Exploring the Functions of Routing

LAN Connections

Routers

Cisco 2800 Series Router

- Routers have the following components:
  - CPU
  - Motherboard
  - RAM
  - ROM
- Routers have network adapters to which IP addresses are assigned.
- Routers may have the following two kinds of ports:
  - Console: For the attachment of a terminal used for management
  - Network: Different LAN or WAN media ports
- Routers forward packets based upon a routing table.

Router Functions

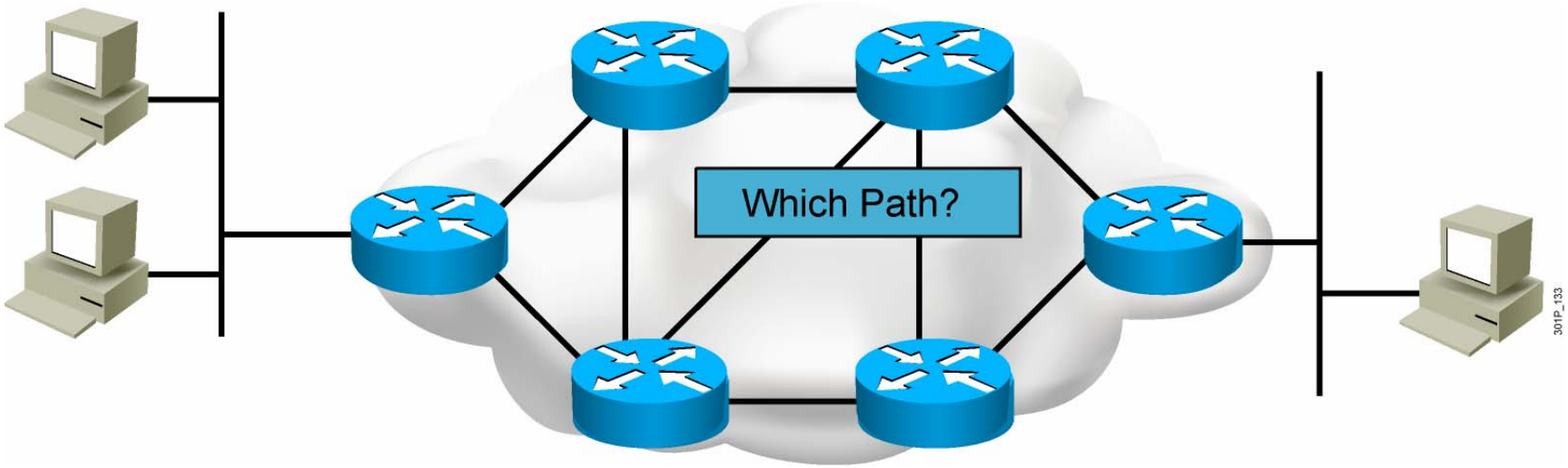
```
RouterX# show ip route
D 192.168.1.0/24 [90/25789217] via 10.1.1.1
R 192.168.2.0/24 [120/4] via 10.1.1.2
O 192.168.3.0/24 [110/229840] via 10.1.1.3
```

1

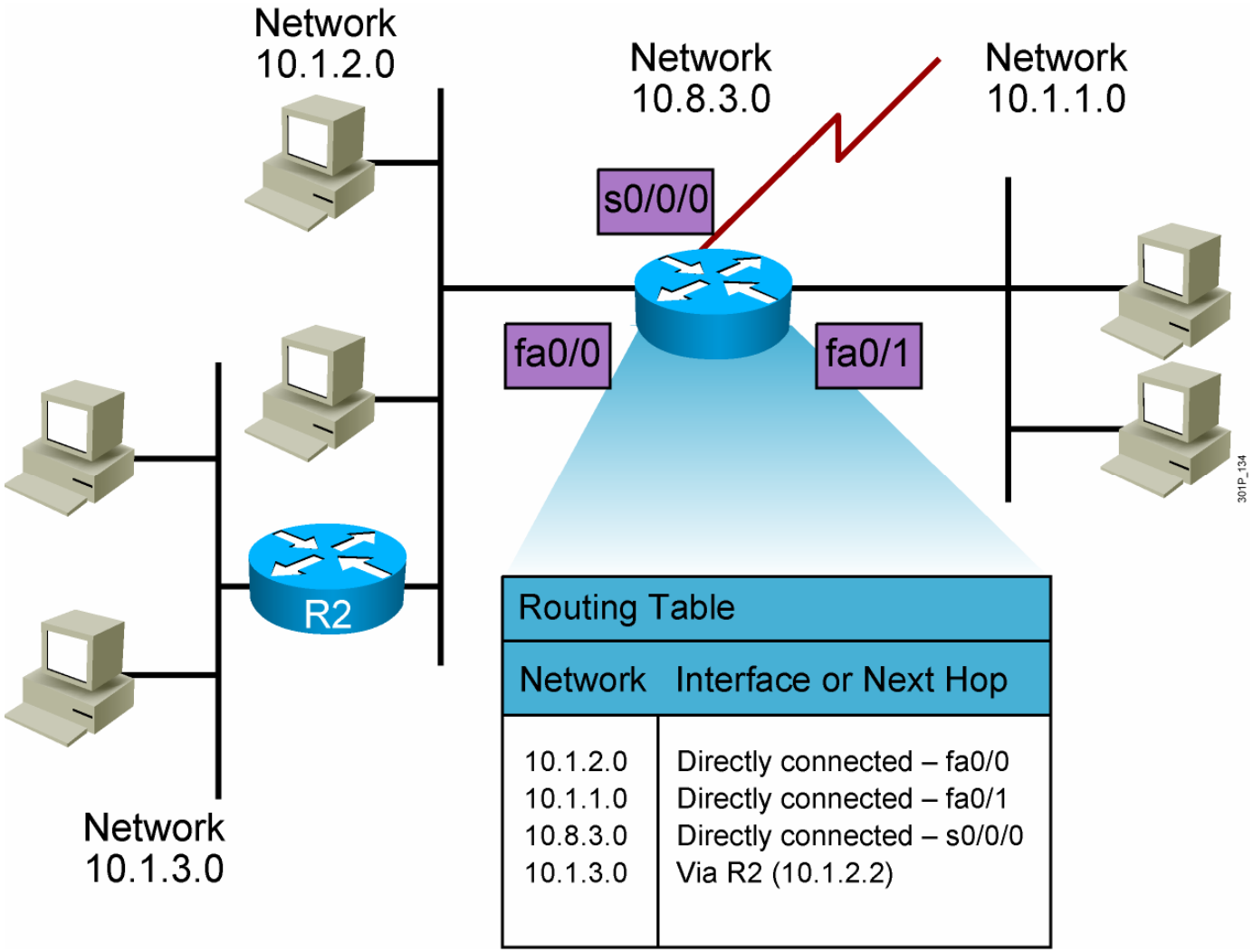
2

1. Lets other routers know about changes
2. Determines where to forward packets

Path Determination



Routing Tables

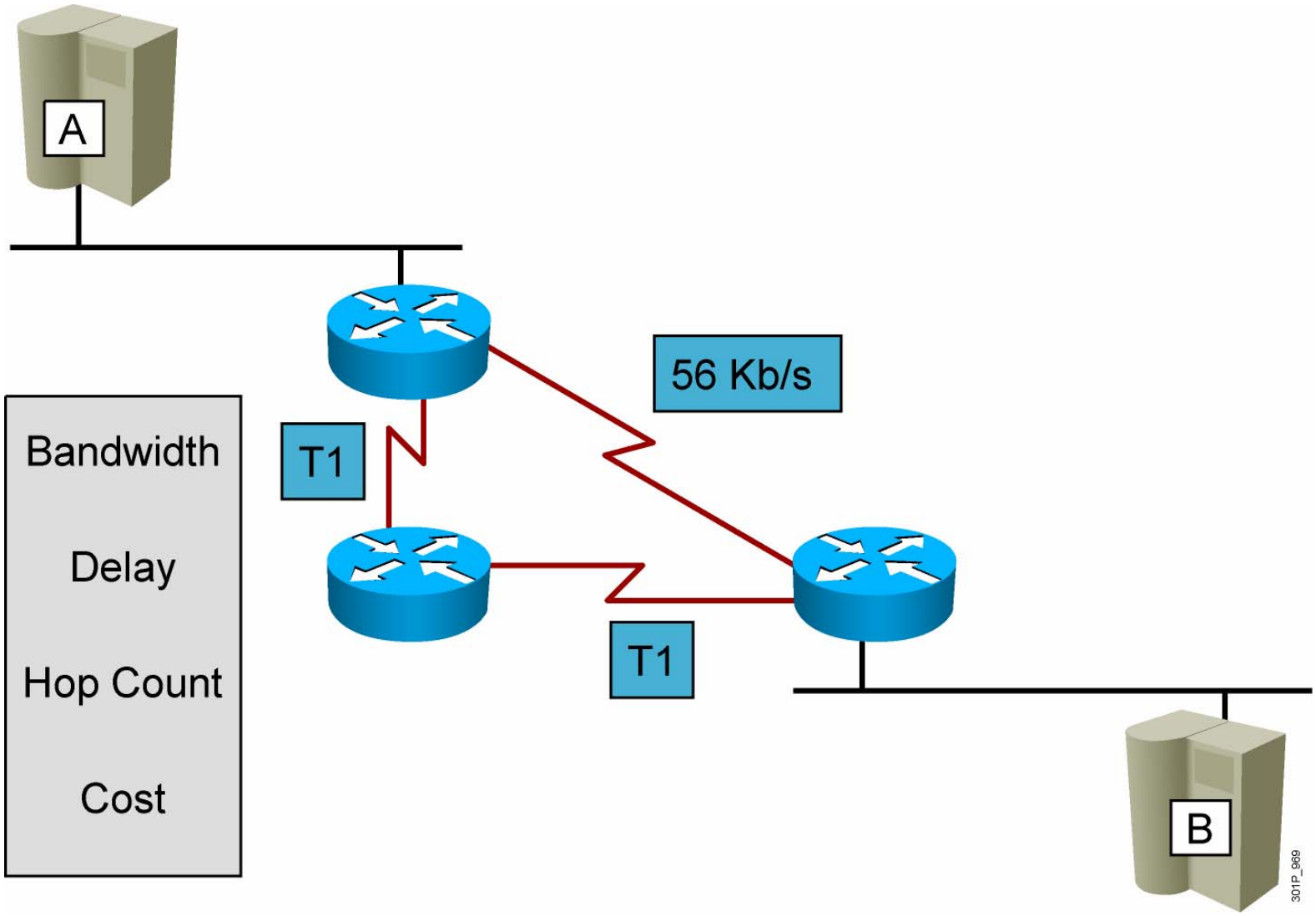


Routing Table	
Network	Interface or Next Hop
10.1.2.0	Directly connected – fa0/0
10.1.1.0	Directly connected – fa0/1
10.8.3.0	Directly connected – s0/0/0
10.1.3.0	Via R2 (10.1.2.2)

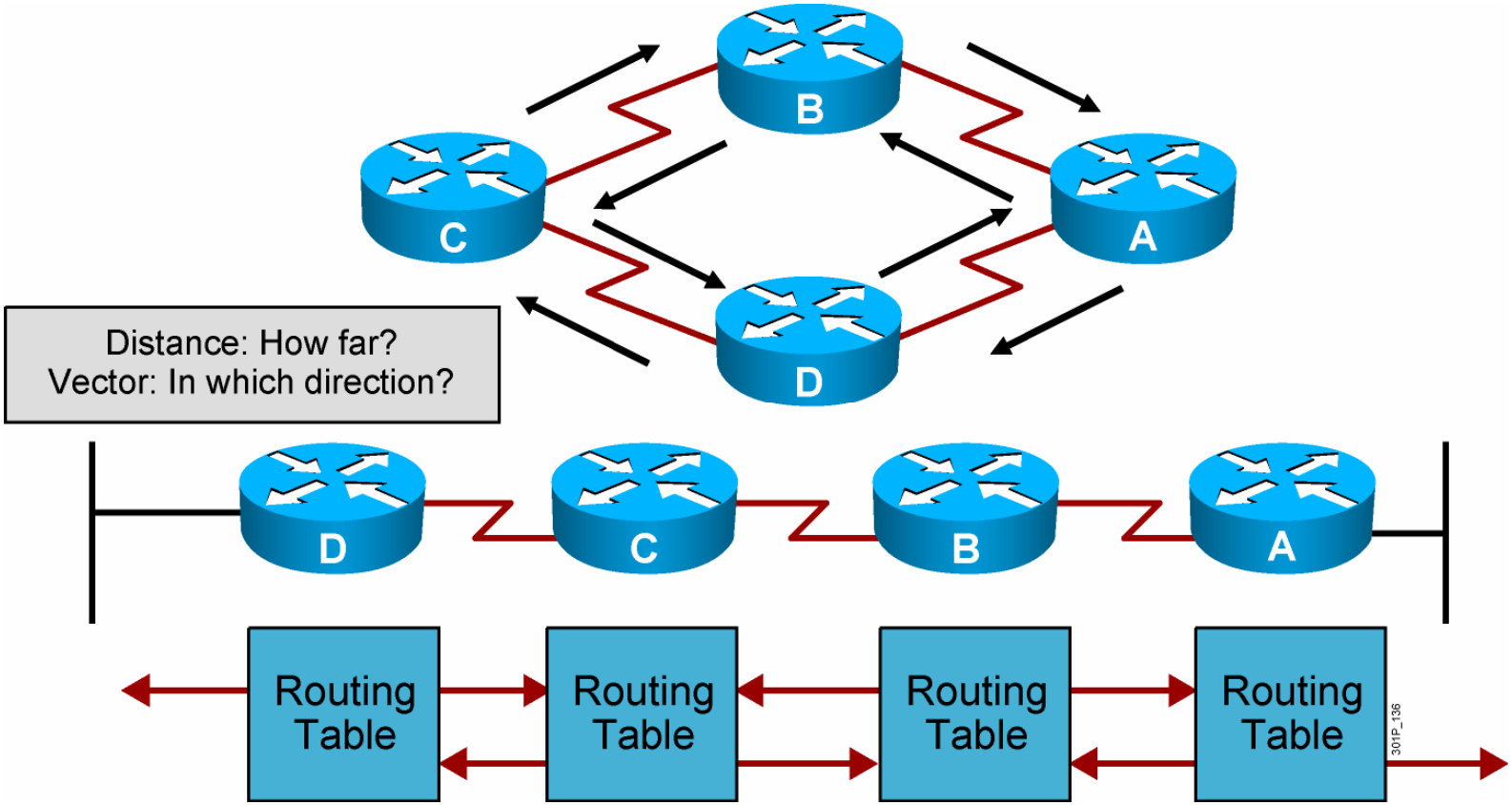
Routing Table Entries

- Directly connected: Router attaches to this network
- Static routing: Entered manually by a system administrator
- Dynamic routing: Learned by exchange of routing information
- Default route: Statically or dynamically learned; used when no explicit route to network is known

Routing Metrics

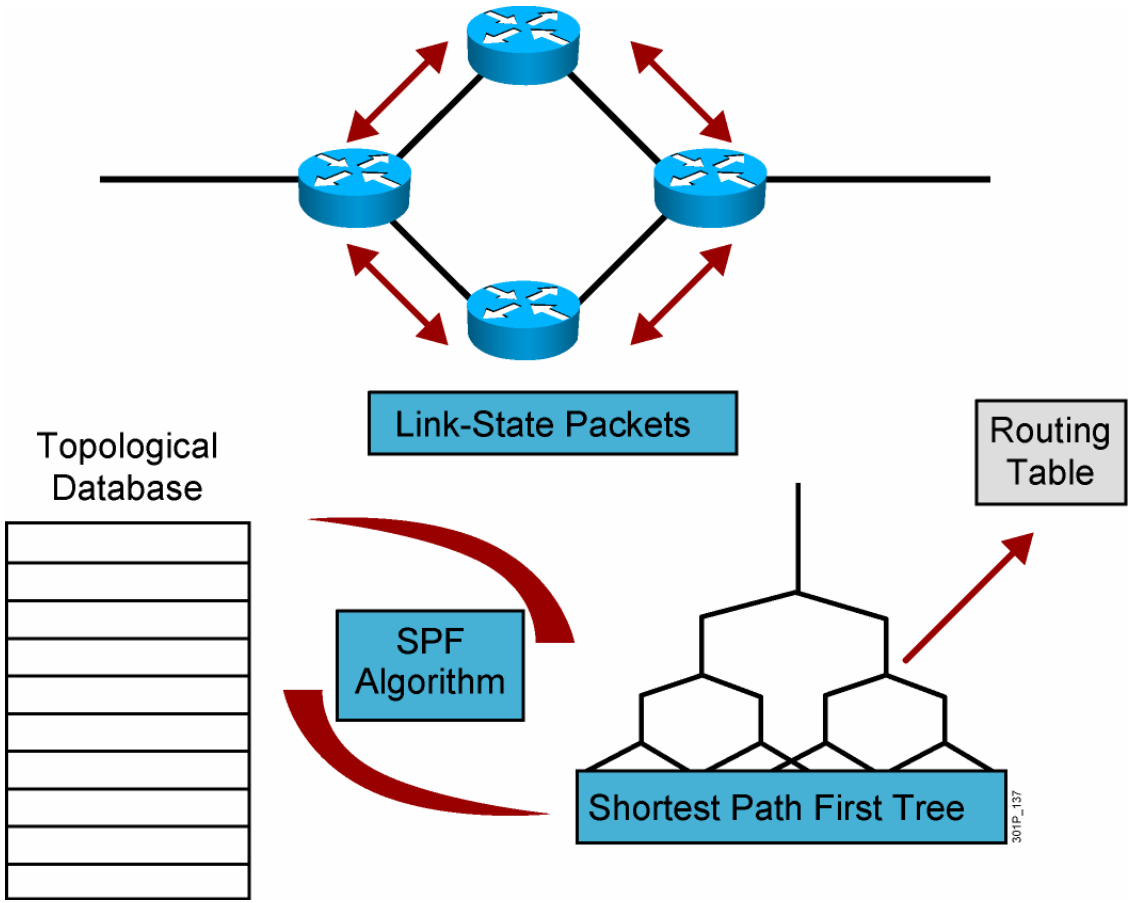


Distance Vector Routing Protocols



Passes periodic copies of routing table to neighbor routes and accumulates distance vectors

Link-State Routing Protocols



After initial flood, passes small event-triggered link-state updates to all other routers

Summary

- Routers have certain components that are also found in computers and switches, such as the CPU, motherboard, RAM, and ROM.
- Routers have two primary functions in the IP packet delivery process: maintaining routing tables and determining the best path to be used to forward packets.
- Routers determine the optimal path for forwarding IP packets between networks. Routers can use different types of routes to reach the destination networks, including static, dynamic, and default routes.
- Routing tables provide an ordered list of best paths to known networks, and include information such as destination, next-hop associations, and routing metrics.
- Routing algorithms process the received updates and populate the routing table with the best route.

Summary (Cont.)

- Commonly used routing metrics include bandwidth, delay, hop count, and cost.
- Distance vector routing protocols build and update routing tables automatically by sending all or some portion of their routing table to neighbors. The distance vector routing approach determines the direction (vector) and distance to any network in the internetwork.
- Link-state routing protocols build and update routing tables automatically, running algorithms against the link-state database to determine the best paths, and flood routing information about their own links to all the routers in the network.
- Cisco developed EIGRP, which combines the best features of the distance vector and link-state routing protocols.

Understanding Binary Basics

LAN Connections

Decimal vs. Binary Numbers

- Decimal numbers are represented by the numbers 0 through 9.
- Binary numbers are represented by a series of 1s and 0s.

Decimal	Binary
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001

Decimal	Binary
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111
16	10000
17	10001
18	10010
19	10011

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Decimal and Binary Numbers Chart

Base-10 Decimal Conversion—63204829

	MSB							LSB
Base^{exponent}	10^7	10^6	10^5	10^4	10^3	10^2	10^1	10^0
Column Value	6	3	2	0	4	8	2	9
Decimal Weight	10000000	1000000	100000	10000	1000	100	10	1
Column Weight	60000000	3000000	200000	0	4000	800	20	9

60000000 + 3000000 + 200000 + 0 + 4000 + 800 + 20 + 9 = 63204829

Base-2 Binary Conversion—1110100 (233)

	MSB							LSB
Base^{exponent}	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Column Value	1	1	1	0	1	0	0	1
Decimal Weight	128	64	32	16	8	4	2	1
Column Value	128	64	32	0	8	0	0	1

128 + 64 + 32 + 0 + 8 + 0 + 0 + 1 = 233

Powers of 2

Power of 2	Calculation	Value
2^0		1
2^1	2	2
2^2	2 * 2	4
2^3	2 * 2 * 2	8
2^4	2 * 2 * 2 * 2	16
2^5	2 * 2 * 2 * 2 * 2	32
2^6	2 * 2 * 2 * 2 * 2 *2	64
2^7	2 * 2 * 2 * 2 * 2 *2 * 2	128

Decimal-to-Binary Conversion

Base^{Exponent}	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Place Value	128	64	32	16	8	4	2	1
Example: Convert decimal 35 to binary	0	0	1	0	0	0	1	1

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$35 = 2^5 + 2^1 + 2^0$

$35 = (32 * 1) + (2 * 1) + (1 * 1)$

$35 = 0 + 0 + 1 + 0 + 0 + 0 + 1 + 1$

$35 = 00100011$

Binary-to-Decimal Conversion

Base^{Exponent}	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Place Value	128	64	32	16	8	4	2	1
Example: Binary Number	1	0	1	1	1	0	0	1
Decimal Number Total: 185	128	0	32	16	8	0	0	1

1 0 1 1 1 0 0 1 = (128 * 1) + (64 * 0) + (32 * 1) + (16 * 1) + (8 * 1) + (4 * 0) + (2 * 0) + (1 * 1)
1 0 1 1 1 0 0 1 = 128 + 0 + 32 + 16 + 8 + 0 + 0 + 1
1 0 1 1 1 0 0 1 = 185

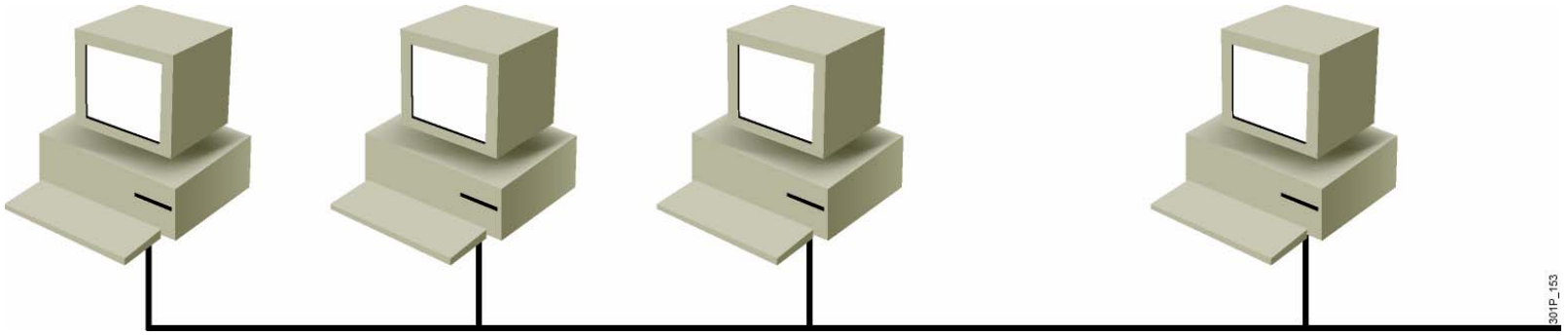
Summary

- All computers operate using a binary system.
- Binary systems (base 2) use only the numerals 0 and 1.
- Decimal systems (base 10) use the numerals 0 through 9.
- Using the powers of 2, a binary number can be converted into a decimal number.
- Using the powers of 2, a decimal number can be converted into a binary number.

Constructing a Network Addressing Scheme

LAN Connections

Flat Topology

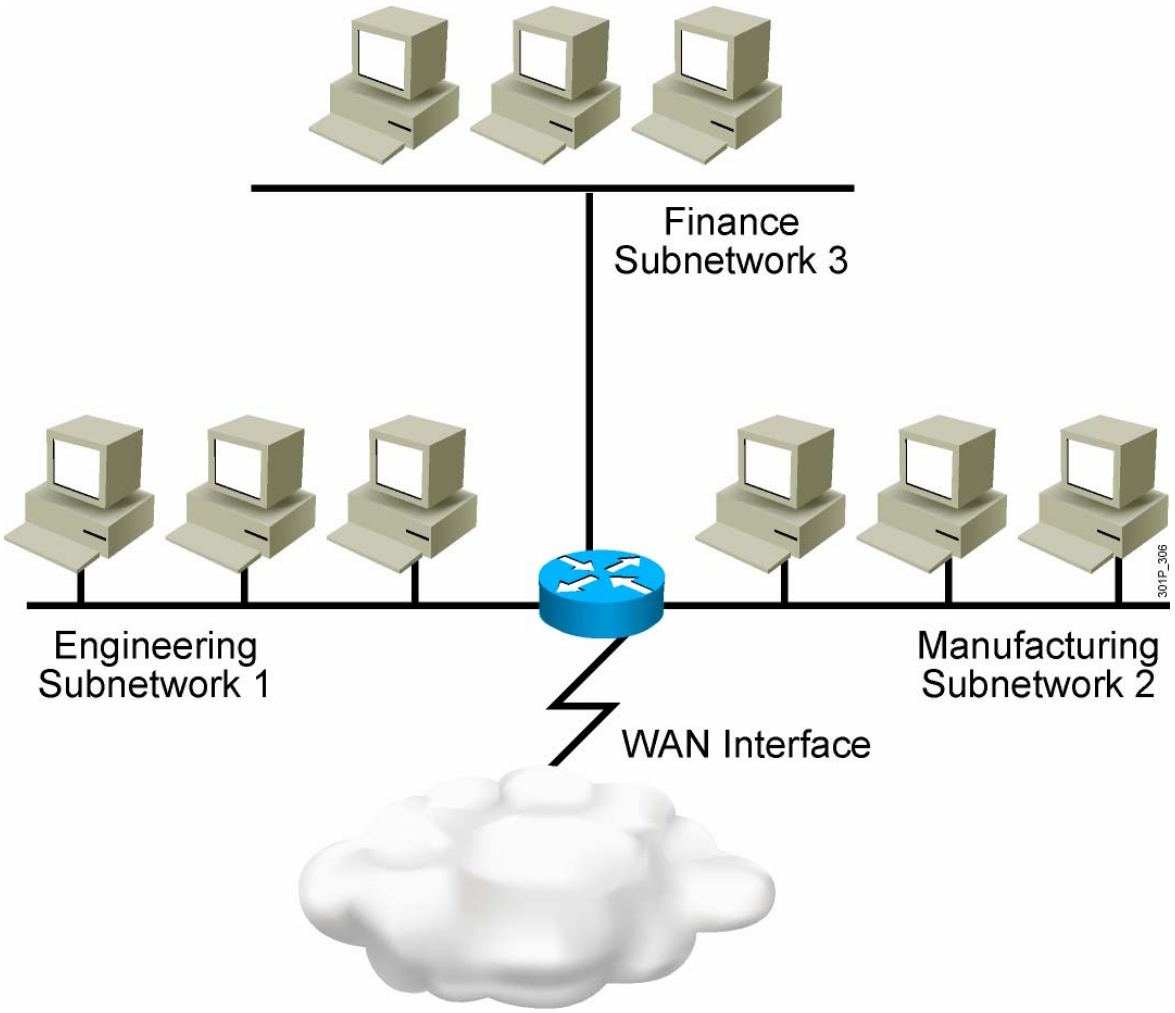


Problems

- All devices share the same bandwidth.
- All devices share the same broadcast domain.
- It is difficult to apply a security policy.

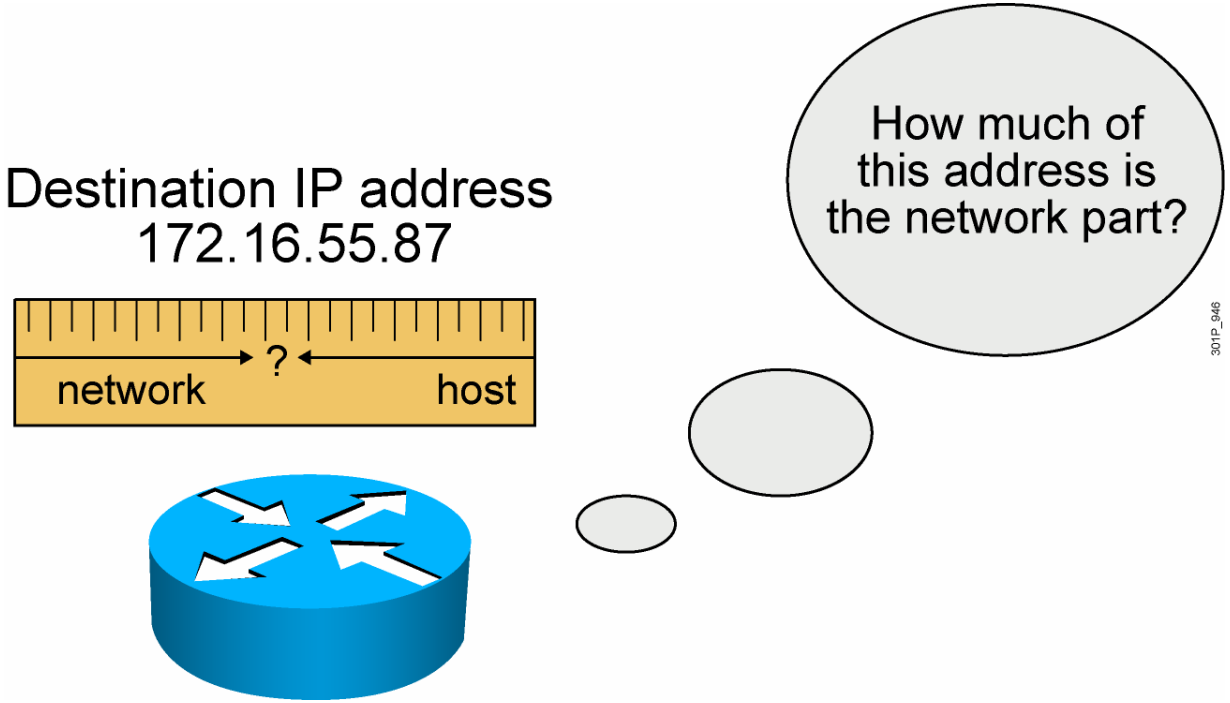
Subnetworks

- Smaller networks are easier to manage.
- Overall traffic is reduced.
- You can more easily apply network security policies.

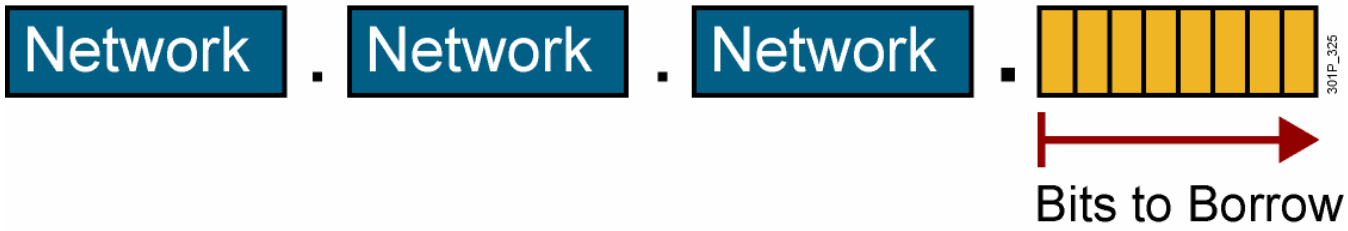


What a Subnet Mask Does

- Tells the router the number of bits to look at when routing
- Defines the number of bits that are significant
- Used as a measuring tool, not to hide anything



Possible Subnets and Hosts for a Class C Network



Number of Bits Borrowed (s)	Number of Subnets Possible (2^s)	Number of Bits Remaining in Host ID (8 - s = h)	Number of Hosts Possible Per Subnet ($2^h - 2$)
1	2	7	126
2	4	6	62
3	8	5	30
4	16	4	14
5	32	3	6
6	64	2	2
7	128	1	2

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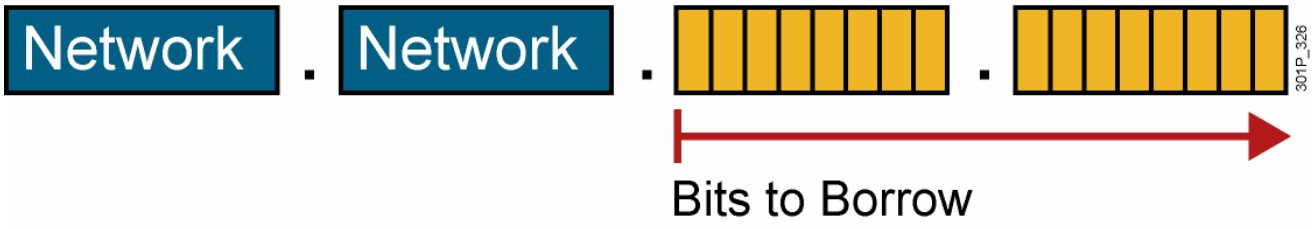
Possible Subnets and Hosts for a Class B Network



Number of Bits Borrowed (s)	Number of Subnets Possible (2^s)	Number of Bits Remaining in Host ID ($16 - s = h$)	Number of Hosts Possible Per Subnet ($2^h - 2$)
1	2	15	32,766
2	4	14	16,382
3	8	13	8,190
4	16	12	4,094
5	32	11	2,046
6	64	10	1,022
7	128	9	510
…	…	…	…

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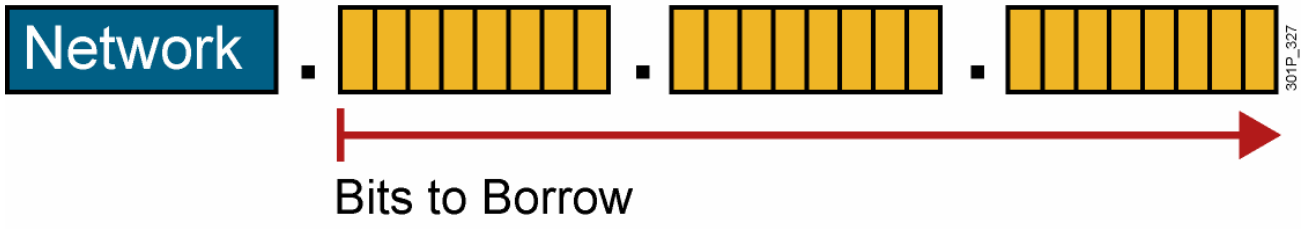
Possible Subnets and Hosts for a Class A Network



Number of Bits Borrowed (s)	Number of Subnets Possible (2^s)	Number of Bits Remaining in Host ID ($24 - s = h$)	Number of Hosts Possible Per Subnet ($2^h - 2$)
1	2	23	8,388,606
2	4	22	4,194,302
3	8	21	2,097,150
4	16	20	1,048,574
5	32	19	524,286
6	64	18	262,142
7	128	17	131,070
…	…	…	…

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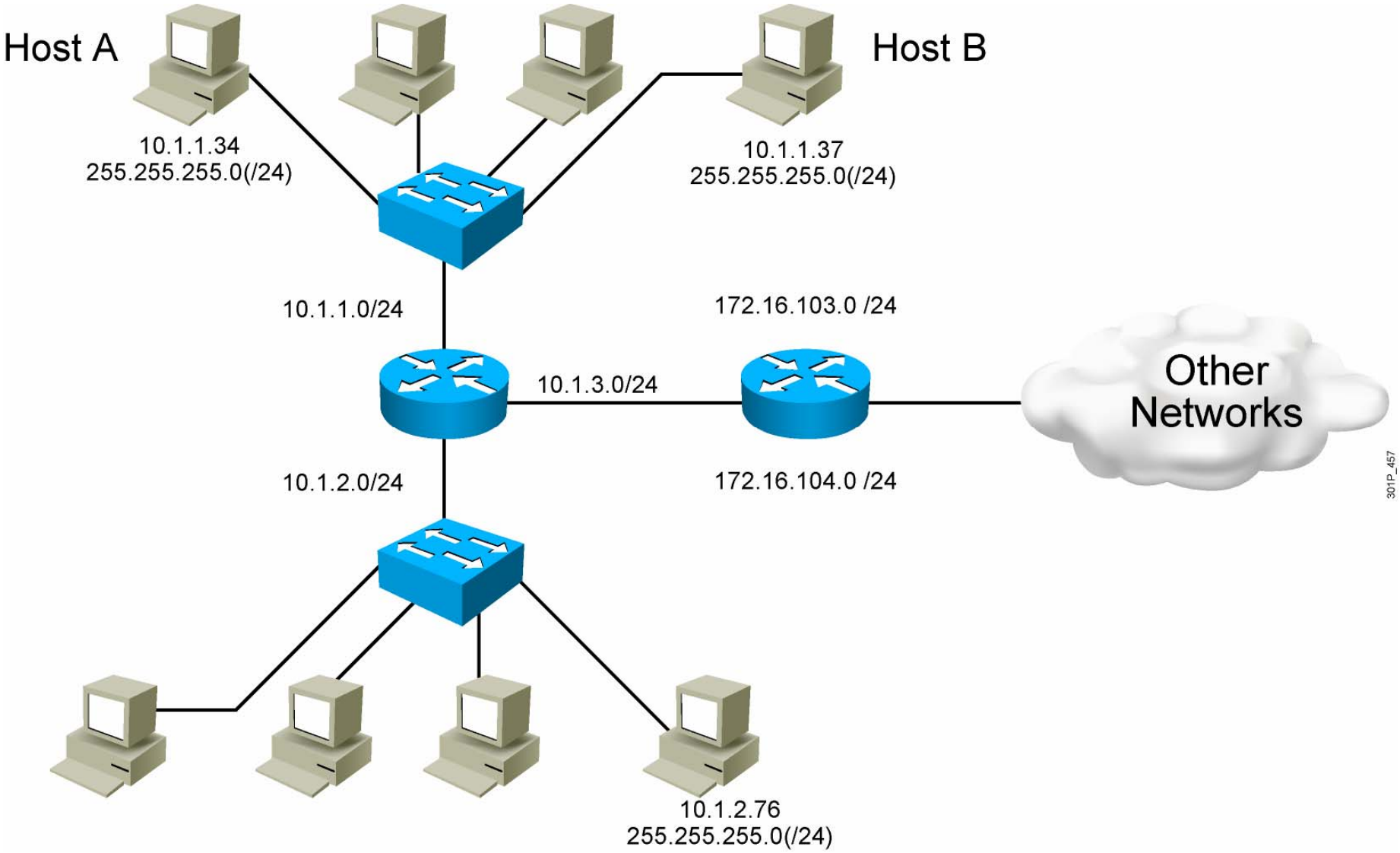
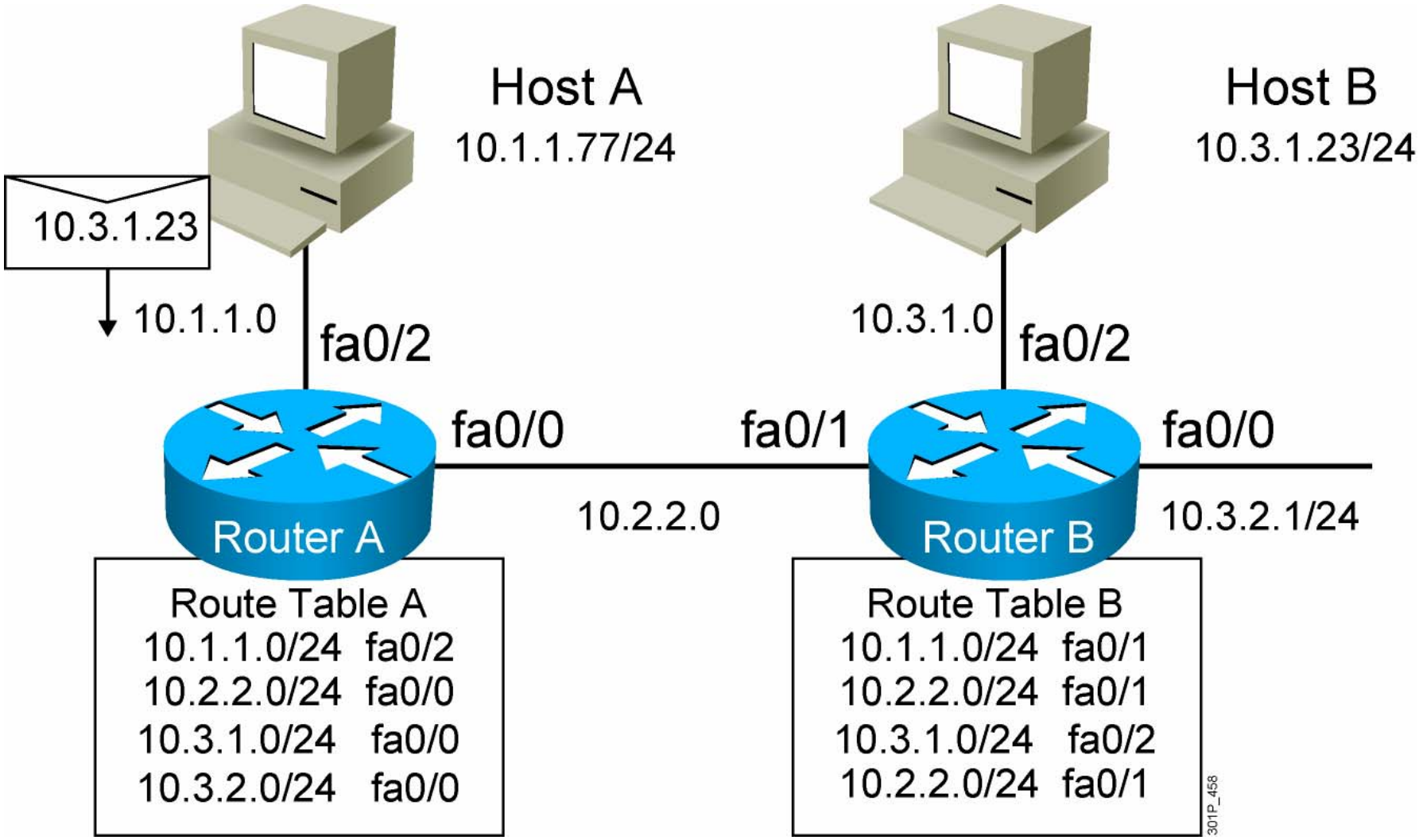
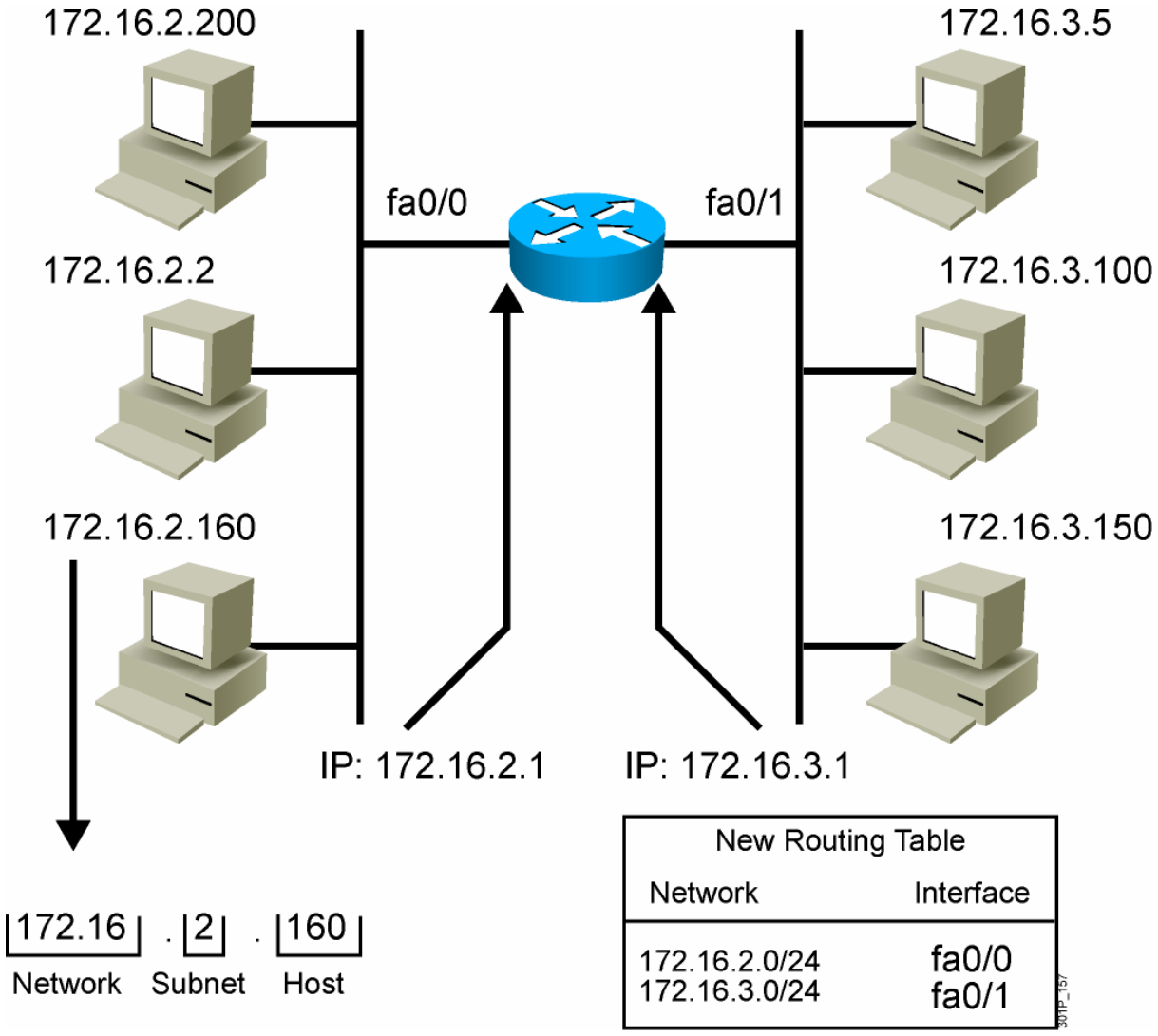
End System Subnet Mask Operation



How Routers Use Subnet Masks



Applying the Subnet Address Scheme



Octet Values of a Subnet Mask

128	64	32	16	8	4	2	1		
1	0	0	0	0	0	0	0	=	128
1	1	0	0	0	0	0	0	=	192
1	1	1	0	0	0	0	0	=	224
1	1	1	1	0	0	0	0	=	240
1	1	1	1	1	0	0	0	=	248
1	1	1	1	1	1	0	0	=	252
1	1	1	1	1	1	1	0	=	254
1	1	1	1	1	1	1	1	=	255

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Subnet masks, like IP addresses, are represented in the dotted decimal format like 255.255.255.0

Default Subnet Masks

Example Class A address (decimal):	10.0.0.0
Example Class A address (binary):	00001010.00000000.00000000.00000000
Default Class A mask (binary):	11111111.00000000.00000000.00000000
Default Class A mask (decimal):	255.0.0.0
Default classful prefix length:	/8

Example Class B address (decimal):	172.16.0.0
Example Class B address (binary):	10010001.10101000.00000000.00000000
Default Class B mask (binary):	11111111.11111111.00000000.00000000
Default Class B mask (decimal):	255.255.0.0
Default classful prefix length:	/16

Example Class C address (decimal):	192.168.42.0
Example Class C address (binary):	11000000.10101000.00101010.00000000
Default Class C mask (binary):	11111111.11111111.11111111.00000000
Default Class C mask (decimal):	255.255.255.0
Default classful prefix length:	/24

Procedure for Implementing Subnets

1. Determine the IP address assigned by the registry authority.
2. Based on the organizational and administrative structure, determine the number of subnets required.
3. Based on the address class and required number of subnets, determine the number of bits you need to borrow from the host ID.
4. Determine the binary and decimal value of the subnet mask.
5. Apply the subnet mask to the network IP address to determine the subnet and host addresses.
6. Assign subnet addresses to specific interfaces.

Eight Easy Steps for Determining Subnet Addresses

IP Address: 192.168.221.37 Subnet Mask /29

Step	Description	Example
1.	Write the octet that is being split in binary.	Fourth octet: 00100101
2.	Write the mask or classful prefix length in binary.	Assigned mask: 255.255.255.248 (/29) Fourth octet: 11111000
3.	Draw a line to delineate the significant bits in the assigned IP address. Cross out the mask so you can view the significant bits in the IP address.	Split octet (binary): 00100101 Split mask (binary): 11111000

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Eight Easy Steps for Determining Subnet Addresses (Cont.)

Step	Description	Example
4.	Copy the significant bits four times.	00100 000 (network address) 00100 001 (first address in subnet) 00100 110 (last address in subnet) 00100 111 (broadcast address)?
5.	In the first line, define the network address by placing all zeros in the significant bits.	
6.	In the last line, define the broadcast address by placing all ones in the significant bits.	
7.	In the middle lines, define the first and last host number.	
8.	Increment the subnet bits by one.	00101 000 (next subnet)

Completed Subnet Addresses

Network address: 192.168.221.32
Subnet mask: 255.255.255.248
First subnet: 192.168.221.32
First host address: 192.168.221.33
Last host address: 192.168.221.38
Broadcast address: 192.168.221.39
Next subnet: 192.168.221.40

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Example: Applying a Subnet Mask for a Class C Address

IP Address 192.168.5.139 Subnet Mask 255.255.255.224

IP Address	192	168	5	139	
IP Address	11000000	10101000	00000101	10001011	
Subnet Mask	11111111	11111111	11111111	11100000	/27
Subnetwork	11000000	10101000	00000101	10000000	
Subnetwork	192	168	5	128	
First Host	192	168	5	10000001=129	
Last Host	192	168	5	10011110=158	
Directed Broadcast	192	168	5	10011111=159	
Next Subnet	192	168	5	10100000=160	

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Example: Applying a Subnet Mask for a Class B Address

IP Address 172.16.139.46 Subnet Mask /20

IP Address	172	16	139	46	
IP Address	10101100	00010000	10001011	00101110	
Subnet Mask	11111111	11111111	11110000	00000000	/20
Subnetwork	10101100	00010000	10000000	00000000	
Subnetwork	172	16	128	0	
First Host	172	16	10000000	00000001=128.1	
Last Host	172	16	10001111	11111110=143.254	
Directed Broadcast	172	16	10001111	11111111=143.255	
Next Subnet	172	16	10010000	00000000=144.0	

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Example: Applying a Subnet Mask for a Class A Address

IP Address 10.172.16.211 Subnet Mask /18

IP Address	10	172	16	211	
IP Address	00001010	10101100	00010000	11010011	
Subnet Mask	11111111	11111111	11000000	00000000	/18
Subnetwork	00001010	10101100	00000000	00000000	
Subnetwork	10	172	0	0	
First Host	10	172	00000000	00000001=0.1	
Last Host	10	172	00111111	11111110=63.254	
Directed Broadcast	10	172	00111111	11111111=63.255	
Next Subnet	10	172	01000000	00000000=64.0	

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Summary

- Networks, particularly large networks, are often divided into smaller subnetworks, or subnets. Subnets can improve network performance and control.
- A subnet address extends the network portion, and is created by borrowing bits from the original host portion and designating them as the subnet field.
- Determining the optimal number of subnets and hosts depends on the type of network and the number of host addresses required.
- The algorithm for computing a number of subnets is 2^s, where *s* is the number of subnet bits.

Summary (Cont.)

- The subnet mask is the tool that the router uses to determine which bits are routing (network and subnet) bits and which bits are host bits.
- End systems use subnet masks to compare the network portion of the local network addresses with the destination addresses of the packets to be sent.
- Routers use subnet masks to determine if the network portion of an IP address is on the corresponding routing table or if the packet needs to be sent to the next router.

Summary (Cont.)

Follow these steps to determine the subnetwork and host addresses using a subnet mask:

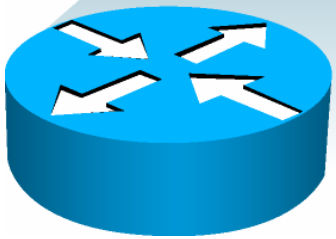
1. Write the octet being split in binary.
2. Write the mask in binary and draw a line to delineate the significant bits.
3. Cross out the mask so you can view the significant bits.
4. Copy the subnet bits four times.
5. Define the network address by placing all zeroes in the host bits.
6. Define the broadcast address by placing all ones in the host bits.
7. Define the first and last host numbers.
8. Increment the subnet bits by one.

Starting a Router

LAN Connections

Initial Startup of the Cisco Router

- System startup routines initiate router software
- Router falls back to startup alternatives if needed



1. Before you start the router, verify the power, cabling, and console connection.
2. Push the power switch to “on.”
3. Observe the boot sequence:
   - Cisco IOS Software output text appears on the console.

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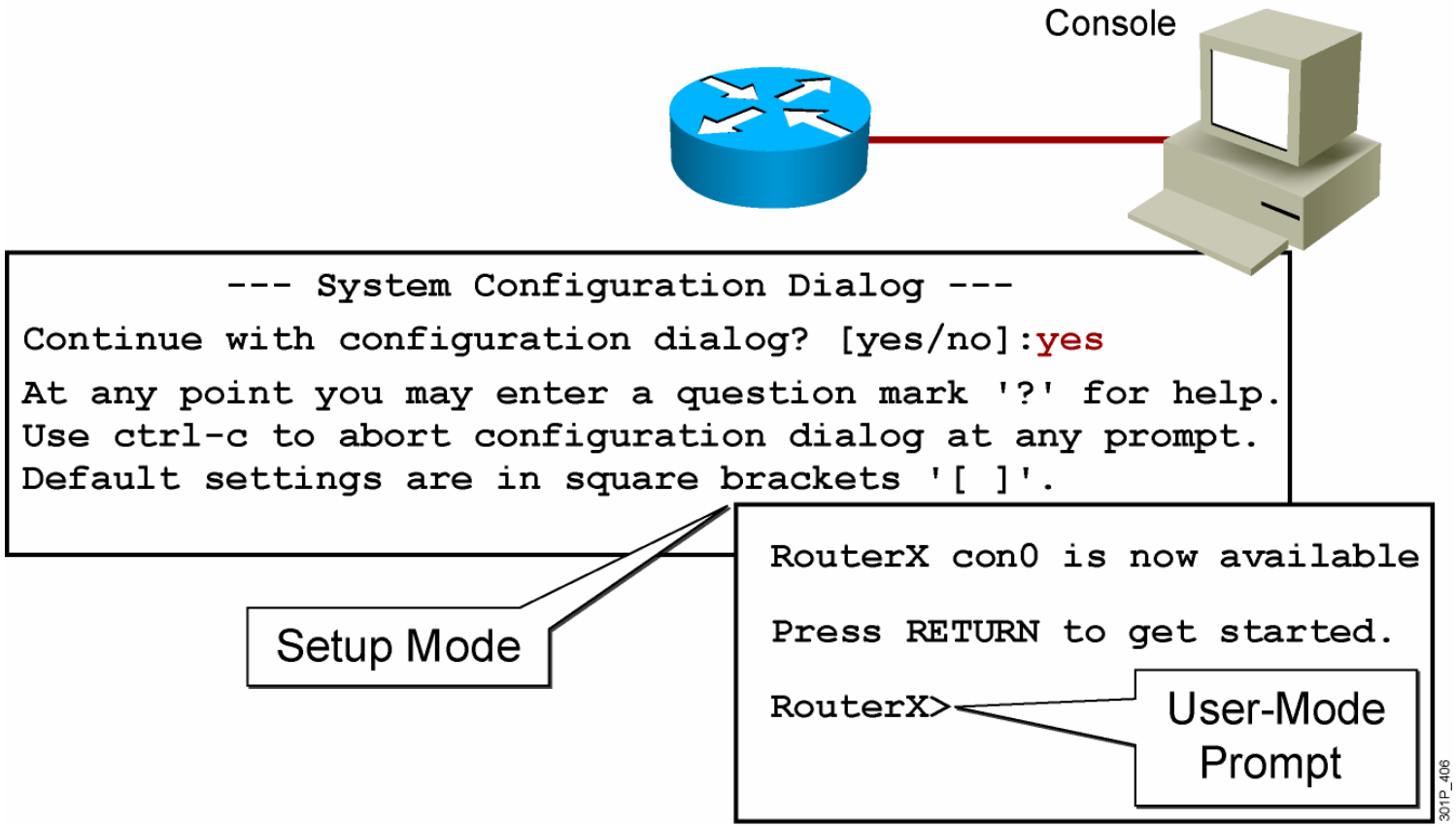
Bootup Output from the Router



Unconfigured vs. Configured Router

Setup: The Initial Configuration Dialog

```
Router#setup


        --- System Configuration Dialog ---

Continue with configuration dialog? [yes/no]: yes

At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.


Basic management setup configures only enough connectivity
for management of the system, extended setup will ask you
to configure each interface on the system

Would you like to enter basic management setup? [yes/no]: no
```

Setup Interface Summary

```
Any interface listed with OK? value "NO" does not have a valid configuration

Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            unassigned      NO  unset  up                    up
FastEthernet0/1            unassigned      NO  unset  up                    up
Serial0/0/0                unassigned      NO  unset  up                    up
Serial0/0/1                unassigned      NO  unset  down                  down
```

Interfaces Found During Startup

Setup Initial Global Parameters

```
Configuring global parameters:

  Enter host name [Router]:RouterX

    The enable secret is a password used to protect access to privileged
    EC and configuration modes. This password, after entered, becomes
    encrypted in the configuration.
  Enter enable secret: Cisco1

    The enable password is used when you do not specify an enable secret
    password, with some older software versions, and some boot images.
  Enter enable password: SanFran3

    The virtual terminal password is used to protect access to the
    router over a network interface.
  Enter virtual terminal password: Sanj0se
  Configure SNMP Network Management? [no]:
```

Setup Initial Protocol Configurations

```
Configure IP? [yes]:
    Configure RIP routing? [yes]: no
Configure CLNS? [no]:
  Configure bridging? [no]:
```

Depending on your software revision this text may appear.

Setup Interface Parameters

```
Configuring interface parameters:

Do you want to configure FastEthernet0/0  interface? [yes]:
  Use the 100 Base-TX (RJ-45) connector? [yes]:
  Operate in full-duplex mode? [no]:
  Configure IP on this interface? [yes]:
    IP address for this interface: 10.2.2.11
    Subnet mask for this interface [255.0.0.0] : 255.255.255.0
    Class A network is 10.0.0.0, 24 subnet bits; mask is /24

Do you want to configure FastEthernet0/1  interface? [yes]: no

Do you want to configure Serial0/0/0  interface? [yes]: no

Do you want to configure Serial0/0/1  interface? [yes]: no
```

Cisco AutoSecure

```
Would you like to go through AutoSecure configuration? [yes]: no
AutoSecure dialog can be started later using "auto secure" CLI
```

Depending on your software revision, this text may appear.

Setup Script Review and Use

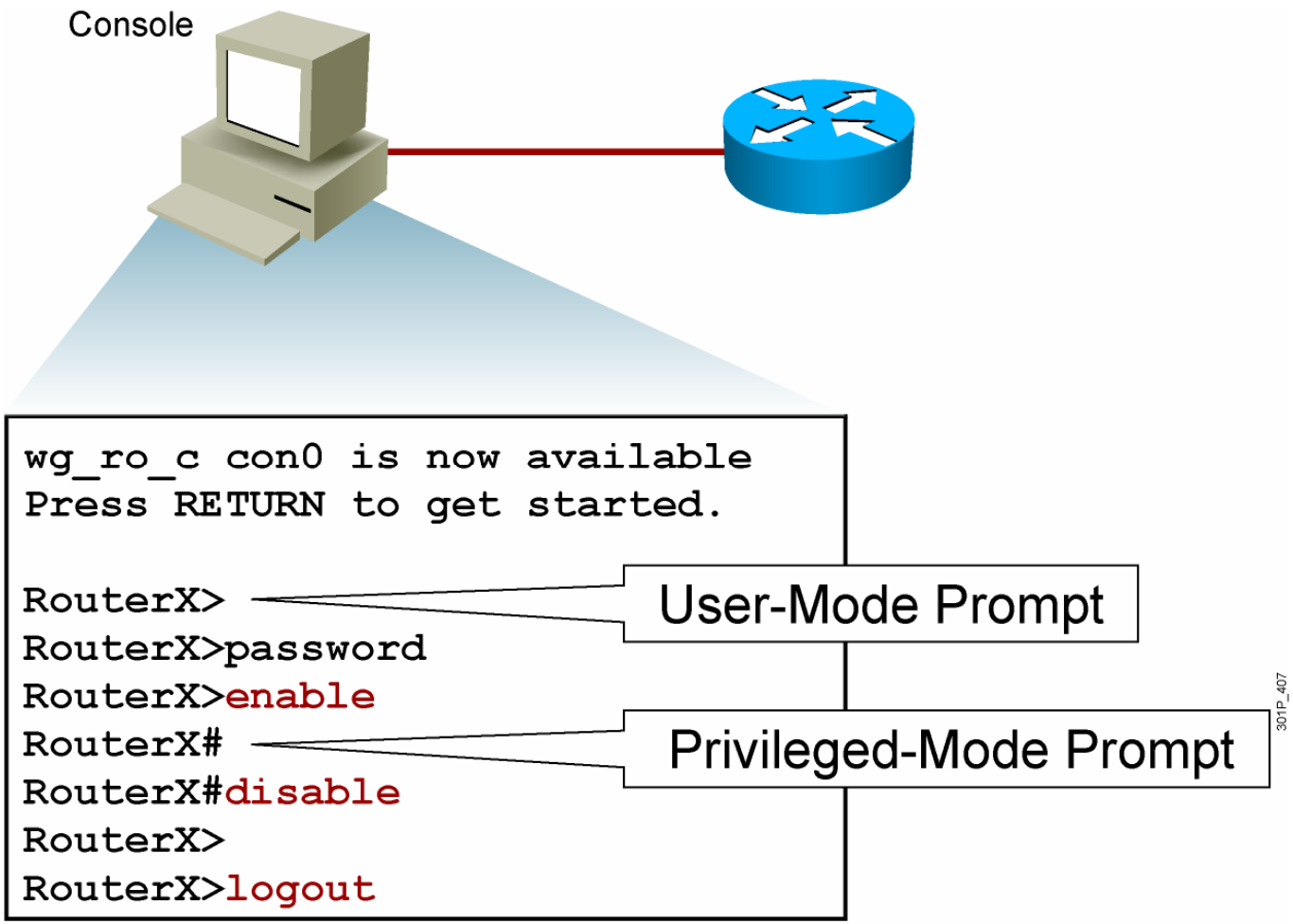
```
The following configuration command script was created:

hostname RouterX
enable secret 5 $1$aNMG$kV3mxjlWDRGXmfwjEBNAf1
enable password cisco
line vty 0 4
password sanjose
no snmp-server
!
ip routing
no clns routing
no bridge 1
!
interface FastEthernet0/0
media-type 100BaseX
half-duplex
ip address 10.2.2.11 255.255.255.0
no mop enabled
!
interface FastEthernet0/1
shutdown
no ip address
!
interface Serial0/0/0
shutdown
no ip address
!
interface Serial0/0/1
shutdown
no ip address
dialer-list 1 protocol ip permit
!
end

[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.

Enter your selection [2]: 2
```

Logging in to the Cisco Router



Router User-Mode Command List

```
RouterX>?
Exec commands:
  access-enable    Create a temporary Access-List entry
  access-profile   Apply user-profile to interface
  clear            Reset functions
  connect          Open a terminal connection
  disable          Turn off privileged commands
  disconnect       Disconnect an existing network connection
  enable           Turn on privileged commands
  exit             Exit from the EXEC
  help             Description of the interactive help system
  lat              Open a lat connection
  lock             Lock the terminal
  login            Log in as a particular user
  logout           Exit from the EXEC
-- More --
```

You can abbreviate a command to the fewest characters that make a unique character string.

Router Privileged-Mode Command List

```
RouterX#?
Exec commands:
  access-enable    Create a temporary Access-List entry
  access-profile   Apply user-profile to interface
  access-template  Create a temporary Access-List entry
  bfe              For manual emergency modes setting
  cd               Change current directory
  clear            Reset functions
  clock            Manage the system clock
  configure        Enter configuration mode
  connect          Open a terminal connection
  copy             Copy from one file to another
  debug            Debugging functions (see also 'undebug')
  delete           Delete a file
  dir              List files on a filesystem
  disable          Turn off privileged commands
  disconnect       Disconnect an existing network connection
  enable           Turn on privileged commands
  erase            Erase a filesystem
  exit             Exit from the EXEC
  help             Description of the interactive help system
-- More --
```

You can complete a command string by entering the unique character string, then pressing the **Tab** key.

show version **Command**

```
Cisco IOS Software, 2800 Software (C2800NM-ADVIPSERVICESK9-M), Version 12.4(12), RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2006 by Cisco Systems, Inc.
Compiled Fri 17-Nov-06 12:02 by prod_rel_team

ROM: System Bootstrap, Version 12.4(13r)T, RELEASE SOFTWARE (fc1)

RouterX uptime is 2 days, 21 hours, 15 minutes
System returned to ROM by power-on
System image file is "flash:c2800nm-advipservicesk9-mz.124-12.bin"


This product contains cryptographic features and is subject to United States and local country laws
governing import, export, transfer and use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption. Importers, exporters, distributors
and users are responsible for compliance with U.S. and local country laws. By using this product you agree
to comply with applicable laws and regulations. If you are unable to comply with U.S. and local laws, return
this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco 2811 (revision 53.50) with 249856K/12288K bytes of memory.
Processor board ID FTX1107A6BB
2 FastEthernet interfaces
2 Serial(sync/async) interfaces
1 Virtual Private Network (VPN) Module
DRAM configuration is 64 bits wide with parity enabled.
239K bytes of non-volatile configuration memory.
62720K bytes of ATA CompactFlash (Read/Write)

Configuration register is 0x2102

RouterX#
```

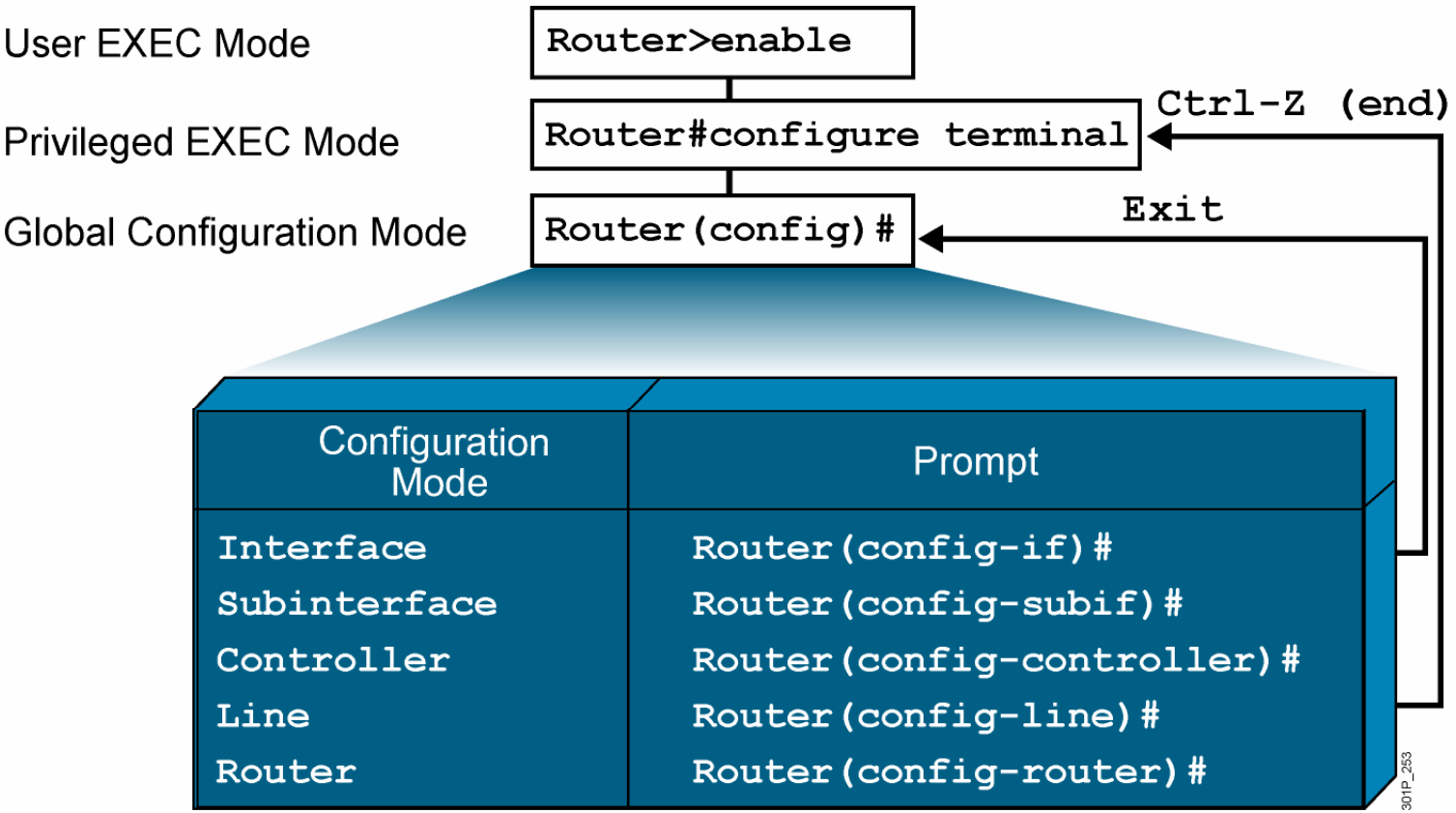
Summary

- The Cisco router startup sequence is similar to the startup sequence of the Cisco Catalyst switch. After performing POST, the router finds and loads the Cisco IOS image. Finally, it finds and loads the device configuration file.
- Use the **enable** command to access the privileged EXEC mode from the user EXEC mode.
- After logging in to a Cisco router, you can verify the initial startup status of a router by using the router status commands: **show version**, **show running-config**, and **show startup-config**

Configuring a Cisco Router

LAN Connections

Overview of Router Modes



Saving Configurations

```
RouterX#
RouterX#copy running-config startup-config
Destination filename [startup-config]?
Building configuration…

RourterX#
```

Copies the current configuration to NVRAM

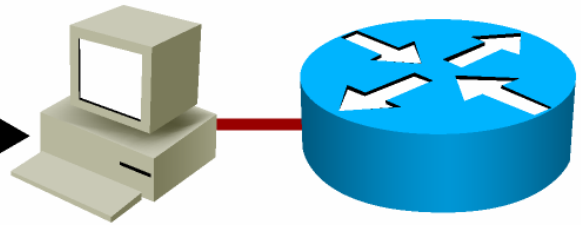
Configuring Router Identification

Router Name

```
Router(config)#hostname RouterX
RouterX(config)#
```

Message-of-the-Day Banner

```
RouterX(config)#banner motd  #
      Enter TEXT message. End with
      the character #. You have
      entered a secured system.
      Authorized access only! #
```



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Console-Line Commands

```
RouterX(config)#line console 0
RouterX(config-line)#exec-timeout 20 30
```

- Modifies console session timeout

```
RouterX(config)#line console 0
RouterX(config-line)#logging synchronous
```

- Redisplays interrupted console input

Configuring an Interface

```
RouterX(config)#interface type number
RouterX(config-if)#
```

- **type** includes serial, ethernet, token ring, fddi, hssi, loopback, dialer, null, async, atm, bri, tunnel, and so on
- **number** is used to identify individual interfaces

```
RouterX(config)#interface type slot/port
RouterX(config-if)#
```

- For modular routers, selects an interface

```
RouterX(config-if)#exit
```

- Quits from current interface configuration mode

Configuring an Interface Description

```
RouterX(config-if)# description string
```

- ***string*** *is a c*omment or a description to help you remember what is attached to this interface.
- The maximum number of characters for the *string* argument is 238.

Disabling or Enabling an Interface

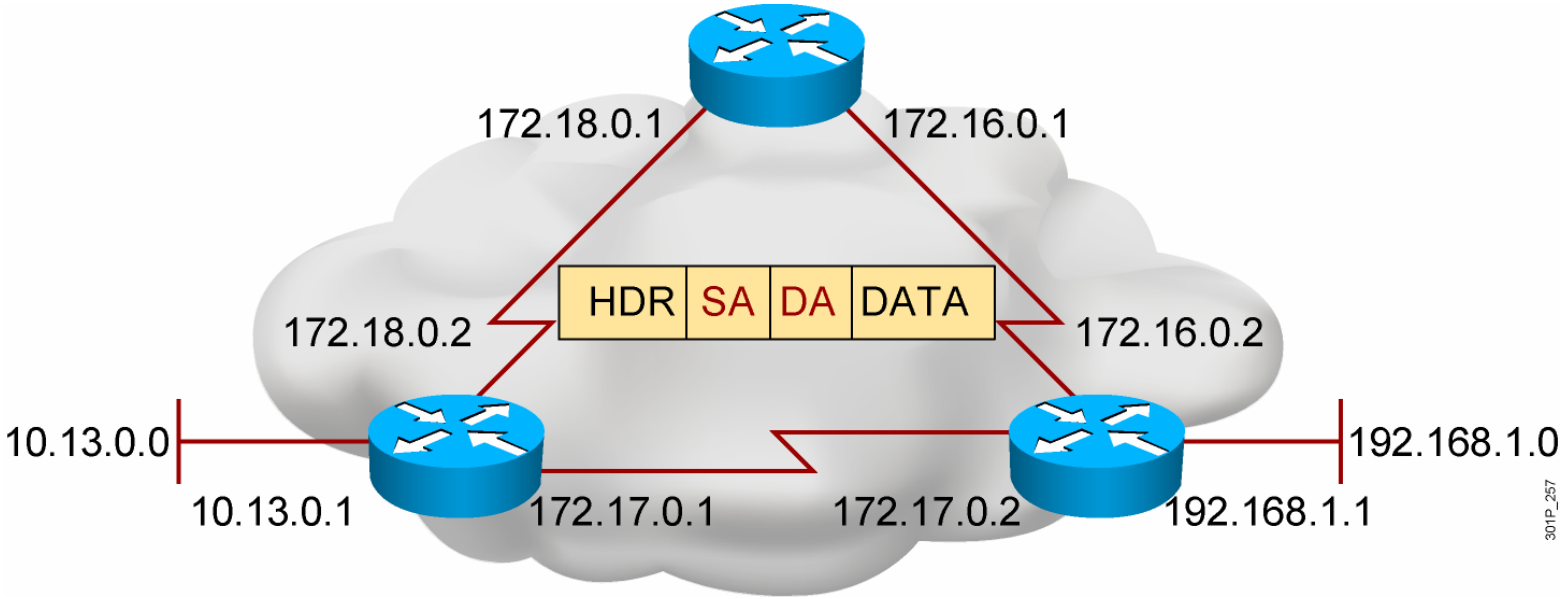
```
RouterX#configure terminal
RouterX(config)#interface serial 0
RouterX(config-if)#shutdown
%LINK-5-CHANGED: Interface Serial0, changed state to administratively down
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0, changed state to down
```

- Administratively turns off an interface

```
RouterX#configure terminal
RouterX(config)#interface serial 0
RouterX(config-if)#no shutdown
%LINK-3-UPDOWN:  Interface Serial0, changed state to up
%LINEPROTO-5-UPDOWN: Line Protocol on Interface Serial0, changed state to up
```

- Enables an interface that is administratively shut down

Configuring IP Addresses

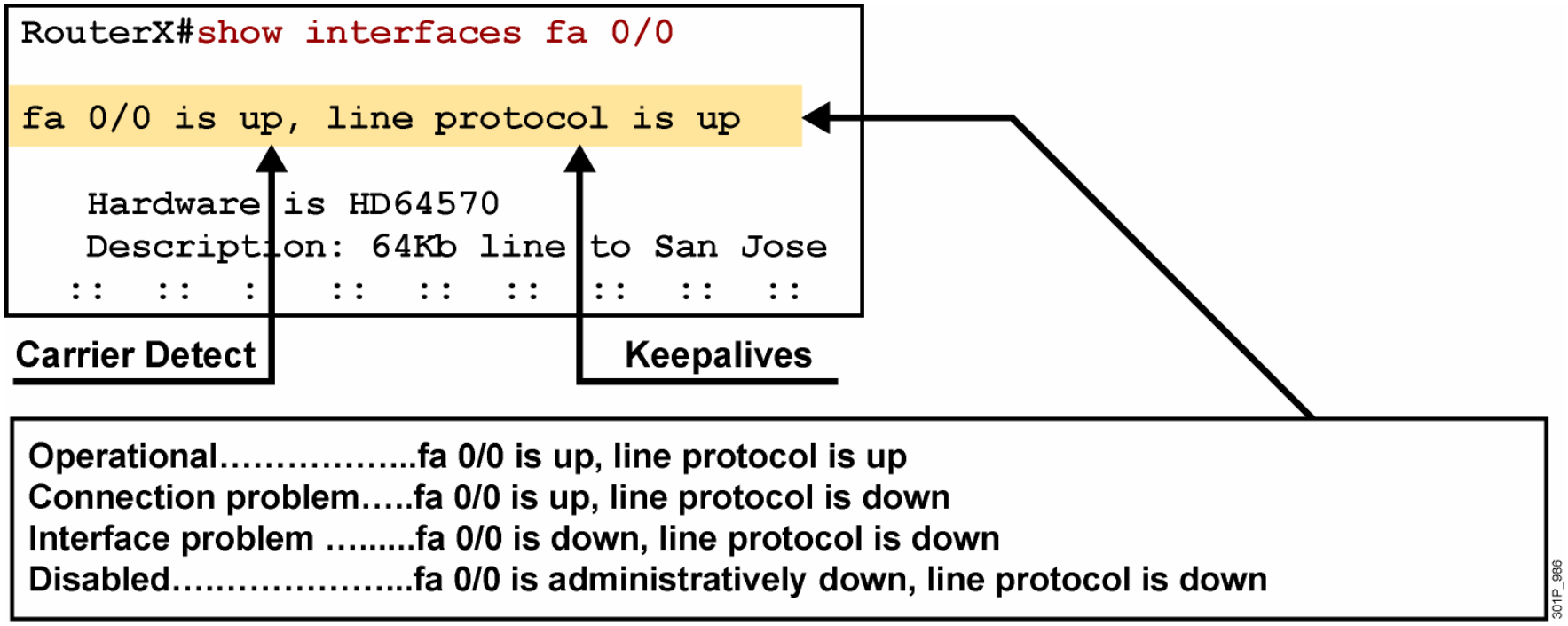


- Unique addressing allows communication between end stations
- Path choice is based on destination address

Router show interfaces Command

```
RouterX#show interfaces
Ethernet0 is up, line protocol is up
  Hardware is Lance, address is 00e0.1e5d.ae2f (bia 00e0.1e5d.ae2f)
  Internet address is 10.1.1.11/24
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 255/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive set (10 sec)
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:07, output 00:00:08, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     81833 packets input, 27556491 bytes, 0 no buffer
     Received 42308 broadcasts, 0 runts, 0 giants, 0 throttles
     1 input errors, 0 CRC, 0 frame, 0 overrun, 1 ignored, 0 abort
     0 input packets with dribble condition detected
     55794 packets output, 3929696 bytes, 0 underruns
     0 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 4 deferred
     0 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

Interpreting the Interface Status



Verifying a Serial Interface Configuration

```
RouterX#show interface serial s0/0/0
Serial0/0 is up, line protocol is up
  Hardware is PowerQUICC Serial
  Internet address is 10.140.4.2/24
  MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation HDLC, loopback not set, keepalive set (10 sec)
  Last input 00:00:09, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
(output omitted)
```

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Summary

- From the privileged EXEC mode, you can enter the global configuration mode, providing access to other configuration modes such as the interface configuration mode or line configuration mode.
- The main function of a router is to relay packets from one network device to another. To do this, the characteristics of the interfaces through which the packets are received and sent must be defined. Interface characteristics, such as the IP address and bandwidth, are configured using the interface configuration mode.

Summary (Cont.)

- In a TCP/IP environment, end stations communicate seamlessly with servers or other end stations. This communication occurs because each node using the TCP/IP protocol suite has a unique 32-bit logical IP address.
- When the router interface configuration has been completed, it can be verified by using **show** commands

Exploring the Packet Delivery Process

LAN Connections