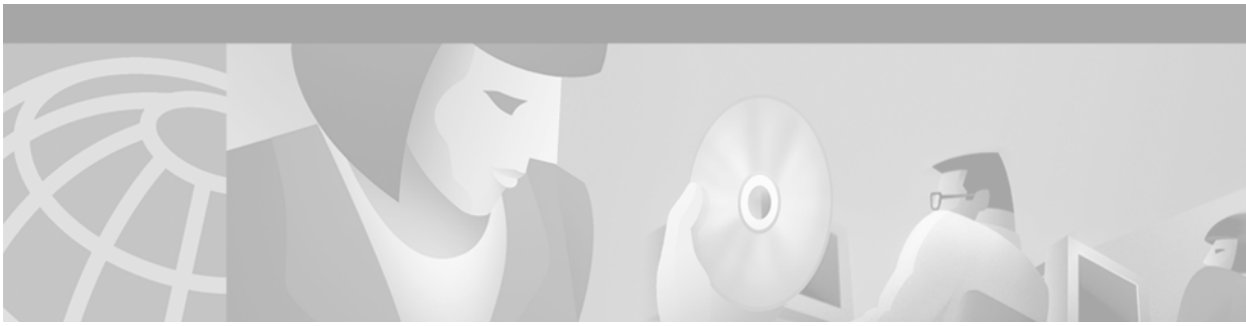

IP Overview

The Internet Protocol (IP) is a packet-based protocol used to exchange data over computer networks. IP handles addressing, fragmentation, reassembly, and protocol demultiplexing. It is the foundation on which all other IP protocols (collectively referred to as the IP Protocol suite) are built. A network-layer protocol, IP contains addressing and control information that allows data packets to be routed.

The Transmission Control Protocol (TCP) is built upon the IP layer. TCP is a connection-oriented protocol that specifies the format of data and acknowledgments used in the transfer of data. TCP also specifies the procedures that the networking devices use to ensure that the data arrives correctly. TCP allows multiple applications on a system to communicate concurrently because it handles all demultiplexing of the incoming traffic among the application programs.

The Cisco implementation of IP provides most of the major services contained in the various protocol specifications. Cisco IOS software also provides the TCP and User Datagram Protocol (UDP) services called Echo and Discard, which are described in RFCs 862 and 863, respectively.

Cisco supports both TCP and UDP at the transport layer, for maximum flexibility in services. Cisco also supports all standards for IP broadcasts.

This overview chapter provides a high-level description of IP. For configuration information, see the appropriate chapter in this publication.

The *Cisco IOS IP Configuration Guide* has the following three parts:

- IP Addressing and Services
- IP Routing Protocols
- IP Multicast

For information on other network protocols, refer to the *Cisco IOS AppleTalk and Novell IPX Configuration Guide* and *Cisco IOS Apollo Domain, Banyan VINES, DECnet, ISO CLNS, and XNS Configuration Guide*.

IP Addressing and Services

IP addressing features such as Address Resolution Protocol (ARP), Next Hop Resolution Protocol (NHRP), and Network Address Translation (NAT) are described in the “Configuring IP Addressing” chapter. Dynamic Host Configuration Protocol (DHCP) is described in the “Configuring DHCP” chapter.

IP services such as IP access lists, Internet Control Message Protocol (ICMP), Hot Standby Router Protocol (HSRP), IP accounting, performance parameters, and MultiNode Balancing (MNLB) Forwarding Agent are described in the “Configuring IP Services” chapter.

Server load balancing allows a network administrator to define a virtual server to represent a group of real servers. For more information on this feature, see the "Configuring Server Load Balancing" chapter.

Mobile IP, which allows users to roam and maintain connectivity beyond their home subnet while consistently maintaining their IP address, is described in the "Configuring Mobile IP" chapter.

IP Routing Protocols

The Cisco implementation of each IP routing protocol is discussed at the beginning of the individual protocol chapters in this publication.

With any of the IP routing protocols, you must create the routing process, associate networks with the routing process, and customize the routing protocol for your particular network. You will need to perform some combination of the tasks in the respective chapters to configure one or more IP routing protocols.

Determining a Routing Process

Choosing a routing protocol is a complex task. When choosing a routing protocol, consider at least the following factors:

- Internetwork size and complexity
- Support for variable-length subnet masks (VLSMs). Enhanced Interior Gateway Routing Protocol (Enhanced IGRP), Intermediate System-to-Intermediate System (IS-IS), static routes, and Open Shortest Path First (OSPF) support VLSMs.
- Internetwork traffic levels
- Security needs
- Reliability needs
- Internetwork delay characteristics
- Organizational policies
- Organizational acceptance of change

The chapters in this publication describe the configuration tasks associated with each supported routing protocol or service. This publication does not provide in-depth information on how to choose routing protocols; you must choose routing protocols that best suit your needs.

Interior and Exterior Gateway Protocols

IP routing protocols are divided into two classes: Interior Gateway Protocols (IGPs) and Exterior Gateway Protocols (EGPs). The IGPs and EGPs that Cisco supports are listed in the following sections:

- Interior Gateway Protocols
- Exterior Gateway Protocols

Note Many routing protocol specifications refer to routers as *gateways*, so the word *gateway* often appears as part of routing protocol names. However, a router usually is defined as a Layer 3 internetworking device, whereas a protocol translation gateway usually is defined as a Layer 7 internetworking device. The reader should understand that regardless of whether a routing protocol name contains the word "gateway," routing protocol activities occur at Layer 3 of the Open System Interconnection (OSI) reference model.

Interior Gateway Protocols

Interior gateway protocols are used for routing networks that are under a common network administration. All IP interior gateway protocols must be specified with a list of associated networks before routing activities can begin. A routing process "listens" to updates from other routers on these networks and broadcasts its own routing information on those same networks. Cisco IOS software supports the following interior routing protocols:

- On-Demand Routing (ODR)
- Routing Information Protocol (RIP)
- Interior Gateway Routing Protocol (IGRP)
- Open Shortest Path First (OSPF)
- Enhanced IGRP (EIGRP)
- Integrated IS-IS

Exterior Gateway Protocols

Exterior gateway protocols are used to exchange routing information between networks that do not share a common administration. IP Exterior Gateway Protocols require the following three sets of information before routing can begin:

- A list of neighbor (or peer) routers with which to exchange routing information
- A list of networks to advertise as directly reachable
- The autonomous system number of the local router

The exterior gateway protocol that is supported by Cisco IOS software is Border Gateway Protocol (BGP).

Multiprotocol BGP is an enhanced BGP that carries routing information for multiple network-layer protocols and 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 Protocol Independent Multicast (PIM) to build data distribution trees.

Multiple Routing Protocols

You can configure multiple routing protocols in a single router to connect networks that use different routing protocols. You can, for example, run RIP on one subnetted network and IGRP on another subnetted network, and exchange routing information between them in a controlled fashion. The available routing protocols were not designed to interoperate, so each protocol collects different types of information and reacts to topology changes in its own way.

For example, RIP uses a hop-count metric and IGRP uses a five-element vector of metric information. If routing information is being exchanged between different networks that use different routing protocols, you can use many configuration options to filter the exchange of routing information.

The Cisco IOS software can handle simultaneous operation of up to 30 dynamic IP routing processes. The combination of routing processes on a router consists of the following protocols (with the limits noted):

- Up to 30 IGRP routing processes
- Up to 30 EIGRP routing processes
- Up to 30 OSPF routing processes
- One RIP routing process
- One IS-IS process
- One BGP routing process

IP Multicast

IP multicast routing provides an alternative to unicast and broadcast transmission. It allows a host to send packets to a subset of all hosts, known as *group transmission*. IP multicast runs on top of the other IP routing protocols.

In addition to IP multicast routing itself, other multicast features are available, each discussed in a separate chapter, as follows:

- Source Specific Multicast (SSM) is an extension of IP multicast where datagram traffic is forwarded to receivers from only those multicast sources to which the receivers have explicitly joined.
- Bidirectional PIM is a variant of the PIM suite of routing protocols for IP multicast. In bidirectional mode, datagram traffic is routed only along a bidirectional shared tree that is rooted at the rendezvous point (RP) for the multicast group.
- Multicast Source Discovery Protocol (MSDP) is a mechanism for the router to discover multicast sources in other PIM domains.
- Pragmatic General Multicast (PGM) is a reliable multicast transport protocol for applications that require ordered, duplicate-free, multicast data delivery from multiple sources to multiple receivers. The PGM Host feature is the Cisco implementation of the transport layer of the PGM protocol, and the PGM Router Assist feature is the Cisco implementation of the network layer of the PGM protocol.
- Unidirectional link routing (UDLR) provides a way to forward multicast packets over a physical unidirectional interface, such as a satellite link.
- The Multicast Routing Monitor (MRM) feature is a management diagnostic tool that provides network fault detection and isolation in a large multicast routing infrastructure. This feature is described in the “Using IP Multicast Tools” chapter.
- Router-Port Group Management Protocol (RGMP) is a Layer 2 protocol that enables a router to communicate to a switch (or a networking device that is functioning as a Layer 2 switch) the multicast group for which the router would like to receive or forward traffic.