

OSPF Point-to-Multipoint Network with Separate Costs per Neighbor

Description

OSPF has two new features related to point-to-multipoint networks. One feature applies to broadcast networks; the other feature applies to nonbroadcast networks.

- On point-to-multipoint, broadcast networks, there is no need to specify neighbors. However, you can specify neighbors with the **neighbor** command, in which case you should specify a cost to that neighbor.
- On point to multipoint, nonbroadcast networks, you now use the **neighbor** command to identify neighbors. Assigning a cost to a neighbor is optional.

Before this feature, some OSPF point-to-multipoint protocol traffic was treated as multicast traffic. Therefore, the **neighbor** command was not needed for point-to-multipoint interfaces because multicast took care of the traffic. Hellos, updates and acknowledgments were sent using multicast. In particular, multicast hellos discovered all neighbors dynamically.

However, some customers were using point-to-multipoint on nonbroadcast media (such as classic IP over ATM), so their routers could not dynamically discover their neighbors. This feature allows the **neighbor** command to be used on point-to-multipoint interfaces.

On any point-to-multipoint interface (broadcast or not), the Cisco IOS software assumed the cost to each neighbor was equal. The cost was configured with the **ip ospf cost** command. In reality, the bandwidth to each neighbor is different, so the cost should be different. With this feature, you can configure a separate cost to each neighbor. This feature applies to point-to-multipoint interfaces only.

Benefits

You can now configure neighbors on point-to-multipoint interfaces and assign a cost to each neighbor. These capabilities allow the router to dynamically discover neighbors over nonbroadcast media and to prefer some routes over others by assigning different costs to neighbors.

Platforms

This feature is supported on these platforms:

- Cisco 1003, Cisco 1004, Cisco 1005
- Cisco 1600 series
- Cisco 2500 series
- Cisco 3600 series

- Cisco 3800 series
- Cisco 4000 series (Cisco 4000, 4000-M, 4500, 4500-M, 4700, 4700-M)
- Cisco 5200 series
- Cisco 7200 series
- Cisco 7500 series
- Cisco AS5300

Configuration Tasks

This section describes the following tasks to configure OSPF point-to-multipoint interfaces. Perform one of these tasks, depending on whether your network is broadcast or nonbroadcast.

- Specify a Neighbor's Cost on Point-to-Multipoint, Broadcast Networks
- Configure an Interface as Point-to-Multipoint, Nonbroadcast

Specify a Neighbor's Cost on Point-to-Multipoint, Broadcast Networks

To treat an interface as point-to-multipoint broadcast and assign a cost to each neighbor, perform the following tasks beginning in interface configuration mode:

Task	Command
Step 1 Configure an interface as point-to-multipoint for broadcast media.	ip ospf network point-to-multipoint
Step 2 Enter global configuration mode.	exit
Step 3 Configure an OSPF routing process and enter router configuration mode.	router ospf <i>process-id</i>
Step 4 Specify a neighbor and assign a cost to the neighbor.	neighbor <i>ip-address cost number</i>
Step 5 Repeat Step 4 for each neighbor if you want to specify a cost. Otherwise, neighbors will assume the cost of the interface, based on the ip ospf cost command.	

Configure an Interface as Point-to-Multipoint, Nonbroadcast

To treat the interface as point-to-multipoint when the media does not support broadcast, perform the following task in interface configuration mode:

Task	Command
Step 1 Configure an interface as point-to-multipoint for nonbroadcast media.	ip ospf network point-to-multipoint non-broadcast
Step 2 Enter global configuration mode.	exit

Task	Command
Step 3 Configure an OSPF routing process and enter router configuration mode.	router ospf <i>process-id</i>
Step 4 Specify an OSPF neighbor and optionally assign a cost to the neighbor.	neighbor <i>ip-address</i> [cost <i>number</i>]
Step 5 Repeat Step 4 for each neighbor.	

Configuration Examples

This section includes the following configuration examples:

- OSPF Point-to-Multipoint, Broadcast
- OSPF Point-to-Multipoint, Nonbroadcast

OSPF Point-to-Multipoint, Broadcast

The following example illustrates a point-to-multipoint network with broadcast.

```
interface Serial0
 ip address 10.0.1.1 255.255.255.0
 encapsulation frame-relay
 ip ospf cost 100
 ip ospf network point-to-multipoint
 frame-relay map ip 10.0.1.3 202 broadcast
 frame-relay map ip 10.0.1.4 203 broadcast
 frame-relay map ip 10.0.1.5 204 broadcast
 frame-relay local-dlci 200
!
router ospf 1
 network 10.0.1.0 0.0.0.255 area 0
 neighbor 10.0.1.5 cost 5
 neighbor 10.0.1.4 cost 10
```

The configuration of the neighbor at 10.0.1.3 is:

```
interface $core2s2
 ip address 10.0.1.3 255.255.255.0
 ip ospf network point-to-multipoint
 encapsulation frame-relay
 frame-relay local-dlci 301
 frame-relay map ip $core7s0_ip 300 broadcast
 no shut
!
router ospf 1
 network 10.0.1.0 0.0.0.255 area 0
```

The output shown for neighbors in the first configuration above looks like this:

```
Router# show ip ospf neighbor
Neighbor ID    Pri  State      Dead Time  Address      Interface
4.1.1.1        1    FULL/ -    00:01:50  10.0.1.5    Serial0
3.1.1.1        1    FULL/ -    00:01:47  10.0.1.4    Serial0
2.1.1.1        1    FULL/ -    00:01:45  10.0.1.3    Serial0
```

The route information in the first configuration above looks like this:

```
Router# show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, 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, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
       U - per-user static route, o - ODR
Gateway of last resort is not set
C    1.0.0.0/8 is directly connected, Loopback0
     10.0.0.0/8 is variably subnetted, 4 subnets, 2 masks
O    10.0.1.3/32 [110/100] via 10.0.1.3, 00:39:08, Serial0
C    10.0.1.0/24 is directly connected, Serial0
O    10.0.1.5/32 [110/5] via 10.0.1.5, 00:39:08, Serial0
O    10.0.1.4/32 [110/10] via 10.0.1.4, 00:39:08, Serial0
```

OSPF Point-to-Multipoint, Nonbroadcast

The following example illustrates a point-to-multipoint network with nonbroadcast.

```
interface Serial0
ip address 10.0.1.1 255.255.255.0
ip ospf network point-to-multipoint non-broadcast
encapsulation frame-relay
no keepalive
frame-relay local-dlci 200
frame-relay map ip 10.0.1.3 202
frame-relay map ip 10.0.1.4 203
frame-relay map ip 10.0.1.5 204
no shut
!
router ospf 1
network 10.0.1.0 0.0.0.255 area 0
neighbor 10.0.1.3 cost 5
neighbor 10.0.1.4 cost 10
neighbor 10.0.1.5 cost 15
```

The following is the configuration for the router on the other side:

```
interface Serial9/2
ip address 10.0.1.3 255.255.255.0
encapsulation frame-relay
ip ospf network point-to-multipoint non-broadcast
no ip mroute-cache
no keepalive
no fair-queue
frame-relay local-dlci 301
frame-relay map ip 10.0.1.1 300
no shut
!
router ospf 1
network 10.0.1.0 0.0.0.255 area 0
```

The output shown for neighbors in the first configuration above looks like this:

```
Router# show ip ospf neighbor
Neighbor ID    Pri   State           Dead Time   Address        Interface
4.1.1.1        1    FULL/ -         00:01:52   10.0.1.5       Serial0
3.1.1.1        1    FULL/ -         00:01:52   10.0.1.4       Serial0
2.1.1.1        1    FULL/ -         00:01:52   10.0.1.3       Serial0
```

Command Reference

This section documents modified commands. All other commands used with this feature are documented in the Cisco IOS Release 11.3 command references.

- **ip ospf network**
- **neighbor (OSPF)**

ip ospf network

To configure the OSPF network type to a type other than the default for a given media, use the **ip ospf network** interface configuration command. To return to the default value, use the **no** form of this command.

```
ip ospf network { broadcast | non-broadcast | { point-to-multipoint [non-broadcast] } }
no ip ospf network
```

Syntax Description

broadcast	Sets the network type to broadcast.
non-broadcast	Sets the network type to NBMA.
point-to-multipoint [non-broadcast]	Sets the network type to point-to-multipoint. The optional non-broadcast keyword sets the point-to-multipoint network to be nonbroadcast. If you use the non-broadcast keyword, the neighbor command is required.

Default

Depends on the network type.

Command Mode

Interface configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0. The **point-to-multipoint** keyword first appeared in Cisco IOS Release 10.3. The **non-broadcast** keyword used with the **point-to-multipoint** keyword first appeared in Cisco IOS Release 11.3 AA.

Using this feature, you can configure broadcast networks as nonbroadcast multiaccess (NBMA) networks when, for example, you have routers in your network that do not support multicast addressing. You can also configure nonbroadcast multiaccess networks (such as X.25, Frame Relay, and SMDS) as broadcast networks. This feature saves you from having to configure neighbors.

Configuring NBMA networks as either broadcast or nonbroadcast assumes that there are virtual circuits from every router to every router or fully meshed network. This is not true for some cases, for example, because of cost constraints or when you have only a partially meshed network. In these

cases, you can configure the OSPF network type as a point-to-multipoint network. Routing between two routers that are not directly connected will go through the router that has virtual circuits to both routers. You do not need to configure neighbors when using this feature.

If this command is issued on an interface that does not allow it, it will be ignored.

OSPF has two features related to point-to-multipoint networks. One feature applies to broadcast networks; the other feature applies to nonbroadcast networks.

- On point-to-multipoint, broadcast networks, you can use the **neighbor** command and you must specify a cost to that neighbor.
- On point to multipoint, nonbroadcast networks, you must use the **neighbor** command to identify neighbors. Assigning a cost to a neighbor is optional.

Examples

The following example sets your OSPF network as a broadcast network:

```
interface serial 0
 ip address 160.89.77.17 255.255.255.0
 ip ospf network broadcast
 encapsulation frame-relay
```

The following example illustrates a point-to-multipoint network with broadcast.

```
interface Serial0
 ip address 10.0.1.1 255.255.255.0
 encapsulation frame-relay
 ip ospf cost 100
 ip ospf network point-to-multipoint
 frame-relay map ip 10.0.1.3 202 broadcast
 frame-relay map ip 10.0.1.4 203 broadcast
 frame-relay map ip 10.0.1.5 204 broadcast
 frame-relay local-dlci 200
!
router ospf 1
 network 10.0.1.0 0.0.0.255 area 0
 neighbor 10.0.1.5 cost 5
 neighbor 10.0.1.4 cost 10
```

Related Commands

frame-relay map
neighbor (OSPF)
x25 map

neighbor (OSPF)

To configure OSPF routers interconnecting to nonbroadcast networks, use this form of the **neighbor** router configuration command. To remove a configuration, use the **no** form of this command.

```
neighbor ip-address [priority number] [poll-interval seconds] [cost number]  
no neighbor ip-address [priority number] [poll-interval seconds] [cost number]
```

Syntax Description

<i>ip-address</i>	Interface IP address of the neighbor.
priority number	(Optional) 8-bit number indicating the router priority value of the nonbroadcast neighbor associated with the IP address specified. The default is 0. This keyword does not apply to point-to-multipoint interfaces.
poll-interval seconds	(Optional) Unsigned integer value reflecting the poll interval. RFC 1247 recommends that this value be much larger than the hello interval. The default is 120 seconds (2 minutes). This keyword does not apply to point-to-multipoint interfaces.
cost number	(Optional) Assigns a cost to the neighbor, in the form of an integer from 1 to 65535. Neighbors with no specific cost configured will assume the cost of the interface, based on the ip ospf cost command. On point-to-multipoint interfaces, this is the only keyword and argument that make sense. This keyword does not apply to NBMA networks.

Default

No configuration is specified.

Command Mode

Router configuration

Usage Guidelines

This command first appeared in Cisco IOS Release 10.0. The **cost** keyword was added in Release 11.3 AA.

X.25 and Frame Relay provide an optional broadcast capability that can be configured in the map to allow OSPF to run as a broadcast network. At the OSPF level you can configure the router as a broadcast network. See the **x25 map** and **frame-relay map** commands in the “X.25 Commands” and “Frame Relay Commands” chapters, respectively, in the *Wide-Area Networking Command Reference* for more detail.

One neighbor entry must be included in the Cisco IOS software configuration for each known nonbroadcast network neighbor. The neighbor address has to be on the primary address of the interface.

If a neighboring router has become inactive (hello packets have not been seen for the Router Dead Interval period), it may still be necessary to send hello packets to the dead neighbor. These hello packets will be sent at a reduced rate called *Poll Interval*.

When the router first starts up, it sends only hello packets to those routers with non-zero priority; that is, routers that are eligible to become designated routers (DR) and backup designated routers (BDR). After DR and BDR are selected, DR and BDR will then start sending hello packets to all neighbors in order to form adjacencies.

Prior to Release 12.0, the **neighbor** command applied to NBMA networks only. With Release 12.0, the **neighbor** command applies to NBMA networks and point-to-multipoint networks. On NBMA networks, the **cost** keyword is not accepted.

Examples

The following example declares a router at address 131.108.3.4 on a nonbroadcast network, with a priority of 1 and a poll interval of 180 seconds:

```
router ospf
 neighbor 131.108.3.4 priority 1 poll-interval 180
```

The following example illustrates a point-to-multipoint network with nonbroadcast.

```
interface Serial0
 ip address 10.0.1.1 255.255.255.0
 ip ospf network point-to-multipoint non-broadcast
 encapsulation frame-relay
 no keepalive
 frame-relay local-dlci 200
 frame-relay map ip 10.0.1.3 202
 frame-relay map ip 10.0.1.4 203
 frame-relay map ip 10.0.1.5 204
 no shut
 !
router ospf 1
 network 10.0.1.0 0.0.0.255 area 0
 neighbor 10.0.1.3 cost 5
 neighbor 10.0.1.4 cost 10
 neighbor 10.0.1.5 cost 15
```

Related Commands

ip ospf network

ip ospf priority