Chapter 1
Cisco Product Line Overview

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This chapter introduces Cisco's product line and provides the following information:

- Cisco's internetworking philosophy
- Terminology and examples of network configuration
- Media and protocols supported by Cisco routers
- Management and security software features
- Hardware configurations and connection options

Internetworking and Cisco

Cisco Systems designs and produces communications products to build multiprotocol, multimedia, multivendor networks. With Cisco Systems products, network managers can interconnect terminals, workstations, computer systems, and different networks to create networks of networks.

Products from Cisco Systems solve the problems of complex internetworks by supporting multiprotocol, multimedia, multivendor networks. Even organizations that do not yet require a complex wide area network (WAN) can connect existing equipment with Cisco Systems products to form a network of any size. With Cisco Systems products, network growth plans need not depend on a single topology, protocol, transmission medium, or vendor.

The key device for building a trouble-free WAN is a Cisco Systems network server. A Cisco Systems network server is a dynamic router that provides a wide variety of network management capabilities in addition to the multiprotocol, multimedia, multivendor internetworking already described.

Just as in interconnecting local area networks (LANs), Cisco Systems network servers help build WANs that achieve the interoperability and connectivity large organizations need. Network servers from Cisco Systems support computers and networking equipment from all vendors, using all available media and virtually any protocol.

A WAN that uses Cisco Systems network servers is both more cost-effective and more efficient. Cisco Systems network servers help organizations take advantage of all their existing computers and networking equipment. The dynamic routing of the network servers ensures that network traffic reaches the intended addresses promptly, regardless of different protocols, equipment from different vendors, and ongoing network configuration changes.

Terminology

A WAN interconnects LANs, host computers, and public and private networks into a communications network that spans a large geographic area. After organizations have become accustomed to the benefits of LANs, they often want to extend their networking capabilities by internetworking different LANs or connecting remote sites to large networks.

An organization may already own hundreds of microcomputers and mainframes manufactured by different vendors, as well as several different kinds of LANs such as Ethernet and Token Ring. Depending on its networking needs, the organization may consider using the following devices to extend its network:

- Terminal servers connect terminals, modems, and microcomputers over serial lines to LANs or WANs. They provide network access to terminals, printers, and computers that have no built-in network support.
- Repeaters connect two network segments that use the same medium, simply regenerating the transmission signal between them. Repeaters protect each network segment from electrical failures of other segments. However, repeaters cannot protect the network from data-related errors.
- Bridges connect two network segments that use the same medium. Bridges protect the resulting network from electrical problems and data-related errors, but not from problems related to higher-level protocols.
- Routers can interconnect networks over longer distances and over certain different media. Because routers support hierarchical network structures, they offer protection from network errors as well as electrical and data-related problems.
- The term *gateway* originally referred to an IP routing device, and was used as part of the naming schemes in early Cisco products. You will find the term gateway used as part of the Cisco software (for example, the Interior Gateway Routing Protocol); however, throughout this manual, we use the term *router* to refer to the device configured for routing, and the term *router/bridge* to refer to the device configured for bridging. The term *network server* refers to Cisco's full line of routing and bridging devices.

Capabilities of the Router

Complex internetworks have grown past the point where they can depend on equipment from a single vendor. Virtually all organizations connecting LANs and creating WANs today have major commitments to hardware and software from many different vendors. Therefore, current and future internetworking requires products that support multiprotocol, multimedia, and multivendor networks.

Routers from Cisco Systems help LANs and WANs achieve interoperability and connectivity. They operate with equipment from all vendors over most available media. This section describes Cisco-supported protocols and media, as well as the capabilities of Cisco Systems routers for routing, network management, and network security.

Support for Multiple Protocols

Large organizations need the flexibility that multiprotocol networks give them to communicate with diverse hardware and software from many vendors. Cisco Systems routers support many networking protocols, as well as several specific routing protocols for compatibility with other networks. Included are protocols based on open standards and proprietary protocols from a variety of vendors.

One Cisco Systems router can forward packets concurrently from any combination of the following networking protocols:

- TCP/IP protocols, the most widely implemented protocol suite on networks of all media types. TCP/IP is today's standard for internetworking, and is supported by most computer vendors, including all UNIX-based workstation manufacturers.
- DECnet Phase IV protocol, Digital Equipment's proprietary networking protocol used on DECnet.
- XNS (Xerox Network Service) protocol, used by Xerox, 3COM, and other XNS vendors.
- Novell IPX, Novell's "External Bridge" protocol (Novell refers to their router functionality as *bridging*).
- Ungermann-Bass protocol, used by Ungermann-Bass routing products and other vendors of these routing products.
- AppleTalk (Phase 1 and Phase 2) protocol, Apple Computer's multiprotocol internetwork product.
- ISO Connectionless Network Services (CLNS) routing protocol, as defined by ISO documents 8473, Connectionless Network Protocol (CLNP), and 9542, End System-Intermediate System (ES-IS) Routing Exchange Protocol. The Cisco ISO CLNS routing implementation is compliant with the Government Open Systems Interconnection Profile (GOSIP).
- Apollo Domain network protocols, the native mode networking protocol for Apollo workstations.
- Banyan VINES networking protocol for networking personal computers.
- Xerox's Universal Protocol (PUP), developed at Xerox's Palo Alto Research Center (PARC), used by some Xerox workstations.
- CHAOSnet protocol, used by LISP machine vendors and other organizations in the AI community.
- X.25 protocols, which permit cost-effective, as-needed use of major public networks world wide. Cisco Systems products support both the X.25 protocol and the X.3/X.28/X.29 specifications for X.25 terminal service.
- DDN protocols, as used with the DDN X.25 Standard, 1822-LH/DH, and HDH (1822-J) attachments. The U.S. Department of Defense specifies DDN X.25 Standard for all new attachments to the Defense Data Network; many established research and military networks use 1822-LH/DH.

- Frame Relay serial encapsulation, which conforms to the Frame Relay Interface specification produced by Cisco Systems, StrataCom, Northern Telecom and Digital Equipment Corporation; allows a single, physical connection between the network server and a switch which provides service.
- Switched Multi-Megabit Data Service (SMDS) protocol, a cell relay technology that provides wide area networking service through service providers.
- Point-to-Point Protocol (PPP), an IP encapsulation method (RFC 1134) that encapsulates IP datagrams and other Network Layer Protocol information over point-to-point links.

Support for Standard Media

For convenient access to existing networks, Cisco Systems network servers support these industry standard networking media:

- Ethernet (IEEE 802.3)
- Token Ring (IEEE 802.5)
- FDDI
- Synchronous serial
- High Speed Serial Interface (HSSI)
- Ultranet

Network servers from Cisco Systems support synchronous serial circuits at many speeds. Customers may use 9.6 and 19.2 kilobits-per-second synchronous serial service, and 56 kilobits-per-second service for medium-traffic connections.

For fast serial service over routes with heavy data needs, Cisco's full duplex, High Speed Serial Interface (HSSI) is capable of transmitting and receiving data at up to 52 Mbps, and supports connectivity to T3, E3, SMDS at DS-3 and other high speed wide area services.

Cisco Systems network servers support T1 circuits at 1,544 kilobits per second, T1C circuits at 3,088 kilobits per second, and British Telecom Megastream and CEPT circuits at 2,048 to 4,096 kilobits per second.

Cisco Systems markets a broad line of synchronous serial media adapters, including RS-232, V.35, and RS-449 to allow their routers to convert to equipment such as modems and DSUs that utilize these interfaces.

Dynamic Network Routing

Transferring data among networks is the primary task of a network server, a task whose efficiency requires up-to-date information about network status. Dynamic network routing, used by Cisco Systems routers, automatically responds to network changes to ensure faster, more reliable packet routing. Continually updated information enables the routers to find the most reliable links and routes with fastest transmission.

A Cisco Systems router monitors traffic on each network link connected to it, and routes the traffic to the appropriate destinations. Because the router is an "intelligent" router, it sends each network segment only the packets destined for it. No segment is burdened by unnecessary traffic.

The Interior Gateway Routing Protocol (IGRP™), developed by Cisco Systems for TCP/IP and ISO CLNS, monitors the network to determine the status of each route and select the best route for each data packet. Network traffic, path reliability, and path speed all influence route selection. Cisco Systems specifically designed IGRP to address the problems of routing on complex networks with many alternative routes, built of media with diverse bandwidth and delay characteristics.

While running IGRP, Cisco Systems routers can concurrently receive and understand messages from other network segments sent using different routing protocols. For example, IP routing protocols supported by Cisco Systems, in addition to IGRP, include:

- Routing Information Protocol (RIP) is the interior routing protocol used by the routing process on Berkeley-derived UNIX systems.
- Exterior Gateway Protocol (EGP) is the routing protocol used by all routers attached to the DDN. The Cisco Systems implementation maintains contact with multiple EGP-speaking routers, preserving routing information when the DDN core routers do not respond.
- Border Gateway Protocol (BGP) is a replacement protocol for EGP. BGP is defined by RFC 1163.

All Cisco Systems routers support the native, dynamic routing protocols used by the various supported network protocols, such as DECnet, Novell IPX, and AppleTalk. This allows compatibility with other vendor's routers. Multiple network protocols and their dynamic routing protocols operate concurrently, sharing the same router and media.

- When routing DECnet packets, the Cisco Systems router acts as a DECnet Level 1 and/or Level 2 router.
- Cisco Systems routers can route XNS and XNS variants such as Novell IPX and Apollo Domain using variations of the RIP routing protocol.
- Cisco's AppleTalk routing implementation uses the Routing Table Management Protocol (RTMP) to provide dynamic routing information.
- Cisco's ISO Connectionless Network Services (CLNS) protocol supports ISO 9542 defining the End System-Intermediate System (ES-IS) routing exchange protocol, and ISO 8473 Connectionless Network Protocol (CLNP).

Network Management Software

Cisco Systems provides a full range of network management tools that network managers and system administrators will find invaluable in the day-to-day operations of their networks.

Dynamic Versus Static Routing Tables

Most network managers must resolve problems that arise from line failures, overloads, equipment outages (either planned or unplanned), and changes to network interconnections. With static routing tables, network managers must spend time developing and installing other routes.

With Cisco Systems' dynamic routing, routers automatically handle routing problems and optimize traffic flow. The network manager can concentrate on true management issues such as network planning, capacity management, and meeting the needs of different user groups.

With Cisco Systems' Interior Gateway Routing Protocol (IGRP), packet routing and flow optimization take place automatically. Therefore, organizations can concentrate on issues such as planning for network growth, high-level network troubleshooting, and user support.

Diagnostic Tools

Network servers from Cisco Systems also provide detailed network management statistics, including traffic statistics, and counts of messages transmitted and received. Remote echo and route-tracing diagnostics help network managers isolate faults and refine network measurements. Cisco Systems also supports the Simple Network Management Protocol (SNMP), the industry standard for network management.

NetCentral Software

Internet work management can be as easy as clicking a mouse button with the Cisco Systems' NetCentral™ software—a dynamic, user-configurable network map operating on a fully integrated relational database.

NetCentral is a high-performance software tool for management of multivendor internetworks. It is designed for network monitoring and in-depth network planning and analysis through use of a dynamic visual network map and integrated relational databases.

The NetCentral network map provides network managers with an instant visual status check of the entire network. Pop-up windows and icons provide real-time statistics for remote networks and devices, so that network analysts and administrators can maintain an accurate picture of their internetwork topology.

NetCentral software operates on the Sun 3/xx series, the SPARCstation workstations, and on the Solbourne workstation. Contact Cisco Systems for more information.

Network Security

Network security is an increasingly important aspect of managing complex networks. Cisco Systems network servers enable network managers to implement several different security features. Optional passwords limit access to the privileged command set, as well as to console and terminal lines. Access lists restrict transmissions to only the specified addresses, whether identifying server ports, hosts, or routers.

Packet-type control specifies which packets may pass, such as mail packets, file transfers, and remote logins. This access-by-service security operates on top of access-list control for complete flexibility and security. Cisco Systems also supports DDN security options for IP packets.

Maintaining Networks

As people use networks more, they come to depend on their capabilities. Network users begin to take for granted that the network will always be available. Network managers face the challenge of meeting this expectation.

At Cisco Systems, hardware reliability is a top engineering priority. Equipment failures rarely occur because all Cisco Systems products meet rigid testing standards.

If problems do occur, Cisco Systems' onboard diagnostic software helps isolate them quickly, enabling customers to identify problems and arrange repairs without being familiar with the equipment. Cisco Systems engineers are always available to help with failure diagnosis, if necessary.

Cisco Systems' standard service includes low-cost board exchange, with replacements delivered by next-day express service. A premium service contract provides 24-hour coverage throughout the continental United States. On-call, on-site service by Cisco Systems field engineers is available anywhere in the world. More information about Cisco's service and support is found in the *Customer Services Product Guide.*

Modular Components for Flexible Configuration

Part of the power and flexibility of Cisco Systems product components is derived from their modular physical configuration options. Customers can choose the chassis, processor, back-panel connector mountings, and communications interfaces best suited to their network.

Chassis Options

The chassis encloses a power supply, component cards, and a backplane. Six models are available for the network server.

- The AGS+™ model is also built on the Cisco A-chassis, and provides a five-slot proprietary cBus™ backplane within the nine-slot standard backplane. The cBus backplane allows connection of Cisco Systems' high-speed interface cards, including the FDDI

controller. It provides interaction with an environmental monitor that oversees an operating environment equipped with a larger power supply and a larger number of interface cards than are available in the AGS model.

- The AGS™ model is built on the Cisco A-chassis, a nine-slot, rack-mounted chassis for network servers in large network configurations requiring high fanouts.
- The MGS™ model is built on the M-chassis, a mid-range, four-slot, tabletop or rack-mountable chassis for medium-sized network servers.
- The CGS™ model is built on the C-chassis, a compact two-slot chassis, designed for remote network servers in an office or desktop environment. This model, which includes a quiet fan, is available in a limited number of configurations only.
- The IGS™ model is a single-board router with two network interfaces. The IGS is designed for remote offices, or to interconnect PC LANs.
- The CRM is Cisco's single board router module with two interfaces that is installed in a Cabletron System MMAC hub.

Processor Options

For high-speed operation, the Cisco network servers use processors based on the MC68020 microprocessor. The Cisco Systems processors contain onboard RAM, system ROM holding all operating system, bootstrap, and diagnostic software, and hardware and software support for a control console.

The CSC/2 processor offers one megabyte of RAM, and is suitable for medium performance applications.

The CSC/3 is Cisco's high-end processor offering four megabytes of RAM. The additional RAM increases the size of the maximum routing table. The CSC/3 processor card provides the increased switching speeds necessary to support Cisco's high-speed network interfaces.

Cisco Systems also offers optional nonvolatile memory that retains configuration information despite power losses or system reboots. With the nonvolatile memory option, the terminal and network servers need not rely on other network servers for configuration and boot service information.

Connector Panel Options

Each chassis model accepts connector panels (also referred to as appliques) in numerous formats, enabling easy configuration of network servers to meet current and future needs. Supported connectors include:

- FDDI standard Media Interface Connector (MIC)
- 25-pin RS-232C D connectors (DCE and DTE)
- 15-pin Ethernet connectors
- 9-pin (DE-9) Token Ring connectors
- V.35 connectors (DCE and DTE)

- RS-449 connectors (DCE and DTE).
- High Speed Serial Interface (HSSI) Connector
- UltraNet connector

Interface Options

Cisco Systems offers a full range of interface options on their network interface cards:

- The Multiport Communications Interface (MCI™) card provides up to two Ethernet ports and up to two synchronous serial ports on a single card. The Ethernet ports support Ethernet versions 1 and 2 and IEEE 802.3 electrical interfaces. The serial ports support RS-232, V.35, RS-449, and X.21 connections.

  The interface processes packets rapidly, without the interframe delays typical of other Ethernet interfaces. By minimizing packet processing time, the MCI card achieves high-circuit utilization.

- The Serial-Port Communications Interface (SCI™) card provides four high-speed serial ports on a single card that support RS-232, V.35, and RS-449, and X.21 connections.

  The serial interfaces on both the MCI and SCI Interface cards support signaling rates of 2.4 kilobits per second to 4 megabits per second. Each synchronous channel can perform full-rate transmission, independent of packet size or the load on adjacent channels.

- The High Speed Serial Interface (HSSI), which consists of the High Speed Serial Communications Interface (HSCI™) card and applique, provides a single, full duplex, synchronous serial interface capable of speeds to 52 megabits per second. The HSSI is a de facto industry standard for providing connections to high speed WAN services such as TS, E3, SMDS at DS-3 via the proper conversion device. These cards may be used only in the AGS+ chassis featuring the cBus high-speed controller card.

- The Ultranet interface, which consists of the HSCI and applique, provides a single, full duplex serial interface capable of speeds up to 125 megabits per second. The UltraNet interface connects to the products from Ultra Network Technologies. These cards may be used only in the AGS+ chassis featuring the cBus high-speed controller card.

- The Multiport Ethernet Controller (MEC™) interface card provides two, four, or six high-speed Ethernet connectors compatible with Versions 1 and 2, and the IEEE 802.3 protocol. These cards may be used only in the AGS+ chassis featuring the cBus high-speed controller card.

- The FDDI Controller Interface (CSC-FCI) card provides a Class A, dual-attach interface for connection to the FDDI standard 62.5/125 micron fiber optic cable using the Media Interface Connector (MIC). These cards may be used only in the AGS+ chassis featuring the cBus high-speed controller card.

- The Cisco 4/16 Token Ring interface (CSC-R16) card provides a single, user-selectable 4 or 16 megabit per second connection to a Token Ring LAN.

- The Cisco Token Ring interface (CSC-R) card provides service to IEEE 802.5 Token Rings running at 4 megabits per second.

  Both of Cisco's Token Ring interface controller cards extends network service to microcomputers and IBM LANs in an easily expandable fashion.

The Cisco *Modular Products Hardware Installation and Reference* and the *IGS Hardware Installation and Reference* describe Cisco's hardware products and provides procedures for installing them into your system. Refer to these manuals for hardware-specific information.