CHAPTER 11

Routing Protocols

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

Technology Description

This section provides the following IP technology descriptions:

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 3.7.1 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 (*IP Address*)	Any	Configuration
Neighbor Type	Neighbor type (*Null, Client, Non Client)*	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 (*Null, Idle, Connect, Active, Open Sent, Open Confirm, Established*)	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 (*down, attempt, init, 1-way, 2-way, exstart, exchange, loading, removed and full*.)	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 (*Level 1, Level 2 or Level 1 and 2*).	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 (*Level 1, Level 2 or Level 1 and 2*).	IPCore	Configuration
Metric Style	The type of metric (*Narrow, Transient, Wide*).	IPCore	Configuration
Metric Value	The value of the metric.	IPCore	Configuration
Address Family	The IP address type (*IPv4, IPv6*).	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 (*Level 1, Level 2 or Level 1 and 2*).	IPCore	Configuration
System ID	The identifier for the neighbor system.	IPCore	Configuration
Admin State	The state of the neighbor (*up, down*).	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.

Network Topology

Please see Chapter 38, “Cisco ANA VNE Topology”.

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