

INTERNETWORKING BASICS

The primary advantage of bridging is increased bandwidth available on a segment because of the decreased number of devices in the collision domain.

Switches have the same basic functionality as bridges but usually have more ports. Each switch port is a separate collision domain, and each port provides dedicated bandwidth.

Virtual local area networks (VLANs) can be used to make a group of switch ports into a separate, isolated LAN. Routing is required for communication between VLANs.

VLANs can function across multiple switches when they are connected by a trunk connection. Inter-switch linking (ISL) is used to create a trunk connection between Fast Ethernet ports on Cisco switches.

Switches make it possible to run Ethernet devices in full-duplex mode. In full-duplex mode, two devices share the Ethernet wire exclusively, enabling faster throughput because no collisions are possible.

Store-and-forward switching reads the entire frame before making a forwarding decision; cut-through switching reads only the first six bytes - the destination media access control (MAC) address - to make a forwarding decision. Store-and-forward switching performs error checking; cut-through switching does not.

The primary advantages of routers are:

- Allow you to connect dissimilar LANs
- Provide multiple paths to a destination network
- Allow the interconnection of large and complex networks

Connection-oriented communication uses a nonpermanent path for data transfer. It involves three steps: establish the connection, transfer the data, and terminate the connection. Connectionless communication uses a permanently established link.

OPEN SYSTEM INTERCONNECT (OSI) MODEL

The layers of the OSI model are 7-application, 6-presentation, 5-session, 4-transport, 3-network, 2-data link, and 1-physical.

Encapsulation, or tunneling, takes frames from one network system and places them inside frames from another network system.

The presentation layer concerns itself with data representation, data encryption, and data compression. It supports different protocols for text, data, sound, video, graphics, and images such as ASCII, MIDI, MPEG, GIF, and JPEG.

The session layer establishes, manages, and terminates sessions between applications. Network file system (NFS), structured query language (SQL), and remote procedure calls (RPCs) are examples of session layer protocols.

The transport layer sits between the upper and lower layers of the OSI model. The transport layer performs flow control by buffering, multiplexing, and parallelization.

It provides end-to-end data transport services by:

- Segmenting upper-layer applications
- Establishing an end-to-end-connection
- Sending segments from one end host to another
- Ensuring reliable data transport

The primary functions of the data link layer of the OSI model are:

- Allows the upper layers of the OSI model to work independently of the physical media
- Performs physical hardware addressing
- Provides optional flow control
- Generates error notification

ROUTER BASIS

EXEC includes the following:

- Context-sensitive help for syntax checking, command prompting, and keyword completion. Use the question mark (?) to activate context-sensitive help.
- Command history that provides a record of recent commands. Use the Up and Down Arrow keys to scroll through the history list. Tab completes a partially entered command.
- Enhanced editing that enables commands retrieved from command history to be changed quickly then re-executed. The terminal editing and terminal no editing commands enable and disable enhanced editing.

Examine the status of a router with the following commands: show version, show memory, show protocols, show running-config (or write terminal), show startup-config (or show configuration), show interfaces, and show flash.

The Cisco Discovery Protocol (CDP) displays summary information about directly connected devices and operates at the data link layer. The show cdp neighbors command displays ID, local and remote port, holdtime, platform, and capability information. The show cdp entry <device id> command displays information about a specific device including all layer 3 addresses and Internetwork Operating System (IOS) versions.

ROUTER CONFIGURATION

The command to back up a router configuration file (copy a configuration file from a router to a Trivial File Transfer Protocol [TFTP] server) is copy running-config tftp. The command to restore a configuration file (copy a configuration file from a TFTP server to a router) is copy tftp running-config.

The commands to set the enable, enable secret, console, and auxiliary passwords on a router are as follows:

- Router(config) #enable **password**
- Router(config) #enable secret **password**
- Router(config) #line aux 0 and Router(config-line) # login and

Router(config-line) #password **password**

- Router(config) #line con 0 and Router(config-line) #login and Router(config-line) #password **password**
- Router(config) #line vty 0 4 and Router(config-line) #login and Router(config-line) #password **password**

To create a banner for a router and a description for an interface, use the banner motd (message of the day) and description commands.

ROUTING PROTOCOLS

Convergence occurs when all routers in an internetwork agree on optimal routes. A routing loop occurs when a packet bounces back and forth between two or more routers. A routing loop is sometimes called counting to infinity.

Distance vector routing protocols send all of their route tables to their neighbors. Link state protocols send the state of their own interfaces to every router in the internetwork.

Counting to infinity is a problem for distance vector routing protocols. It can be eliminated or mitigated by using the following techniques: maximum hop count, split horizon, route poisoning, and hold-down timers.

Router resource usage, bandwidth consumption, and update synchronization are problems for link state routing protocols. They can be eliminated or reduced by using the following techniques:

- Lengthening update frequency
- Exchanging route summaries
- Using time stamps or sequence numbers

Routing Information Protocol (RIP) can be configured on a router with the following commands:

- Router (config) # router rip
- Router (config-router) # network <network>

Interior Gateway Routing Protocol (IGRP) can be configured on a router with the following commands:

- Router (config) # router igrp <autonomous system number>
- Router (config-router) # network <network>

PROTOCOL (TCP/IP)

File Transfer Protocol (FTP)	21
Telnet	23
Simple Mail Transfer Protocol (SMTP)	25
Domain Name System (DNS)	53
TFTP	69

Simple Network Management Protocol (SNMP)

161, 162

TCP provides a connection-oriented and reliable service to the applications that use its services with the use of acknowledgements, sequence number checking, error and duplication checking, and the TCP three-way handshake. User Datagram Protocol (UDP) provides a connectionless and best-effort service to the applications that use its services.

Address Resolution Protocol (ARP) maps a known IP address to a physical address. Reverse Address Resolution Protocol (RARP) maps a known physical address to a logical address.

Understand the basic concepts of IP addressing. Dotted-decimal notation is the decimal representation of a 32-bit IP address. The dotted-decimal notation represents the four octets of bits by performing binary-to-decimal conversion for each octet and providing a decimal value for each octet.

Memorize the decimal representation of classes A, B, and C addresses as well as the number of networks and nodes each supports.

Class A	1 through 126
Class B	128 through 191
Class C	192 through 223

Recognize the default mask for each class of IP address.

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

The most important basic commands used to monitor IP with Cisco routers are show ip interface, show ip protocol, and show ip route.

The network number and broadcast address for a given subnet are the first and last IP addresses, respectively. The range of usable IP addresses is all addresses between the network number and broadcast address. In binary format, the network number has all of the host of the address set to 0. The broadcast address has all of the host bits set to 1.

INTERNET PACKET EXCHANGE (IPX)

IPX addresses consist of a network number and a node number. The node number is the node's MAC address.

- IPX can be configured on a router with the following commands:
- Router (config) # ipx routing
- Router (config) # interface ethernet 0
- Router (config-if) # ipx network <network> encapsulation sap

Recognize the common commands used to monitor IPX activity on a router: show ipx interface, show ipx route, show ipx servers, show ipx traffic, debug ipx routing activity, and debug ipx sap activity.

ACCESS LISTS

A list of the import access list numeric identifiers is as follows:

1 through 99	IP standard access list
100 through 199	IP extended access list
800 through 899	IPX standard access list
900 through 999	IPX extended access list
1000 through 1099	Service Advertisement Protocols (SAP) access list

Two rules for applying a wildcard mask to an IP address are:

- A 1 bit in the wildcard mask indicates that the corresponding bit in the IP address can be ignored. Thus, the IP address bit can be either 1 or 0.
- A 0 in the wildcard mask indicates that the corresponding bit in the IP address must be strictly followed. Thus, the value must be exactly the same as specified in the IP address.

The difference in the capabilities of IP extended access lists in comparison with IP standard access lists is that standard access lists filter IP traffic based on source IP address or address range. IP extended access lists filter traffic based on source and destination addresses, ports, and many other fields.

WIDE AREA NETWORK (WAN) PROTOCOLS

The interface between the customer network and the WAN provider network occurs between the data terminal equipment (DTE) and the data communication equipment (DCE). DTE devices are usually routers. DCE devices are usually modems, channel service units/data service units (CSUs/DSUs), and terminal adapter/network terminations 1 (TA/NT1s).

Frame Relay is a high-speed, packet-switching, WAN protocol that operates at the data link layer. It runs on nearly any type of serial interface, uses frame check sequence (FCS) as its error-checking mechanism, and relies on a discard eligibility bit for congestion management. A virtual circuit must connect two DTE devices within a Frame Relay network. Permanent virtual circuits (PVCs) are more widely used than switched virtual circuits (SVCs) in Frame Relay networks.

Data link connection identifier (DLCI) serves as the addressing scheme within a Frame Relay network. Local Management Information (LMI) is a set of enhancements to Frame Relay that was developed by Cisco, StrataCom, Northern Telecom, and DEC. Cisco routers support LMI variations for American National Standards Institute (ANSI), Q933a, and Cisco.

DLCIs are mapped to network layer addresses through inverse ARP or by using the frame-relay map command.

Committed Information Rate (CIR) is the rate, in bits per second, at which data is transferred across the Frame Relay network.

A single physical interface can be configured with several virtual subinterfaces. Each subinterface can be configured with different addressing information. Subinterfaces can be created and accessed using the serial interface number followed by a period and a number (such as serial 0.78).

The commands to configure Frame Relay on a router are:

- Router (config) # encapsulation frame-relay cisco
- Router (config) # frame-relay lmi-type cisco
- Router (config) # interface serial 0
- Router (config-if) # frame-relay interface-dlci <dlci number>

The basic commands to monitor Frame Relay activity on a router are show frame-relay pvc, show frame-relay lmi, show frame-relay map, and debug frame-relay lmi.

Password Authentication Protocol (PAP) uses a two-way handshake to authenticate Point-to-Point Protocol (PPP) connections and transmits username/password information in clear text. Challenge Handshake Authentication Protocol (CHAP) uses a three-way handshake and relies on secret, encrypted passwords and unique IDs to authenticate PPP.

The commands to configure PPP on a router are:

- Router (config) # username <name> password <password>
- Router (config) # interface serial 0
- Router (config-if) # encapsulation ppp
- Router (config-if) # ppp authentication chap

The basic commands to monitor PPP actively on a router are show interface and debug ppp chap.

Integrated services digital network (ISDN) can be ordered as either basic rate interface (BRI) or primary rate interface (PRI). ISDN functions represent devices or hardware functions within ISDN. Reference points describe the logical interfaces between functions.

ISDN can be used to:

- Add bandwidth for telecommuting
- Improve Internet response time
- Carry multiple network layer protocols
- Encapsulate other WAN services

Dial-on-demand routing (DDR) works with ISDN to establish and terminate connections. It uses access lists to look for interesting traffic.

The commands to configure ISDN on a router are:

- Router (config) # isdn switch-type <switch-type>
- Router (config) # dialer-list <dialer-group> protocol <protocol-name> permit
- Router (config-if) # interface bri 0
- Router (config-if) # encapsulation PPP
- Router (config-if) # dialer-group <number>

- Router (config-if) # dialer map <protocol> <next-hop address> name <hostname> speed <number> <dial-string>
- Router (config-if) dialer idle-timeout <seconds>

The basic commands to monitor ISDN and DDR activity on a router are show controller bri, show interface bri, and show dialer.

This CramNotes is provided by Coriolis. To read further details on this subject we suggest you to consider purchasing the book below.



[CCNA Routing and Switching Exam Prep](#) by Mark A. Poplar, et al (Hardcover)

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[CCNA Routing and Switching Exam Cram, 2E](#) by Jason T. Waters, et al (Paperback)

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[Exam Cram Ccnp Routing \(Exam Cram\)](#) by Eric McMasters, et al (Paperback)

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