area-id* range *ipv4net* not-advertise

**delete** protocols ospf area *area-id* range *ipv4net* [ not-advertise ]

**show** protocols ospf area *area-id* range *ipv4net*

### Command Default

By default, routes are advertised and routes are not substituted.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4net*

A range to summarize, expressed as an IPv4 network in the format *ip-address/prefix*.

**not-advertise**

Directs the router not to advertise routes in the specified range.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      area-type {
        range {
          not-advertise
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to direct the router to summarize routes that match a prefix range. This command may be used only with an Area Border Router (ABR).

Use the **set** form of this command to set the area range.

Use the **delete** form of this command to remove area range configuration.

Use the **show** form of this command to display area range configuration.

## protocols ospf area <area-id> virtual-link <ipv4> authentication <method>

Sets the authentication characteristics for a virtual link.

### Syntax

```
set protocols ospf area area-id virtual-link ipv4 authentication [ md5 | md5-key-id 1-255 | plaintext | plaintext-password password ]
```

```
delete protocols ospf area area-id virtual-link ipv4 authentication [ md5 | md5-key-id 1-255 | plaintext | plaintext-password password ]
```

```
show protocols ospf area area-id virtual-link ipv4 authentication
```

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area identifier of a virtual link, expressed as an IPv4 address.

**md5**

Specifies the MD5 authentication key to use as input to the MD5 hashing algorithm. This key must be the same on both the sending and receiving systems.

A hash value is sent through the network, computed from the password in the OSPF packet and the password, by using the Message Digest algorithm.

**md5-key-ID 1-255**

Sets the MD5 authentication key identifier. This identifier must be the same on both the sending and receiving systems. The identifier ranges from 1 through 255.

**plaintext**

Specifies the plain-text authentication method.

**plaintext-password *password***

Sets the password to use in plain-text authentication. This password must be eight or fewer characters and be the same on both the sending and receiving systems.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        authentication {
          md5 {
            md5
            md5-key 1-255
            plaintext
            plaintext-password password
          }
        }
      }
    }
  }
}
```

```
}  
  }  
}
```

## Usage Guidelines

Use this command to set the authentication characteristics for a virtual link.

In plain-text authentication, passwords are sent through the network in plain text. In MD5 authentication, the system uses the Message Digest 5 (MD5) algorithm to compute a hash value from the contents of the OSPF packet and the password. The hash value and the MD5 key are included in the transmitted packet, and the receiving system (configured with the same password) calculates its own hash function, which must match.

Use the **set** form of this command to specify the authentication characteristics for a link.

Use the **delete** form of this command to remove the authentication characteristics for a link.

Use the **show** form of this command to display the authentication characteristics for a link.



## protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>

Sets the dead interval for a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* dead-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* dead-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* dead-interval

### Command Default

The dead interval is 4 times the hello interval.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The time, in seconds, that the virtual link should wait to detect hello packets from neighboring routers before declaring the neighbor down. The interval ranges from 1 through 65535. The default interval is 4 times the hello interval.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        dead-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to specify the interval during which a virtual link should expect a hello packet from its neighbor.

If the dead interval passes before the interface receives a hello packet from a neighbor, the status of the neighbor is changed to out-of-service and all associated state is cleared.

The dead interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication from each other.

Use the **set** form of this command to set the dead interval for a link.

Use the **delete** form of this command to restore the default dead interval, which is 4 times the hello interval, for a link.

Use the **show** form of this command to display the dead interval for a link.

## protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>

Sets the interval between OSPF hello packets on a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* hello-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* hello-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* hello-interval

### Command Default

Hello packets are sent every 10 seconds.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The interval, in seconds, between hello packets. This interval must be the same for all nodes on the network. The interval ranges from 1 through 65535. The default interval is 10 seconds.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        hello-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the interval at which OSPF hello packets are sent for a virtual link.

A hello packet is an OSPF packet that detects and maintains relationships with neighbors on the same network (directly connected routers). The greater the interval between hello packets, the less router traffic occurs, but the longer it takes for topological changes to be detected.

The hello interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication from each other.

Use the **set** form of this command to set the interval between OSPF hello packets on a virtual link.

Use the **delete** form of this command to restore the default interval, which is 10 seconds, between OSPF hello packets on a virtual link.

Use the **show** form of this command to display the interval between OSPF hello packets on a virtual link.

## protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>

Sets the retransmission interval for a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval

### Command Default

Unacknowledged LSAs are retransmitted at five-second intervals.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The interval, in seconds, between the retransmission of unacknowledged LSAs. This interval must be the same for all nodes on the network. The interval ranges from 5 through 65535. The default interval is 5 seconds.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        retransmit-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the retransmission interval for a virtual link. This interval is the number of seconds before retransmitting an unacknowledged link-state advertisement (LSA).

When an OSPF router sends an LSA to a neighbor, the neighbor acknowledges receipt with a link-state acknowledgement (LS Ack) packet. If the local router fails to receive the expected LS Ack packet, it retransmits the LSA at the interval specified by this command. This interval must be the same for all nodes on the network.

Use the **set** form of this command to set the retransmission interval for a virtual link.

Use the **delete** form of this command to restore the default retransmission interval, which is 5 seconds, for a virtual link.

Use the **show** form of this command to display the retransmission interval for a virtual link.

## protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>

Sets the transmission delay for a virtual link in an OSPF area.

### Syntax

**set protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay** *delay*

**delete protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay**

**show protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay**

### Command Default

Link-state transmissions occur at one-second intervals.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*delay*

The delay, in seconds, between link-state transmissions. This delay must be the same for all nodes on the network. The delay ranges from 1 through 65535. The default delay is 1 second.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        transmit-delay delay
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the transmission delay for a virtual link in an OSPF area. This delay is the estimated time that is required to send a link-state update (LSU) packet.

This timer accommodates transmission and propagation delays on the network, particularly on low-speed networks in which delays may be significant. The router increments the age of link-state advertisements (LSAs) in LSU packets to account for these delays.

The transmission delay includes both the transmission time and propagation delay across the network. The delay is added to the age of the LSA packet before the LSA is transmitted. The LSA age helps the network sequence LSAs, so that it can determine which of competing LSAs is the most recent and trustworthy.

LSAs are numbered in sequence, but the sequence numbers are finite, and so cannot be used as the sole determinant of the most recent LSA. Instead, OSPF also tracks the age of LSAs. Each time the LSA is forwarded to another router, its current age is incremented by the transmission delay. The age of the LSA packet, together with its sequence number, helps the receiving router to determine which version of a received LSA is more recent and, therefore, to be used.

Use the **set** form of this command to set the transmission delay for a virtual link in an OSPF area.

Use the **delete** form of this command to restore the default transmission delay, which is 1 second, for a virtual link in an OSPF area.

Use the **show** form of this command to display the transmission delay for a virtual link in an OSPF area.



## protocols ospf auto-cost reference-bandwidth <bandwidth>

Directs the system to use the reference-bandwidth method for calculating the administrative cost.

### Syntax

**set protocols ospf auto-cost reference-bandwidth** *bandwidth*

**delete protocols ospf auto-cost reference-bandwidth**

**show protocols ospf auto-cost reference-bandwidth**

### Command Default

The default reference bandwidth is  $10^8$ .

### Parameters

*bandwidth*

The reference-bandwidth rate in megabits per second (Mbps). The rate ranges from 1 through 4294967.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    auto-cost {
      reference-bandwidth bandwidth
    }
  }
}
```

### Usage Guidelines

Use this command to set a reference-bandwidth rate for calculating the OSPF cost. The OSPF rate is calculated as the reference bandwidth divided by the actual bandwidth.

An explicitly set cost for an area overrides automatically calculated rates.

Use the **set** form of this command to set the reference-bandwidth rate for calculating the OSPF cost.

Use the **delete** form of this command to restore the default reference-bandwidth rate, which is  $10^8$  Mbps, for calculating the OSPF cost.

Use the **show** form of this command to display the (current) reference-bandwidth rate for OSPF cost.

## protocols ospf default-information originate

Sets the characteristics of an external default route that is originated into an OSPF routing domain.

### Syntax

```
set protocols ospf default-information originate { always | metric metric | metric-type type | route-map map-name }
delete protocols ospf default-information originate [ always | metric | metric-type | route-map ]
show protocols ospf default-information originate [ always | metric | metric-type | route-map ]
```

### Command Default

By default, the system does not generate an external default route into the OSPF routing domain. When enabled to do so, the default route depends on the type of area into which the default route is being advertised.

- In stub areas, a Type 3 link-state advertisement is generated with a metric of 1 and the metric type is ignored.
- In not-so-stubby areas (NSSAs) that are configured to import summary advertisements, a Type 7 LSA with a metric of 1 and a metric type of 2 is generated.
- In NSSAs that are configured not to import summary advertisements, a Type 3 LSA with metric of 1 and the metric type is ignored.
- In a totally stub area, only a default route is advertised and allowed into the area. Summary and external routes are not advertised in the area.

### Parameters

#### **always**

Always advertises the default route.

#### **metric** *metric*

Specifies the metric to apply to the default route. The metric ranges from 0 through 16777214.

#### **metric-type** *type*

The metric type of an external route, which specifies how cost is calculated, to associate with the Type 5 default link-state advertisement (LSA). The metric type is either of the following:

- 1: Adds internal cost to external cost. (E1 routes use the redistributed cost plus the cost to the ASBR.)
- 2: Uses only external cost. (E2 routes use only the redistributed cost.) In case of two ASBRs advertising the same E2 cost, the internal cost to ASBR is used to break the tie.

The default type is 2.

#### *map-name*

The default route is generated if the specified route map is satisfied.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    default-information {
```

```

        originate {
            always
            metric metric
            metric-type type
            route-map map-name
        }
    }
}

```

## Usage Guidelines

Use this command to redistribute the default route (0.0.0.0) into an OSPF routing domain.

If routes are redistributed in this way, the router automatically becomes an Autonomous System Boundary Router (ASBR). The router must have a default route configured before it can generate one, unless the **always** keyword is specified.

Use the **set** form of this command to enable generation of an external default route into the OSPF routing domain.

Use the **delete** form of this command to disable generation of an external default route into the OSPF routing domain or to restore default parameter values.

Use the **show** form of this command to display default route distribution configuration. Use this command to redistribute the default route (0.0.0.0) into an OSPF routing domain.

### NOTE

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL. The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field. Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

## protocols ospf default-metric <metric>

Sets default metric to be applied to routes being redistributed into OSPF.

### Syntax

```
set protocols ospf default-metric metric
```

```
delete protocols ospf default-metric metric
```

```
show protocols ospf default-metric
```

### Parameters

*metric*

The metric to apply to routes from other protocols that are redistributed into OSPF. The metric ranges from 1 through 16777214.

### Modes

Configuration mode

### Configuration Statement

```
protocols {  
  ospf {  
    default-metric metric  
  }  
}
```

### Usage Guidelines

Use this command to set the default metric to apply to routes from other protocols that are redistributed into OSPF.

Use the **set** form of this command to set the default OSPF metric.

Use the **delete** form of this command to restore the default value for default metric.

Use the **show** form of this command to display the default OSPF metric.

## protocols ospf distance

Sets the OSPF administrative distance by route type.

### Syntax

```
set protocols ospf distance { global global | ospf [ external external | inter-area inter | intra-area intra ] }
delete protocols ospf distance [ global | ospf [ external | inter-area | intra-area ] ]
show protocols ospf distance [ global | ospf [ external | inter-area | intra-area ] ]
```

### Command Default

The default administrative distance for OSPF routes is 110.

### Parameters

#### **global** *global*

Sets the administrative distance for all routes. The distance ranges from 1 through 255.

#### **external** *external*

Sets the OSPF administrative distance for external routes (routes learned from another protocol by redistribution). The distance ranges from 1 through 255. The default distance is 110.

#### **inter-area** *inter*

Sets the OSPF administrative distance for interarea routes (routes to another area). The distance ranges from 1 through 255. The default is distance 110.

#### **intra-area** *intra*

Sets the OSPF administrative distance for intra-area routes (routes within an area). The distance ranges from 1 through 255. The default distance is 110.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    distance {
      global global
      ospf {
        external external
        inter-area inter
        intra-area intra
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the administrative distance for OSPF routes.

The administrative distance indicates the trustworthiness of a router or group of routers as a source of routing information. In general, as the distance increases, the entity becomes less trusted. An administrative distance of 1 usually represents a directly connected network, and an administrative distance of 255 indicates that the routing source is unreliable or unknown. The administrative distance that is conventionally applied to OSPF is 110.

Use the **set** form of this command to set the administrative distance.

Use the **delete** form of this command to restore the default administrative distance, which is 110.

Use the **show** form of this command to display the administrative distance.

## protocols ospf distribute-list <list-number>

Specifies an access list to filter networks in routing updates.

### Syntax

```
set protocols ospf distribute-list list-number [ export type ] [ import ] }
```

```
delete protocols ospf distribute-list list-number [ export type | import ]
```

```
show protocols ospf distribute-list list-number
```

### Parameters

*list-number*

The number of an access list to filter networks in routing updates. The number is a number from one of the following ranges of numbers:

1-99: IP standard access list.

100-199: IP extended access list.

1300-1999: IP standard access list (expanded range).

2000-2699: IP extended access list (expanded range).

**export** *type*

Specifies the type of export routes to filter. The type is one of the following: **bgp**, **connected**, **kernel**, **rip**, or **static**. Multiple types can be specified by creating additional **export** configuration nodes.

**import**

The filter for incoming routing updates.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    distribute-list list-number {
      export type
      import
    }
  }
}
```

### Usage Guidelines

Use this command to specify an access list to filter networks in routing updates.

**NOTE**

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL.

The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field.

Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to specify an access list to filter networks in routing updates.

Use the **delete** form of this command to remove an access list from filtering networks in routing updates.

Use the **show** form of this command to display the configuration.



## protocols ospf log

Enables OSPF protocol logs.

### Syntax

```
set protocols ospf log { all | events | ifsm | lsa | nfsm | nsm | packet | rib | route}
delete protocols ospf log { all | events | ifsm | lsa | nfsm | nsm | packet | rib | route}
show protocols ospf log { all | events | ifsm | lsa | nfsm | nsm | packet | rib | route}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF logs.

**events**  
Enables only OSPF event logs.

**ifsm**  
Enables only OSPF IFSM logs.

**lsa**  
Enables only OSPF LSA logs.

**nfsm**  
Enables only OSPF NFSM logs.

**nsm**  
Enables only OSPF NSM logs.

**packet**  
Enables only OSPF packet logs.

**rib**  
Enables only OSPF RIB logs.

**route**  
Enables only OSPF route logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      all
      events
      ifsm
    }
  }
}
```

```
        lsa
        nfsm
        nsm
        packet
        rib
        route
    }
}
```

## Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) logs.

Use the **delete** form of this command to remove OSPF logs.

Use the **show** form of this command to view OSPF logs.

## protocols ospf log events

Enables OSPF event logs.

### Syntax

```
set protocols ospf log events { abr | all | asbr | lsa | nssa | os | router | vlink }
delete protocols ospf log events { abr | all | asbr | lsa | nssa | os | router | vlink }
show protocols ospf log events { abr | all | asbr | lsa | nssa | os | router | vlink }
```

### Command Default

None

### Parameters

|               |                                      |
|---------------|--------------------------------------|
| <b>abr</b>    | Enables OSPF event ABR logs.         |
| <b>all</b>    | Enables all OSPF event logs          |
| <b>asbr</b>   | Enables only OSPF event ASBR logs.   |
| <b>lsa</b>    | Enables only OSPF event LSA logs.    |
| <b>nssa</b>   | Enables only OSPF event NSSA logs.   |
| <b>os</b>     | Enables only OSPF event OS logs.     |
| <b>router</b> | Enables only OSPF event router logs. |
| <b>vlink</b>  | Enables only OSPF event vlink logs.  |

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      events {
        abr
        all
        asbr
        lsa
        nssa
      }
    }
  }
}
```

```
    ospf
  router
  vlink
  }
}
```

## Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) event logs.

Use the **delete** form of this command to remove OSPF event logs.

Use the **show** form of this command to view OSPF event logs.

## protocols ospf log ifsm

Enables OSPF IFSM logs.

### Syntax

```
set protocols ospf log ifsm { all | events | status | timers}
delete protocols ospf log ifsm { all | events | status | timers}
show protocols ospf log ifsm { all | events | status | timers}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF IFSM logs.

**events**  
Enables only OSPF IFSM event logs.

**status**  
Enables only OSPF IFSM status logs.

**timers**  
Enables only OSPF IFSM timer logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      ifsm {
        all
        events
        status
        timers
      }
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) interface finite-state machine (IFSM) logs.

Use the **delete** form of this command to remove OSPF IFSM logs.

Use the **show** form of this command to view OSPF IFSM logs.

## protocols ospf log lsa

Enables OSPF LSA logs.

### Syntax

```
set protocols ospf log lsa { all | flooding | generate| install| maxage| refresh}
delete protocols ospf log lsa { all | flooding | generate| install| maxage| refresh}
show protocols ospf log lsa { all | flooding | generate| install| maxage| refresh}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF LSA logs.

**flooding**  
Enables only OSPF LSA flooding logs.

**generate**  
Enables only OSPF LSA generation logs.

**install**  
Enables only OSPF LSA installation logs.

**maxage**  
Enables only OSPF LSA maximum age logs.

**refresh**  
Enables only OSPF LSA refresh logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      lsa {
        all
        flooding
        generate
        install
        maxage
        refresh
      }
    }
  }
}
```

## Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) LSA logs.

Use the **delete** form of this command to remove OSPF LSA logs.

Use the **show** form of this command to view OSPF LSA logs.

## protocols ospf log nfsm

Enables OSPF NFSM logs.

### Syntax

```
set protocols ospf log nfsm { all | events | status | timers }
delete protocols ospf log nfsm { all | events | status | timers }
show protocols ospf log nfsm { all | events | status | timers }
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF NFSM logs.

**events**  
Enables only OSPF NFSM event logs.

**status**  
Enables only OSPF NFSM status logs.

**timers**  
Enables only OSPF NFSM timers logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      nfsm {
        all
        events
        status
        timers
      }
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) neighbor FSM (NFSM) logs.

Use the **delete** form of this command to remove OSPF NFSM logs.

Use the **show** form of this command to view OSPF NFSM logs.



## protocols ospf log nsm

Enables OSPF NSM logs.

### Syntax

```
set protocols ospf nsm { all | interface | redistribute}
delete protocols ospf nsm { all | interface | redistribute}
show protocols ospf nsm { all | interface | redistribute}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF NSM logs.

**interface**  
Enables only OSPF interface logs.

**redistribute**  
Enables only OSPF redistribute logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      nsm {
        all
      }
      interface
      redistribute
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to enable OSPF NSM log.

Use the **delete** form of this command to remove an OSPF NSM log.

Use the **show** form of this command to remove an OSPF NSM log.

## protocols ospf log packet

Enables OSPF packet logs.

### Syntax

```
set protocols ospf log packet { all | dd | detail| hello| ls-ack| ls-request| ls-update| recv| send}
```

```
delete protocols ospf log packet { all | dd | detail| hello| ls-ack| ls-request| ls-update| recv| send}
```

```
show protocols ospf log packet { all | dd | detail| hello| ls-ack| ls-request| ls-update| recv| send}
```

### Command Default

None

### Parameters

#### all

Enables all OSPF packet logs.

#### dd

Enables only OSPF packet DD logs.

#### detail

Enables only OSPF packet detail logs.

#### hello

Enables only OSPF packet hello logs.

#### ls-ack

Enables only OSPF packet ls-ack logs.

#### ls-request

Enables only OSPF packet ls-request logs.

#### ls-update

Enables only OSPF packet ls-update logs.

#### recv

Enables only OSPF packet receive logs.

#### send

Enables only OSPF packet send logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      packet {
        all
        dd
```

```
        detail
        hello
        ls-ack
ls-request
    ls-update
        recv
        send
    }
}
}
```

## Usage Guidelines

Use the **set** form of this command to enable Open Shortest Path First (OSPF) packet logs.

Use the **delete** form of this command to remove OSPF packet logs.

Use the **show** form of this command to view OSPF packet logs.

## protocols ospf log rib

Enables OSPF RIB logs.

### Syntax

```
set protocols ospf log rib { all | interface | redistribute}
delete protocols ospf log rib { all | interface | redistribute}
show protocols ospf log rib { all | interface | redistribute}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF RIB logs.

**interface**  
Enables only OSPF RIB interface logs.

**redistribute**  
Enables only OSPF RIB redistribute logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      rib {
        all
      }
      interface
      redistribute
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to enable OSPF RIB logs.

Use the **delete** form of this command to remove OSPF RIB logs.

Use the **show** form of this command to view OSPF RIB logs.

## protocols ospf log route

Enables OSPF route logs.

### Syntax

```
set protocols ospf log route { all | ase | ia | install | spf}
delete protocols ospf log route { all | ase | ia | install | spf}
show protocols ospf log route { all | ase | ia | install | spf}
```

### Command Default

None

### Parameters

**all**  
Enables all OSPF route all logs.

**ase**  
Enables only OSPF route ASE logs.

**ia**  
Enables only OSPF route IA logs.

**install**  
Enables only OSPF route install logs.

**SPF**  
Enables only OSPF route SPF logs.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    log {
      route {
        all
        ase
        ia
        install
        spf
      }
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to enable OSPF route logs.

Use the **delete** form of this command to remove OSPF route logs.

Use the **show** form of this command to view OSPF route logs.

## protocols ospf neighbor <ipv4>

Creates an OSPF neighbor and sets or modifies its characteristics.

### Syntax

**set** protocols ospf neighbor *ipv4* { poll-interval *interval* | priority *priority* }

**delete** protocols ospf neighbor *ipv4* [ poll-interval | priority ]

**show** protocols ospf neighbor *ipv4* [ poll-interval | priority ]

### Parameters

*ipv4*

The IPv4 address of the OSPF neighbor that is being created.

**poll-interval** *interval*

Sets the interval, in seconds, at which the specified neighbor is polled to determine whether it can still be reached. The interval ranges from 1 through 65535. The default interval is 120.

**priority** *priority*

Sets the priority of the specified neighbor. The number for the priority ranges from 0 through 255, where the lower the number, the higher the priority. The default number is 1.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    neighbor ipv4 {
      poll-interval interval
      priority priority
    }
  }
}
```

### Usage Guidelines

Use this command to create an OSPF neighbor and set or modify its characteristics.

Use the **set** form of this command to create an OSPF neighbor or modify its characteristics.

Use the **delete** form of this command to remove an OSPF neighbor or reset neighbor characteristics to default values.

Use the **show** form of this command to display characteristics of an OSPF neighbor.

## protocols ospf overflow database external limit <number> recovery <time>

Sets the maximum number of AS-External-LSAs that are allowed in the OSPF database.

### Syntax

**set** protocols ospf overflow database external limit *number* recovery *time*

**delete** protocols ospf overflow database external limit *number* recovery [*time*]

**show** protocols ospf overflow database external limit *number* recovery

### Parameters

*number*

The maximum number of AS-External-LSAs that are allowed in the OSPF database. The number ranges from 0 through 2147483647.

*time*

The number of seconds that the router waits before exiting the overflow state. The number of seconds ranges from 0 through 65535. A number of 0 indicates that there is no recovery and the router stays in the overflow state until an administrator intervenes.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    overflow {
      database {
        external {
          limit number {
            recovery time {
            }
          }
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to limit the number of external LSAs in the database when the router is in a wait state. It can be used to protect the router from excessive memory usage.

Use the **set** form of this command to specify the maximum number of AS-External-LSAs that are allowed in the OSPF database.

Use the **delete** form of this command to remove the limit on the number of AS-External-LSAs that are allowed in the OSPF database.

Use the **show** form of this command to display the current recovery time and maximum number of AS-External-LSAs that are allowed in the database.



## protocols ospf overflow database hard limit <number>

Sets a maximum number of LSAs that are allowed in the OSPF database and shuts down any instance that exceeds the limit.

### Syntax

```
set protocols ospf overflow database hard limit number
delete protocols ospf overflow database hard limit [number]
show protocols ospf overflow database hard limit
```

### Parameters

*number*

The maximum number of LSAs that are allowed in the database. The number ranges from 0 through 4294967294.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    overflow {
      database {
        hard {
          limit number
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to limit the number of link-state acknowledgments (LSAs) that are allowed in the OSPF database and shuts down any instance that exceeds the specified limit.

Use the **set** form of this command to set the maximum number of LSAs that are allowed in the OSPF database.

Use the **delete** form of this command to remove the maximum number of LSAs that are supported in the OSPF database.

Use the **show** form of this command to display the current maximum number of LSAs that are allowed in the OSPF database.

## protocols ospf overflow database soft limit

Sets a maximum number of LSAs that are allowed in the OSPF database and sends a warning if the limit is exceeded.

### Syntax

```
set protocols ospf overflow database soft limit number
delete protocols ospf overflow database soft limit [number]
show protocols ospf overflow database soft limit
```

### Parameters

*number*

The maximum number of LSAs that are allowed in the database. The number ranges from 0 through 4294967294.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    overflow {
      database {
        soft {
          limit number
        }
      }
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to set the maximum number of LSAs that are allowed in the OSPF database and send a warning if the limit is exceeded.

Use the **delete** form of this command to remove the maximum number of LSAs that are supported in the OSPF database.

Use the **show** form of this command to display the current maximum number of LSAs that are allowed in the OSPF database.

## protocols ospf parameters

Sets global OSPF parameters.

### Syntax

```
set protocols ospf parameters {opaque-lsa | rfc1583-compatibility | router-id ipv4}
delete protocols ospf parameters [opaque-lsa | rfc1583-compatibility | router-id ]
show protocols ospf parameters
```

### Command Default

By default, support for opaque LSAs is disabled. By default, RFC 1583 support is disabled.

If no router ID is explicitly configured, the OSPF process calculates an ID for the router by using the following algorithm.

1. Use the IP address of the loopback interface.
2. Use the highest IP address of the address on router interfaces.
3. If no interfaces are defined, use 0.0.0.0.

### Parameters

#### opaque-lsa

Enables support for opaque LSAs, as described in RFC 2370.

#### rfc1583-compatibility

Indicates whether the handling of AS external routes complies with RFC 1583.

OSPF RFCs that are subsequent to RFC 1583 enhance the way external route calculations are performed. This option controls the preference rules that are used in external route calculations when choosing among multiple AS-external-LSAs that advertise the same destination.

When set to "enabled," the preference rules remain those specified by RFC 1583. When set to "disabled," the preference rules are those stated in later RFCs, which prevent routing loops when AS-external-LSAs for the same destination have been originated from different areas.

To minimize the chance of routing loops, all OSPF routers in an OSPF routing domain should have **rfc1583-compatibility** set identically. When there are routers present that have not been updated with the functionality that is specified in later RFCs, all routers should have **rfc1583-compatibility** enabled. Otherwise, all routers should have **rfc1583-compatibility** disabled, preventing all routing loops. The default setting is disabled.

#### router id *ipv4*

Sets an explicit router identifier, overriding the router ID that is calculated by the OSPF process. The format of the identifier is an IPv4 address.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    parameters {
```

```
abr-type type
opaque-lsa
rfc1583-compatibility
router-id ipv4
}
}
}
```

## Usage Guidelines

Use this command to set global OSPF parameters.

### NOTE

Modifying the router ID causes the router to restart.

Use the **set** form of this command to set global OSPF parameters.

Use the **delete** form of this command to restore the default settings of global OSPF parameters.

Use the **show** form of this command to display the (current) global OSPF parameters.

## protocols ospf passive-interface

Suppresses OSPF routing updates on an interface.

### Syntax

```
set protocols ospf passive-interface interface
delete protocols ospf passive-interface [ interface ]
show protocols ospf passive-interface
```

### Command Default

Routing updates are not suppressed.

### Parameters

*interface*

The identifier of an interface. Supported interface types are:

- Data plane
- Loopback

For more information about these interface types, refer to [Supported Interface Types](#) on page 169.

You can suppress routing updates on multiple interfaces by creating multiple **passive-interface** configuration nodes.

**default**

Suppresses routing updates on all interfaces.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    passive-interface interface
  }
}
```

### Usage Guidelines

Use this command to suppress OSPF routing updates on an interface. OSPF traffic can be received on the interface, but the traffic is not sent on the interface.

Use the **set** form of this command to suppress OSPF routing updates on an interface.

Use the **delete** form of this command to remove the suppression of OSPF routing updates on an interface.

Use the **show** form of this command to display the suppression configuration of OSPF routing updates.

## protocols ospf passive-interface-exclude

Excludes the suppression of OSPF routing updates on an interface.

### Syntax

```
set protocols ospf passive-interface-exclude interface
delete protocols ospf passive-interface-exclude interface
show protocols ospf passive-interface-exclude
```

### Command Default

Routing updates are not suppressed and **passive-interface** is configured.

### Parameters

*interface*

The identifier of an interface. Supported interface types are:

- Data plane
- Loopback

For more information about these interface types, refer to [Supported Interface Types](#) on page 169.

You can exclude the suppression of routing updates on multiple interfaces by creating multiple **passive-interface-exclude** configuration nodes.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    passive-interface-exclude interface
  }
}
```

### Usage Guidelines

Use this command to exclude the suppression of OSPF routing updates on an interface. OSPF traffic can be neither received on the interface nor sent through the interface.

Use the **set** form of this command to exclude the suppression of OSPF routing updates on an interface.

Use the **delete** form of this command to restore the default behavior, that is, routing updates are not suppressed.

Use the **show** form of this command to display the suppression configuration of OSPF routing updates.

## Examples

The following example shows how to exclude the suppression of OSPF routing update suppression on the 10.11.121.134 interface.

```
vyatta@Rn# set protocols ospf passive-interface-exclude 10.11.121.134
vyatta@R6# show protocols ospf
ospf {
    passive-interface-exclude 10.11.121.134
}
```

## protocols ospf redistribute bgp

Sets the parameters for redistribution of BGP routes into OSPF.

### Syntax

```
set protocols ospf redistribute bgp { metric metric | metric-type type | route-map map-name }
```

```
delete protocols ospf redistribute bgp [ metric | metric-type | route-map ]
```

```
show protocols ospf redistribute bgp [ metric | metric-type | route-map ]
```

### Command Default

BGP routes that are redistributed into OSPF are assigned a routing metric of 1 and a metric type of 2. By default, no route map is applied to redistributed BGP routes.

### Parameters

#### **metric** *metric*

Applies the specified metric to BGP routes that are redistributed into OSPF. The metric ranges from 1 through 16. The default metric is 1.

#### **metric-type** *type*

The external route metric type, that specifies how cost is calculated, to be associated with the Type 5 default link-state advertisement (LSA). Supported values are:

1: Internal cost is added to external cost. (E1 routes use the redistributed cost plus the cost to the autonomous system boundary router (ASBR).)

2: External cost only. (E2 routes use only the redistributed cost.)

The default is 2.

#### **route-map** *map-name*

Redistributes routes that satisfy the specified route map.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    redistribute {
      bgp {
        metric metric
        metric-type type
        route-map map-name
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the parameters for redistribution of BGP routes into OSPF.



**NOTE**

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL.

The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field.

Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to set the parameters for redistribution of BGP routes.

Use the **delete** form of this command to remove the parameters for redistribution of BGP routes.

Use the **show** form of this command to display the parameters for redistribution of BGP routes.

## protocols ospf redistribute connected

Sets the parameters for redistribution of connected routes into OSPF.

### Syntax

```
set protocols ospf redistribute connected { metric metric | metric-type type | route-map map-name }
delete protocols ospf redistribute connected [ metric | metric-type | route-map ]
show protocols ospf redistribute connected [ metric | metric-type | route-map ]
```

### Command Default

Connected routes that are redistributed into OSPF are assigned a routing metric of 1 and a metric type of 2. By default, no route map is applied to redistributed connected routes.

### Parameters

#### **metric** *metric*

Applies the specified metric to connected routes that are redistributed into OSPF. The metric ranges from 1 through 16. The default metric is 1.

#### **metric-type** *type*

The metric type of an external route, which specifies how cost is calculated, to associate with the Type 5 default link-state advertisement (LSA). The metric type is either of the following:

- 1: Adds internal cost to external cost. (E1 routes use the redistributed cost plus the cost to the ASBR.)
- 2: Uses only external cost. (E2 routes use only the redistributed cost.)

The default type is 2.

#### **route-map** *map-name*

Redistributes routes that satisfy the specified route map.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    redistribute {
      connected {
        metric metric
        metric-type type
        route-map map-name
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the parameters for redistribution of connected routes into OSPF.

**NOTE**

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL.

The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field.

Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to set the parameters for redistribution of connected routes.

Use the **delete** form of this command to remove the parameters for redistribution of connected routes.

Use the **show** form of this command to display the parameters for redistribution of connected routes.

## protocols ospf redistribute kernel

Sets the parameters for redistribution of kernel routes into OSPF.

### Syntax

```
set protocols ospf redistribute kernel { metric metric | metric-type type | route-map map-name }
delete protocols ospf redistribute kernel [ metric | metric-type | route-map ]
show protocols ospf redistribute kernel [ metric | metric-type | route-map ]
```

### Command Default

Kernel routes that are redistributed into OSPF are assigned a routing metric of 1 and a metric type of 2. By default, no route map is applied to redistributed kernel routes.

### Parameters

#### **metric** *metric*

Applies the specified metric to kernel routes that are redistributed into OSPF. The metric ranges from 1 through 16. The default metric is 1.

#### **metric-type** *type*

The metric type of an external route, which specifies how cost is calculated, to associate with the Type 5 default link-state advertisement (LSA). The metric type is either of the following:

- 1: Adds internal cost to external cost. (E1 routes use the redistributed cost plus the cost to the ASBR.)
- 2: Uses only external cost. (E2 routes use only the redistributed cost.)

The default type is 2.

#### **route-map** *map-name*

Redistributes routes that satisfy the specified route map.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    redistribute {
      kernel {
        metric metric
        metric-type type
        route-map map-name
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the parameters for redistribution of kernel routes into OSPF.

**NOTE**

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL.

The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field.

Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to set the parameters for redistribution of kernel routes.

Use the **delete** form of this command to remove the parameters for redistribution of kernel routes.

Use the **show** form of this command to display the parameters for redistribution of kernel routes.

## protocols ospf redistribute <protocol> <options>

Sets the parameters for redistribution of routes based on the protocol value into OSPF. Protocol extends to bgp, connected, static, rip, and kernel. Options extends to metric, metric-type and route\_map

### Syntax

**set protocols ospf redistribute** *protocol*{**metric** *metric* | **metric-type** *type* | **route-map** *map-name*}

**delete protocols ospf redistribute** *protocol*[**metric** | **metric-type** | **route-map**]

**show protocols ospf redistribute** *protocol*[**metric** | **metric-type** | **route-map**]

### Command Default

All IGP routes redistributed into OSPF are assigned a default metric of 20 and a metric type of 2. All EGP routes redistributed into OSPF are assigned a default metric of 1 and a metric type of 2. By default, a route map is not applied to redistributed routes.

### Parameters

**protocol** *protocol*

The values are defined as follows:

- **bgp**: Sets the parameters for redistribution of connected routes into OSPF.
- **kernel**: Sets the parameters for redistribution of kernel routes into OSPF.
- **rip**: Sets the parameters for redistribution of RIP routes into OSPF.
- **static**: Sets the parameters for redistribution of static routes into OSPF.
- **connected**: Sets the parameters for redistribution of connected routes into OSPF.

**metric** *metric*

Applies the specified metric to routes being redistributed into OSPF.

The range is 1 to 16777214.

**metric-type** *type*

The external route metric type, that specifies how cost is calculated, to be associated with the Type 5 default link-state advertisement (LSA). Supported values are:

1: Internal cost is added to external cost. (E1 routes use the redistributed cost plus the cost to the autonomous system boundary router (ASBR).)

2: External cost only. (E2 routes use only the redistributed cost.)

The default is 2.

**route-map** *map-name*

Redistributes routes satisfying the specified route map.

### Modes

Configuration mode.

## Configuration Statement

```
protocols {
    ospf {
        redistribute {
            protocol {
                metric metric
                metric-type type
                route-map map-name
            }
        }
    }
}
```

## Usage Guidelines

Use this command to define the parameters for redistribution of routes into OSPF.

### NOTE

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL. The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field. Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to set route redistribution parameters.

Use the **delete** form of this command to remove route redistribution parameters.

Use the **show** form of this command to display route redistribution configuration.

## protocols ospf redistribute rip

Sets the parameters for redistribution of RIP routes into OSPF.

### Syntax

```
set protocols ospf redistribute rip { metric metric | metric-type type | route-map map-name }
delete protocols ospf redistribute rip [ metric | metric-type | route-map ]
show protocols ospf redistribute rip [ metric | metric-type | route-map ]
```

### Command Default

RIP routes that are redistributed into OSPF are assigned a routing metric of 1 and a metric type of 2. By default, no route map is applied to redistributed RIP routes.

### Parameters

#### **metric** *metric*

Applies the specified metric to RIP routes that are redistributed into OSPF. The metric ranges from 1 through 16. The default metric is 1.

#### **metric-type** *type*

The metric type of an external route, which specifies how cost is calculated, to associate with the Type 5 default link-state advertisement (LSA). The metric type is either of the following:

- 1: Adds internal cost to external cost. (E1 routes use the redistributed cost plus the cost to the ASBR.)
- 2: Uses only external cost. (E2 routes use only the redistributed cost.)

The default type is 2.

#### **route-map** *map-name*

Redistributes routes that satisfy the specified route map.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    redistribute {
      rip {
        metric metric
        metric-type type
        route-map map-name
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the parameters for redistribution of Routing Information Protocol (RIP) routes into OSPF.



**NOTE**

When extended ACLs are used directly or in a route map, the route must be specified in the source field of the ACL and the net mask of the route must be specified in the destination field of the ACL.

The inverse mask of the source field is applied to the prefix prior to the comparison with the source. The inverse mask for the destination field is applied to the net mask of the prefix prior to the comparison with the net-mask as specified in the destination field.

Effectively, the prefix must match the source with the application of inverse mask of the source field. And the net mask for the prefix must match the destination with the application of the inverse mask of the destination field.

Use the **set** form of this command to set the parameters for redistribution of RIP routes.

Use the **delete** form of this command to remove the parameters for redistribution of RIP routes.

Use the **show** form of this command to display the parameters for redistribution of RIP routes.

## protocols ospf redistribute static

Sets the parameters for redistribution of static routes into OSPF.

### Syntax

```
set protocols ospf redistribute static { metric metric | metric-type type | route-map map-name }
```

```
delete protocols ospf redistribute static [ metric | metric-type | route-map ]
```

```
show protocols ospf redistribute static [ metric | metric-type | route-map ]
```

### Command Default

Static routes that are redistributed into OSPF are assigned a routing metric of 1 and a metric type of 2. By default, no route map is applied to redistributed static routes.

### Parameters

#### **metric** *metric*

Applies the specified metric to static routes that are redistributed into OSPF. The metric ranges from 1 through 16. The default metric is 1.

#### **metric-type** *type*

The metric type of an external route, which specifies how cost is calculated, to associate with the Type 5 default link-state advertisement (LSA). The metric type is either of the following:

1: Adds internal cost to external cost. (E1 routes use the redistributed cost plus the cost to the ASBR.)

2: Uses only external cost. (E2 routes use only the redistributed cost.)

The default type is 2.

#### **route-map** *map-name*

Redistributes routes that satisfy the specified route map.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    redistribute {
      static {
        metric metric
        metric-type type
        route-map map-name
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the parameters for redistribution of static routes into OSPF.

Use the **set** form of this command to set the parameters for redistribution of static routes.

Use the **delete** form of this command to remove the parameters for redistribution of static routes.

Use the **show** form of this command to display the parameters for redistribution of static routes.

## protocols ospf refresh timers <value>

Sets the time of the OSPF link-state refresh timer.

### Syntax

**set protocols ospf refresh timers** *value*

**delete protocols ospf refresh timers** [*value*]

**show protocols ospf refresh timers**

### Command Default

By default, the refresh timer expires every 30 minutes (1,800 seconds).

### Parameters

*value*

The time, in seconds, of the OSPF link-state refresh timer. The time ranges from 10 through 1800.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    refresh {
      timers value
    }
  }
}
```

### Usage Guidelines

Use this command to set the time of the OSPF link-state refresh timer.

A link-state refresh is a mechanism for validating a link-state acknowledgment (LSA) and resetting its age before it reaches the maximum age. When the link-state refresh timer expires, the router floods a new link-state update to all its neighbors who reset the age of the LSA.

Use the **set** form of this command to set the time of the refresh timer.

Use the **delete** form of this command to restore the default time, which 1800 seconds, of the refresh timer.

Use the **show** form of this command to display the current time of the refresh timer.

## protocols ospf summary-address <address> <action>

Sets the advertise and tag parameters for the summary network and mask.

### Syntax

```
set protocols ospf summary-address address { advertise tag address | not-advertise }
delete protocols ospf summary-address address [ advertise tag address | not-advertise ]
show protocols ospf summary-address address
```

### Parameters

*address*

The IPv4 address of the summary network and its mask.

**advertise**

The summary address to be advertised.

**not-advertise**

The dead-neighbor polling interval. The summary networks within range are not advertised.

**tag** *address*

The neighbor priority. The priority number ranges from 0 through 4294967295. There is no default value for tag.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    summary-address address
    advertise {
      tag address
    }
    not-advertise
  }
}
```

### Usage Guidelines

Use the **set** form of this command to set the advertise and tag parameters for the summary network and mask.

Use the **delete** form of this command to delete the advertise and tag parameters for the summary network and mask.

Use the **show** form of this command to display the advertise and tag parameters for the summary network and mask.

## show ip ospf

Displays high-level information about OSPF configuration.

### Syntax

```
show ip ospf
```

### Modes

Operational mode

### Usage Guidelines

Use this command to display high-level information about OSPF configuration.

### Examples

The following example shows how to display high-level information about OSPF configuration.

```
vyatta@vyatta:~$ show ip ospf
OSPF Routing Process, Router ID: 10.100.10.1
Supports only single TOS (TOS0) routes
This implementation conforms to RFC2328
RFC1583Compatibility flag is disabled
OpaqueCapability flag is disabled
Initial SPF scheduling delay 200 millise(c)s
Minimum hold time between consecutive SPFs 1000 millise(c)s
Maximum hold time between consecutive SPFs 10000 millise(c)s
Hold time multiplier is currently 1
SPF algorithm last executed 1w2d01h ago
SPF timer is inactive
Refresh timer 10 secs
Number of external LSA 1. Checksum Sum 0x000083e4
Number of opaque AS LSA 0. Checksum Sum 0x00000000
Number of areas attached to this router: 1

Area ID: 10.1.0.0
Shortcutting mode: Default, S-bit consensus: no
Number of interfaces in this area: Total: 1, Active: 1
Number of fully adjacent neighbors in this area: 2
Area has no authentication
Number of full virtual adjacencies going through this area: 0
SPF algorithm executed 3 times
Number of LSA 4
Number of router LSA 3. Checksum Sum 0x0000ccad
Number of network LSA 1. Checksum Sum 0x00000df2
Number of summary LSA 0. Checksum Sum 0x00000000
Number of ASBR summary LSA 0. Checksum Sum 0x00000000
Number of NSSA LSA 0. Checksum Sum 0x00000000
Number of opaque link LSA 0. Checksum Sum 0x00000000
Number of opaque area LSA 0. Checksum Sum 0x00000000
vyatta@vyatta:~$
```

## show ip ospf border-routers

Displays information about OSPF border routers.

### Syntax

```
show ip ospf border-routers
```

### Modes

Operational mode

### Usage Guidelines

Use this command to display information about OSPF border routers.

### Examples

The following example shows how to display information about OSPF border routers.

```
vyatta@vyatta:~$ show ip ospf border-routers

OSPF process 0 VRF (default) internal Routing Table
Codes: i - Intra-area route, I - Inter-area route
i 10.0.100.3 [10] via 10.1.1.3, dp0s5, ASBR, Area 10.0.0.1
```

## show ip ospf database

Displays OSPF database information.

### Syntax

```
show ip ospf database [ max-age | self-originate | { asbr-summary | external | network | nssa-external | opaque-area | opaque-
as | opaque-link | router | summary } [ adv-router ipv4 | ipv4 [ adv-router ipv4 | self-originate ] ] ]
```

### Parameters

#### max-age

Display OSPF max-age database.

#### self-originate

Display OSPF self-originate database.

#### asbr-summary

Display OSPF Autonomous System Border Router (ASBR) summary database.

#### external

Display OSPF external database.

#### network

Display OSPF network database.

#### nssa-external

Display OSPF NSSA external database.

#### opaque-area

Display OSPF opaque-area database.

#### opaque-as

Display OSPF opaque-as database.

#### opaque-link

Display OSPF opaque-link database.

#### router

Display OSPF router database.

#### summary

Display summary of OSPF database.

#### adv-router *ipv4*

Display the OSPF database for a given address of the advertised router specified.

#### *ipv4*

Display the OSPF database for a given address.

#### self-originate

Display the self-originate OSPF database for a given address.

### Modes

Operational mode



## Usage Guidelines

Use this command to display OSPF database information.

## Examples

The following example shows how to display general information about the OSPF database.

```
vyatta@vyatta:~$ show ip ospf database

      OSPF Router with ID (10.100.10.1)

          Router Link States (Area 10.1.0.0)

Link ID      ADV Router    Age  Seq#           CkSum  Link count
10.1.0.33    10.1.0.33     123  0x800003e5    0x791f  1
10.1.0.58    10.1.0.58     123  0x80000562    0x4e7e  1
10.100.10.1  10.100.10.1   117  0x800001b6    0xfe13  1

          Net Link States (Area 10.1.0.0)

Link ID      ADV Router    Age  Seq#           CkSum
10.1.0.58    10.1.0.58     123  0x800003df    0x0bf3

          AS External Link States

Link ID      ADV Router    Age  Seq#           CkSum  Route
76.0.0.0     10.1.0.58     1850 0x800000b3    0x83e4  E2 76.0.0.0/8 [0x0]

vyatta@vyatta:~$
```

## show ip ospf interface

Displays information about OSPF configuration and status for an interface.

### Syntax

```
show ip ospf interface [ interface ]
```

### Command Default

If no interfaces are specified, then information for all interfaces is displayed.

### Parameters

*interface*

An interface for which to display information.

### Modes

Operational mode

### Usage Guidelines

Use this command to display information about OSPF configuration and status for an interface.

### Examples

The following example shows how to display information about OSPF configuration and status for all interfaces.

```
vyatta@vyatta:~$ show ip ospf interface
dpOp192p1 is up, line protocol is up
  Internet Address 19.1.1.1/24, Area 0.0.0.0, MTU 1500
  Process ID 0, Router ID 50.0.100.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State Backup, Priority 1
  Designated Router (ID) 50.0.100.2, Interface Address 19.1.1.2
  Backup Designated Router (ID) 50.0.100.1, Interface Address 19.1.1.1
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  Hello due in 00:00:00
  Neighbor Count is 1, Adjacent neighbor count is 1
  Crypt Sequence Number is 27
  Hello received 577 sent 578, DD received 3 sent 4
  LS-Req received 0 sent 1, LS-Upd received 11 sent 12
  LS-Ack received 11 sent 10, Discarded 0
dpOp224p1 is down, line protocol is down
  Internet Address 22.2.2.2/24, Area 0.0.0.1 [NSSA], MTU 1500
  Process ID 0, Router ID 50.0.100.1, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State Down, Priority 1
  No designated router on this network
  No backup designated router on this network
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
vyatta@vyatta:~$
```

## show ip ospf neighbor

Displays information about OSPF neighbors for an address or interface.

### Syntax

```
show ip ospf neighbor [ interface | ipv4 | detail | address ipv4 ]
```

### Command Default

If no interfaces are specified, then information about all neighbors is displayed.

### Parameters

*interface*

An interface for which to display neighbor information.

*ipv4*

An address for which to display neighbor information.

**detail**

Displays detailed neighbor information for all neighbors.

**address** *ipv4*

Displays neighbor information for the specified address.

### Modes

Operational mode

### Usage Guidelines

Use this command to display information about OSPF neighbors for an address or interface.

### Examples

The following example shows how to display information about OSPF neighbors for all neighbors.

```
vyatta@vyatta:~$ show ip ospf neighbor

OSPF process 0 VRF(default):
Neighbor      ID Pri State      Dead Time  Address  Interface
22.22.22.22   1   Full/Backup 00:00:07  193.1.1.2 dp0p192p1
3.3.3.3       1   Full/Backup 00:00:31  194.1.1.2 dp0p224p1
```

## show ip ospf route

Displays information about OSPF routes.

### Syntax

```
show ip ospf route
```

### Modes

Operational mode

### Usage Guidelines

Use this command to display information about OSPF routes.

### Examples

The following example shows how to display information about OSPF routes.

```
vyatta@vyatta:~$ show ip ospf route

OSPF process 0:
Codes: C - connected, D - Discard, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2

E2 10.1.1.0/24 [10/20] via 10.1.1.3, dp0s5
C   10.1.1.0/24 [10] is directly connected, dp0s4, Area 0.0.0.0
C   10.1.1.0/24 [10] is directly connected, dp0s5, Area 10.0.0.1
O   10.1.1.1/32 [10] via 10.1.1.3, dp0s5, Area 10.0.0.1
E2 10.1.1.0/24 [10/20] via 10.1.1.3, dp0s5
```

## show ip route ospf

Displays all IP OSPF routes.

### Syntax

```
show ip route ospf
```

### Modes

Operational mode

### Usage Guidelines

Use this command to display all IP OSPF routes.

### Examples

The following example shows how to display all IP OSPF routes.

```
vyatta@vyatta:~$ show ip route ospf

IP Route Table for VRF "default"
O E2 *> 10.1.1.0/24 [110/20] via 10.1.1.3, dp0s5, 00:04:29
O   *> 10.1.1.1/32 [110/10] via 10.1.1.3, dp0s5, 00:04:30
O E2 *> 10.1.1.0/24 [110/20] via 10.1.1.3, dp0s5, 00:04:29
```

## show monitoring protocols ospf

Displays the debugging flags for the OSPF protocol.

### Syntax

```
show monitoring protocols ospf
```

### Modes

Operational mode

### Usage Guidelines

Use this command to see how debugging is set for OSPF.

# OSPF Area Commands

---

- protocols ospf area <area-id>.....128
- protocols ospf area <area-id> area-type normal.....129
- protocols ospf area <area-id> area-type nssa <action>.....130
- protocols ospf area <area-id> area-type stub <action>.....132
- protocols ospf area <area-id> authentication <type>.....133
- protocols ospf area <area-id> network <ipv4net>.....135
- protocols ospf area <area-id> range <ipv4net> not-advertise.....136
- protocols ospf area <area-id> virtual-link <ipv4> authentication <method>.....137
- protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>.....139
- protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>.....141
- protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>.....143
- protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>.....145

## protocols ospf area <area-id>

Defines an OSPF area.

### Syntax

**set** protocols ospf area *area-id*

**delete** protocols ospf area *area-id*

**show** protocols ospf area *area-id*

### Parameters

*area-id*

The identifier of the OSPF area that is being created, expressed either as an IP address or a decimal value.

### Modes

Configuration mode

### Configuration Statement

```
protocols {  
    ospf {  
        area area-id  
    }  
}
```

### Usage Guidelines

Use this command to create an area within an OSPF Autonomous System (AS).

Use the **set** form of this command to create an OSPF area.

Use the **delete** form of this command to remove an OSPF area.

Use the **show** form of this command to display an OSPF area.



## protocols ospf area <area-id> area-type normal

Designates an OSPF area as a normal area.

### Syntax

**set** protocols ospf area *area-id* area-type normal

**delete** protocols ospf area *area-id* area-type

**show** protocols ospf area *area-id* area-type

### Parameters

*area-id*

The identifier of an OSPF area, expressed as an IP address or a decimal value.

### Modes

Configuration mode

### Configuration Statement

```
protocols {  
  ospf {  
    area area-id {  
      area-type {  
        normal  
      }  
    }  
  }  
}
```

### Usage Guidelines

Use this command to designate an OSPF area as a normal area.

A normal area is an area that is neither a stub area nor a not-so-stubby area. All external routes are advertised into normal areas.

Use the **set** form of this command to set the OSPF area type as normal.

Use the **delete** form of this command to remove area type configuration.

Use the **show** form of this command to display an area type configuration.

## protocols ospf area <area-id> area-type nssa <action>

Designates an OSPF area as an NSSA.

### Syntax

```
set protocols ospf area area-id area-type nssa [ default-cost cost | [ default-information-originate [ metric 0-16777214 | metric-type { 1 | 2 } ] ] | no-summary | translate { always | candidate } }
```

```
delete protocols ospf area area-id area-type nssa [ default-cost cost | default-information-originate [ metric 0-16777214 | metric-type { 1 | 2 } ] ] | no-summary | translate { always | candidate } }
```

```
show protocols ospf area area-id area-type nssa
```

### Command Default

By default, summary routes are generated into the area, and only Type 7 LSAs from the candidate NSSA ABR are translated.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**default-cost** *cost*

Sets the administrative cost, or metric, that applies to the default route in the specified OSPF area. The cost ranges from 0 through 6777215.

**default-information-originate**

Distributes the default route into an NSSA area.

**metric:** The OSPF default metric.

**metric-type:** Specifies the OSPF metric type on how cost is calculated for default routes. The metric type is either of the following:

- 1: Adds internal cost to external cost.
- 2: Uses only external cost.

The default type is 2.

**no-summary**

Prevents route summaries from being generated into the area.

**translate**

Directs the NSSA ABR when to translate Type 7 LSAs into Type 5 AS-External-LSAs. The direction is either of the following:

**always:** Always translates Type 7 LSAs into Type 5 AS-External-LSAs.

**candidate:** Translates only Type 7 LSAs from the candidate NSSA ABR.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
```

```

area area-id {
  area-type {
    nssa {
      default-cost cost
      default-information-originate
      metric 0-16777214
      metric-type 1-2
      no-summary
      translate {
        always
        candidate
      }
    }
  }
}

```

## Usage Guidelines

Use this command to designate an OSPF area as a not-so-stubby area.

Type 5 AS-External-LSAs are not allowed in stubby areas, but Type 7 LSAs may be translated into Type 5 LSAs by the not-so-stubby (NSSA) area border router and may traverse the NSSA in this manner. Interarea routes are not allowed.

Use the **set** form of this command to set the OSPF area type to not-so-stubby.

Use the **delete** form of this command to designate an OSPF area.

Use the **show** form of this command to display an area type configuration.

## protocols ospf area <area-id> area-type stub <action>

Designates an OSPF area as a stub area.

### Syntax

**set** protocols ospf area *area-id* area-type stub { **default-cost** *cost* | **no-summary** }

**delete** protocols ospf area *area-id* area-type stub [ **default-cost** | **no-summary** ]

**show** protocols ospf area *area-id* area-type stub [ **default-cost** ]

### Command Default

By default, summary routes are generated into the area.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**default-cost** *cost*

Sets the administrative cost, or metric, that applies to the default route in the specified OSPF area. The cost ranges from 0 through 6777215.

**no-summary**

Prevents route summaries from being generated into the area.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      area-type {
        stub {
          default-cost cost
          no-summary
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to designate an OSPF area as a stub area. No Type 5 AS-External-LSAs are allowed into a stub area.

Use the **set** form of this command to set the OSPF area type to stub.

Use the **delete** form of this command to remove area type configuration.

Use the **show** form of this command to display an area type configuration.

## protocols ospf area <area-id> authentication <type>

Sets the authentication type of an OSPF area.

### Syntax

```
set protocols ospf area area-id authentication { plaintext | md5 }
delete protocols ospf area area-id authentication [ plaintext | md5 ]
show protocols ospf area area-id authentication
```

### Command Default

The authentication is plain text.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

**plaintext**

Specifies that passwords are sent through the network in plain text.

**md5**

Specifies the MD5 authentication key to use as input to the MD5 hashing algorithm. This key must be the same on both the sending and receiving systems.

A hash value is sent through the network, computed from the password in the OSPF packet and the password, by using the Message Digest algorithm.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      authentication
        plaintext
        md5
    }
  }
}
```

### Usage Guidelines

Use this command to set the authentication type of an OSPF area.

In plain-text authentication, passwords are sent through the network in plain text. In MD5 authentication, the system uses the Message Digest 5 (MD5) algorithm to compute a hash value from the contents of the OSPF packet and the password. The hash value and the MD5 key are included in the transmitted packet, and the receiving system (configured with the same password) calculates its own hash function, which must match.

Use the **set** form of this command to set the authentication type of an OSPF area.

Use the **delete** form of this command to remove the authentication type of an OSPF area.

Use the **show** form of this command to display the authentication type of an OSPF area.

## protocols ospf area <area-id> network <ipv4net>

Sets the network address of an OSPF area.

### Syntax

```
set protocols ospf area area-id network ipv4net
delete protocols ospf area area-id network [ipv4net]
show protocols ospf area area-id network
```

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4net*

Multinode. A network to use for the specified OSPF area. The format is *ip-address/prefix*.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      network ipv4net
    }
  }
}
```

### Usage Guidelines

Use the **set** form of this command to set the network address of an OSPF area.

Use the **delete** form of this command to delete the network address of an OSPF area.

Use the **show** form of this command to display the network address of an OSPF area.

## protocols ospf area <area-id> range <ipv4net> not-advertise

Directs the router to summarize routes that match a prefix range.

### Syntax

**set** protocols ospf area *area-id* range *ipv4net* not-advertise

**delete** protocols ospf area *area-id* range *ipv4net* [ not-advertise ]

**show** protocols ospf area *area-id* range *ipv4net*

### Command Default

By default, routes are advertised and routes are not substituted.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4net*

A range to summarize, expressed as an IPv4 network in the format *ip-address/prefix*.

**not-advertise**

Directs the router not to advertise routes in the specified range.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      area-type {
        range {
          not-advertise
        }
      }
    }
  }
}
```

### Usage Guidelines

Use this command to direct the router to summarize routes that match a prefix range. This command may be used only with an Area Border Router (ABR).

Use the **set** form of this command to set the area range.

Use the **delete** form of this command to remove area range configuration.

Use the **show** form of this command to display area range configuration.



## protocols ospf area <area-id> virtual-link <ipv4> authentication <method>

Sets the authentication characteristics for a virtual link.

### Syntax

```
set protocols ospf area area-id virtual-link ipv4 authentication [ md5 | md5-key-id 1-255 | plaintext | plaintext-password
password ]
```

```
delete protocols ospf area area-id virtual-link ipv4 authentication [ md5 | md5-key-id 1-255 | plaintext | plaintext-password
password ]
```

```
show protocols ospf area area-id virtual-link ipv4 authentication
```

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area identifier of a virtual link, expressed as an IPv4 address.

**md5**

Specifies the MD5 authentication key to use as input to the MD5 hashing algorithm. This key must be the same on both the sending and receiving systems.

A hash value is sent through the network, computed from the password in the OSPF packet and the password, by using the Message Digest algorithm.

**md5-key-ID 1-255**

Sets the MD5 authentication key identifier. This identifier must be the same on both the sending and receiving systems. The identifier ranges from 1 through 255.

**plaintext**

Specifies the plain-text authentication method.

**plaintext-password *password***

Sets the password to use in plain-text authentication. This password must be eight or fewer characters and be the same on both the sending and receiving systems.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        authentication {
          md5 {
            md5
            md5-key 1-255
            plaintext
            plaintext-password password
          }
        }
      }
    }
  }
}
```

```

}
}
}
}

```

## Usage Guidelines

Use this command to set the authentication characteristics for a virtual link.

In plain-text authentication, passwords are sent through the network in plain text. In MD5 authentication, the system uses the Message Digest 5 (MD5) algorithm to compute a hash value from the contents of the OSPF packet and the password. The hash value and the MD5 key are included in the transmitted packet, and the receiving system (configured with the same password) calculates its own hash function, which must match.

Use the **set** form of this command to specify the authentication characteristics for a link.

Use the **delete** form of this command to remove the authentication characteristics for a link.

Use the **show** form of this command to display the authentication characteristics for a link.

## protocols ospf area <area-id> virtual-link <ipv4> dead-interval <interval>

Sets the dead interval for a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* dead-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* dead-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* dead-interval

### Command Default

The dead interval is 4 times the hello interval.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The time, in seconds, that the virtual link should wait to detect hello packets from neighboring routers before declaring the neighbor down. The interval ranges from 1 through 65535. The default interval is 4 times the hello interval.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        dead-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to specify the interval during which a virtual link should expect a hello packet from its neighbor.

If the dead interval passes before the interface receives a hello packet from a neighbor, the status of the neighbor is changed to out-of-service and all associated state is cleared.

The dead interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication from each other.

Use the **set** form of this command to set the dead interval for a link.

Use the **delete** form of this command to restore the default dead interval, which is 4 times the hello interval, for a link.

Use the **show** form of this command to display the dead interval for a link.

## protocols ospf area <area-id> virtual-link <ipv4> hello-interval <interval>

Sets the interval between OSPF hello packets on a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* hello-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* hello-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* hello-interval

### Command Default

Hello packets are sent every 10 seconds.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The interval, in seconds, between hello packets. This interval must be the same for all nodes on the network. The interval ranges from 1 through 65535. The default interval is 10 seconds.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        hello-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the interval at which OSPF hello packets are sent for a virtual link.

A hello packet is an OSPF packet that detects and maintains relationships with neighbors on the same network (directly connected routers). The greater the interval between hello packets, the less router traffic occurs, but the longer it takes for topological changes to be detected.

The hello interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication from each other.

Use the **set** form of this command to set the interval between OSPF hello packets on a virtual link.

Use the **delete** form of this command to restore the default interval, which is 10 seconds, between OSPF hello packets on a virtual link.

Use the **show** form of this command to display the interval between OSPF hello packets on a virtual link.

## protocols ospf area <area-id> virtual-link <ipv4> retransmit-interval <interval>

Sets the retransmission interval for a virtual link.

### Syntax

**set** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval *interval*

**delete** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval

**show** protocols ospf area *area-id* virtual-link *ipv4* retransmit-interval

### Command Default

Unacknowledged LSAs are retransmitted at five-second intervals.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*interval*

The interval, in seconds, between the retransmission of unacknowledged LSAs. This interval must be the same for all nodes on the network. The interval ranges from 5 through 65535. The default interval is 5 seconds.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        retransmit-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the retransmission interval for a virtual link. This interval is the number of seconds before retransmitting an unacknowledged link-state advertisement (LSA).

When an OSPF router sends an LSA to a neighbor, the neighbor acknowledges receipt with a link-state acknowledgement (LS Ack) packet. If the local router fails to receive the expected LS Ack packet, it retransmits the LSA at the interval specified by this command. This interval must be the same for all nodes on the network.

Use the **set** form of this command to set the retransmission interval for a virtual link.

Use the **delete** form of this command to restore the default retransmission interval, which is 5 seconds, for a virtual link.

Use the **show** form of this command to display the retransmission interval for a virtual link.



## protocols ospf area <area-id> virtual-link <ipv4> transmit-delay <delay>

Sets the transmission delay for a virtual link in an OSPF area.

### Syntax

**set protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay** *delay*

**delete protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay**

**show protocols ospf area** *area-id* **virtual-link** *ipv4* **transmit-delay**

### Command Default

Link-state transmissions occur at one-second intervals.

### Parameters

*area-id*

The ID of the OSPF area being configured, expressed as an IP address or a decimal value.

*ipv4*

The area ID of the virtual link, expressed as an IPv4 address.

*delay*

The delay, in seconds, between link-state transmissions. This delay must be the same for all nodes on the network. The delay ranges from 1 through 65535. The default delay is 1 second.

### Modes

Configuration mode

### Configuration Statement

```
protocols {
  ospf {
    area area-id {
      virtual-link ipv4 {
        transmit-delay delay
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the transmission delay for a virtual link in an OSPF area. This delay is the estimated time that is required to send a link-state update (LSU) packet.

This timer accommodates transmission and propagation delays on the network, particularly on low-speed networks in which delays may be significant. The router increments the age of link-state advertisements (LSAs) in LSU packets to account for these delays.

The transmission delay includes both the transmission time and propagation delay across the network. The delay is added to the age of the LSA packet before the LSA is transmitted. The LSA age helps the network sequence LSAs, so that it can determine which of competing LSAs is the most recent and trustworthy.

LSAs are numbered in sequence, but the sequence numbers are finite, and so cannot be used as the sole determinant of the most recent LSA. Instead, OSPF also tracks the age of LSAs. Each time the LSA is forwarded to another router, its current age is incremented by the transmission delay. The age of the LSA packet, together with its sequence number, helps the receiving router to determine which version of a received LSA is more recent and, therefore, to be used.

Use the **set** form of this command to set the transmission delay for a virtual link in an OSPF area.

Use the **delete** form of this command to restore the default transmission delay, which is 1 second, for a virtual link in an OSPF area.

Use the **show** form of this command to display the transmission delay for a virtual link in an OSPF area.

# OSPF Interface Commands

---

- interfaces <interface> <interface-name> ip ospf.....148
- interfaces <interface> <interface-name> ip ospf authentication <text>..... 149
- interfaces <interface> <interface-name> ip ospf bandwidth <bandwidth>..... 151
- interfaces <interface> <interface-name> ip ospf cost <cost>.....152
- interfaces <interface> <interface-name> ip ospf dead-interval <interval>..... 154
- interfaces <interface> <interface-name> ip ospf hello-interval <interval>.....156
- interfaces <interface> <interface-name> ip ospf mtu-ignore.....158
- interfaces <interface> <interface-name> ip ospf network <type>.....160
- interfaces <interface> <interface-name> ip ospf priority <priority>.....162
- interfaces <interface> <interface-name> ip ospf retransmit-interval <interval>.....164
- interfaces <interface> <interface-name> ip ospf transmit-delay <delay>..... 166

## interfaces <interface> <interface-name> ip ospf

Enables OSPF on an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf*

**delete interfaces** *interface interface-name ip ospf*

**show interfaces** *interface interface-name ip ospf*

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf
    }
  }
}
```

### Usage Guidelines

Use this command to enable the Open Shortest Path First (OSPF) routing protocol on an interface.

Use the **set** form of this command to enable OSPF on an interface.

Use the **delete** form of this command to disable OSPF on and remove all OSPF configuration from an interface.

Use the **show** form of this command to display the OSPF configuration on an interface.

## interfaces <interface> <interface-name> ip ospf authentication <text>

Sets the authentication method to use for OSPF on an interface.

### Syntax

```
set interfaces interface interface-name ip ospf authentication { md5 | md5-key-id key-id md5-key md5-key | plaintext |
plaintext-password password }
```

```
delete interfaces interface interface-name ip ospf authentication [ md5 | md5-key-id key-id md5-key md5-key | plaintext |
plaintext-password password ]
```

```
show interfaces interface interface-name ip ospf authentication
```

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

**md5 key-id** *key-id*

Sets a key that identifies the MD5 key. This key must be the same on both the sending and receiving systems. The key ranges from 1 through 255.

**md5-key** *md5-key*

Sets a password-like MD5 key of up to 16 alphanumeric characters to use as input to the MD5 hashing algorithm. The longer the key, the stronger the security. This key must be the same on both the sending and receiving systems.

**plaintext-password** *password*

A password to use in plain-text authentication. This password must be eight or fewer characters and be the same on both the sending and receiving systems.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        authentication {
          md5 {
            key-id key-id {
              md5-key md5-key
            }
          }
          plaintext
          plaintext-password password
        }
      }
    }
  }
}
```

## Usage Guidelines

Use this command to set the authentication method to use for OSPF on an interface. This authentication is independent of the authentication that is configured for the OSPF area.

In plain-text authentication, passwords are sent through the network in plain text. In MD5 authentication, the system uses the Message Digest 5 (MD5) algorithm to compute a hash value from the contents of the OSPF packet and the password. The hash value and the MD5 key are included in the transmitted packet, and the receiving system (configured with the same password) calculates its own hash function, which must match.

The authentication parameters must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not consider adjacencies and disregard communication from each other.

Use the **set** form of this command to set the authentication method to use for OSPF on an interface.

Use the **delete** form of this command to remove the authentication method for OSPF from an interface.

Use the **show** form of this command to display the authentication method to use for OSPF on an interface.

## interfaces <interface> <interface-name> ip ospf bandwidth <bandwidth>

Sets the bandwidth of an interface for calculating OSPF cost.

### Syntax

**set interfaces** *interface interface-name* ip ospf bandwidth *bandwidth*

**delete interfaces** *interface interface-name* ip ospf bandwidth [ *bandwidth* ]

**show interfaces** *interface interface-name* ip ospf bandwidth

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*bandwidth*

The bandwidth of the specified data plane interface in kilobits per second. The bandwidth ranges from 1 through 10000000.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        bandwidth bandwidth
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the bandwidth of an interface for calculating OSPF cost.

Use the **set** form of this command to set the bandwidth of an interface for calculating OSPF cost.

Use the **delete** form of this command to remove the bandwidth of an interface for calculating OSPF cost.

Use the **show** form of this command to display the bandwidth of an interface for calculating OSPF cost.

## interfaces <interface> <interface-name> ip ospf cost <cost>

Sets the routing cost of OSPF on an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf cost cost*

**delete interfaces** *interface interface-name ip ospf cost*

**show interfaces** *interface interface-name ip ospf cost*

### Command Default

For details on the default of OSPF cost, refer to the usage guidelines that follow.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*cost*

The link-state metric (OSPF cost) to be advertised in the link-state advertisement (LSA) as the cost of sending packets over the interface. The cost ranges from 1 through 65535.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        cost cost
      }
    }
  }
}
```

### Usage Guidelines

Use this command to manually override the default cost of OSPF that is computed by the system on an interface. Only one cost can be set for each interface.

By default, the metric that is associated with a link is computed as follows:

$Cost = 108 / bandwidth$

The cost of reaching any destination is the sum of the costs of the individual hops. Costs are always rounded to the nearest integer. Costs lower than 1 are rounded up to 1.



Table 2 shows the OSPF costs for some common media types.

**TABLE 2** OSPF Costs for Common Media Types

| Media Type         | OSPF Cost |
|--------------------|-----------|
| 56 Kbps            | 1785      |
| 64 Kbps            | 1562      |
| 128 Kbps           | 781       |
| 256 Kbps           | 390       |
| 512 Kbps           | 195       |
| 768 Kbps           | 130       |
| T1 (1,544 Mbps)    | 64        |
| E1 (2,048 Mbps)    | 48        |
| 4 Mbps Token Ring  | 6         |
| 10 Mbps Ethernet   | 10        |
| 16 Mbps Token Ring | 6         |
| T3 (44.736 Mbps)   | 2         |
| 100+ Mbps          | 1         |

The values in Table 2 show how OSPF fails to distinguish between interfaces that are faster than 100 Mbps, for example, between Fast Ethernet (100 Mbps) and Gigabit Ethernet (1000 Mbps) interfaces. If you want to distinguish interfaces equal to or greater than 100 Mbps, you must manually configure the cost of the interface by using this command.

Use the **set** form of this command to set the cost of OSPF on an interface.

Use the **delete** form of this command to restore the default cost of OSPF on an interface.

Use the **show** form of this command to display the cost of OSPF on an interface.

## interfaces <interface> <interface-name> ip ospf dead-interval <interval>

Sets the OSPF dead interval for an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf dead-interval interval*

**delete interfaces** *interface interface-name ip ospf dead-interval*

**show interfaces** *interface interface-name ip ospf dead-interval*

### Command Default

The dead interval is 4 times the hello interval.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*interval*

The time, in seconds, that the specified interface waits to detect hello packets from neighboring routers before declaring a neighbor down. The interval ranges from 1 through 65535. The default interval is 4 times the hello interval.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        dead-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to specify the interval during which an interface should expect a hello packet from its neighbor.

If the dead interval passes before the interface receives a hello packet from a neighbor, the status of the neighbor is changed to out-of-service and all associated state is cleared.

The dead interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication from each other.

Use the **set** form of this command to set the OSPF dead interval for an interface.

Use the **delete** form of this command to restore the default OSPF dead interval, which is 4 times the hello interval, for an interface.

Use the **show** form of this command to display the OSPF dead interval for an interface.

## interfaces <interface> <interface-name> ip ospf hello-interval <interval>

Sets the interval between OSPF hello packets on an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf hello-interval interval*

**delete interfaces** *interface interface-name ip ospf hello-interval*

**show interfaces** *interface interface-name ip ospf hello-interval*

### Command Default

Hello packets are sent every 10 seconds.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*interval*

The interval, in seconds, between hello packets. This interval must be the same for all nodes on the network. The interval ranges from 1 through 65535. The default interval is 10 seconds.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        hello-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the interval at which OSPF hello packets are sent on an interface.

A hello packet is an OSPF packet that detects and maintains relationships with neighbors on the same network (directly connected routers). The greater the interval between hello packets, the less router traffic occurs, but the longer it takes for topological changes to be detected.

The hello interval must be the same for all routers that are to establish two-way communication within a network. If two routers do not agree on these parameters, they do not establish adjacencies and disregard communication for each other.

Use the **set** form of this command to set the interval between OSPF hello packets on an interface.

Use the **delete** form of this command to restore the default interval, which is 10 seconds, between OSPF hello packets on an interface.

Use the **show** form of this command to display the interval between OSPF hello packets on an interface.

## interfaces <interface> <interface-name> ip ospf mtu-ignore

Disables detection of MTU mismatches on an interface.

### Syntax

**set interfaces** *interface interface-name* ip ospf mtu-ignore

**delete interfaces** *interface interface-name* ip ospf mtu-ignore

**show interfaces** *interface interface-name* ip ospf

### Command Default

Detection of MTU mismatches is enabled by default.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        mtu-ignore
      }
    }
  }
}
```

### Usage Guidelines

Use this command to disable detection of maximum transmission unit (MTU) mismatches on an OSPF interface.

OSPF sends the MTU of the interface in a database description packet. If the MTUs of OSPF neighbors do not match, they cannot form an OSPF adjacency and will be stuck in Exstart state. MTU mismatch detection detects MTU mismatches and indicates them in the form of a debug message.

Detection of MTU mismatches is an important troubleshooting feature. If mismatch detection is not enabled, MTU mismatches can be detected only by examining configuration for both interfaces.

Some network setups exist in which MTU mismatches are unavoidable and even part of the setup. Detection of MTU mismatches for only these cases should be disabled, so that normal OSPF adjacencies can be formed.

Use the **set** form of this command to disable detection of MTU mismatches on an interface.

Use the **delete** form of this command to re-enable detection of MTU mismatches on an interface.

Use the **show** form of this command to display whether detection of MTU mismatches on an interface is enabled or disabled.

## interfaces <interface> <interface-name> ip ospf network <type>

Sets the OSPF network type for an interface.

### Syntax

**set interfaces** *interface interface-name* ip ospf network [ broadcast | non-broadcast | point-to-multipoint | point-to-point ]

**delete interfaces** *interface interface-name* ip ospf network

**show interfaces** *interface interface-name* ip ospf network

### Command Default

Broadcast is supported.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*type*

The network type for this interface. The type is one of the following:

**broadcast:** The interface supports broadcast mode, such as a LAN link.

**non-broadcast:** The interface does not support broadcast mode.

**point-to-point:** The interface supports point-to-point mode.

**point-to-multipoint:** The interface supports point-to-multipoint mode, such as a PPP interface or a point-to-point logical interface on Frame Relay.

The default type is broadcast.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        network type
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the OSPF network type for the interface.

Use the **set** form of this command to set the OSPF network type for an interface.



Use the **delete** form of this command to remove the OSPF network type for an interface.

Use the **show** form of this command to display the OSPF network type for an interface.

## interfaces <interface> <interface-name> ip ospf priority <priority>

Sets the OSPF priority for an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf priority priority*

**delete interfaces** *interface interface-name ip ospf priority*

**show interfaces** *interface interface-name ip ospf priority*

### Command Default

An OSPF interface has a priority of 1.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*priority*

The OSPF priority for the specified interface. The priority ranges from 0 through 255, where a router with priority 0 can never become the designated router and cannot take part in the DR/BDR election. The default priority is 1.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        priority priority
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the OSPF priority for an interface on the broadcast network to which the interface is connected. The priority determines which routers are selected as the designated router (DR) and backup designated router (BDR) of the area.

The DR and BDR reduce the amount of traffic on OSPF overhead on broadcast networks by reducing the number of adjacent routers to which a router must flood its topological information. In broadcast networks (such as Ethernet), each router establishes an adjacency with only the DR and BDR rather than with every router in its area. The DR and BDR then flood this information to all other routers on the network segment.

The priority ranges from 0 through 255. In general, the router with the highest priority is elected as the DR, and the router with the second-highest priority is elected as the BDR. The higher the number, the higher the priority.

A router with a priority of 0 is ineligible for election as a DR or BDR.

Use the **set** form of this command to set the OSPF priority for an interface.

Use the **delete** form of this command to restore the default OSPF priority, which is 1, for an interface.

Use the **show** form of this command to display the OSPF priority for an interface.

## interfaces <interface> <interface-name> ip ospf retransmit-interval <interval>

Sets the OSPF retransmission interval for an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf retransmit-interval interval*

**delete interfaces** *interface interface-name ip ospf retransmit-interval*

**show interfaces** *interface interface-name ip ospf retransmit-interval*

### Command Default

Unacknowledged LSAs are retransmitted at five-second intervals.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*interval*

The time, in seconds, to wait for an acknowledgment after which the system retransmits an LSA packet to its neighbors. The interval ranges from 5 to 65535. The default interval is 5 seconds.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        retransmit-interval interval
      }
    }
  }
}
```

### Usage Guidelines

Use this command to specify how long an interface will wait for an acknowledgment of a link-state update before resending the update.

The LSU packet is part of the exchange of topology databases between routers. When the initial database description (DD) packet is sent, it contains only the headers of the link-state advertisements (LSAs). If the receiving router determines that it requires that piece of the OSPF topology, it sends a link-state request packet to request the complete LSA from the sending router.

After the update packet is sent, the sending router waits for an acknowledgement, either implicit or explicit, from the receiving router. In an explicit acknowledgement, the receiving router sends a link-state acknowledge (LS-Ack) packet to the router that sent the update. In an implicit acknowledgement, the router that sent the update receives an LSA from the receiving router that contains the update information.

If the retransmission interval passes with neither an explicit nor an implicit acknowledgement, the sending router retransmits the LSU packet.

Too high an interval slows network convergence. Too small an interval causes unnecessary retransmission.

Use the **set** form of this command to set the OSPF retransmission interval for an interface.

Use the **delete** form of this command to restore the default OSPF retransmission interval, which is 5 seconds, for an interface.

Use the **show** form of this command to display the OSPF retransmission level for an interface.

## interfaces <interface> <interface-name> ip ospf transmit-delay <delay>

Sets the OSPF transmission delay for an interface.

### Syntax

**set interfaces** *interface interface-name ip ospf transmit-delay delay*

**delete interfaces** *interface interface-name ip ospf transmit-delay*

**show interfaces** *interface interface-name ip ospf transmit-delay*

### Command Default

Link-state transmissions occur at one-second intervals.

### Parameters

*interface*

A type of interface. For detailed keywords and arguments that can be specified as interface types, refer to [Supported Interface Types](#) on page 169.

*interface-name*

The name of an interface.

*delay*

The delay, in seconds, between link-state transmissions. This delay must be the same for all nodes on the network. The delay ranges from 1 through 65535. The default delay is 1 second.

### Modes

Configuration mode

### Configuration Statement

```
interfaces {
  interfaces interface-name {
    ip {
      ospf {
        transmit-delay delay
      }
    }
  }
}
```

### Usage Guidelines

Use this command to set the OSPF transmission delay for an interface. This delay is the estimated time required to send an LSU packet.

This timer accommodates transmission and propagation delays on the network, particularly on low-speed networks in which delays may be significant. The router increments the age of link-state advertisements (LSAs) in link-state update (LSU) packets to account for these delays.

The delay includes both the transmission time and the propagation delay across the network. The delay is added to the age of the LSA packet before the LSA is transmitted. The LSA age helps the network sequence LSAs, so that it can determine which of competing LSAs is the more recent and trustworthy.

LSAs are numbered in sequence, but the sequence numbers are finite, and so cannot be used as the sole determinant of the most recent LSA. Instead, OSPF also tracks the age of LSAs. Each time an LSA is forwarded to another router, its current age is incremented by the transmission delay. The age of the packet, together with its sequence number, help the receiving router to determine which version of a received LSA is more recent and, therefore, to be used.

Use the **set** form of this command to set the OSPF transmission delay for an interface.

Use the **delete** form of this command to restore the default OSPF transmission delay, which is one second, for an interface.

Use the **show** form of this command to display the OSPF transmission delay for an interface.





# Supported Interface Types

The following table shows the syntax and parameters of supported interface types. Depending on the command, some of these types may not apply.

| Interface Type | Syntax   | Parameters   |
|----------------|--|--|
| Bridge         | <b>bridge</b> <i>brx</i>   | <i>brx</i> : The name of a bridge group. The name ranges from br0 through br999.   |
| Data plane     | <b>dataplane</b> <i>interface-name</i>   | <p><i>interface-name</i>: The name of a data plane interface. Following are the supported formats of the interface name:</p> <ul style="list-style-type: none"> <li>• <b>dp<math>x</math>py<math>z</math></b>—The name of a data plane interface, where <ul style="list-style-type: none"> <li>— <b>dp<math>x</math></b> specifies the data plane identifier (ID). Currently, only dp0 is supported.</li> <li>— <b>py</b> specifies a physical or virtual PCI slot index (for example, p129).</li> <li>— <b>p<math>z</math></b> specifies a port index (for example, p1). For example, dp0p1p2, dp0p160p1, and dp0p192p1.</li> </ul> </li> <li>• <b>dp<math>x</math>em<math>y</math></b>—The name of a data plane interface on a LAN-on-motherboard (LOM) device that does not have a PCI slot, where <b>em<math>y</math></b> specifies an embedded network interface number (typically, a small number). For example, dp0em3.</li> <li>• <b>dp<math>x</math>s<math>y</math></b>—The name of a data plane interface on a device that is installed on a virtual PCI slot, where <b><math>x</math>s<math>y</math></b> specifies an embedded network interface number (typically, a small number). For example, dp0s2. Currently, this format applies only when using the KVM or Hyper-V platforms.</li> <li>• <b>dp<math>x</math>P<math>n</math>py<math>z</math></b>—The name of a data plane interface on a device that is installed on a secondary PCI bus, where <b>P<math>n</math></b> specifies the bus number. You can use this format to name data plane interfaces on large physical devices with multiple PCI buses. For these devices, it is possible to have network interface cards installed on different buses with these cards having the same slot ID. The value of <i>n</i> must be an integer greater than 0. For example, dp0P1p162p1 and dp0P2p162p1.</li> </ul> |
| Data plane vif | <b>dataplane</b> <i>interface-name</i> <b>vif</b> <i>vif-id</i> [ <b>vlan</b> <i>vlan-id</i> ] | <p><i>interface-name</i>: Refer to the preceding description.</p> <p><i>vif-id</i>: A virtual interface ID. The ID ranges from 1 through 4094.</p> <p><i>vlan-id</i>: The VLAN ID of a virtual interface. The ID ranges from 1 through 4094.</p>   |
| Loopback       | <b>loopback</b> <i>lo</i><br>or<br><b>loopback</b> <i>lo<math>n</math></i>                     | <i>n</i> : The name of a loopback interface, where <i>n</i> ranges from 1 through 99999.   |
| OpenVPN        | <b>openvpn</b> <i>vtunx</i>  | <i>vtunx</i> : The identifier of an OpenVPN interface. The identifier ranges from vtun0 through vtun $x$ , where <i>x</i> is a nonnegative integer.  |
| Tunnel         | <b>tunnel</b> <i>tunx</i><br>or<br><b>tunnel</b> <i>tunx</i> <b>parameters</b>                 | <i>tunx</i> : The identifier of a tunnel interface you are defining. The identifier ranges from tun0 through tun $x$ , where <i>x</i> is a nonnegative integer.  |

| Interface Type | Syntax   | Parameters   |
|----------------|--|--|
| Virtual tunnel | <b>vti</b> <i>vtix</i>   | <p><i>vtix</i>: The identifier of a virtual tunnel interface you are defining. The identifier ranges from vti0 through vti<i>x</i>, where <i>x</i> is a nonnegative integer.</p> <p><b>Note:</b> This interface does not support IPv6.</p>   |
| VRRP           | <i>parent-interface</i> <b>vrrp</b> <b>vrrp-group</b> <i>group</i> | <p><i>parent-interface</i>: The type and identifier of a parent interface; for example, data plane dpOp1p2 or bridge br999.</p> <p><i>group</i>: A VRRP group identifier.</p> <p>The name of a VRRP interface is not specified. The system internally constructs the interface name from the parent interface identifier plus the VRRP group number; for example, dpOp1p2v99. Note that VRRP interfaces support the same feature set as does the parent interface.</p> |

# List of Acronyms

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|        |   |
|--------|---|
| ACL    | access control list                           |
| ADSL   | Asymmetric Digital Subscriber Line            |
| AH     | Authentication Header                         |
| AMI    | Amazon Machine Image                          |
| API    | Application Programming Interface             |
| AS     | autonomous system                             |
| ARP    | Address Resolution Protocol                   |
| AWS    | Amazon Web Services                           |
| BGP    | Border Gateway Protocol                       |
| BIOS   | Basic Input Output System                     |
| BPDU   | Bridge Protocol Data Unit                     |
| CA     | certificate authority                         |
| CCMP   | AES in counter mode with CBC-MAC              |
| CHAP   | Challenge Handshake Authentication Protocol   |
| CLI    | command-line interface                        |
| DDNS   | dynamic DNS                                   |
| DHCP   | Dynamic Host Configuration Protocol           |
| DHCPv6 | Dynamic Host Configuration Protocol version 6 |
| DLCI   | data-link connection identifier               |
| DMI    | desktop management interface                  |
| DMVPN  | dynamic multipoint VPN                        |
| DMZ    | demilitarized zone                            |
| DN     | distinguished name                            |
| DNS    | Domain Name System                            |
| DSCP   | Differentiated Services Code Point            |
| DSL    | Digital Subscriber Line                       |
| eBGP   | external BGP                                  |
| EBS    | Amazon Elastic Block Storage                  |
| EC2    | Amazon Elastic Compute Cloud                  |
| EGP    | Exterior Gateway Protocol                     |
| ECMP   | equal-cost multipath                          |
| ESP    | Encapsulating Security Payload                |
| FIB    | Forwarding Information Base                   |
| FTP    | File Transfer Protocol                        |
| GRE    | Generic Routing Encapsulation                 |
| HDLC   | High-Level Data Link Control                  |
| I/O    | Input/Output                                  |
| ICMP   | Internet Control Message Protocol             |
| IDS    | Intrusion Detection System                    |

|        |   |
|--------|---|
| IEEE   | Institute of Electrical and Electronics Engineers         |
| IGMP   | Internet Group Management Protocol                        |
| IGP    | Interior Gateway Protocol                                 |
| IPS    | Intrusion Protection System                               |
| IKE    | Internet Key Exchange                                     |
| IP     | Internet Protocol   |
| IPOA   | IP over ATM   |
| IPsec  | IP Security   |
| IPv4   | IP Version 4  |
| IPv6   | IP Version 6  |
| ISAKMP | Internet Security Association and Key Management Protocol |
| ISM    | Internet Standard Multicast                               |
| ISP    | Internet Service Provider                                 |
| KVM    | Kernel-Based Virtual Machine                              |
| L2TP   | Layer 2 Tunneling Protocol                                |
| LACP   | Link Aggregation Control Protocol                         |
| LAN    | local area network  |
| LDAP   | Lightweight Directory Access Protocol                     |
| LLDP   | Link Layer Discovery Protocol                             |
| MAC    | medium access control                                     |
| mGRE   | multipoint GRE  |
| MIB    | Management Information Base                               |
| MLD    | Multicast Listener Discovery                              |
| MLPPP  | multilink PPP   |
| MRRU   | maximum received reconstructed unit                       |
| MTU    | maximum transmission unit                                 |
| NAT    | Network Address Translation                               |
| NBMA   | Non-Broadcast Multi-Access                                |
| ND     | Neighbor Discovery  |
| NHRP   | Next Hop Resolution Protocol                              |
| NIC    | network interface card                                    |
| NTP    | Network Time Protocol                                     |
| OSPF   | Open Shortest Path First                                  |
| OSPFv2 | OSPF Version 2  |
| OSPFv3 | OSPF Version 3  |
| PAM    | Pluggable Authentication Module                           |
| PAP    | Password Authentication Protocol                          |
| PAT    | Port Address Translation                                  |
| PCI    | peripheral component interconnect                         |
| PIM    | Protocol Independent Multicast                            |
| PIM-DM | PIM Dense Mode  |
| PIM-SM | PIM Sparse Mode   |
| PKI    | Public Key Infrastructure                                 |

|         |   |
|---------|---|
| PPP     | Point-to-Point Protocol                               |
| PPPoA   | PPP over ATM  |
| PPPoE   | PPP over Ethernet                                     |
| PPTP    | Point-to-Point Tunneling Protocol                     |
| PTMU    | Path Maximum Transfer Unit                            |
| PVC     | permanent virtual circuit                             |
| QoS     | quality of service                                    |
| RADIUS  | Remote Authentication Dial-In User Service            |
| RHEL    | Red Hat Enterprise Linux                              |
| RIB     | Routing Information Base                              |
| RIP     | Routing Information Protocol                          |
| RIPng   | RIP next generation                                   |
| RP      | Rendezvous Point                                      |
| RPF     | Reverse Path Forwarding                               |
| RSA     | Rivest, Shamir, and Adleman                           |
| Rx      | receive   |
| S3      | Amazon Simple Storage Service                         |
| SLAAC   | Stateless Address Auto-Configuration                  |
| SNMP    | Simple Network Management Protocol                    |
| SMTP    | Simple Mail Transfer Protocol                         |
| SONET   | Synchronous Optical Network                           |
| SPT     | Shortest Path Tree                                    |
| SSH     | Secure Shell  |
| SSID    | Service Set Identifier                                |
| SSM     | Source-Specific Multicast                             |
| STP     | Spanning Tree Protocol                                |
| TACACS+ | Terminal Access Controller Access Control System Plus |
| TBF     | Token Bucket Filter                                   |
| TCP     | Transmission Control Protocol                         |
| TKIP    | Temporal Key Integrity Protocol                       |
| ToS     | Type of Service                                       |
| TSS     | TCP Maximum Segment Size                              |
| Tx      | transmit  |
| UDP     | User Datagram Protocol                                |
| VHD     | virtual hard disk                                     |
| vif     | virtual interface                                     |
| VLAN    | virtual LAN   |
| VPC     | Amazon virtual private cloud                          |
| VPN     | virtual private network                               |
| VRRP    | Virtual Router Redundancy Protocol                    |
| WAN     | wide area network                                     |
| WAP     | wireless access point                                 |
| WPA     | Wired Protected Access                                |