



# CHAPTER 11

## Routing Protocols

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This chapter describes the level of support that Cisco ANA provides for routing protocols, as follows:

- [Technology Description, page 11-1](#)
- [Information Model Objects \(IMOs\), page 11-3](#)
- [Vendor-Specific Inventory and IMOs, page 11-7](#)
- [Service Alarms, page 11-7](#)

For information on network topology, see [Chapter 38, “Cisco ANA VNE Topology.”](#)

## Technology Description

This section provides the following IP technology descriptions:

- [BGP](#)
- [MP-BGP](#)
- [OSPF](#)
- [IS-IS](#)

Please see Part 1: Cisco VNEs in this guide for information about which devices support the various technologies.

## BGP

The Border Gateway Protocol (BGP) routes traffic between autonomous systems. An autonomous system is a network or group of networks under common administration and with common routing policies. BGP exchanges routing information for the Internet and is the protocol used between ISPs. Customer networks, such as universities and corporations, usually employ an Interior Gateway Protocol (IGP), such as RIP or OSPF, to exchange routing information within their networks. Customers connect to ISPs, and ISPs use BGP to exchange customer and ISP routes. When BGP is used between autonomous systems, the protocol is referred to as external BGP (eBGP). If a service provider is using BGP to exchange routes within an autonomous system, the protocol is referred to as interior BGP (iBGP).

BGP is a very robust and scalable routing protocol, as evidenced by the fact that it is the routing protocol employed on the Internet. To achieve scalability at this level, BGP uses many route parameters, called attributes, to define routing policies and maintain a stable routing environment. BGP neighbors exchange full routing information when the TCP connection between neighbors is first established. When changes

to the routing table are detected, the BGP routers send to their neighbors only those routes that have changed. BGP routers do not send periodic routing updates, and BGP routing updates advertise only the optimal path to a destination network.

## MP-BGP

Multiprotocol BGP (MP-BGP) adds capabilities to BGP to enable multicast routing policy throughout the Internet and to connect multicast topologies within and between BGP autonomous systems. That is, MP-BGP is an enhanced BGP that carries IP multicast routes. BGP carries two sets of routes, one set for unicast routing and one set for multicast routing. The routes associated with multicast routing are used by the Protocol Independent Multicast (PIM) to build data distribution trees.

## eBGP/iBGP

As noted previously, BGP is an inter-autonomous system routing protocol. When BGP is used between autonomous systems (AS), the protocol is referred to as external BGP (eBGP). If a service provider is using BGP to exchange routes within an AS, then the protocol is referred to as interior BGP (iBGP).

## OSPF

Open Shortest Path First (OSPF) is a routing protocol developed for IP networks by the IGP working group of the Internet Engineering Task Force (IETF). It was derived from several research efforts, including a version of OSI's IS-IS routing protocol.

OSPF has two primary characteristics:

- It is an open protocol. Its specification is in the public domain (RFC 1247).
- It is based on the Shortest Path First (SPF) algorithm, sometimes known as the Dijkstra algorithm.

OSPF is a link-state routing protocol that calls for the sending of link-state advertisements (LSAs) to all other routers within the same hierarchical area. Information on attached interfaces, metrics used, and other variables are included in OSPF LSAs. As OSPF routers accumulate link-state information, they use the SPF algorithm to calculate the shortest path to each node.

In addition to OSPF versions 1 and 2, Cisco ANA 3.7.2 supports OSPF version 3 which includes IPv6 feature implementation support.

## IS-IS

Intermediate System to Intermediate System (IS-IS) is an OSI link-state hierarchical routing protocol that floods the network with link-state information to build a complete, consistent picture of a network topology. IS-IS distinguishes between Level 1 and Level 2 ISs. Level 1 ISs communicate with other Level 1 ISs in the same area. Level 2 ISs route between Level 1 areas and form an intradomain routing backbone.

# Information Model Objects (IMOs)

This section describes the following IMOs:

- [BGP Neighbor Entry \(IBgpNeighbourEntry\)](#)
- [OSPF Process \(IOspfProcess\)](#)
- [OSPF Neighbor \(IOspfNeighbor\)](#)
- [OSPF Interface \(IOspfInterface\)](#)
- [SPF Timers \(ISpfTimers\)](#)
- [ISIS Process \(IISISProcess\)](#)
- [ISIS Metric \(IISISMetric\)](#)
- [ISIS Interface \(IISISInterface\)](#)
- [ISIS Neighbor \(IISISNeighbor\)](#)

## BGP Neighbor Entry

The [BGP Neighbor Entry](#) IMO represents both the configuration and the outcome of running the Border Gateway Protocol (BGP) within a group of participating routers in a BGP neighborhood. It contains information about the connection with a remote BGP peer. It is the entry of the BGP Neighbors Table attribute of the [Multi Protocol BGP Entity](#) object (see [VPN and VRF](#)), representing the BGP routing service concept in the IMO.

**Table 11-1** *BGP Neighbor Entry (IBgpNeighbourEntry)*

| Attribute Name              | Attribute Description                                                               | Scheme | Polling Interval |
|-----------------------------|-------------------------------------------------------------------------------------|--------|------------------|
| Remote Identifier           | Identifier of the remote peer ( <i>IP Address</i> )                                 | Any    | Configuration    |
| Neighbor Type               | Neighbor type ( <i>Null, Client, Non Client</i> )                                   | Any    | Configuration    |
| Distributing Interface      | Distributing IP interface                                                           | Any    | Configuration    |
| Remote Address              | Remote peer IP address                                                              | Any    | Configuration    |
| Remote Autonomous System    | Remote peer autonomous system                                                       | Any    | Configuration    |
| Status                      | Status ( <i>Null, Idle, Connect, Active, Open Sent, Open Confirm, Established</i> ) | Any    | Configuration    |
| Hold Time                   | Established hold time in seconds                                                    | Any    | Configuration    |
| Keep Alive Time             | Established keepalive time in seconds                                               | Any    | Configuration    |
| Peer Autonomous System (AS) | The AS to which the peer belongs.                                                   | Any    | Configuration    |

## OSPF Process

The [OSPF Process](#) IMO contains identifying information for the OSPF process and the router on which it is configured.

**Table 11-2** *OSPF Process (IOspfProcess)*

| Attribute Name | Attribute Description                      | Scheme | Polling Interval |
|----------------|--------------------------------------------|--------|------------------|
| Process ID     | Unique process identifier.                 | Any    | Configuration    |
| OSPF Version   | The OSPF version (v1, v2 or v3)            | Any    | Configuration    |
| Router ID      | The IP address of the OSPF process router. | Any    | Configuration    |

## OSPF Neighbor

The [OSPF Neighbor](#) IMO contains information about the OSPF neighboring router.

**Table 11-3** *OSPF Neighbor (IOspfNeighbor)*

| Attribute Name             | Attribute Description                                                                                                                                                                                   | Scheme | Polling Interval |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------|
| Neighbor ID                | IP Address that represents the OSPF Router ID of the neighboring router. The Neighbor ID is learned when Hello packets are received from the neighbor, or is configured if this is a virtual adjacency. | Any    | Configuration    |
| Outgoing Interface         | Identifier of the OSPF Interface through which the neighbor is known.                                                                                                                                   | Any    | Configuration    |
| Neighbor State             | The state of a conversation being held with a neighboring router ( <i>down, attempt, init, 1-way, 2-way, exstart, exchange, loading, removed and full.</i> )                                            | Any    | Configuration    |
| Neighbor Interface Address | IP Address of the neighbor's OSPF interface.                                                                                                                                                            | Any    | Configuration    |
| Area ID                    | The ID of the network segment to which the neighbor belongs.                                                                                                                                            | Any    | Configuration    |

## OSPF Interface

The [OSPF Interface](#) IMO represents the connection between the OSPF router and the attached network.

**Table 11-4** *OSPF Interface (IOspfInterface)*

| Attribute Name    | Attribute Description                                                                                                                                                                                                                                                                                                            | Scheme | Polling Interval |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------|
| Area ID           | The Area ID of the area to which the attached network belongs. All routing protocol packets originating from the interface are labelled with this Area ID.                                                                                                                                                                       | Any    | Configuration    |
| Network Type      | The OSPF interface type (point-to-point, broadcast, NBMA, or virtual link.)                                                                                                                                                                                                                                                      | Any    | Configuration    |
| Cost              | The cost of sending a data packet on the interface, expressed in the link state metric.                                                                                                                                                                                                                                          | Any    | Configuration    |
| State             | The functional level of an interface (down, loopback, waiting, point-to-point, DR other, backup, DR). State determines whether or not full adjacencies are allowed to form over the interface.                                                                                                                                   | Any    | Configuration    |
| Interface Address | The IP address of the interface used by the OSPF process.                                                                                                                                                                                                                                                                        | Any    | Configuration    |
| Interface Name    | The name of the interface used by the OSPF process.                                                                                                                                                                                                                                                                              | Any    | Configuration    |
| Network Type      | The type of network to which the OSPF interface belongs.                                                                                                                                                                                                                                                                         | Any    | Configuration    |
| IF Priority       | An 8-bit unsigned integer representing the priority of the router. When two routers attached to a network both attempt to become designated router, the one with the highest router priority takes precedence. A router whose router priority is set to 0 is ineligible to become the designated router on the attached network. | Any    | Configuration    |
| DR ID             | The router ID of the designated router that advertises link state for the network.                                                                                                                                                                                                                                               | Any    | Configuration    |
| BDR ID            | The router ID of the backup designated router that becomes the designated router upon failure of the current designated router.                                                                                                                                                                                                  | Any    | Configuration    |

## SPF Timers

The [SPF Timers](#) IMO contains parameters that control OSPF shortest path first (SPF) throttling.

**Table 11-5** *SPF Timers (ISpfTimers)*

| Attribute Name | Attribute Description                                                         | Scheme  | Polling Interval |
|----------------|-------------------------------------------------------------------------------|---------|------------------|
| Schedule Delay | Initial delay to schedule an SFP calculation after a change, in milliseconds. | Product | Configuration    |
| Min Hold Time  | Minimum hold time between two consecutive SPF calculations, in milliseconds.  | Product | Configuration    |
| Max Wait Time  | Maximum wait time between two consecutive SPF calculations, in milliseconds.  | Product | Configuration    |

## IS-IS Process

The [IS-IS Process](#) IMO contains identifying information for the IS-IS process and the router on which it is configured.

The tag (process ID) can be used to identify multiple IS-IS processes by providing a meaningful name for a routing process. This name must be unique among all IP router processes for a given router. If the tag is not specified, the process is referenced with a null tag.

**Table 11-6** *ISIS Process (IISISProcess)*

| Attribute Name      | Attribute Description                                                                                                         | Scheme | Polling Interval |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------|--------|------------------|
| ISIS Interface      | The interfaces running the IS-IS protocol.                                                                                    | IpCore | Configuration    |
| ISIS Metric         | Metric used for the redistributed route.                                                                                      | IpCore | Configuration    |
| ISIS Neighbor       | The routers with which this router has IS-IS adjacencies.                                                                     | IpCore | Configuration    |
| Manual Area Address | The ID of the IS-IS area to which the router belongs.                                                                         | IpCore | Configuration    |
| IS Type             | The type of the IS ( <i>Level 1, Level 2 or Level 1 and 2</i> ).                                                              | IpCore | Configuration    |
| System ID           | The system ID of the router.                                                                                                  | IpCore | Configuration    |
| Process ID          | The area tag of the IS-IS instance. When there are multiple IS-IS areas, the area tag is used to identify the IS-IS instance. | IpCore | Configuration    |

## ISIS Metric

The [ISIS Metric](#) IMO represents the metric used for the redistributed route. This is a number in the range 0-63 if the router is configured with the metric-style narrow command or a number in the range 0 - 16777215 if the router is configured with the metric-style transition or metric-style wide command. Default value is 10.

**Table 11-7** *ISIS Metric (IISISMetric)*

| Attribute Name | Attribute Description                                                                           | Scheme | Polling Interval |
|----------------|-------------------------------------------------------------------------------------------------|--------|------------------|
| IS Type        | Level at which the Intermediate System is running ( <i>Level 1, Level 2 or Level 1 and 2</i> ). | IpCore | Configuration    |
| Metric Style   | The type of metric ( <i>Narrow, Transient, Wide</i> ).                                          | IpCore | Configuration    |
| Metric Value   | The value of the metric.                                                                        | IpCore | Configuration    |
| Address Family | The IP address type ( <i>IPv4, IPv6</i> ).                                                      | IpCore | Configuration    |

## ISIS Interface

The [ISIS Interface](#) IMO represents the interfaces on which the IS-IS is configured.

**Table 11-8** *ISIS Interface (IISISInterface)*

| Attribute Name | Attribute Description                           | Scheme | Polling Interval |
|----------------|-------------------------------------------------|--------|------------------|
| Interface Name | The interface name of the neighbor.             | IpCore | Configuration    |
| Interface OID  | The interface on which the IS-IS is configured. | IpCore | Configuration    |

## ISIS Neighbor

The [ISIS Neighbor](#) IMO represents the routers with which this router has IS-IS adjacencies.

**Table 11-9** *ISIS Neighbor (IISISNeighbor)*

| Attribute Name | Attribute Description                                                                                                                      | Scheme | Polling Interval |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------|--------|------------------|
| IS Type        | The IS type of the neighbor ( <i>Level 1, Level 2 or Level 1 and 2</i> ).                                                                  | IpCore | Configuration    |
| System ID      | The identifier for the neighbor system.                                                                                                    | IpCore | Configuration    |
| Admin State    | The state of the neighbor ( <i>up, down</i> ).                                                                                             | IpCore | Configuration    |
| Hold Time      | Holding time, in seconds, for this adjacency. The value is based on received IS-to-IS Hello (IIH) PDUs and the elapsed time since receipt. | IpCore | Configuration    |
| SNPA           | Subnetwork point of attachment (SNPA) for the neighbor.                                                                                    | IpCore | Configuration    |
| Interface Name | The interface name of the neighbor.                                                                                                        | IpCore | Configuration    |
| IP Address     | The IP address of the neighbor.                                                                                                            | IpCore | Configuration    |
| Address Family | The IP address type (IPv4, IPv6).                                                                                                          | IpCore | Configuration    |

## Vendor-Specific Inventory and IMOs

There are no vendor-specific inventory or IMOs for this technology.

## Service Alarms

The following alarms are supported for this technology:

- [BGP Neighbor Loss](#), page 41-9
- [BGP Process Down](#), page 41-10
- [BGP Link Down](#), page 41-7
- [OSPF Neighbor State Change](#), page 41-51

