CHAPTER 2

Internet Protocol "IP"

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

Technology Description

IP

The Internet Protocol (IP) is a network layer (Layer 3) protocol that contains addressing information and some control information that enables packets to be routed. IP is documented in RFC 791 and is the primary network layer protocol in the Internet protocol suite. Along with the Transmission Control Protocol (TCP), IP represents the heart of the Internet protocols. IP has two primary responsibilities: providing connectionless, best-effort delivery of datagrams through an inter-network; and providing fragmentation and reassembly of data-grams to support data links with different Maximum Transmission Unit (MTU) sizes.

ARP

Address Resolution Protocol (ARP) is a protocol for mapping an Internet Protocol address (IP address) to a physical machine address, known as a Media Access Control or MAC address that is recognized in the local network. For example, in IP Version 4, the most common level of IP in use today, an address is 32 bits long. In an Ethernet local area network, however, addresses for attached devices are 48 bits long. A table, usually called the ARP cache, is used to maintain a correlation between each MAC address and its corresponding IP address. ARP provides the protocol rules for making this correlation and providing address conversion in both directions.

HSRP

Hot Standby Router Protocol (HSRP) is a routing protocol that provides automatic router backup by allowing host computers on the Internet to use multiple routers that act as a single virtual router, maintaining connectivity even if the first hop router fails, because other routers are on hot standby and ready to go. The protocol is fully compatible with Novell's Internetwork Packet Exchange (IPX), AppleTalk, and Banyan VINES, and (in some configurations) with Xerox Network Systems (XNS) and DECnet.

Developed by Cisco and specified in RFC 2281, HSRP ensures that only a single router (called the active router) is forwarding packets on behalf of the virtual router at any given time. A standby router is chosen to be ready to become the active router, in the event that the current active router fails. HSRP defines a mechanism used to determine active and standby routers by referring to their IP addresses. Once these are determined, the failure of an active router will not cause any significant interruption of connectivity.

On any given LAN, there may be multiple, possibly overlapping, hot standby groups, each with a single Media Access Control (MAC) address and IP address; the IP address should belong to the primary subnet, but must be different from any actual or virtual addresses allocated to any routers or hosts on the network.

GRE

Generic Routing Encapsulation (GRE) is a tunneling protocol, originated by Cisco Systems and standardized in RFC 2784. It was designed to encapsulate a wide variety of network layer packets inside IP tunneling packets. The original packet is the payload for the final packet. The protocol is used on the Internet to secure virtual private networks.

Inventory and Information Model Objects (IMOs)

This section includes the following tables:

IP Interface

The following network layer IP Interface object, which represents the IP level functionality of an interface configuration in a network element, is primarily bound by its Containing Termination Points attribute to a Data Link Layer Interface object, and is primarily accessed by a Routing Entity.

Table 2-1 IP Interface (IIPInterface)

Attribute Name	Attribute Description
IP Address	Primary IP address
Subnetwork Mask	Primary IP subnetwork mask
IP Interface Addresses	Array of all IP Interface Addresses
Interface Name	Interface name
Interface Description	Interface description
IP Interface State	IP interface state (*Unknown, Up, Down*)
OSPF Interface Cost	2x10^9/<interface speed in BPS>
MTU	Maximum transmit units
Lookup Method	Lookup method (*Route Table First*, *Host Table First*)
Address Resolution Type	Address resolution type/s
ARP Timeout	ARP table entry aging timeout
Secured ARP	Secured ARP settings (*Enable*, *Disable*)
ICMP Mask Reply	Control message mask reply
IGMP Proxy	Group management proxy
HSRP Groups	Arrays of Hot Standby Router Protocol (HSRP) Group Entry (valid only for Cisco routers that implement HSRP)
IP Multiplexing Table	Array of IP Multiplexing Entries
IANA Type	IANA type of the sub/layer
Containing Termination Points	Underlying termination points (connection or physical)
Contained Connection Termination Points	Bound Connection Termination Points

IP Multiplexer Entry

The following IP Multiplexer Entry object, of the IP Multiplexing Table of an IP Interface object, is used when an IP Interface is bound to multiple Virtual Connection based Data Link layer interfaces such as ATM Interface and Frame Relay Interface in order to map a Destination IP Subnet with a specific Virtual Connection.

Table 2-2 IP Multiplexer Entry (IIPMuxEntry)

Attribute Name	Attribute Description
Termination Point	Virtual data link layer encapsulation
Destination IP Subnet	Destination IP subnet

IP Interface Address

The following IP Interface Address object describes one of possible multiple IP Addresses along with their Subnetwork Masks assigned to an IP Interface, using an IP Subnetwork object, and whether it is the Primary or a Secondary one.

Table 2-3 IP Interface Address (IIPInterfaceAddress)

Attribute Name	Attribute Description
Type	IP address type (*Primary*, *Secondary*)
IP Subnet	IP subnetwork

IP Subnetwork

The following IP Subnetwork type (not an IMO object) describes an IP Subnetwork Address (with the host part being zeroed) or alternatively a Host IP Address along with the IP Subnetwork Mask.

Table 2-4 IP Subnetwork (IPSubnet)

Attribute Name	Attribute Description
IP Address	IP address
Subnetwork Mask	IP subnetwork mask

Routing Entity

The following Routing Entity object describes the routing and address resolution protocols independent forwarding component of an IP router, which is bound by its Logical Sons attribute to all Network layer IP Interface objects, which IP Packets are being routed between, by this Routing Entity.

Table 2-5 Routing Entity (IRoutingEntity)

Attribute Name	Attribute Description
Routing Table	Array of Equivalent (Shared Destination) Routing Entries
ARP Entity	Address resolution entity (ARP Entity)
Routing Table Changes	Routing table changes count
Name	Routing entity name
Logical Sons	Array of all IP Interfaces which IP packets are being routed between, by this Routing Entity

Equivalent Routing Entry

The following Equivalent Routing Entry and Routing Entry objects describe a routing table's entries, each as an array of routing entries sharing a single IP Subnetwork destination. Based on their protocol type some of the device's routing table's entries, which are not relevant to the IMO model, may not be presented in this table structure.

Table 2-6 Equivalent Routing Entry (IRoutingEntries)

Attribute Name	Attribute Description
Routing Entries	Array of Routing Entries (sharing a single destination)

Routing Entry

Table 2-7 Routing Entry (IRoutingEntry)

Attribute Name	Attribute Description
Destination IP Subnet	Final destination IP subnet
Next Hop IP Address	Next hop IP address
Type	Route entry type (*Null*, *Other*, *Invalid*, *Direct*, *Indirect*, *Static*)
Routing Protocol Type	Routing protocol type (*Null, Other, "Local, Network Managed, ICMP, EGP, GGP, Hello, RIP, IS-IS, ES-IS, Cisco IGRP, BBN SPF IGP, OSPF, BGP, EIGRP*)
Outgoing Interface Name	Outgoing IP interface name

ARP Entity

The following ARP Entity object describes a routing domain wide Internet Protocol (IP) address to Media Access Control (MAC) Address Resolution Protocol Entity.

Table 2-8 ARP Entity (IARPEntity)

Attribute Name	Attribute Description
ARP Table	Array of ARP Entries

ARP Entry

The following ARP Entry object describes a routing domain wide Internet Protocol (IP) address to Media Access Control (MAC) Address Resolution Protocol Table's Entry.

Table 2-9 ARP Entry (IARPEntry)

Attribute Name	Attribute Description
IP Address	Internet Protocol (IP) address
MAC Address	Media Access Control (MAC) address

Table 2-9 ARP Entry (IARPEntry) (continued)

Attribute Name	Attribute Description
Port	Data link layer (MAC) interface
Entry Type	ARP entry type (*Null, Other, Invalid, Dynamic, Static*)

IP Address Pool

The following IP Address Pool with its IP Range Based Address Pool Entry and IP Subnet Based Address Pool Entry objects describe an IP Address Pool of a Gateway/Router device for distribution to local and remote parties by protocols such as DHCP and IPCP.

Table 2-10 IP Address Pool (IIPPool)

Attribute Name	Attribute Description
IP Address Pool Entries	Array of IP Range Based Address Pool Entries or IP Subnet Based Address Pool Entries
Name	IP addresses pool name
Index	IP addresses pool index

IP Range Based Address Pool Entry

Table 2-11 IP Range Based Address Pool Entry (IIPRangeBasedIPPoolEntry)

Attribute Name	Attribute Description
Start IP Address	Start IP address of the IP address pool
End IP Address	End IP address of the IP address pool
Unused Addresses	Unused addresses count
Used Addresses	Used addresses count
Reserved Addresses	Reserved addresses count

IP Subnet Based Address Pool Entry

Table 2-12 IP Subnet Based Address Pool Entry (IIPSubnetBasedIPPoolEntry)

Attribute Name	Attribute Description
IP Subnet	IP Subnetwork of the IP address pool
Unused Addresses	Unused addresses count
Used Addresses	Used addresses count
Reserved Addresses	Reserved addresses count

Hot Standby Router Protocol (HSRP) Group Entry

The following Cisco Specific Hot Standby Router Protocol (HSRP) Group Entry object, describes both the configuration and the outcome information of running this protocol within a group (two) of routers, connected to the same segment of Ethernet networks for providing backup to a router in the event of failure, by presenting an appearance of a single **virtual router** with a single set of IP and MAC addresses on that **Local Area Network (LAN)**.

Table 2-13 Hot Standby Router Protocol (HSRP) Group Entry (IHSRPGroupEntry)

Attribute Name	Attribute Description
Group Number	Group number
Port Description	Port description
Priority	Priority from *0* (*Lowest*) to *255* (*Highest*) used for active router selection
Coupled Router	Coupled active or standby router IP address (as the group is implemented by only two routers)
State	Protocol state (*Disabled, Initial, Learn, Listen, Speak, Standby, Active*)
Virtual IP Address	Virtual IP address used by this group
Virtual MAC Address	Virtual MAC address used by this group

Generic Routing Encapsulation (GRE) Tunnel Interface

The following network layer Generic Routing Encapsulation (GRE) Tunnel Interface object, which represents a GRE Tunnel interface configuration in a network element, is primarily accessed by an IP Interface bound by its Contained Connection Termination Points attribute.

Table 2-14 Generic Routing Encapsulation (GRE) Tunnel Interface (ITunnelGRE)

Attribute Name	Attribute Description
Name	Tunnel name
Tunnel Destination and Source	Tunnel destination and source IP addresses
IP Address	Primary IP address
IP Interface State	IP interface state (*Unknown, Up, Down*)
IANA Type	IANA type of the sub/layer
Containing Termination Points	Underlying termination points (connection or physical)
Contained Connection Termination Points	Bound Connection Termination Points

Network Topology

The discovery of the Internet Protocol (IP) network layer is unsupported.

However, IP addresses and subnets are used for signature/test for the underlying **MPLS** and **PPP** layers topology discovery by searching for the existence of the local IP Address in any one hop away remote side's routing table. For more information see Chapter 12, "Multiprotocol Label Switching "MPLS"" and Chapter 8, "Point-to-Point Protocol "PPP" and High Level Data Link Control "HDLC"".

In particular, a comparison is made between the local and remote IP Addresses of IP Interfaces found under the same subnet.

Service Alarms

The following alarms are supported for this technology:

- All IP Interfaces Down/IP Interface Up
- GRE Tunnel Down/GRE Tunnel Up
- IP Interface Down/IP Interface Up
- HSRP Group Member Not Active/HSRP Group Member Active

Note For a detailed description of these alarms and for information about correlation see the *Cisco Active Network Abstraction Fault Management User Guide, 3.6.*