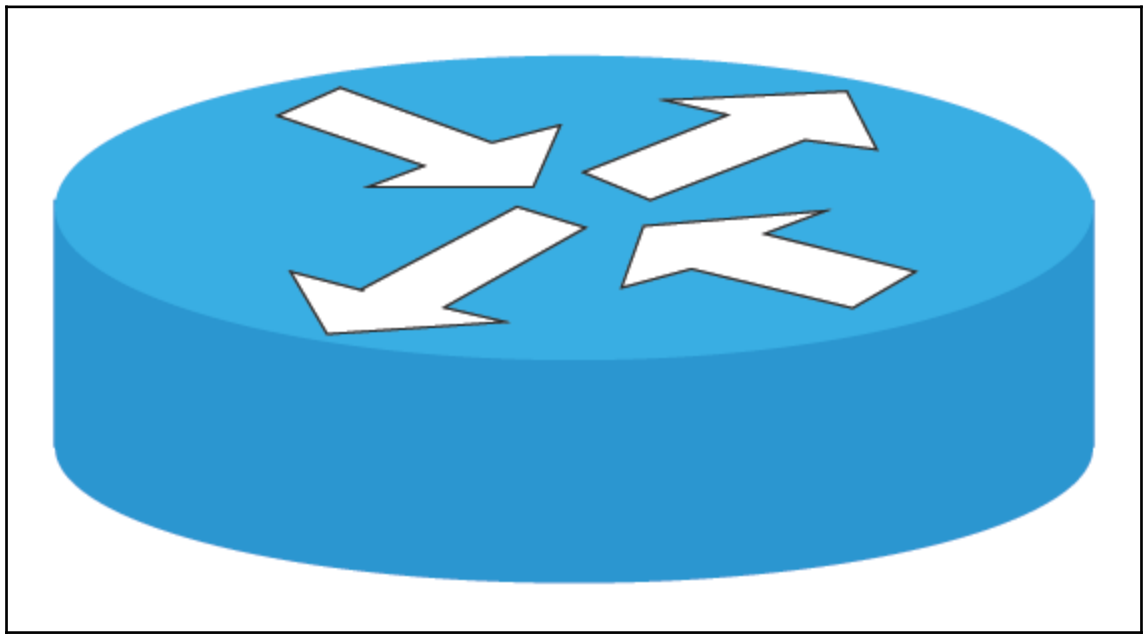
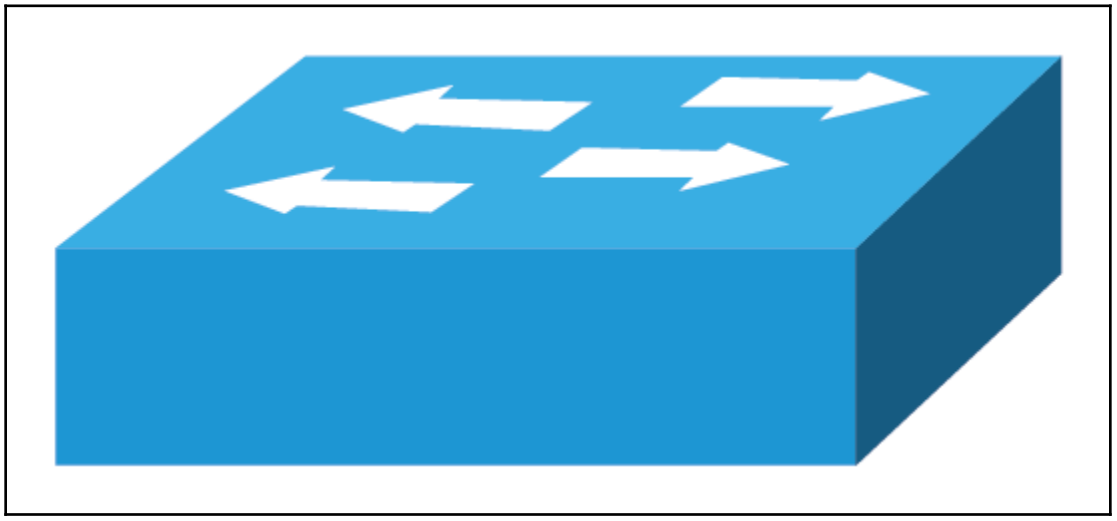
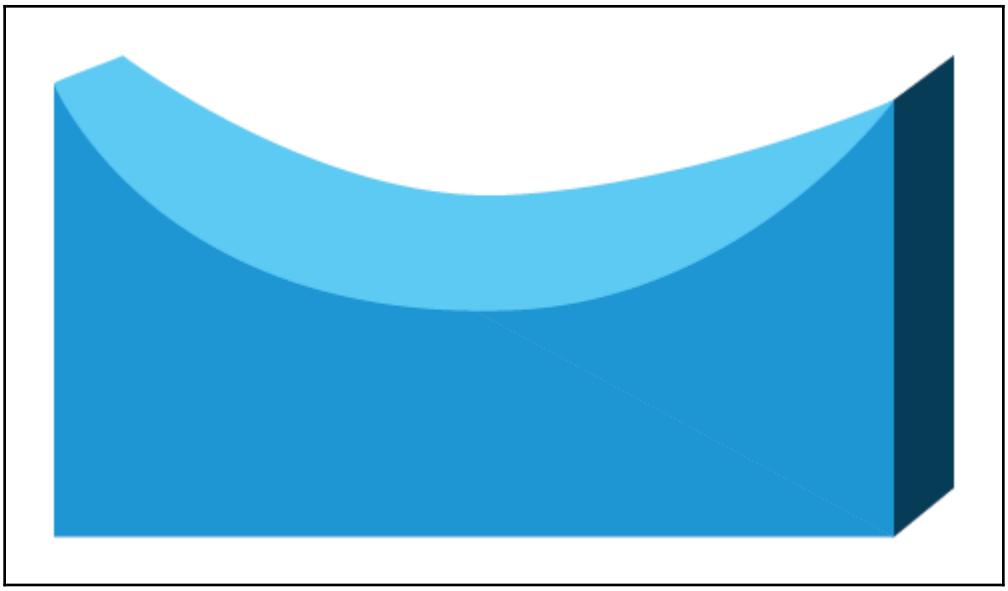
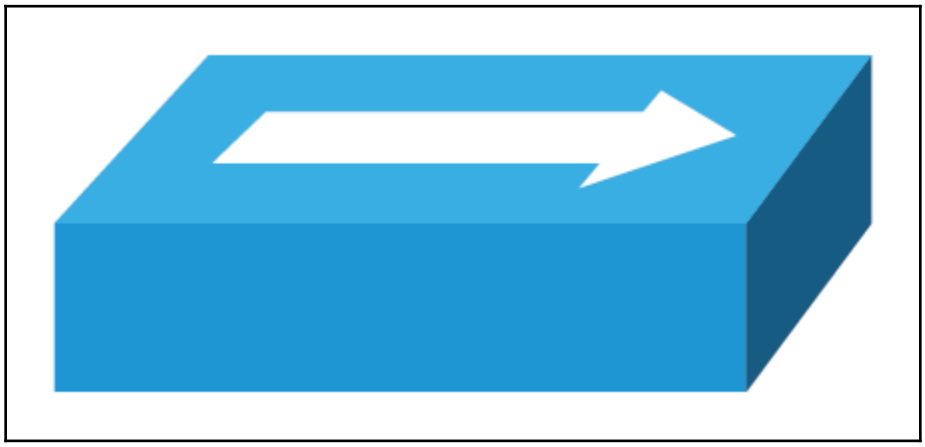
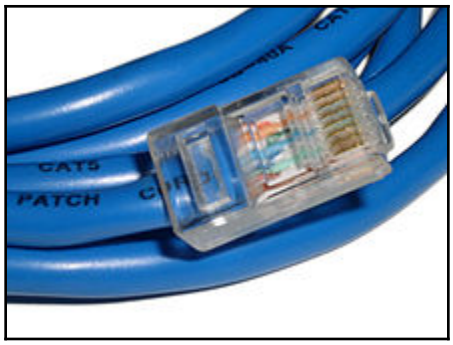
Chapter 1: Internetworking Models

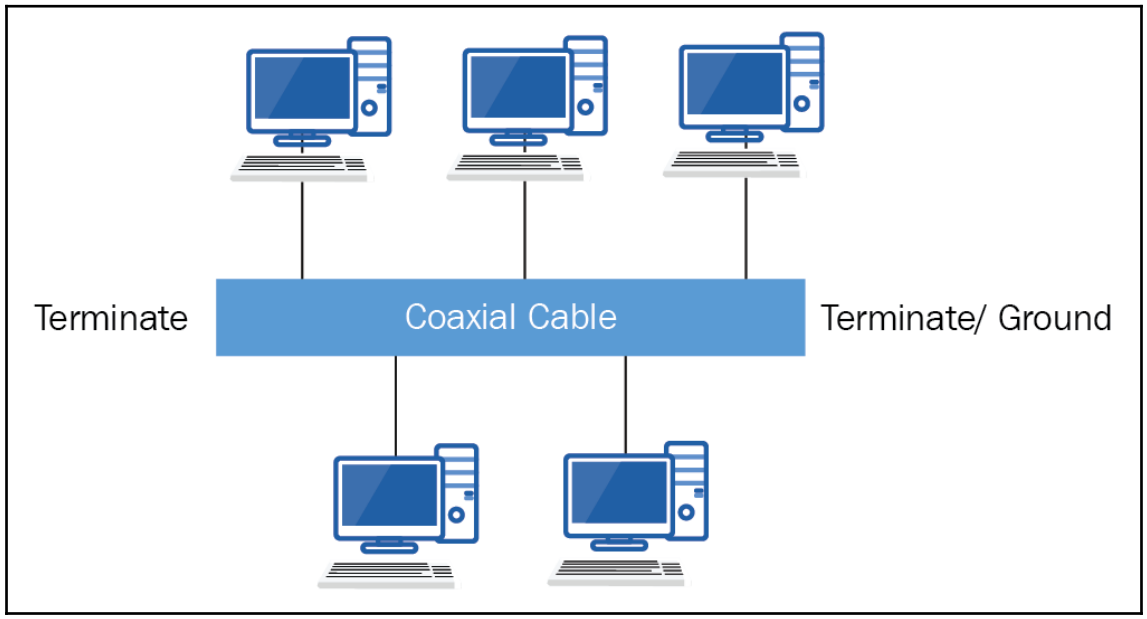


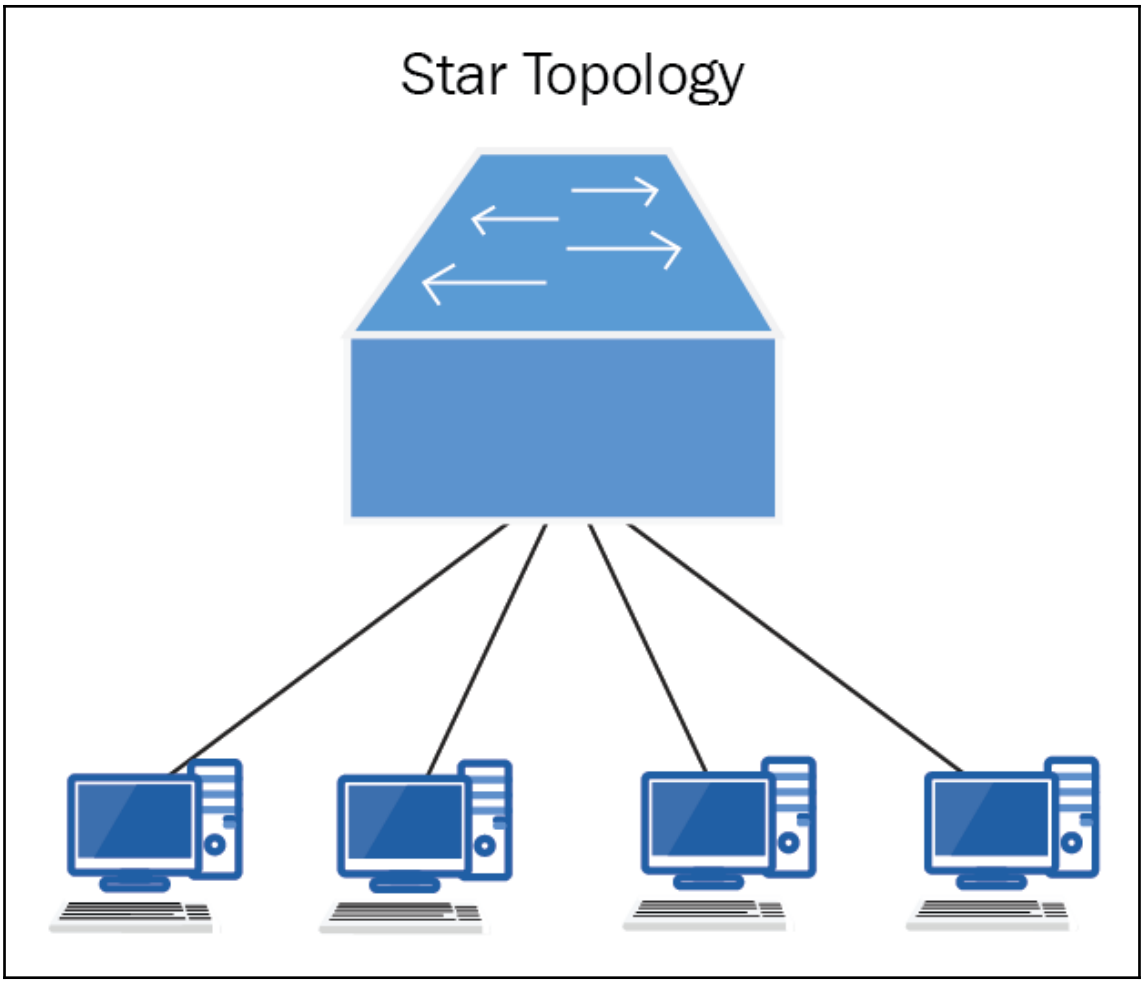


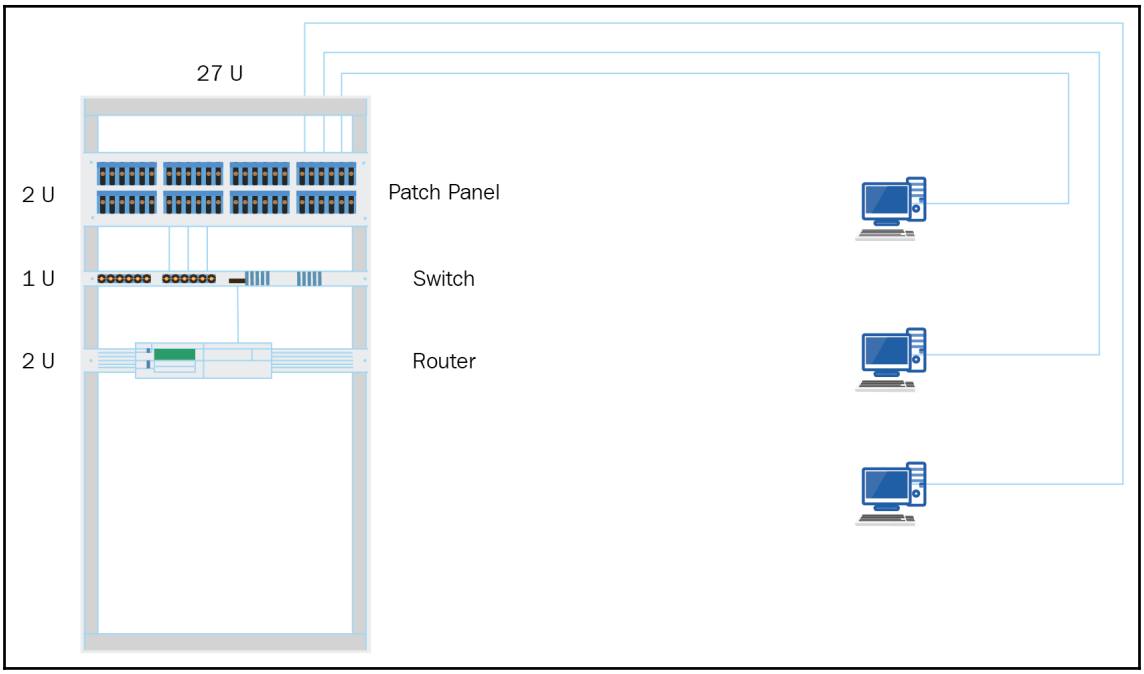


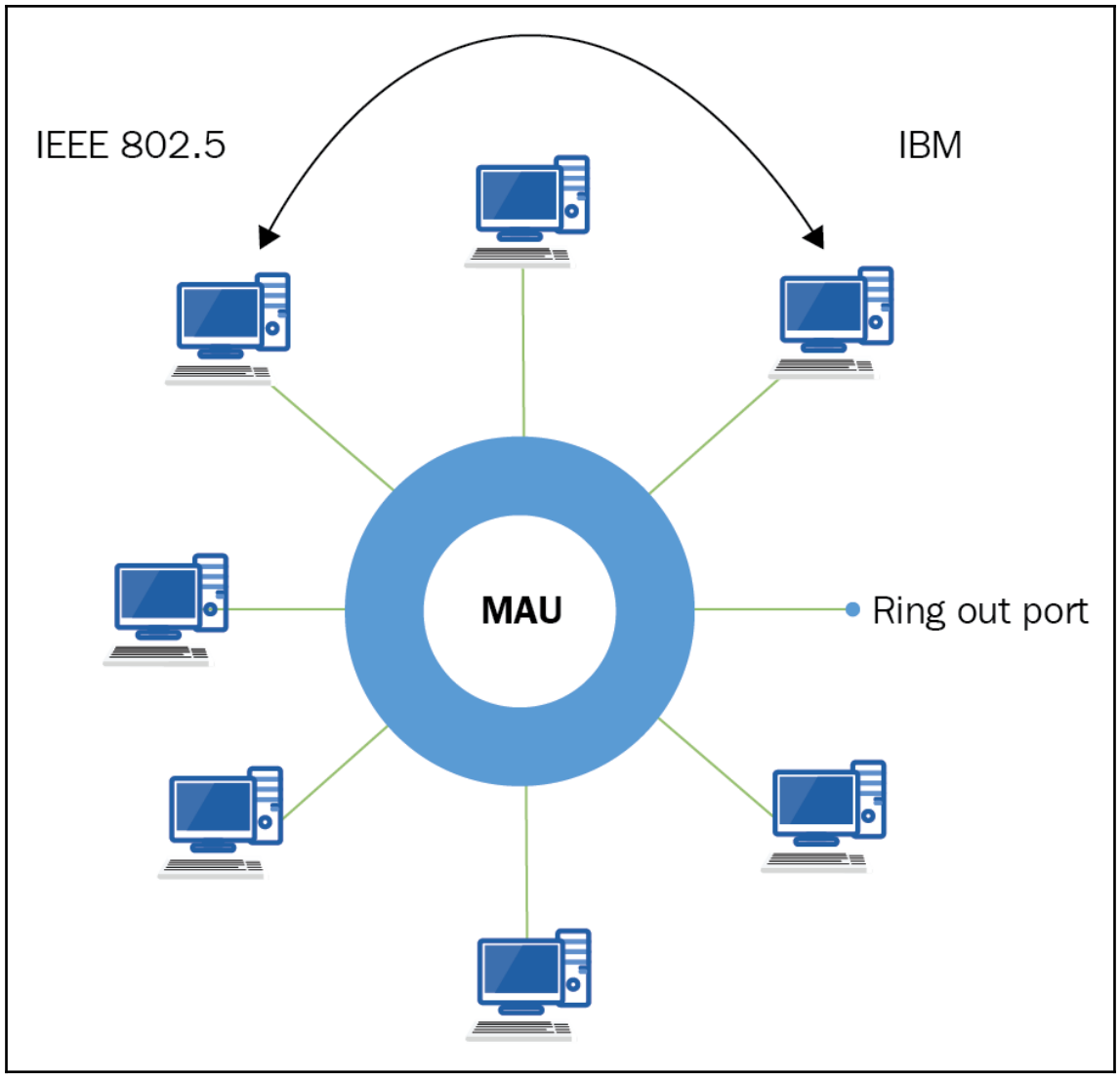


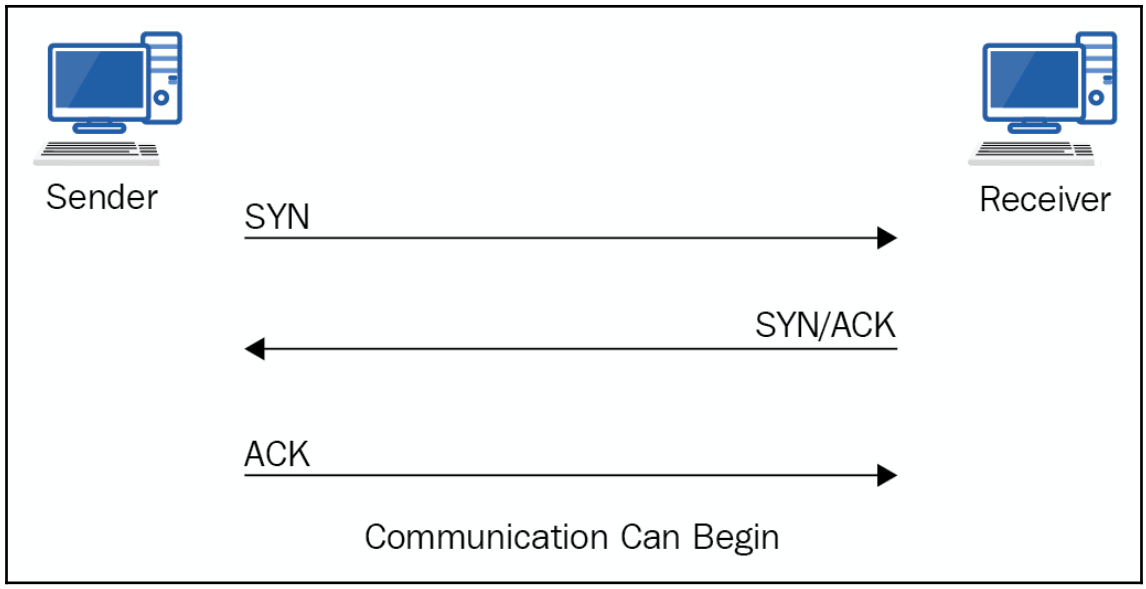

CAT5
PATCH

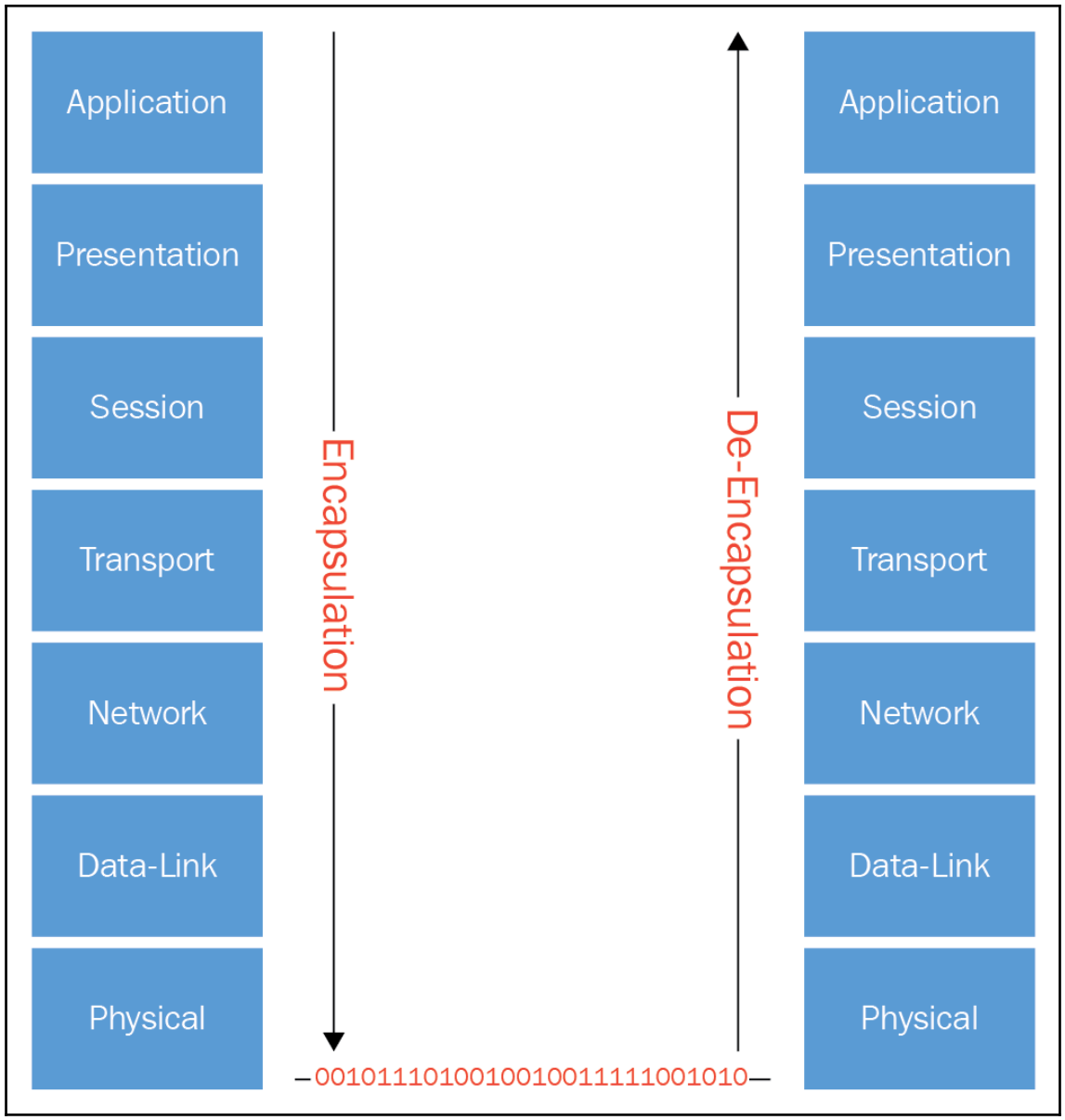

Terminate
Coaxial Cable
Terminate/ Ground


Star Topology

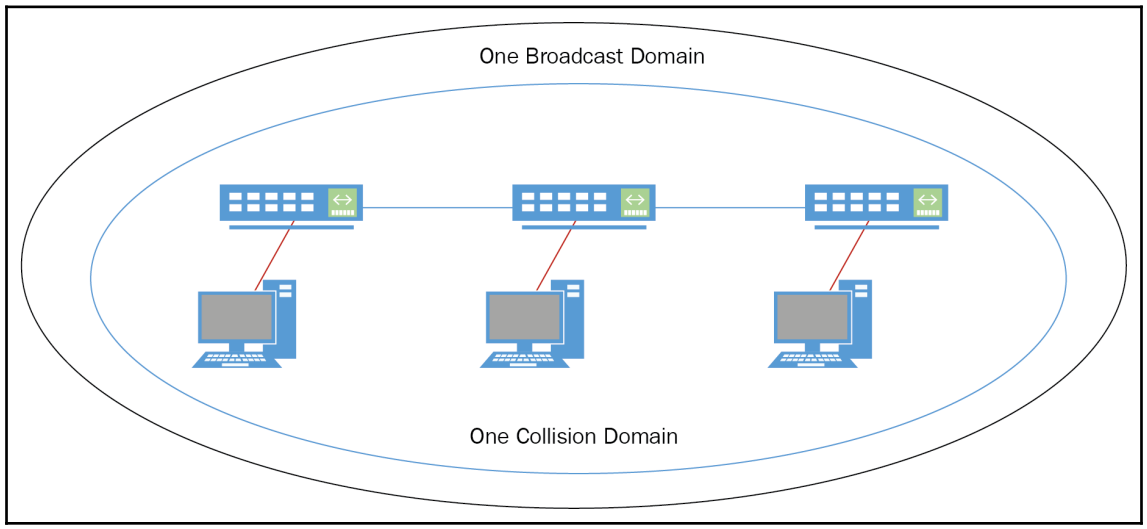

27 U
2 U
Patch Panel
1 U
Switch
2 U
Router

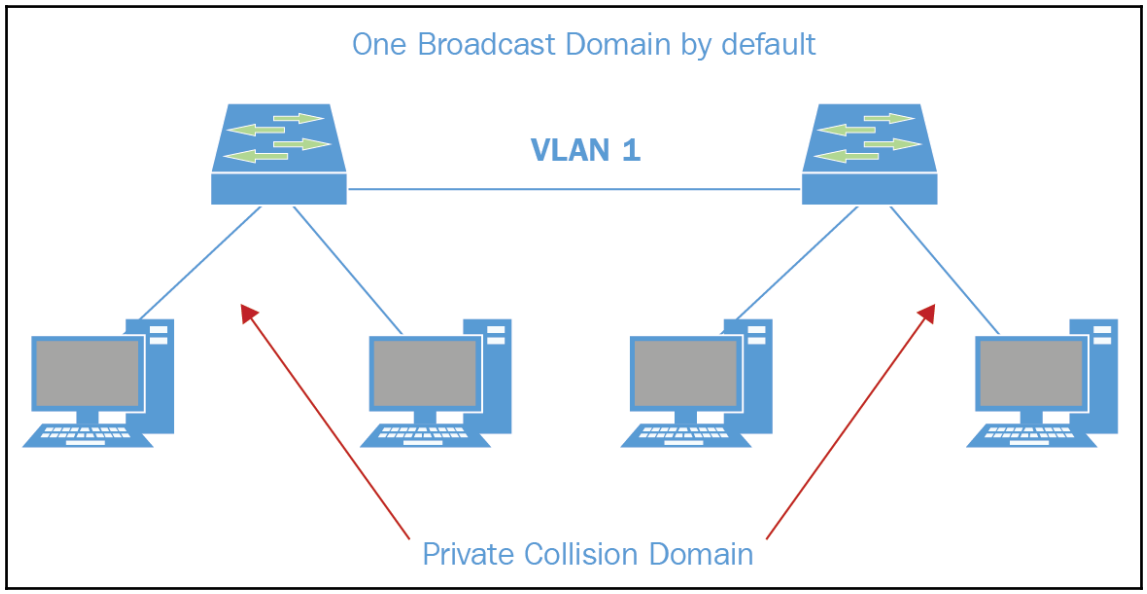

IEEE 802.5
IBM
MAU
Ring out port

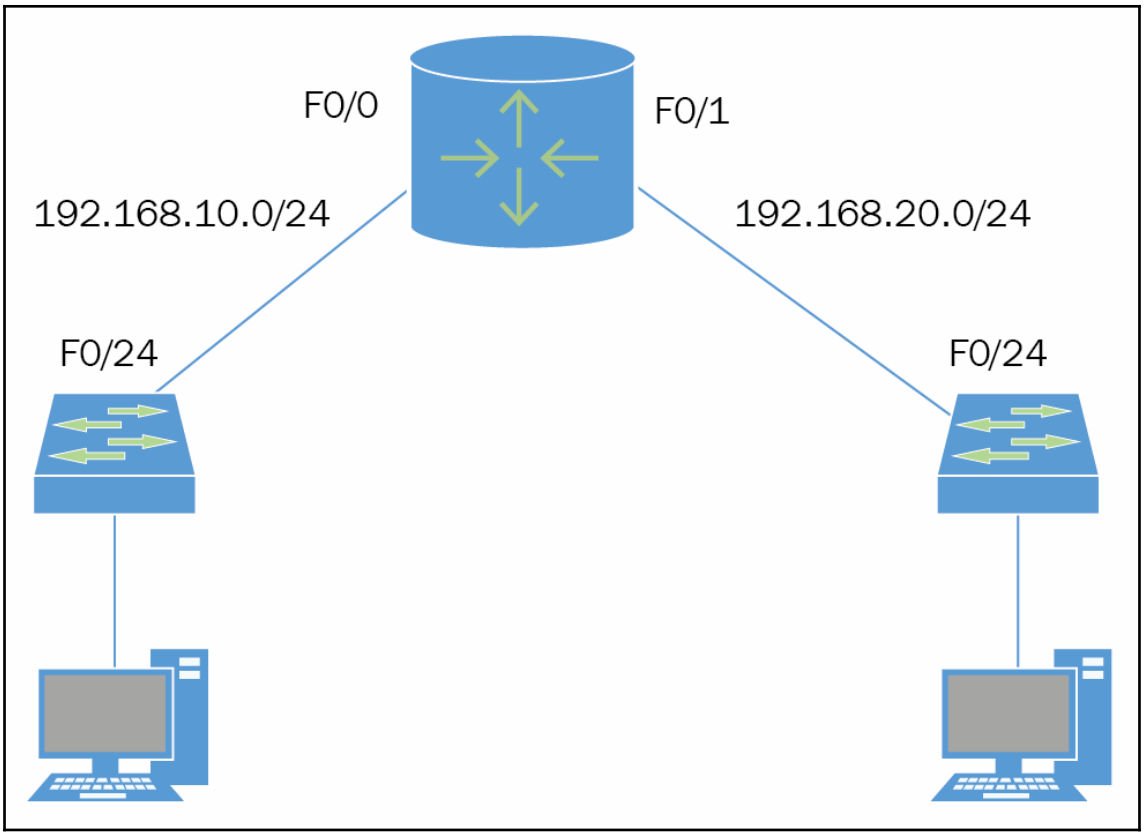

Sender
Receiver
SYN
SYN/ACK
ACK
Communication Can Begin

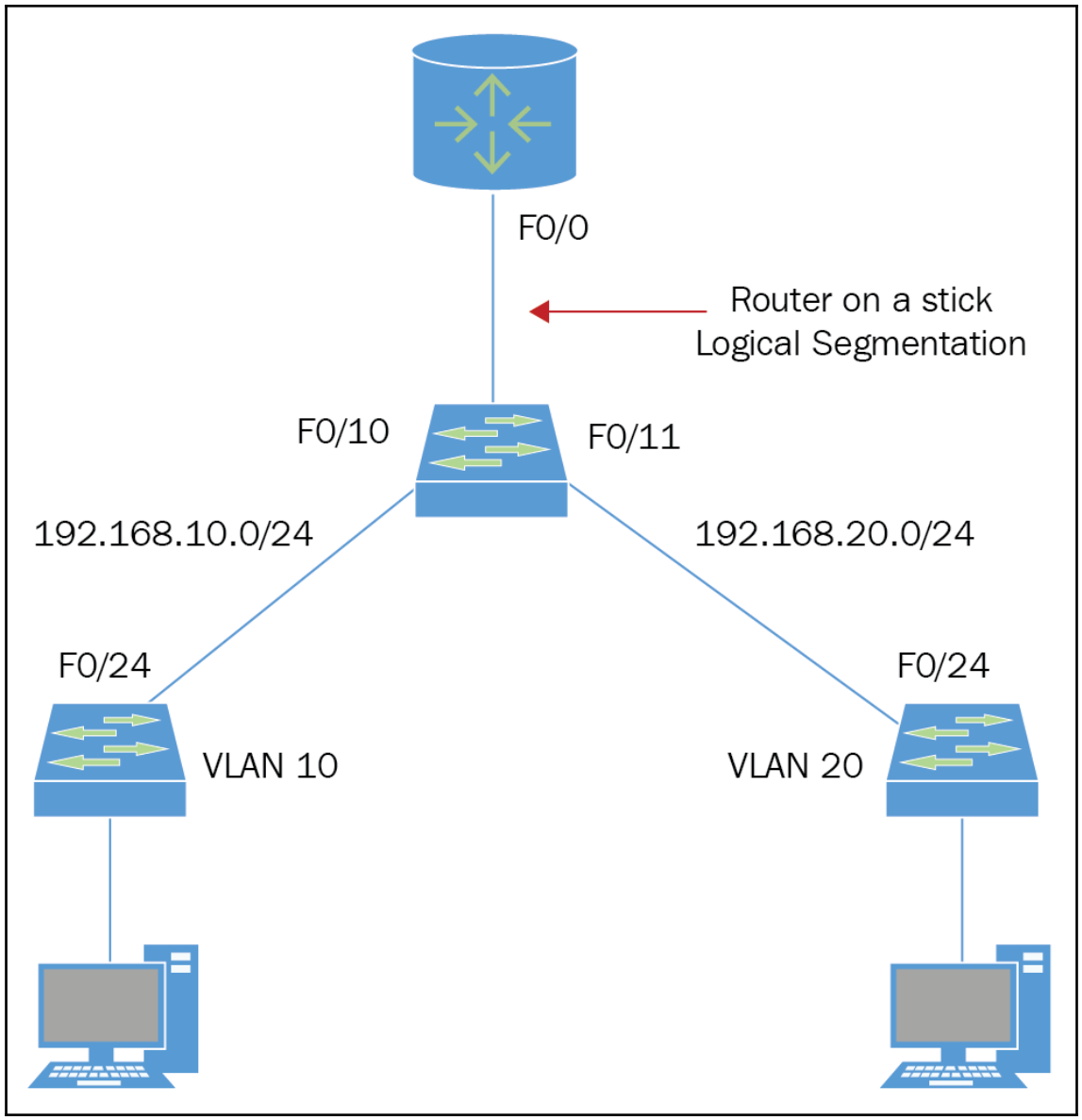

Application
Presentation
Session
Transport
Network
Data-Link
Physical
Encapsulation
00101110100100100111110010 10
De-Encapsulation
Application
Presentation
Session
Transport
Network
Data-Link
Physical

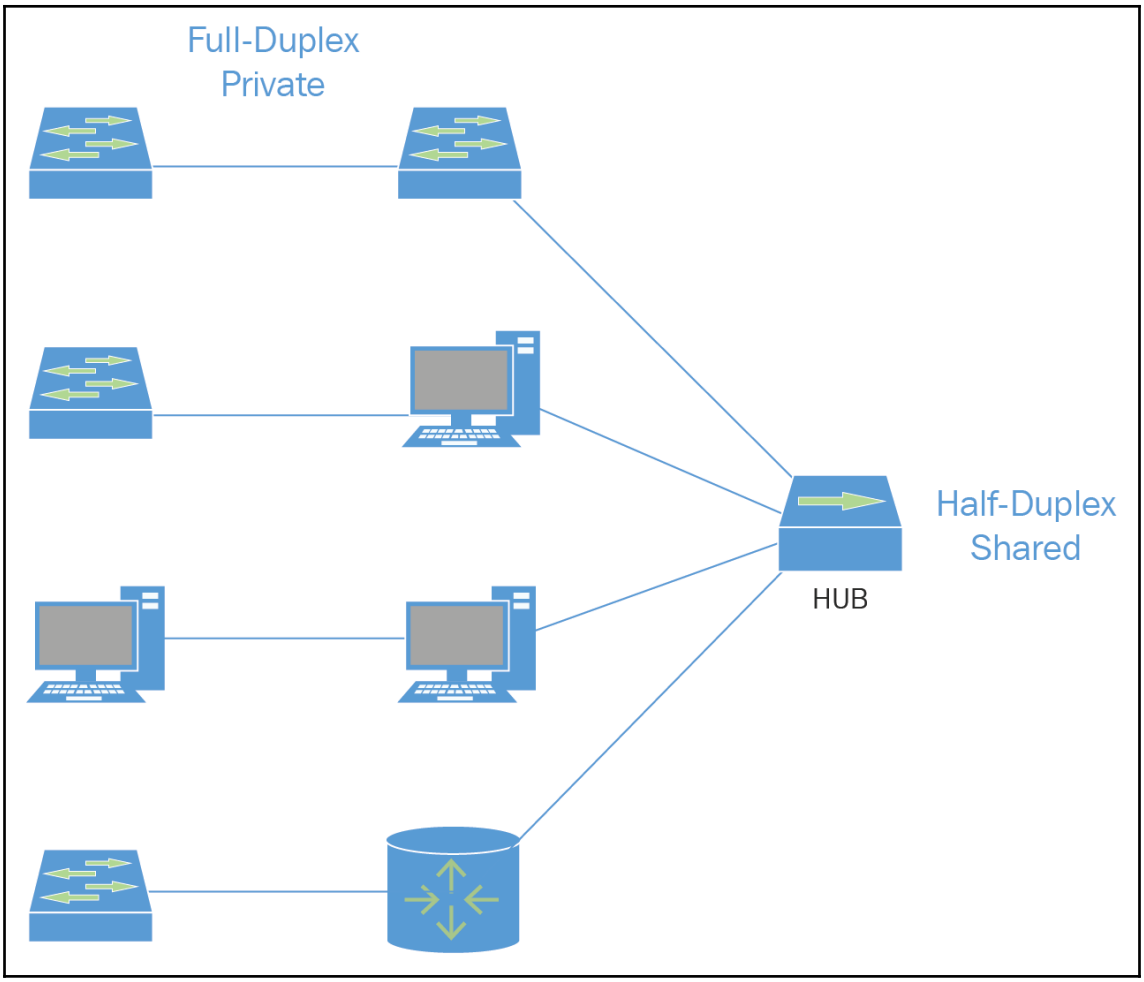
Chapter 2: Ethernet Networking and Data Encapsulations

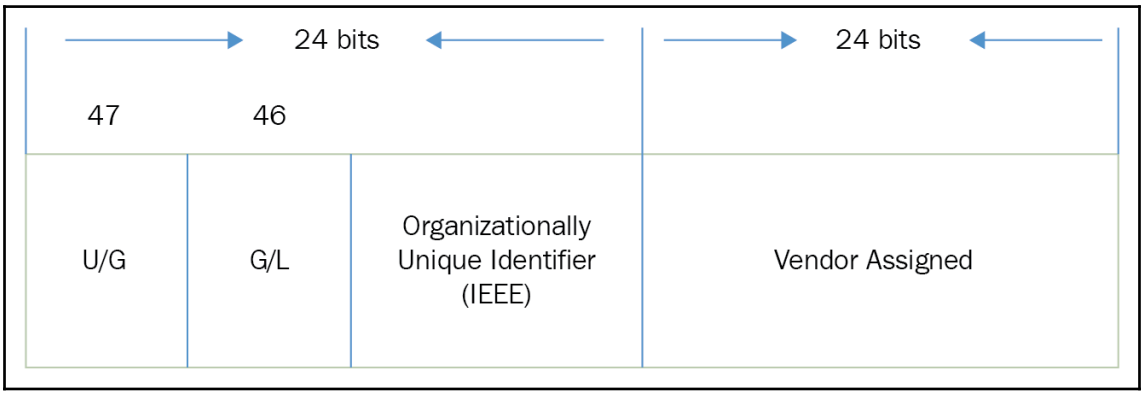





F0/0
F0/1
192.168.10.0/24
192.168.20.0/24
F0/24
F0/24


F0/0
Router on a stick
Logical Segmentation
F0/10
F0/11
192.168.10.0/24
192.168.20.0/24
F0/24
F0/24
VLAN 10
VLAN 20


Full-Duplex
Private
HUB
Half-Duplex
Shared


24 bits
24 bits
47
46
U/G
G/L
Organizationally
Unique Identifier
(IEEE)
Vendor Assigned

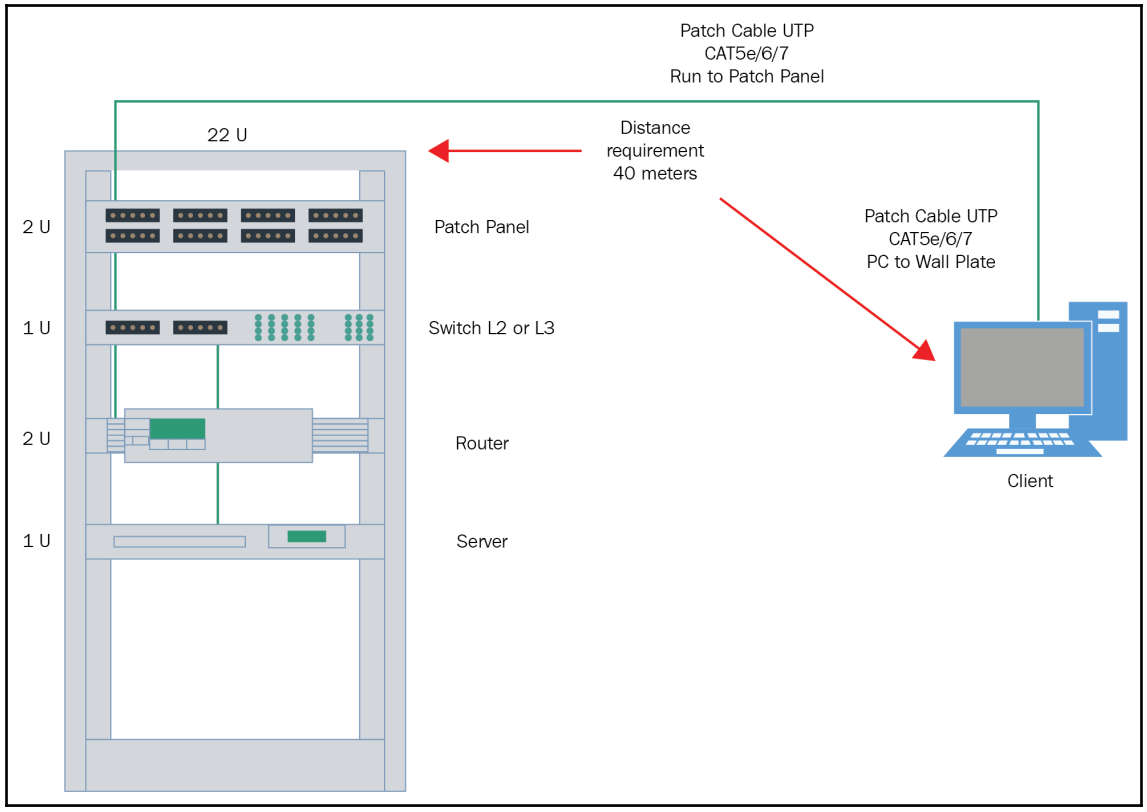
128·64·32·16·8·4·2·1

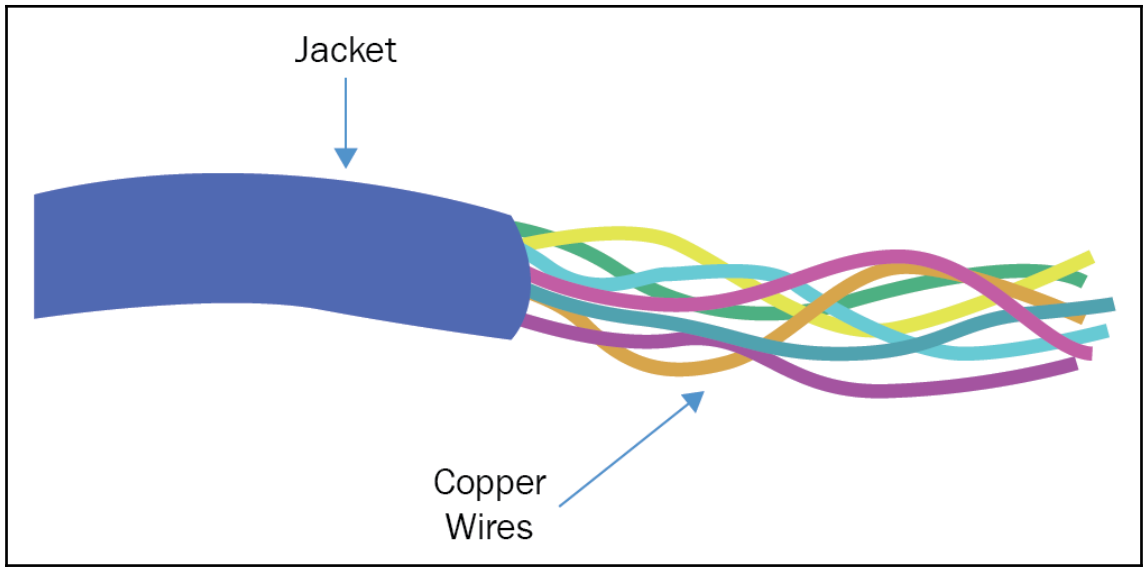
8421	8421

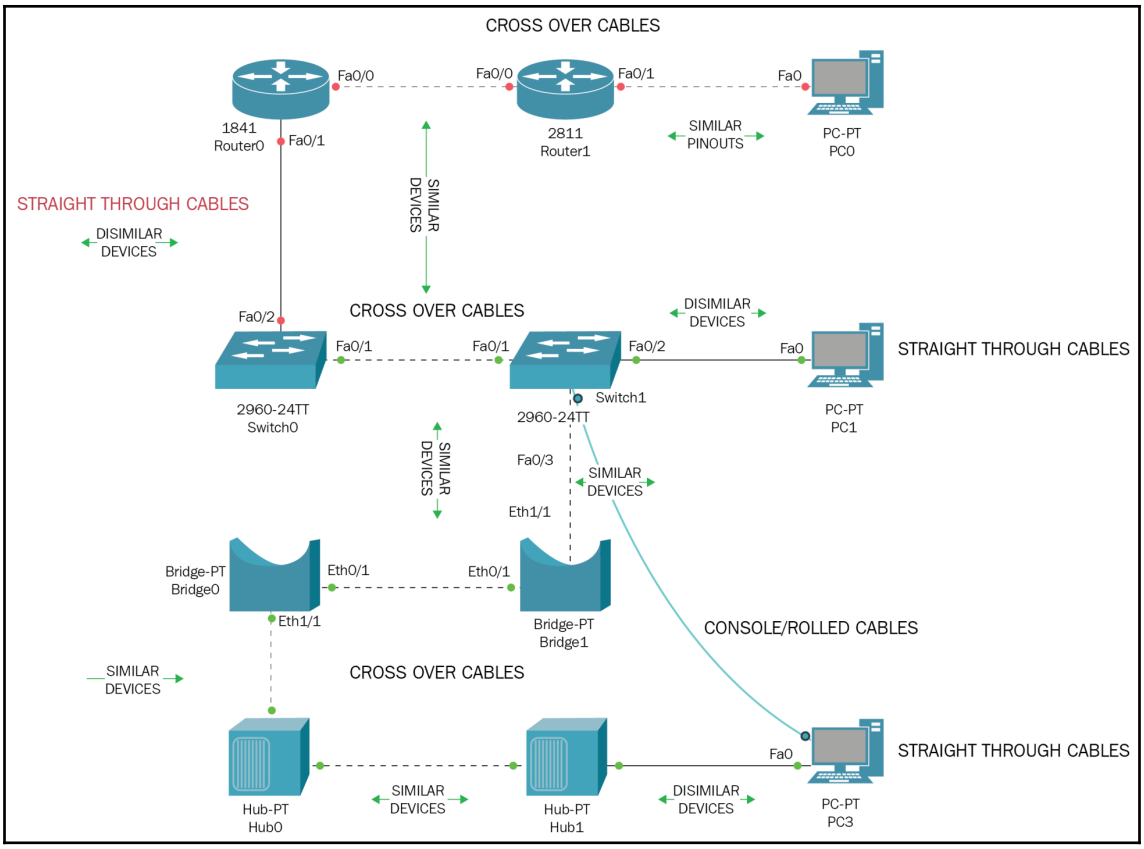
Ethernet_II

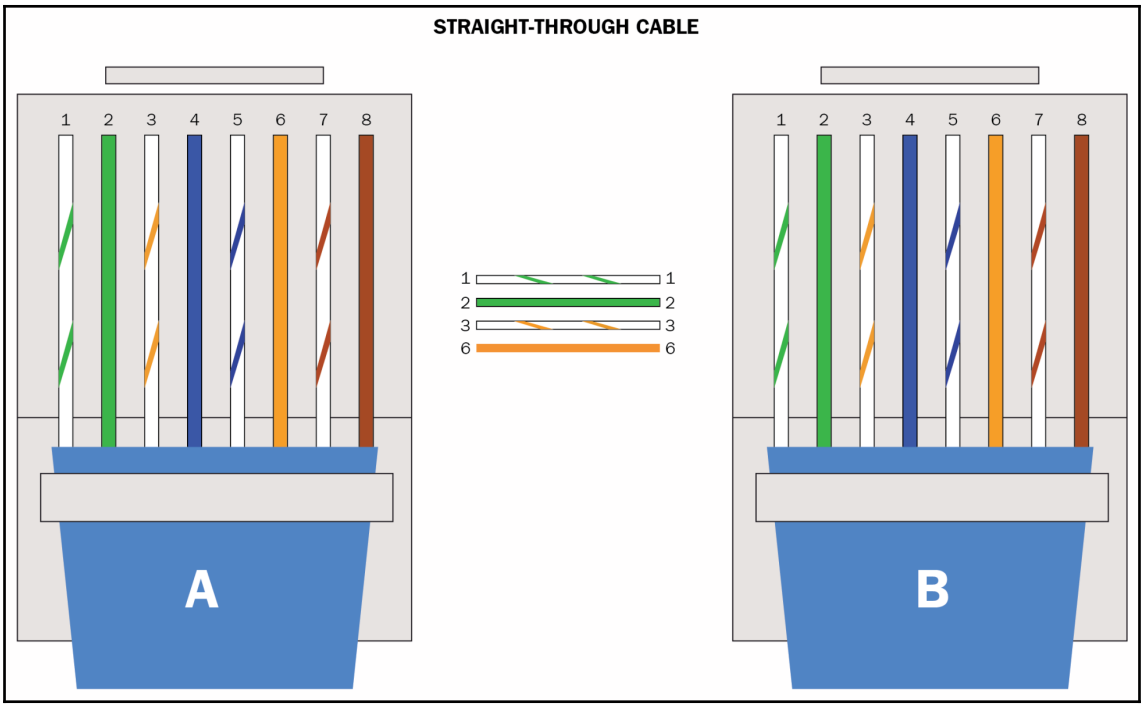
Preamble 7 bytes	5FD 1 byte	Destination 6 bytes	Source 6 bytes	Type 2 bytes	Data and Pad 46-1500 bytes	FCS 4 bytes

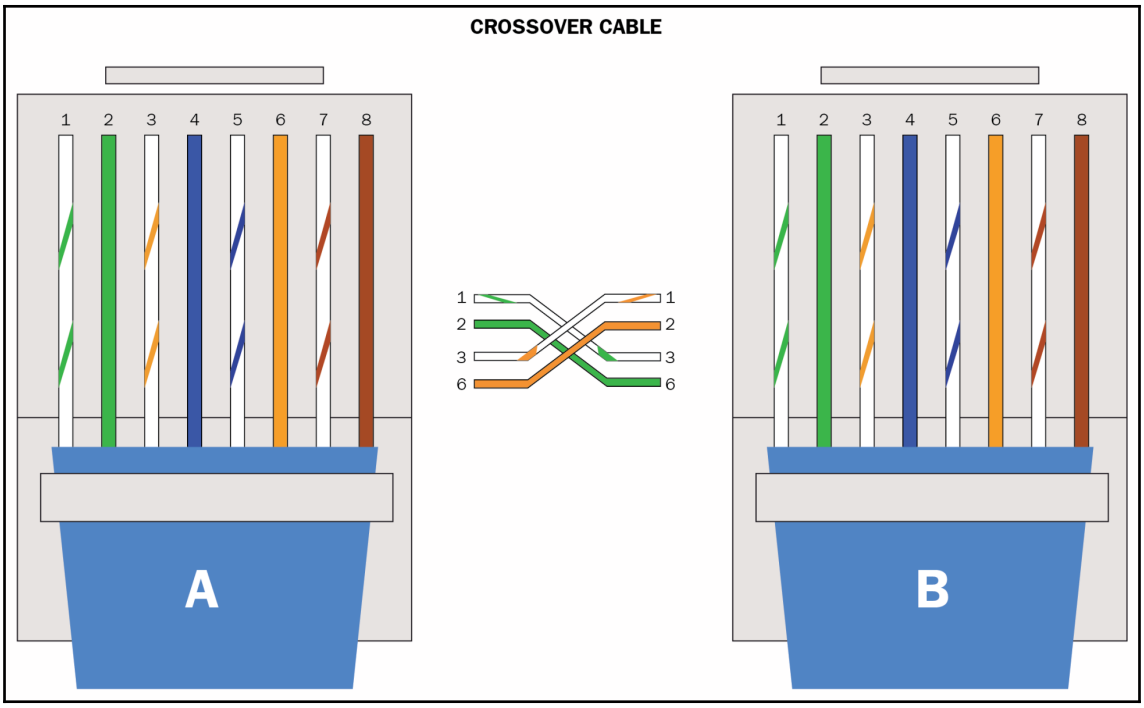
Packet

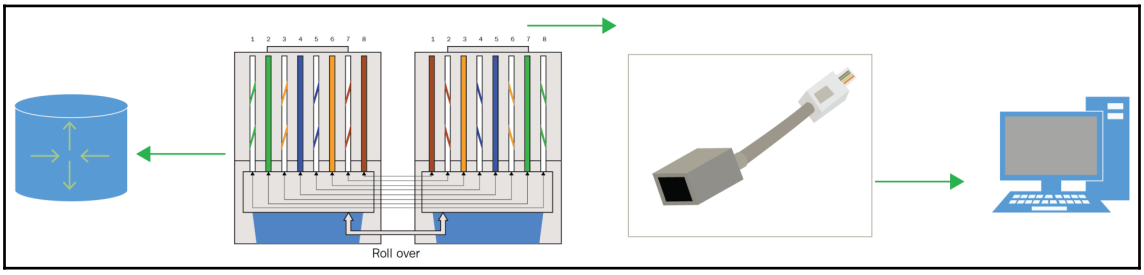


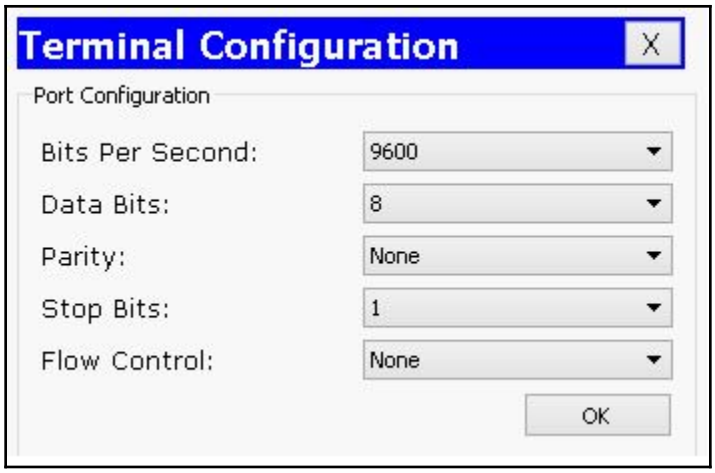

Jacket
Copper
Wires

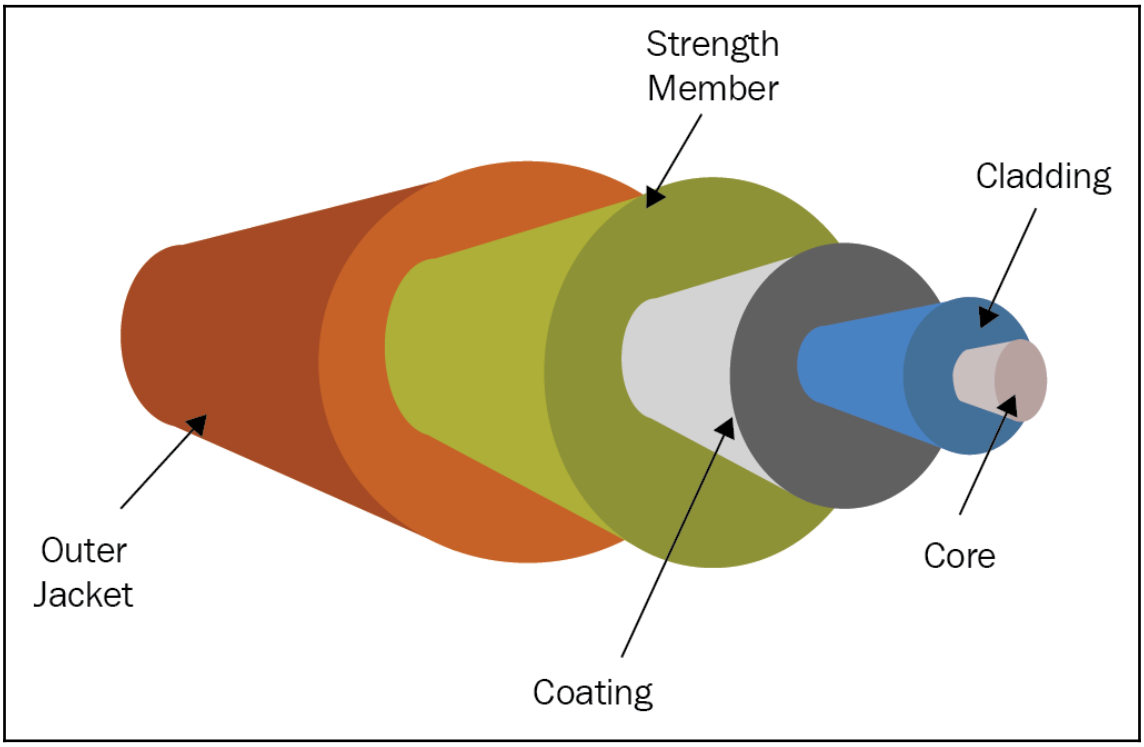

CROSS OVER CABLES
Fa0/0
Fa0/0
Fa0/1
Fa0
1841
Router0
Fa0/1
2811
Router1
SIMILAR
PINOUTS
PC-PT
PC0
STRAIGHT THROUGH CABLES
DISIMILAR
DEVICES
SIMILAR
DEVICES
CROSS OVER CABLES
DISIMILAR
DEVICES
Fa0/2
Fa0/1
Fa0/1
Fa0/2
Fa0
STRAIGHT THROUGH CABLES
2960-24TT
Switch0
Switch1
2960-24TT
PC-PT
PC1
SIMILAR
DEVICES
Fa0/3
SIMILAR
DEVICES
Eth1/1
Bridge-PT
Bridge0
Eth0/1
Eth0/1
Bridge-PT
Bridge1
Eth1/1
CONSOLE/ROLLED CABLES
SIMILAR
DEVICES
CROSS OVER CABLES
Fa0
STRAIGHT THROUGH CABLES
Hub-PT
Hub0
SIMILAR
DEVICES
Hub-PT
Hub1
DISIMILAR
DEVICES
PC-PT
PC3

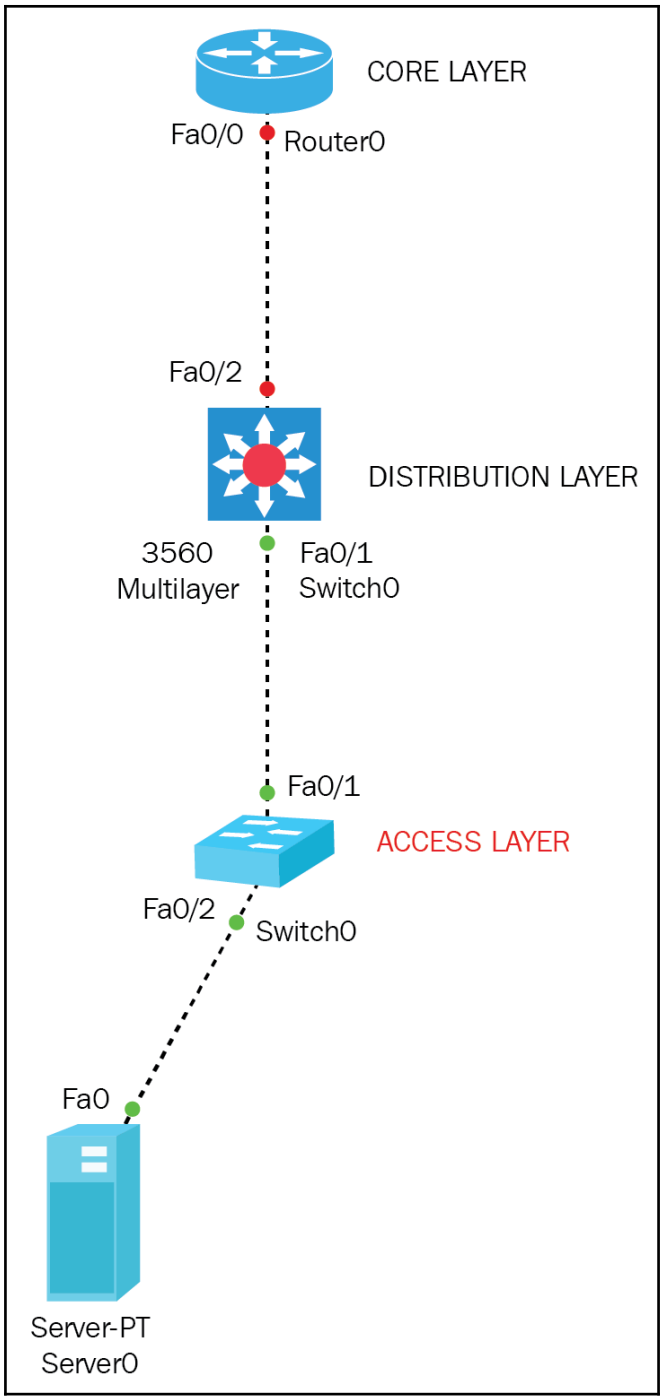

STRAIGHT-THROUGH CABLE
1 2 3 4 5 6 7 8
A
1 1
2 2
3 3
6 6
1 2 3 4 5 6 7 8
B


CROSSOVER CABLE
1 2 3 4 5 6 7 8
A
1 2 3 6
1 2 3 6
1 2 3 4 5 6 7 8
B

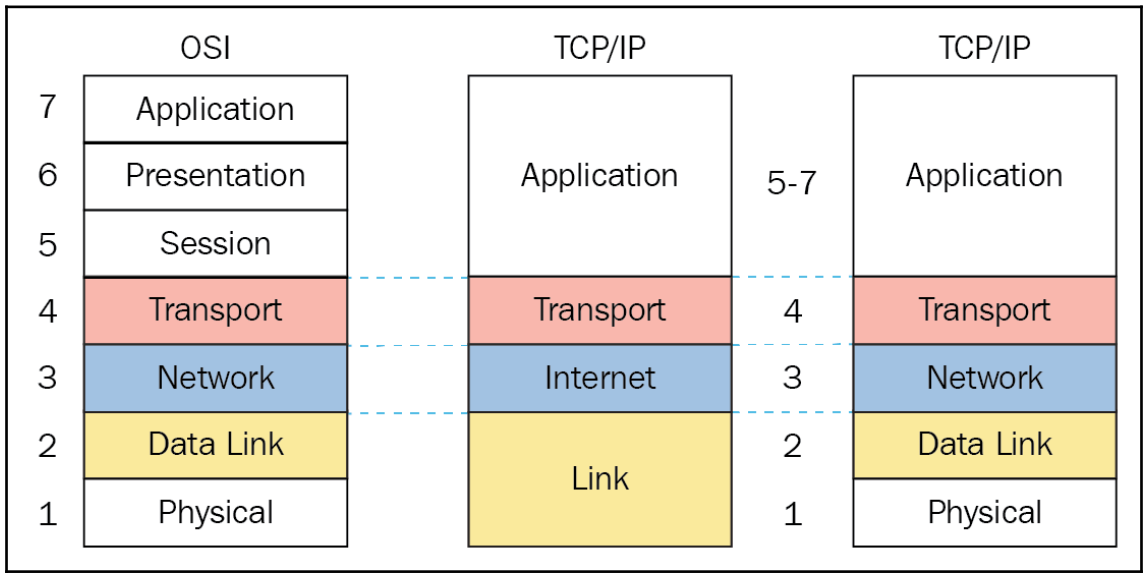

Roll over

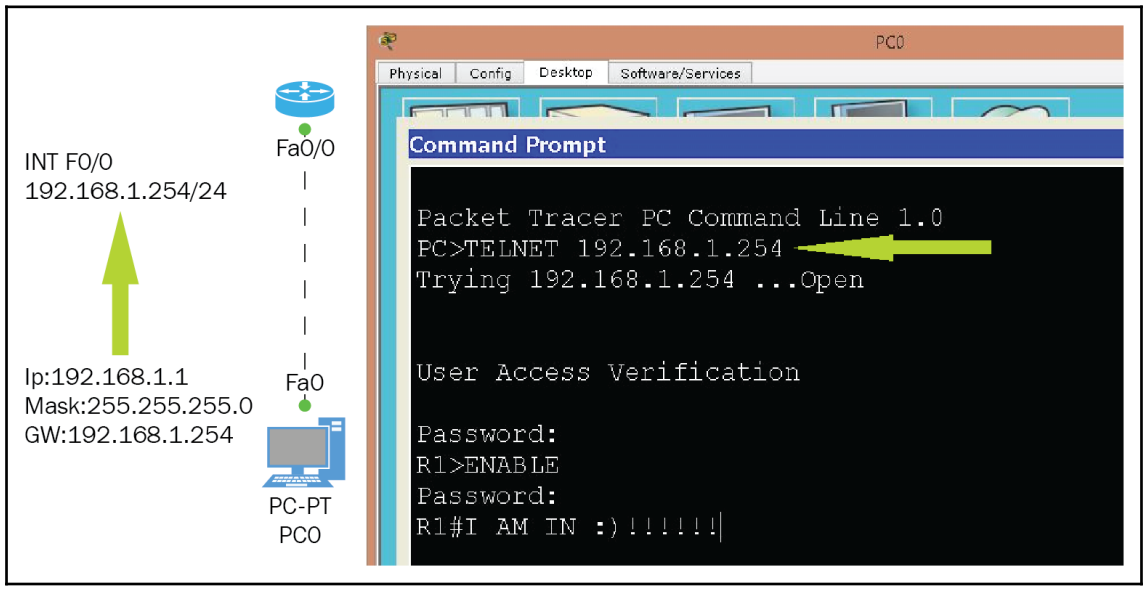

Terminal Configuration
X
Port Configuration
Bits Per Second:
9600
Data Bits:
8
Parity:
None
Stop Bits:
1
Flow Control:
None
OK

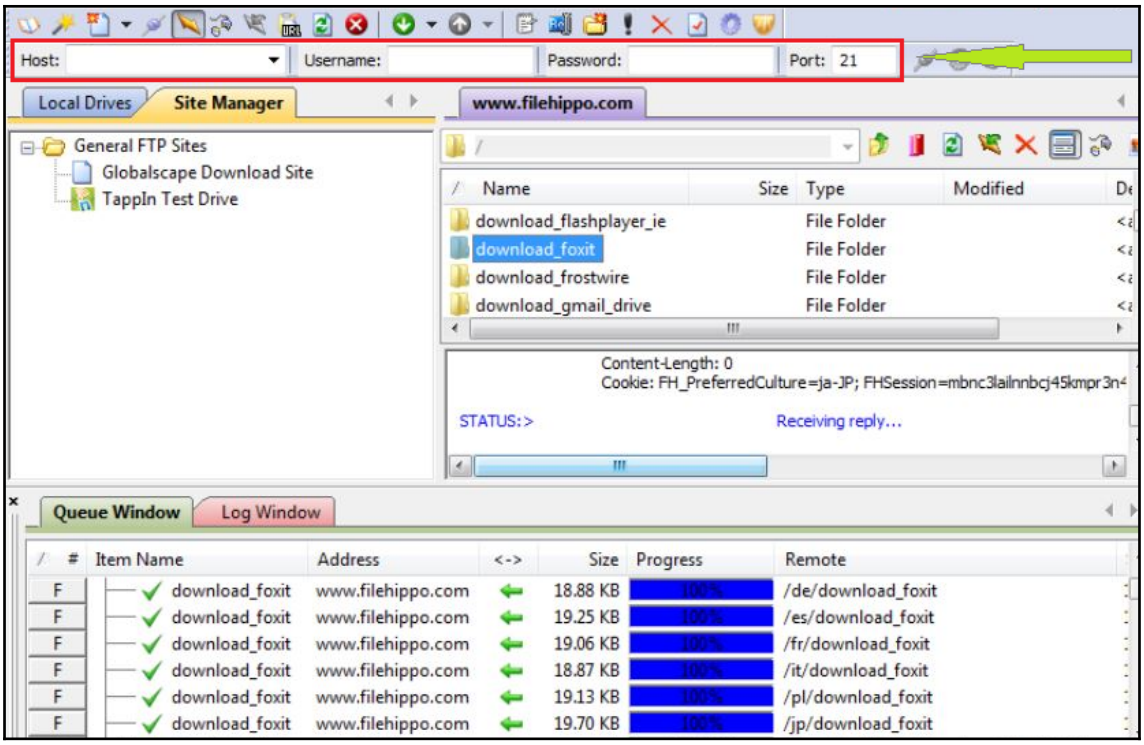

Strength Member
Cladding
Outer Jacket
Core
Coating

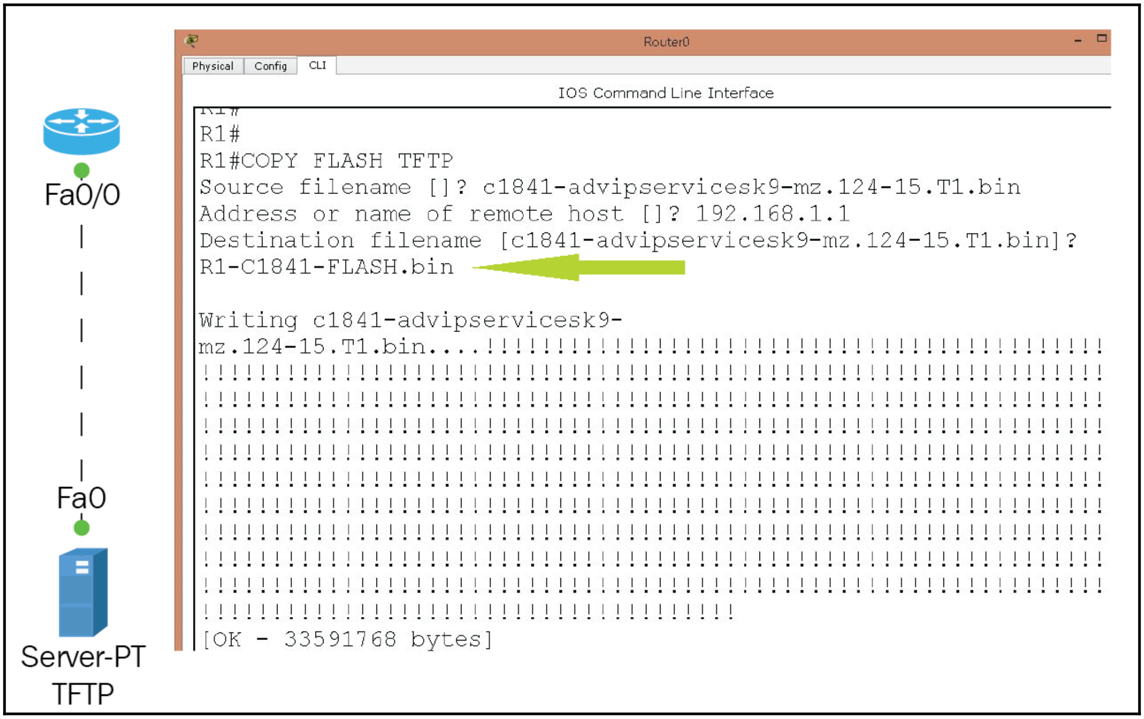

CORE LAYER
Fa0/0
Router0
Fa0/2
DISTRIBUTION LAYER
3560
Multilayer
Fa0/1
Switch0
Fa0/1
ACCESS LAYER
Fa0/2
Switch0
Fa0
Server-PT
Server0

Chapter 3: Introducing the TCP/IP

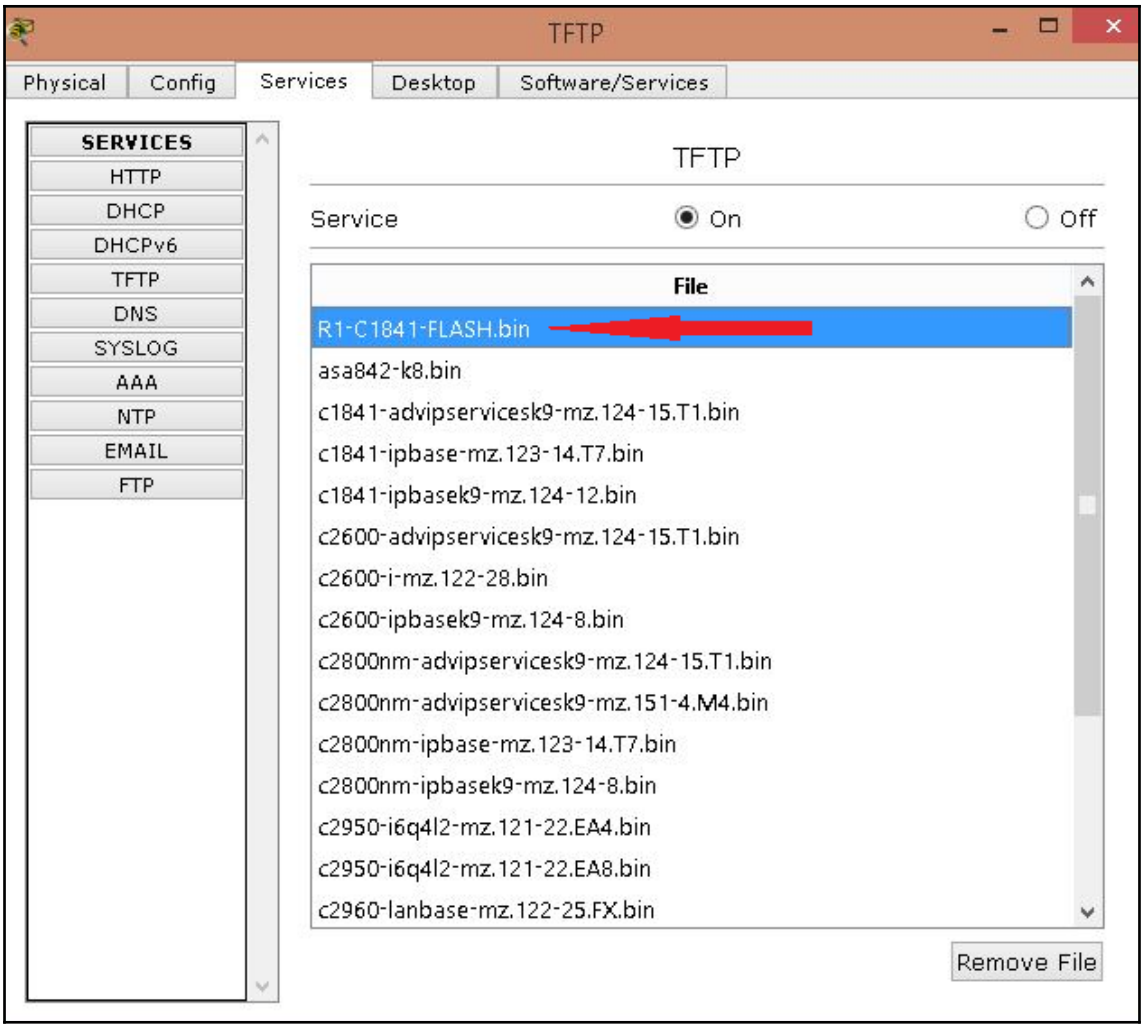


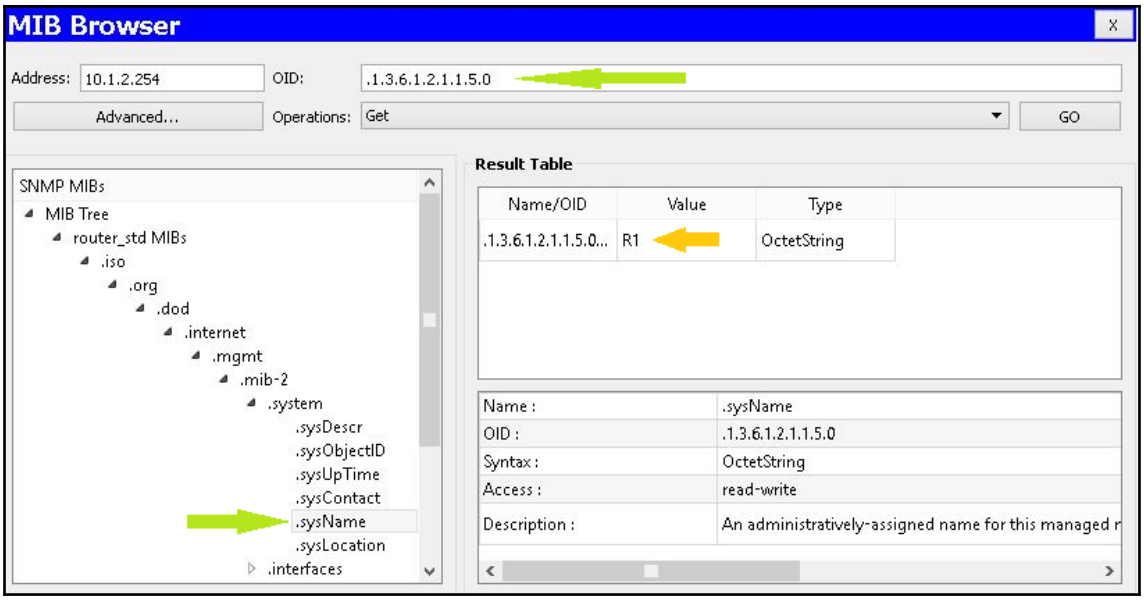


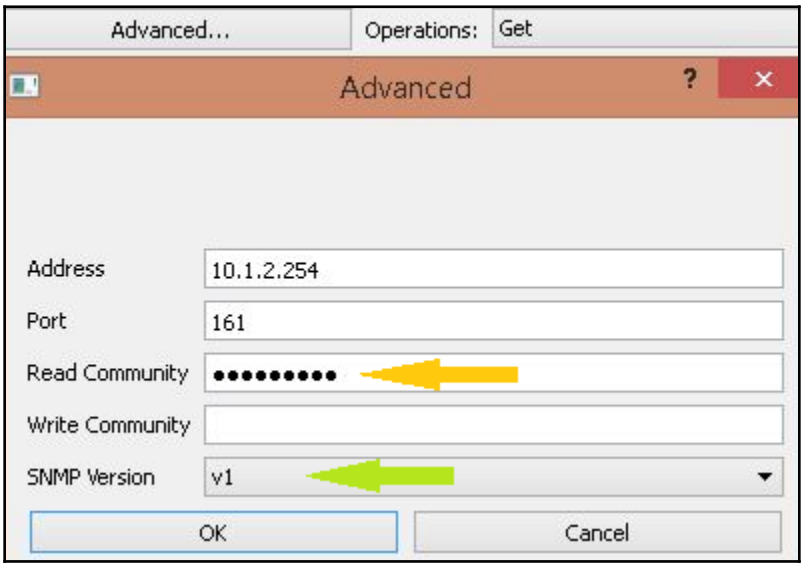

Host:
Username:
Password:
Port: 21
Local Drives
Site Manager
www.filehippo.com
General FTP Sites
Globalscape Download Site
TappIn Test Drive
Name
Size
Type
Modified
download_flashplayer_ie
File Folder
download_foxit
File Folder
download_frostwire
File Folder
download_gmail_drive
File Folder
Content-Length: 0
Cookie: FH_PreferredCulture=ja-JP; FHSession=mbnc3lailnnbcj45kmpr3n4
STATUS:>
Receiving reply...
Queue Window
Log Window
Item Name
Address
<->
Size
Progress
Remote
download_foxit www.filehippo.com 18.88 KB 100% /de/download_foxit
download_foxit www.filehippo.com 19.25 KB 100% /es/download_foxit
download_foxit www.filehippo.com 19.06 KB 100% /fr/download_foxit
download_foxit www.filehippo.com 18.87 KB 100% /it/download_foxit
download_foxit www.filehippo.com 19.13 KB 100% /pl/download_foxit
download_foxit www.filehippo.com 19.70 KB 100% /jp/download_foxit

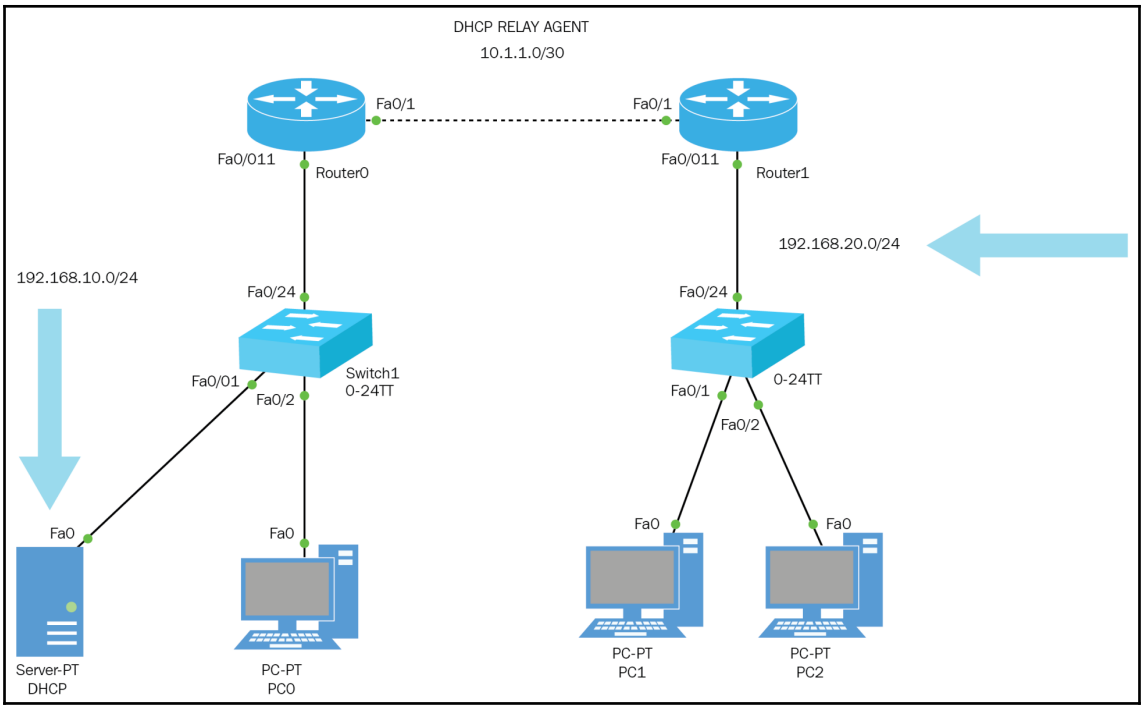


Fa0/0
Fa0
Server-PT
TFTP
Router0
Physical
Config
CLI
IOS Command Line Interface
R1#
R1#COPY FLASH TFTP
Source filename []? c1841-advipservicesk9-mz.124-15.T1.bin
Address or name of remote host []? 192.168.1.1
Destination filename [c1841-advipservicesk9-mz.124-15.T1.bin]?
R1-C1841-FLASH.bin
Writing c1841-advipservicesk9-
mz.124-15.T1.bin....
[OK - 33591768 bytes]


TFTP
Physical
Config
Services
Desktop
Software/Services
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
TFTP
Service
On
Off
File
R1-C1841-FLASH.bin
asa842-k8.bin
c1841-advipservicesk9-mz.124-15.T1.bin
c1841-ipbase-mz.123-14.T7.bin
c1841-ipbasek9-mz.124-12.bin
c2600-advipservicesk9-mz.124-15.T1.bin
c2600-i-mz.122-28.bin
c2600-ipbasek9-mz.124-8.bin
c2800nm-advipservicesk9-mz.124-15.T1.bin
c2800nm-advipservicesk9-mz.151-4.M4.bin
c2800nm-ipbase-mz.123-14.T7.bin
c2800nm-ipbasek9-mz.124-8.bin
c2950-i6q4l2-mz.121-22.EA4.bin
c2950-i6q4l2-mz.121-22.EA8.bin
c2960-lanbase-mz.122-25.FX.bin
Remove File


MIB Browser
Address: 10.1.2.254
OID: .1.3.6.1.2.1.1.5.0
Advanced...
Operations: Get
GO
SNMP MIBs
MIB Tree
router_std MIBs
.iso
.org
.dod
.internet
.mgmt
.mib-2
.system
.sysDescr
.sysObjectID
.sysUpTime
.sysContact
.sysName
.sysLocation
.interfaces
Result Table
Name/OID
Value
Type
.1.3.6.1.2.1.1.5.0...
R1
OctetString
Name : .sysName
OID : .1.3.6.1.2.1.1.5.0
Syntax : OctetString
Access : read-write
Description : An administratively-assigned name for this managed r

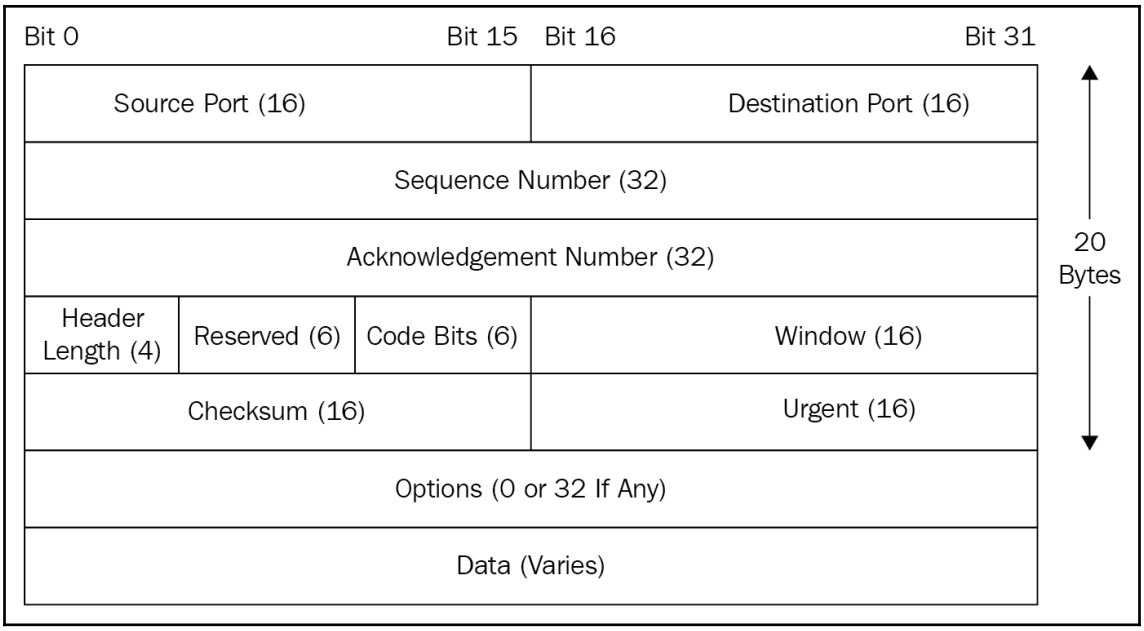

Advanced...
Operations: Get
Advanced
Address
10.1.2.254
Port
161
Read Community
Write Community
SNMP Version
v1
OK
Cancel

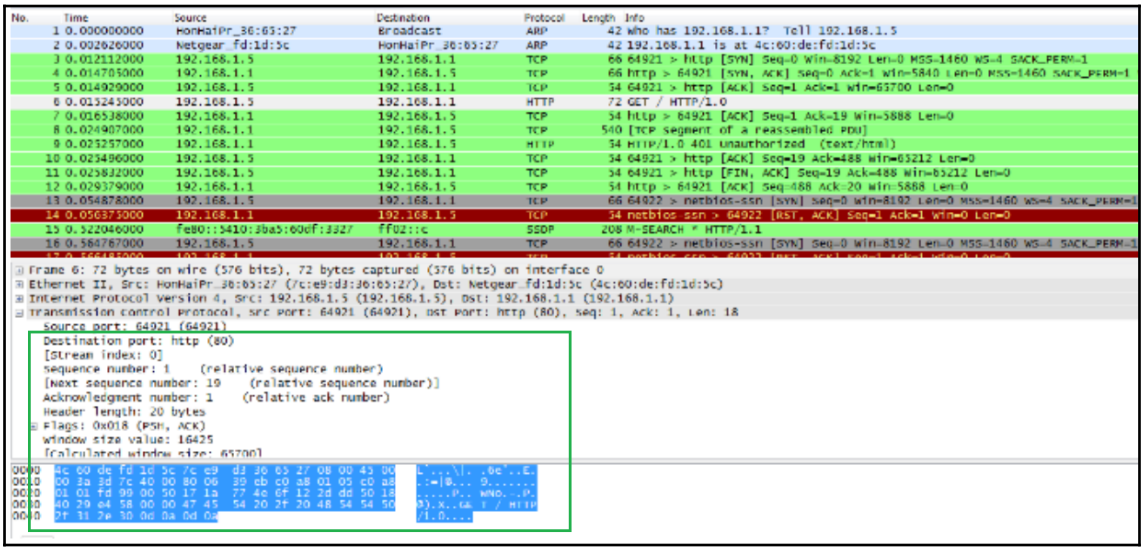


Add | Save | Remove

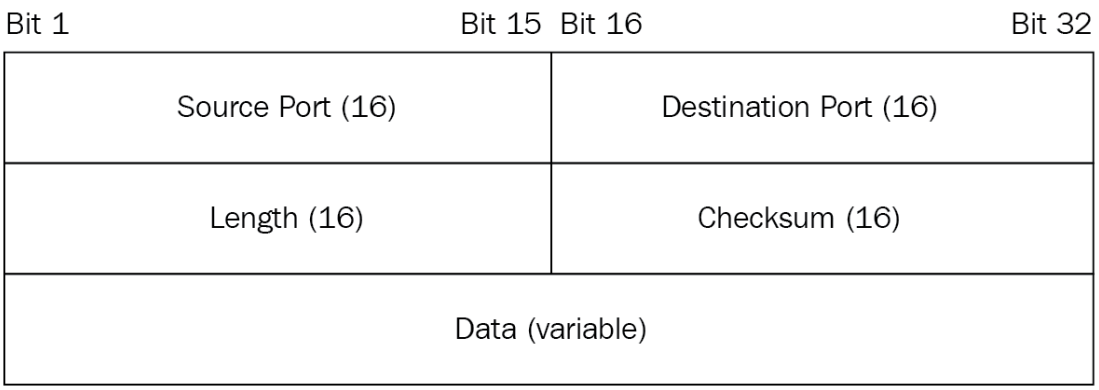
Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Serv
192.168.20.0	192.168.20.254	192.168.10.1	192.168.20.50	255.255.255.0		0.0.0
192.168.10.0	192.168.10.254	192.168.10.1	192.168.10.50	255.255.255.0	206	0.0.0.0
serverPool	0.0.0.0	0.0.0.0	192.168.100.0	255.255.255.0	256	0.0.0.0

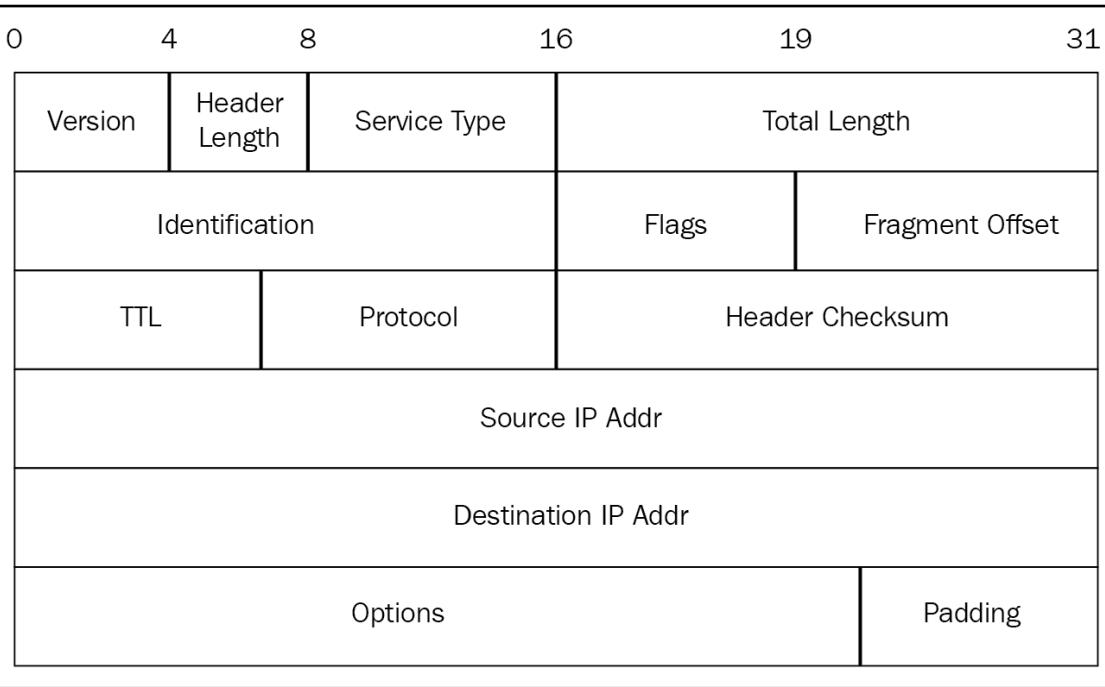
```
interface FastEthernet0/0
 ip address 192.168.20.254 255.255.255.0
 ip helper-address 192.168.10.1
```

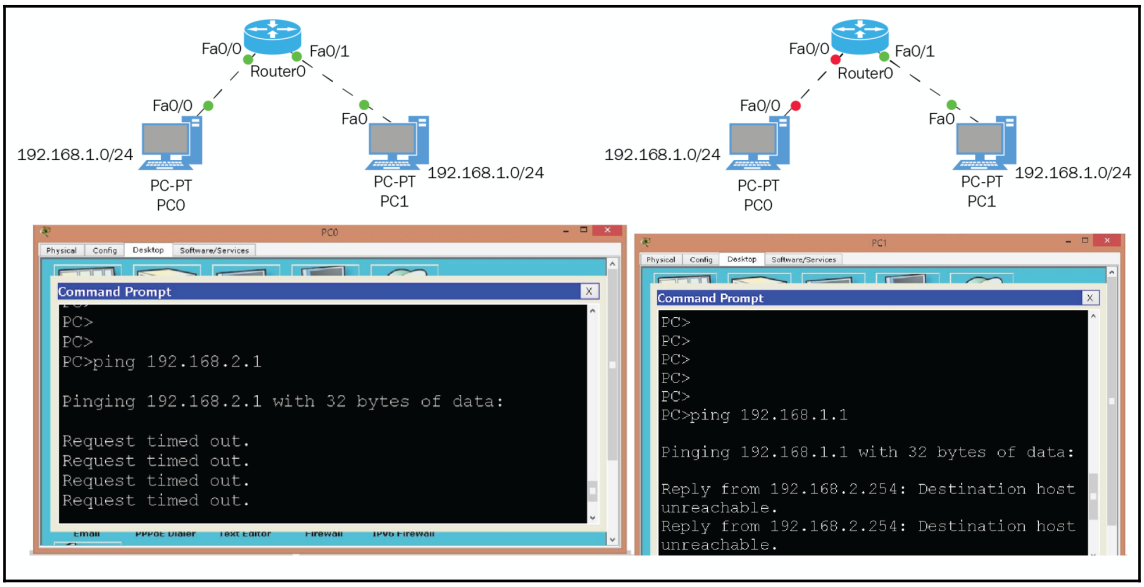

Bit 0
Bit 15
Bit 16
Bit 31
Source Port (16)
Destination Port (16)
Sequence Number (32)
Acknowledgement Number (32)
Header Length (4)
Reserved (6)
Code Bits (6)
Window (16)
Checksum (16)
Urgent (16)
Options (0 or 32 If Any)
Data (Varies)
20 Bytes


No. Time Source Destination Protocol Length Info
1 0.000000000 HonHaiPr_36:65:27 Broadcast ARP 42 Who has 192.168.1.1? Tell 192.168.1.5
2 0.002626000 Netgear_fd:1d:5c HonHaiPr_36:65:27 ARP 42 192.168.1.1 is at 4c:60:de:fd:1d:5c
3 0.012112000 192.168.1.5 192.168.1.1 TCP 66 64921 > http [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=4 SACK_PERM=1
4 0.014705000 192.168.1.1 192.168.1.5 TCP 66 http > 64921 [SYN, ACK] Seq=0 Ack=1 Win=5840 Len=0 MSS=1460 SACK_PERM=1
5 0.014929000 192.168.1.5 192.168.1.1 TCP 54 64921 > http [ACK] Seq=1 Ack=1 Win=65700 Len=0
6 0.015243000 192.168.1.5 192.168.1.1 HTTP 72 GET / HTTP/1.0
7 0.016538000 192.168.1.1 192.168.1.5 TCP 54 http > 64921 [ACK] Seq=1 Ack=19 Win=5888 Len=0
8 0.024907000 192.168.1.1 192.168.1.5 TCP 540 [TCP segment of a reassembled PDU]
9 0.025257000 192.168.1.1 192.168.1.5 HTTP 54 HTTP/1.0 401 Unauthorized (text/html)
10 0.025496000 192.168.1.5 192.168.1.1 TCP 54 64921 > http [ACK] Seq=19 Ack=488 Win=65212 Len=0
11 0.025832000 192.168.1.5 192.168.1.1 TCP 54 64921 > http [FIN, ACK] Seq=19 Ack=488 Win=65212 Len=0
12 0.029379000 192.168.1.1 192.168.1.5 TCP 54 http > 64921 [ACK] Seq=488 Ack=20 Win=5888 Len=0
13 0.054878000 192.168.1.5 192.168.1.1 TCP 66 64922 > netbios-ssn [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=4 SACK_PERM=1
14 0.056875000 192.168.1.1 192.168.1.5 TCP 54 netbios-ssn > 64922 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
15 0.522046000 fe80::5410:3ba5:60df:3327 ff02::c SSDP 208 M-SEARCH * HTTP/1.1
16 0.564767000 192.168.1.5 192.168.1.1 TCP 66 64922 > netbios-ssn [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=4 SACK_PERM=1
Frame 6: 72 bytes on wire (576 bits), 72 bytes captured (576 bits) on interface 0
Ethernet II, Src: HonHaiPr_36:65:27 (7c:e9:d3:36:65:27), Dst: Netgear_fd:1d:5c (4c:60:de:fd:1d:5c)
Internet Protocol Version 4, Src: 192.168.1.5 (192.168.1.5), Dst: 192.168.1.1 (192.168.1.1)
Transmission Control Protocol, Src Port: 64921 (64921), Dst Port: http (80), Seq: 1, Ack: 1, Len: 18
Source port: 64921 (64921)
Destination port: http (80)
[Stream index: 0]
Sequence number: 1 (relative sequence number)
[Next sequence number: 19 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Header length: 20 bytes
Flags: 0x018 (PSH, ACK)
Window size value: 16425
[Calculated window size: 65700]
0000 4c 60 de fd 1d 5c 7c e9 d3 36 65 27 08 00 45 00
0010 00 3a 3d 7c 40 00 80 06 89 eb c0 a8 01 05 c0 a8
0020 01 01 fd 99 00 50 17 1a 77 4e 6f 12 2d dd 50 18
0030 40 29 e4 58 00 00 47 45 54 20 2f 20 48 54 54 50
0040 2f 31 2e 30 0d 0a 0d 0a

The UDP Segment Format








```
Frame 5: 114 bytes on wire (912 bits), 114 bytes captured (912 bits) on interface 0
Ethernet II, Src: c2:01:1a:18:00:00 (c2:01:1a:18:00:00), Dst: c2:02:09:58:00:00 (c2:02:09:58:00:00)
Internet Protocol Version 4, Src: 192.168.12.1 (192.168.12.1), Dst: 192.168.12.2 (192.168.12.2)
Internet Control Message Protocol
    Type: 8 (Echo (ping) request)
    Code: 0
    Checksum: 0x6c78 [correct]
    Identifier (BE): 0 (0x0000)
    Identifier (LE): 0 (0x0000)
    Sequence number (BE): 1 (0x0001)
    Sequence number (LE): 256 (0x0100)
    [Response frame: 6]
  Data (72 bytes)
      Data: 00000000000111d0abcdabcdabcdabcdabcdabcdabcdabcd...
      [Length: 72]
```

```
PC>arp -a
  Internet Address      Physical Address      Type
  192.168.1.254         0001.9735.c101        dynamic

PC>arp -d
PC>arp -a
No ARP Entries Found
PC>
```

Chapter 4: Subnetting in IPv4

Bit Values are the same on all the octets:

128 64 32 16 8 4 2 1 Maximum Value of any octet 255 or 11111111

00000000. 00000000. 00000000.00000000

1st Octet	2nd Octet	3rd Octet	4th Octet

11111111.11111111.11111111.11|000000

Magic Line

Octet of interest

	128	64	32	16	8	4	2	1	Bit Values
192.168.1.	0	0	0	| 0	0	0	0	0	
	2	4	8	32	16	8	4	2	

subnets → ← Hosts

192.168.1.0

192.168.1.32

192.168.1.64

192.168.1.96

192.168.1.128

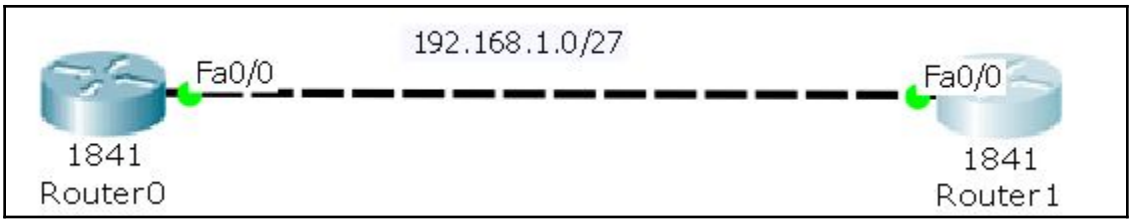
192.168.1.160

192.168.1.192

192.168.1.224

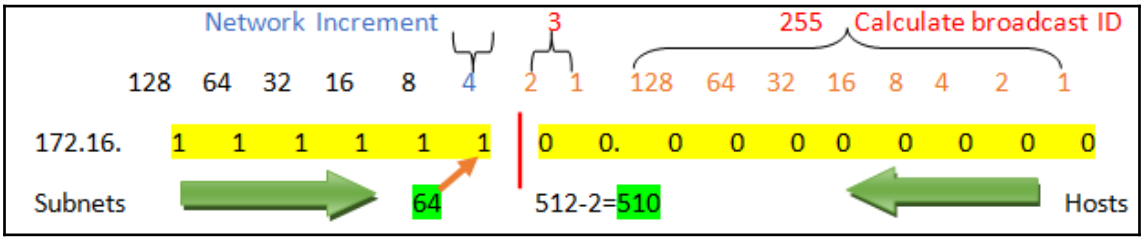
the highlighted address would be considered using the zero network

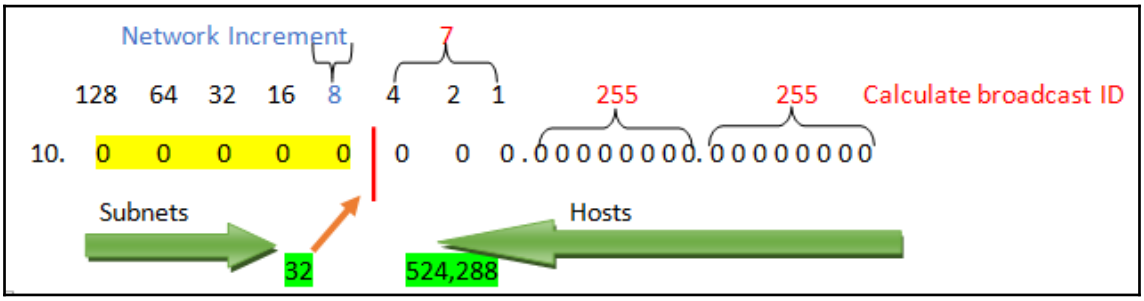
All these addresses are network ID's.

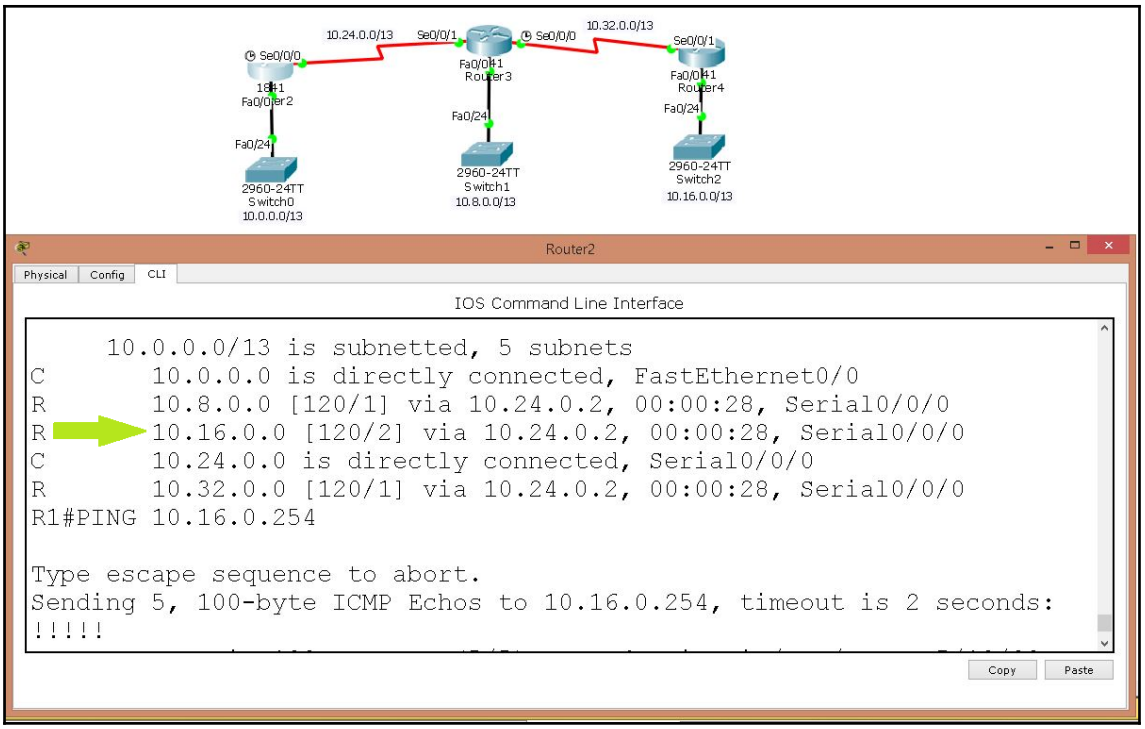


	128	64	32	16	8	4	2	1
192.168.1.	1	1	1	1	1	1	0	0

The mask would be 255.255.255.252 (6 bits on in the last octet 252)

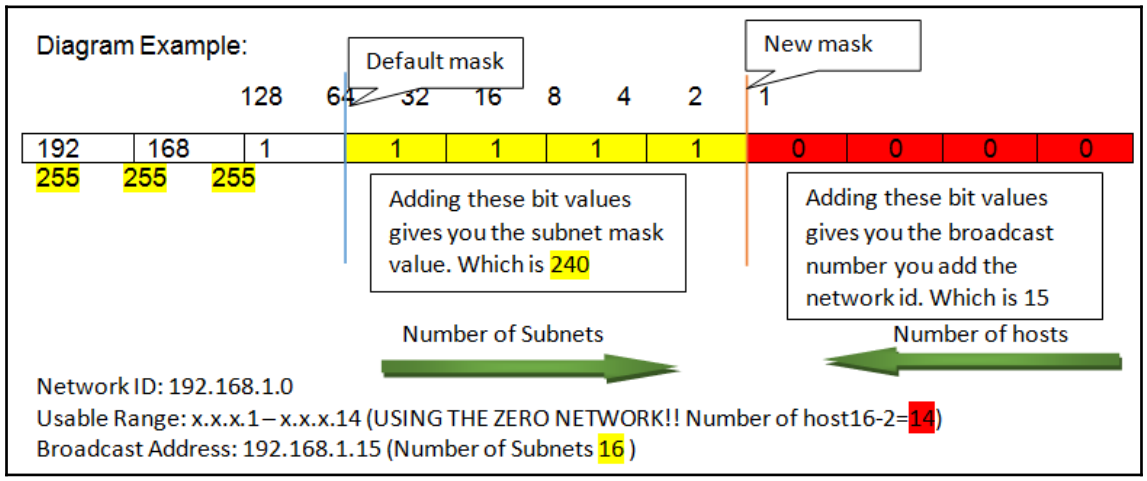






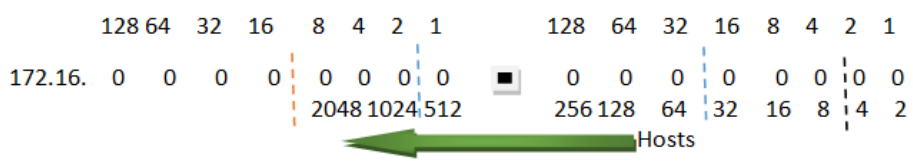
HEX	Covert to binary	Decimal
	E | 4	
E4	8421 | 8421 11100100	128 64 32 16 8 4 2 1 = 228

Chapter 5: Variable Length Subnet Mask and Route Summarization

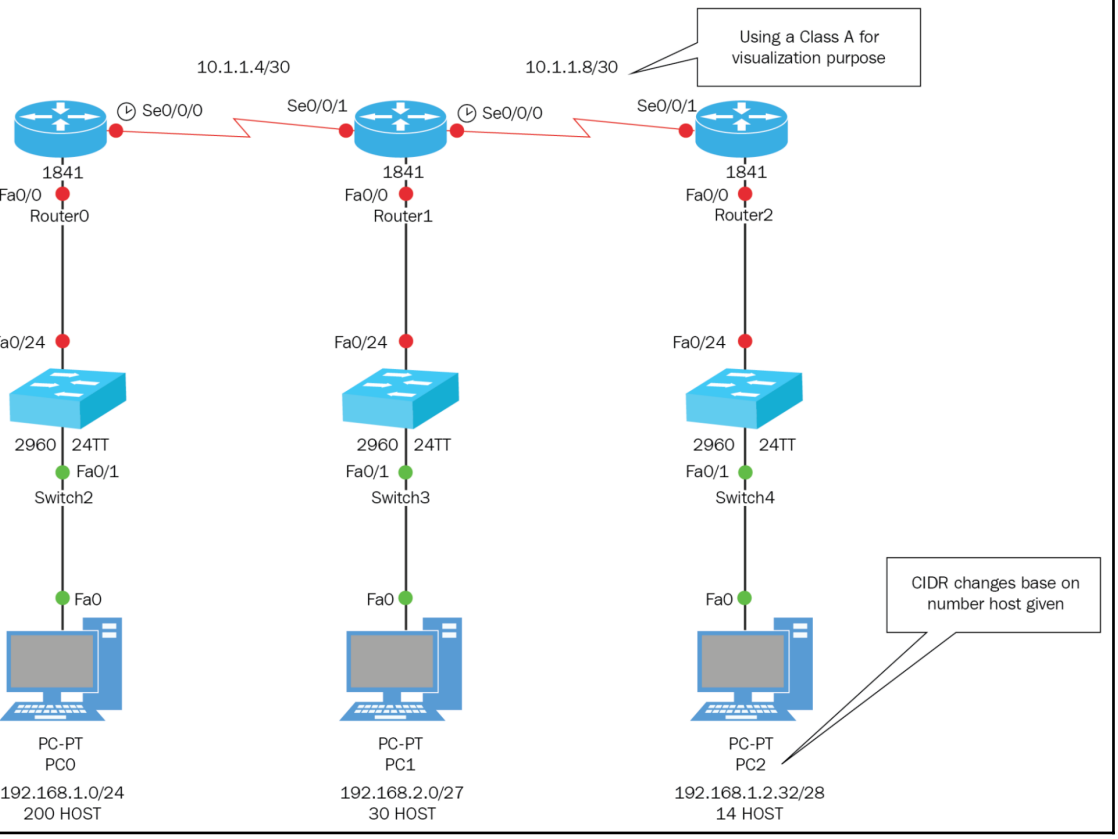


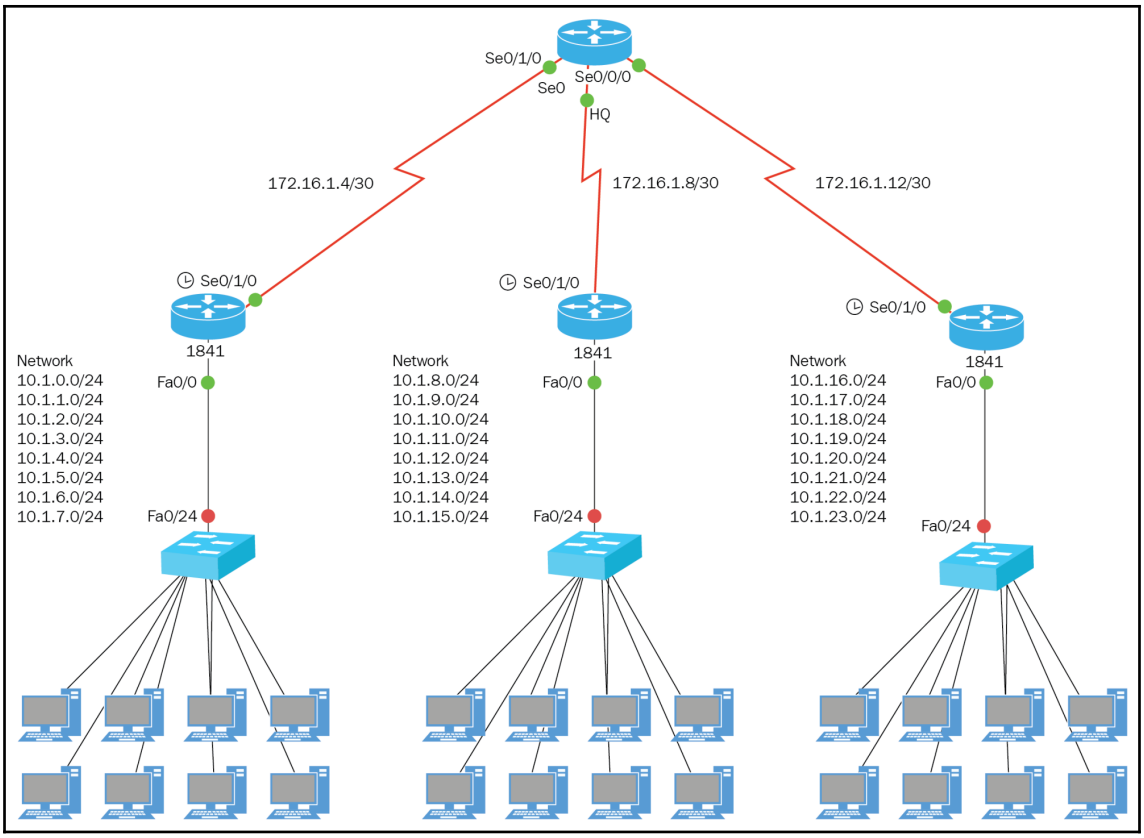
	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
172.16.	0	0	0	0	0	0	0	0	■	0	0	0	0	0	0	0	0

Number of host	Network ID	Range	Broadcast	CIDR
2000				
1200				
500				
16				
2				



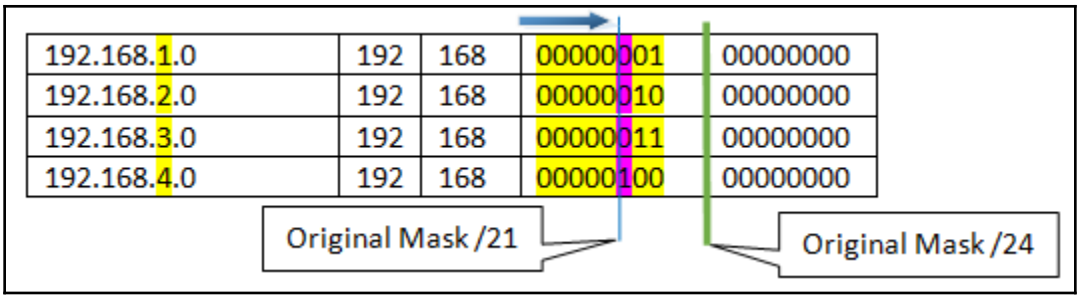
Number of host	Network ID	Range	Broadcast	CIDR
2000	172.16.0.0	x.x.0.1 – x.x15.254	172.16.15.255	/20
1200	172.16.16.0	x.x.16.1 – x.x.31.254	172.16.31.255	/20
500	172.16.32.0	x.x.32.1 – x.x.33.254	172.16.33.254	/23
16	172.16.34.0	x.x.34.1 – x.x.34.30	172.16.34.31	/27
2	172.16.34.32	x.x.34.33 – x.x.34.34	172.16.34.35	/30




Se0/1/0
Se0
Se0/0/0
HQ
172.16.1.4/30
172.16.1.8/30
172.16.1.12/30
Se0/1/0
1841
Network
10.1.0.0/24
10.1.1.0/24
10.1.2.0/24
10.1.3.0/24
10.1.4.0/24
10.1.5.0/24
10.1.6.0/24
10.1.7.0/24
Fa0/0
Fa0/24
Se0/1/0
1841
Network
10.1.8.0/24
10.1.9.0/24
10.1.10.0/24
10.1.11.0/24
10.1.12.0/24
10.1.13.0/24
10.1.14.0/24
10.1.15.0/24
Fa0/0
Fa0/24
Se0/1/0
1841
Network
10.1.16.0/24
10.1.17.0/24
10.1.18.0/24
10.1.19.0/24
10.1.20.0/24
10.1.21.0/24
10.1.22.0/24
10.1.23.0/24
Fa0/0
Fa0/24

```
     10.0.0.0/24 is subnetted, 24 subnets
D       10.1.0.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.1.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.2.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.3.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.4.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.5.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.6.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.7.0 [90/2172416] via 172.16.1.5, 00:05:18, Serial0/1/0
D       10.1.8.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.9.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.10.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.11.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.12.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.13.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.14.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.15.0 [90/2172416] via 172.16.1.9, 00:05:17, Serial0/1/1
D       10.1.16.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.17.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.18.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.19.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.20.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.21.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.22.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
D       10.1.23.0 [90/2172416] via 172.16.1.13, 00:05:16, Serial0/0/0
     172.16.0.0/30 is subnetted, 3 subnets
C       172.16.1.4 is directly connected, Serial0/1/0
C       172.16.1.8 is directly connected, Serial0/1/1
```

```
Gateway of last resort is not set

     10.0.0.0/21 is subnetted, 3 subnets
D       10.1.0.0 [90/2172416] via 172.16.1.5, 00:00:11, Serial0/1/0
D       10.1.8.0 [90/2172416] via 172.16.1.9, 00:02:34, Serial0/1/1
D       10.1.16.0 [90/2172416] via 172.16.1.13, 00:01:57, Serial0/0/0
     172.16.0.0/30 is subnetted, 3 subnets
C       172.16.1.4 is directly connected, Serial0/1/0
C       172.16.1.8 is directly connected, Serial0/1/1
C       172.16.1.12 is directly connected, Serial0/0/0
HQ#
```



128 64 32 16 8 4 2 1

192.168. 0 0 0 0 0 0 0 0. 00000000 (sum of all bits)

Network ID	Range	Broadcast
192.168.0.0	x.x.0.1 – x.x.7.254	192.168.7.255

128 64 32 16 8 4 2 1

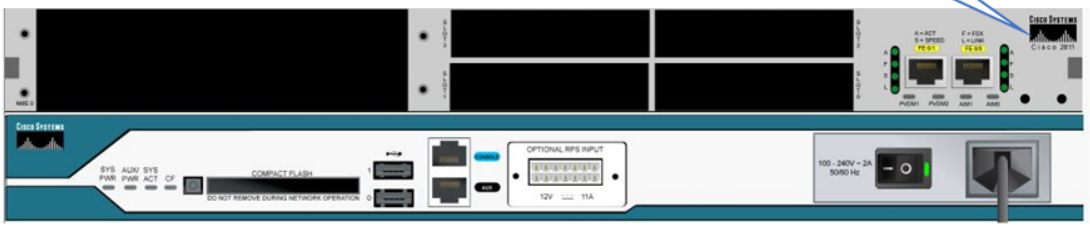
192.168.100.0	192	168	0 1 1 0 0 1 0 0	00000000
192.168.101.0	192	168	0 1 1 0 0 1 0 1	00000000
192.168.102.0	192	168	0 1 1 0 0 1 1 0	00000000
192.168.103.0	192	168	0 1 1 0 0 1 1 1	00000000

Chapter 6: The IOS User Interface

1841 Router

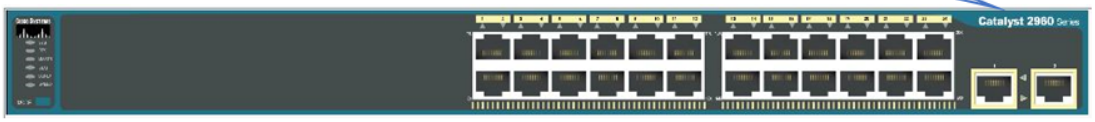
```
System image file is "flash:c1841-advipservicesk9-mz.124-15.T1.bin"
```

2811 Router

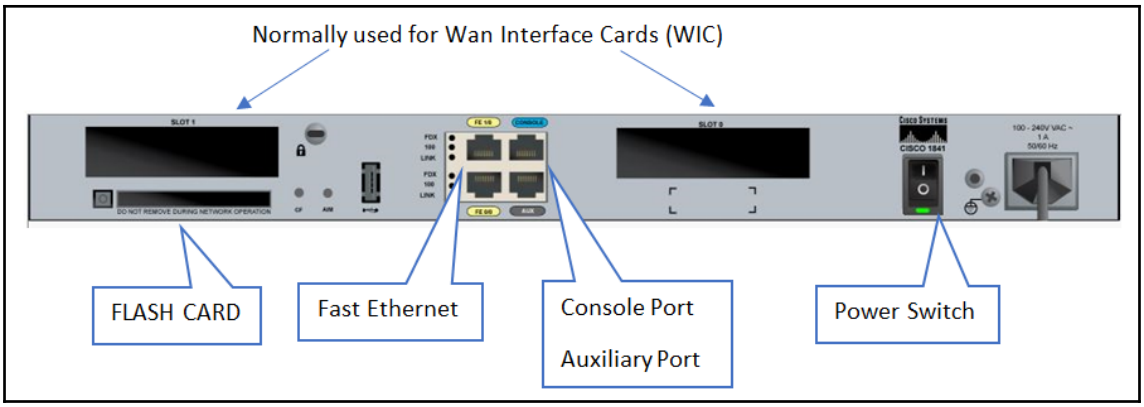


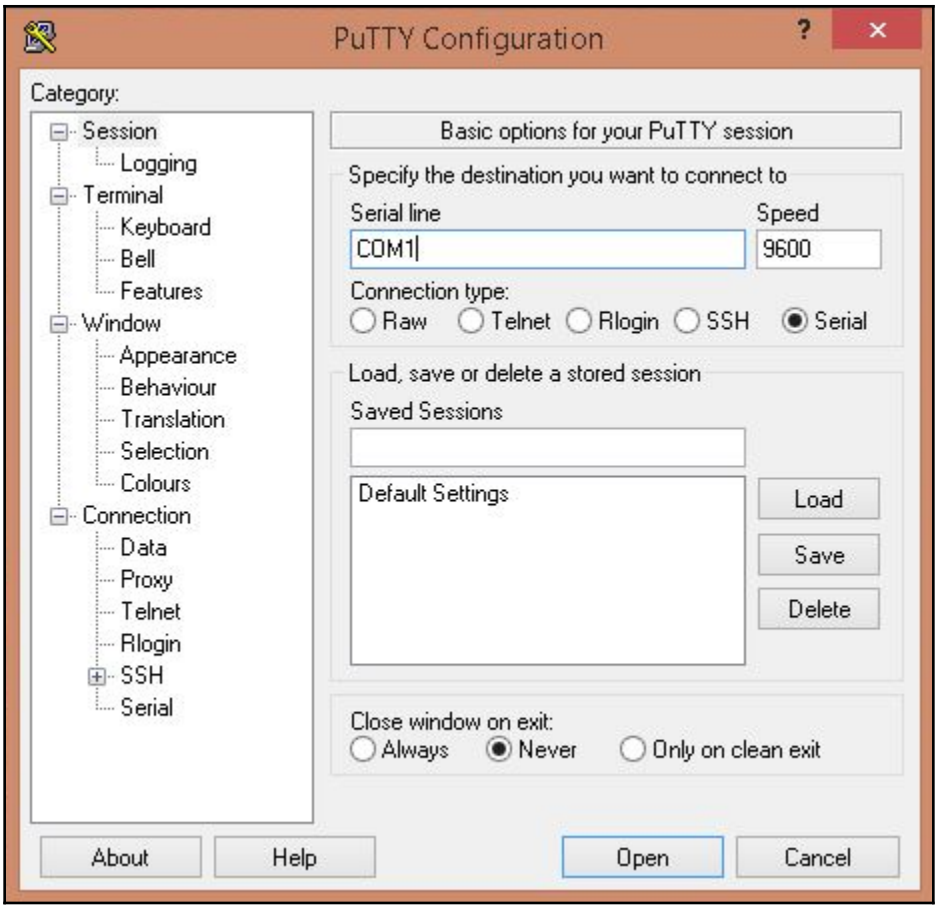
```
System image file is "c2800nm-advipservicesk9-mz.124-15.T1.bin"
```

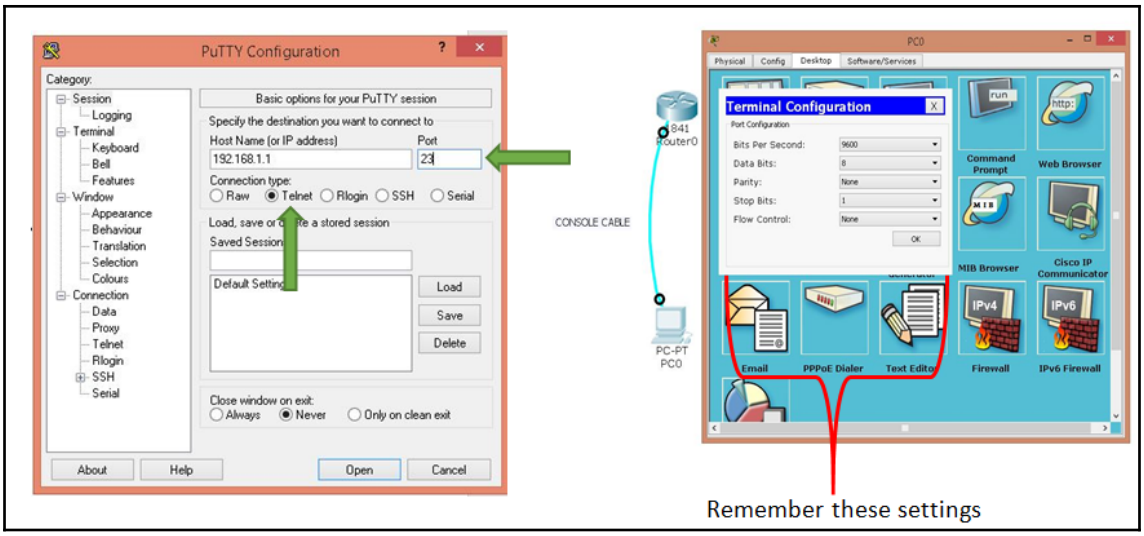
2960 Switch

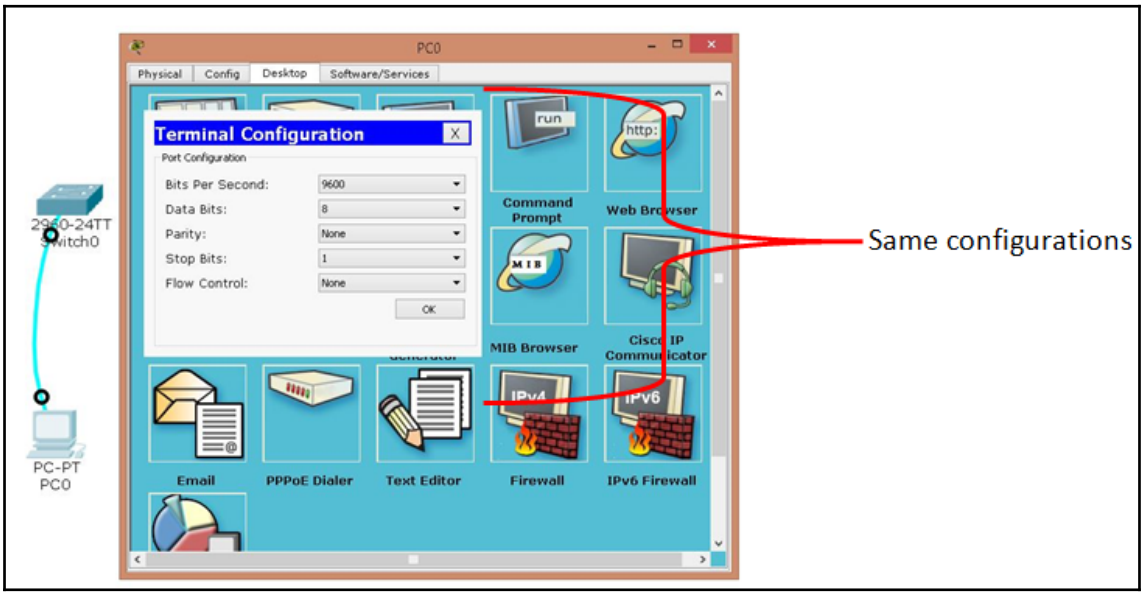


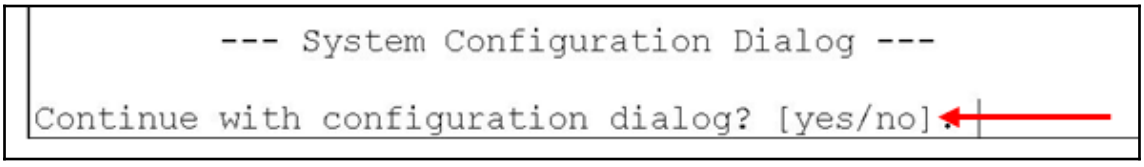
```
Directory of flash:/

    1  -rw-     4414921          <no date>  c2960-lanbase-mz.122-25.FX.bin
```

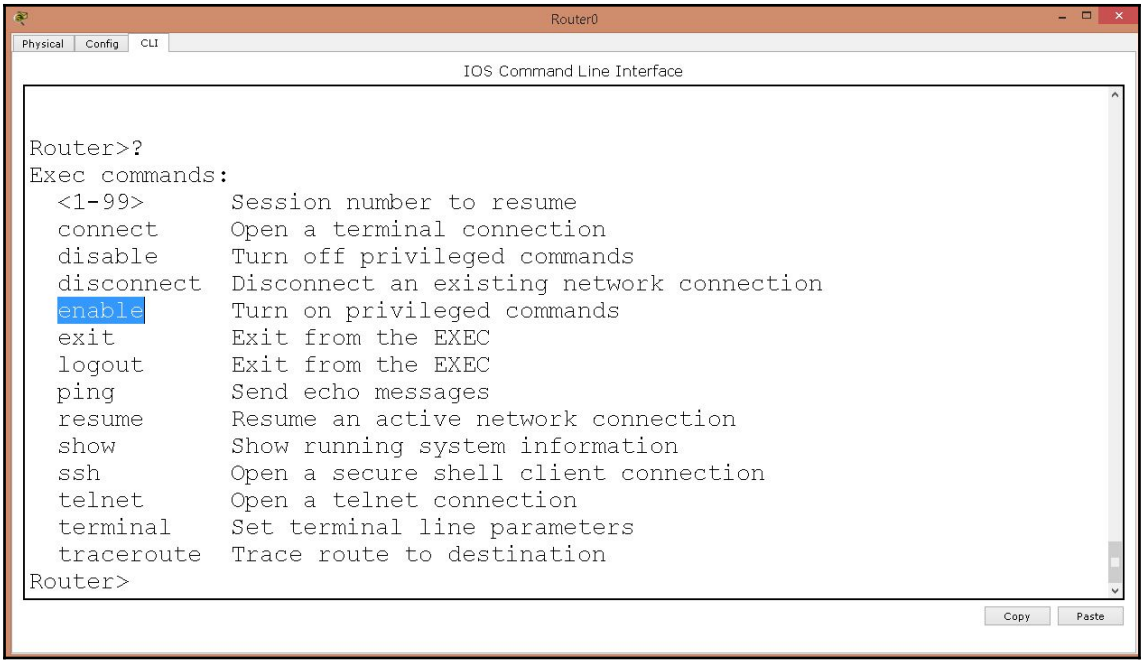

Normally used for Wan Interface Cards (WIC)
FLASH CARD
Fast Ethernet
Console Port
Auxiliary Port
Power Switch

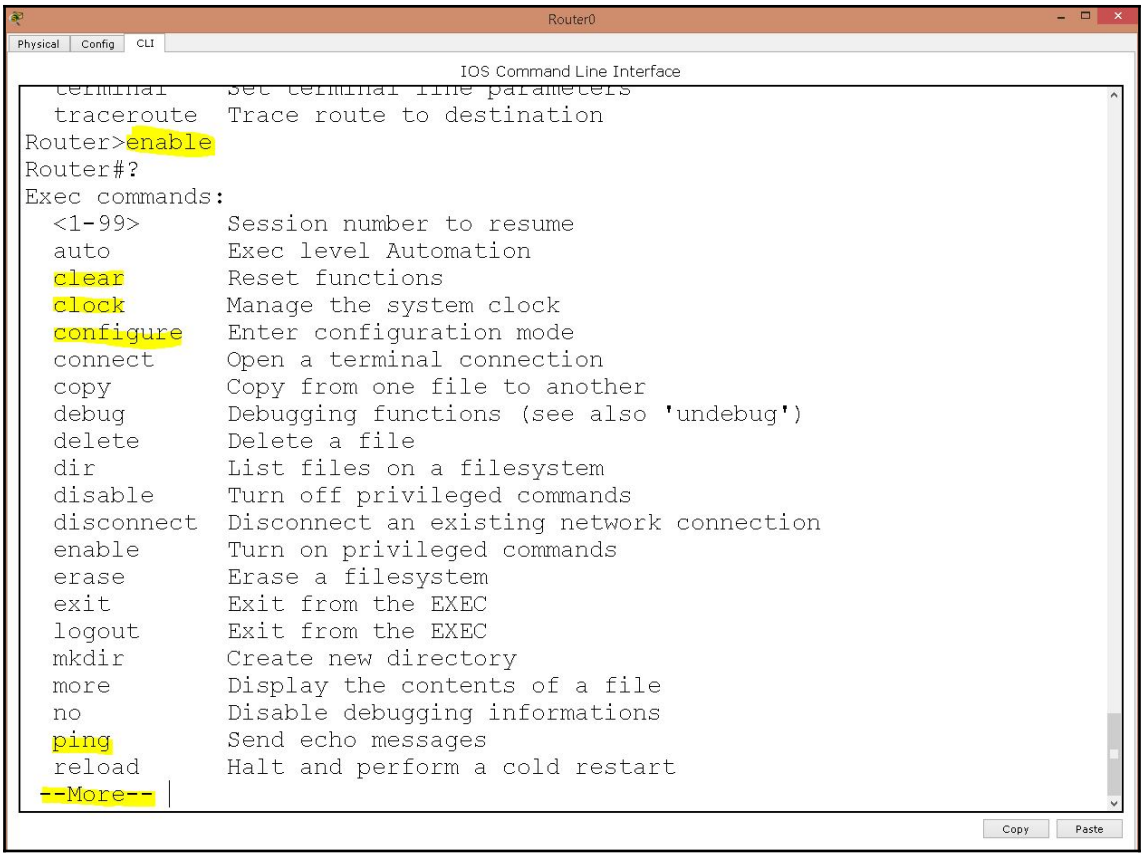

PuTTY Configuration
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
Telnet
Rlogin
SSH
Serial
Basic options for your PuTTY session
Specify the destination you want to connect to
Serial line
Speed
COM1
9600
Connection type:
Raw
Telnet
Rlogin
SSH
Serial
Load, save or delete a stored session
Saved Sessions
Default Settings
Load
Save
Delete
Close window on exit:
Always
Never
Only on clean exit
About
Help
Open
Cancel


PuTTY Configuration
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
Telnet
Rlogin
SSH
Serial
Basic options for your PuTTY session
Specify the destination you want to connect to
Host Name (or IP address)
Port
192.168.1.1
23
Connection type:
Raw
Telnet
Rlogin
SSH
Serial
Load, save or delete a stored session
Saved Sessions
Default Settings
Load
Save
Delete
Close window on exit:
Always
Never
Only on clean exit
About
Help
Open
Cancel
CONSOLE CABLE
PC-PT
PC0
PC0
Physical
Config
Desktop
Software/Services
Terminal Configuration
Port Configuration
Bits Per Second:
9600
Data Bits:
8
Parity:
None
Stop Bits:
1
Flow Control:
None
OK
Command Prompt
Web Browser
MIB Browser
Cisco IP Communicator
Email
PPPoE Dialer
Text Editor
Firewall
IPv6 Firewall
Remember these settings


PC0
Physical
Config
Desktop
Software/Services
Terminal Configuration
Port Configuration
Bits Per Second:
9600
Data Bits:
8
Parity:
None
Stop Bits:
1
Flow Control:
None
OK
Command Prompt
Web Browser
MIB Browser
Email
PPPoE Dialer
Text Editor
Firewall
IPv6 Firewall
2950-24TT
Switch0
PC-PT
PC0
Same configurations


--- System Configuration Dialog ---
Continue with configuration dialog? [yes/no]:


Router0
Physical
Config
CLI
IOS Command Line Interface
Router>?
Exec commands:
<1-99> Session number to resume
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
logout Exit from the EXEC
ping Send echo messages
resume Resume an active network connection
show Show running system information
ssh Open a secure shell client connection
telnet Open a telnet connection
terminal Set terminal line parameters
traceroute Trace route to destination
Router>
Copy
Paste




```
Router#clear ?
  aaa                 Clear AAA values
  access-list         Clear access list statistical information
  arp-cache           Clear the entire ARP cache
  cdp                 Reset cdp information
  frame-relay         Clear Frame Relay information
  ip                  IP
  ipv6                IPv6
  line                Reset a terminal line
  mac-address-table   MAC forwarding table
  vtp                 Clear VTP items
Router#clear
```

```
Router#configure ?
  terminal  Configure from the terminal
  <cr>
```

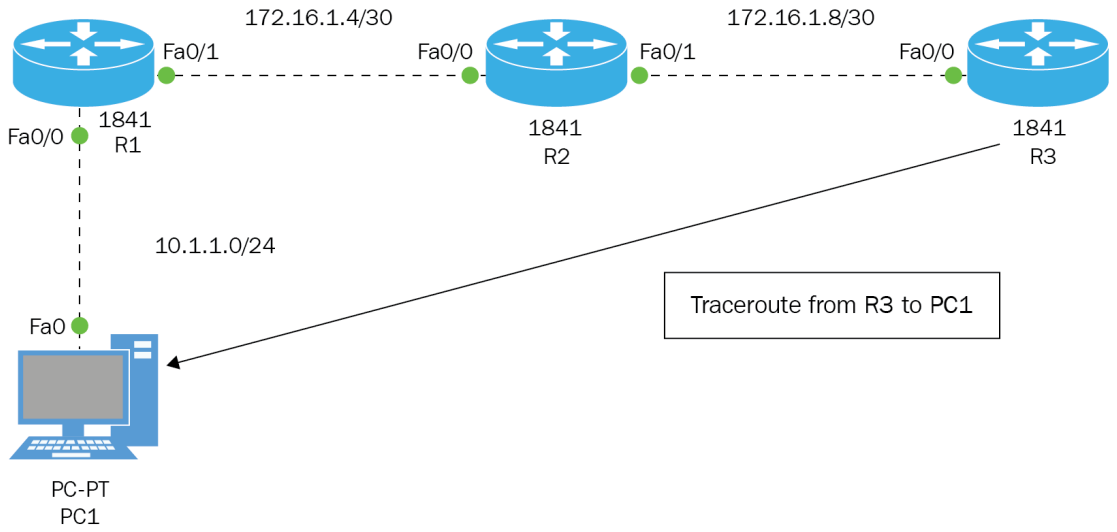
```
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#
```

```
Router#confi
Router#configure term
Router#configure terminal
```

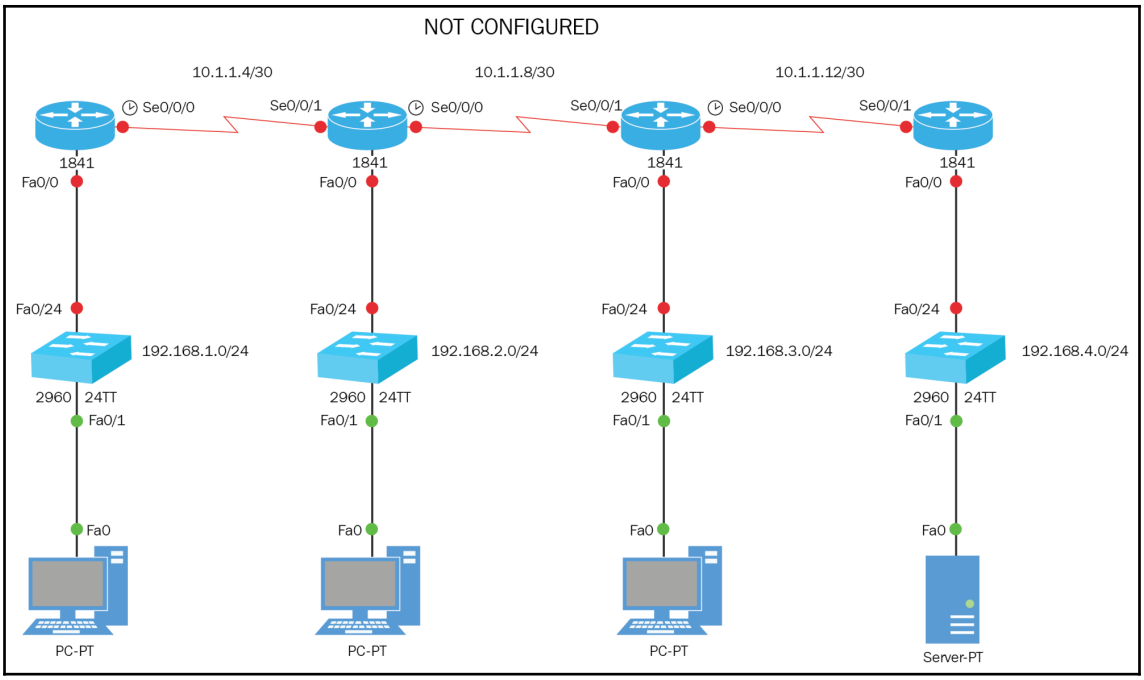
```
Router#ping 10.1.1.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.1, timeout is 2 seconds:
.!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 0/0/1 ms
```

```
  resume      Resume an active network connection
  rmdir       Remove existing directory
  send        Send a message to other tty lines
  setup       Run the SETUP command facility
  show        Show running system information
  ssh         Open a secure shell client connection
  telnet      Open a telnet connection
  terminal    Set terminal line parameters
  traceroute  Trace route to destination
  undebug     Disable debugging functions (see also 'debug')
  vlan        Configure VLAN parameters
  write       Write running configuration to memory, network, or terminal
Router#
```

```
Router(config-if)#do sh ip int brief
Interface                  IP-Address      OK? Method Status                Protocol
FastEthernet0/0            10.1.1.254      YES manual up                    up
FastEthernet0/1            unassigned      YES unset  administratively down down
Vlan1                      unassigned      YES unset  administratively down down
Router(config-if)#
```




```
R3#traceroute IP 10.1.1.1
Type escape sequence to abort.
Tracing the route to 10.1.1.1
  1   172.16.1.9      0 msec    0 msec    0 msec
  2   172.16.1.5      1 msec    0 msec    0 msec
  3   10.1.1.1        0 msec    1 msec    0 msec
R3#
```




```
R1#COPY RUN START
Destination filename [startup-config]?
Building configuration...
[OK]
R1#
```

```
R1#erase start
Erasing the nvram filesystem will remove all configuration files! Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
R1#Reload
```

Chapter 7: Managing the Cisco Internetwork

```
R1#COPY RUN START
Destination filename [startup-config]?
Building configuration...
[OK]
R1#
```

```
R1#ping 192.168.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.4.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/10/18 ms

R1#copy start tftp
Address or name of remote host []? 192.168.4.1
Destination filename [R1-confg]?

Writing startup-config...!!
[OK - 1058 bytes]

1058 bytes copied in 0.012 secs (88166 bytes/sec)
R1#
```

Verify connectivity

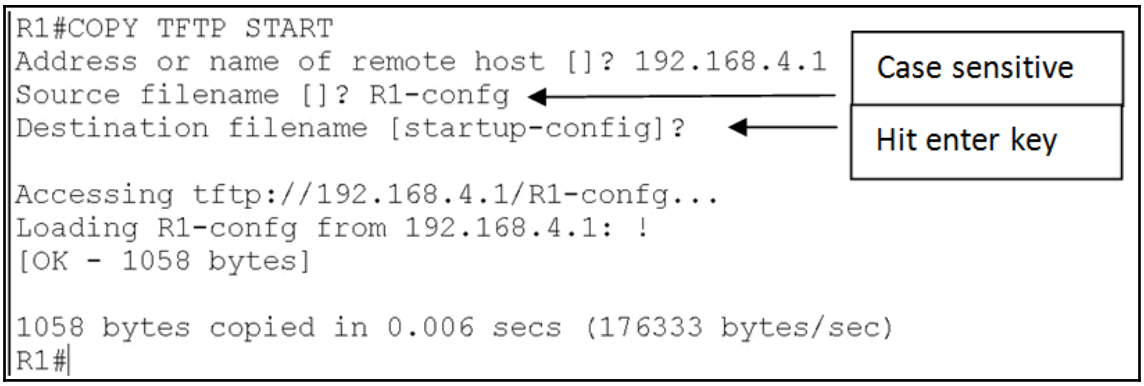
Command used

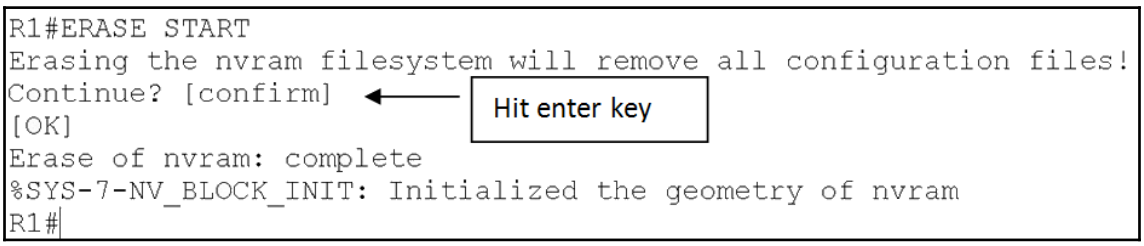
IP address of TFTP

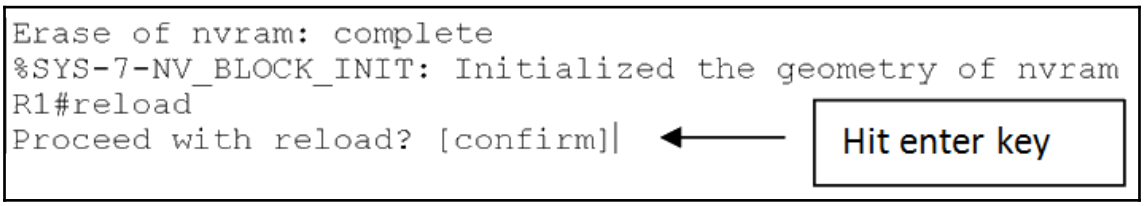
Hit ENTER for default

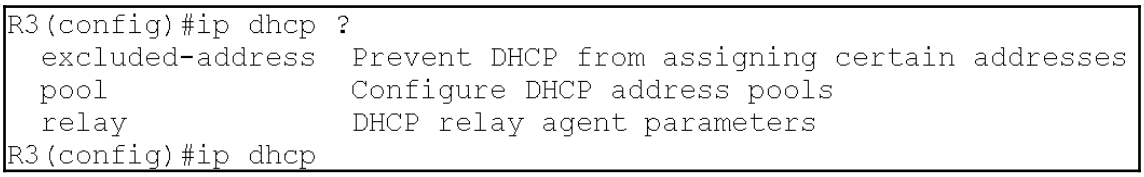
```
R1#sh start
Using 1058 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname R1
!
!
!
enable secret 5 $1$mERr$/8NQictp9.m0ns.z98EQq1
enable password 7 0802657D2A36
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
username LDIAZ privilege 15 password 7 0802657D2A36
```

```
R1#sh run
Building configuration...

Current configuration : 1107 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname R1
!
!
!
enable secret 5 $1$mERr$/8NQictp9.m0ns.z98EQq1
enable password 7 0802657D2A36
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
username LDIAZ privilege 15 password 7 0802657D2A36
username bob privilege 7 password 7 08205C5E051C
```


R1#COPY TFTP START
Address or name of remote host []? 192.168.4.1
Source filename []? R1-confg
Destination filename [startup-config]?
Accessing tftp://192.168.4.1/R1-confg...
Loading R1-confg from 192.168.4.1: !
[OK - 1058 bytes]
1058 bytes copied in 0.006 secs (176333 bytes/sec)
R1#
Case sensitive
Hit enter key


R1#ERASE START
Erasing the nvram filesystem will remove all configuration files!
Continue? [confirm]
[OK]
Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
R1#
Hit enter key


Erase of nvram: complete
%SYS-7-NV_BLOCK_INIT: Initialized the geometry of nvram
R1#reload
Proceed with reload? [confirm]
Hit enter key

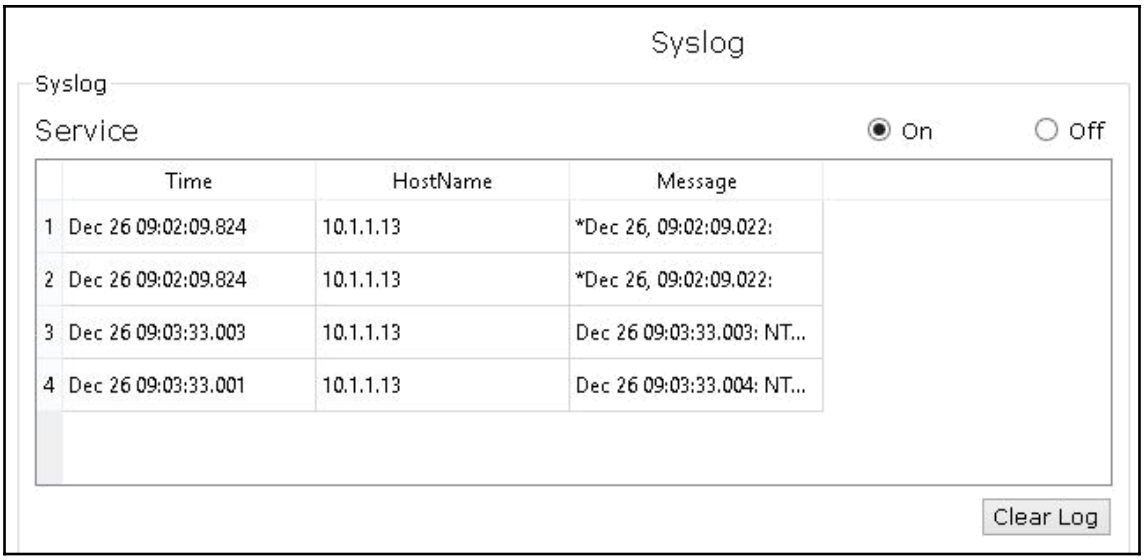

R3(config)#ip dhcp ?
excluded-address Prevent DHCP from assigning certain addresses
pool Configure DHCP address pools
relay DHCP relay agent parameters
R3(config)#ip dhcp

```
R3(config)#ip dhcp pool ACCT_LAN
R3(dhcp-config)#?
  default-router  Default routers
  dns-server      Set name server
  exit            Exit from DHCP pool configuration mode
  network         Network number and mask
  no              Negate a command or set its defaults
  option          Raw DHCP options
R3(dhcp-config)#
```

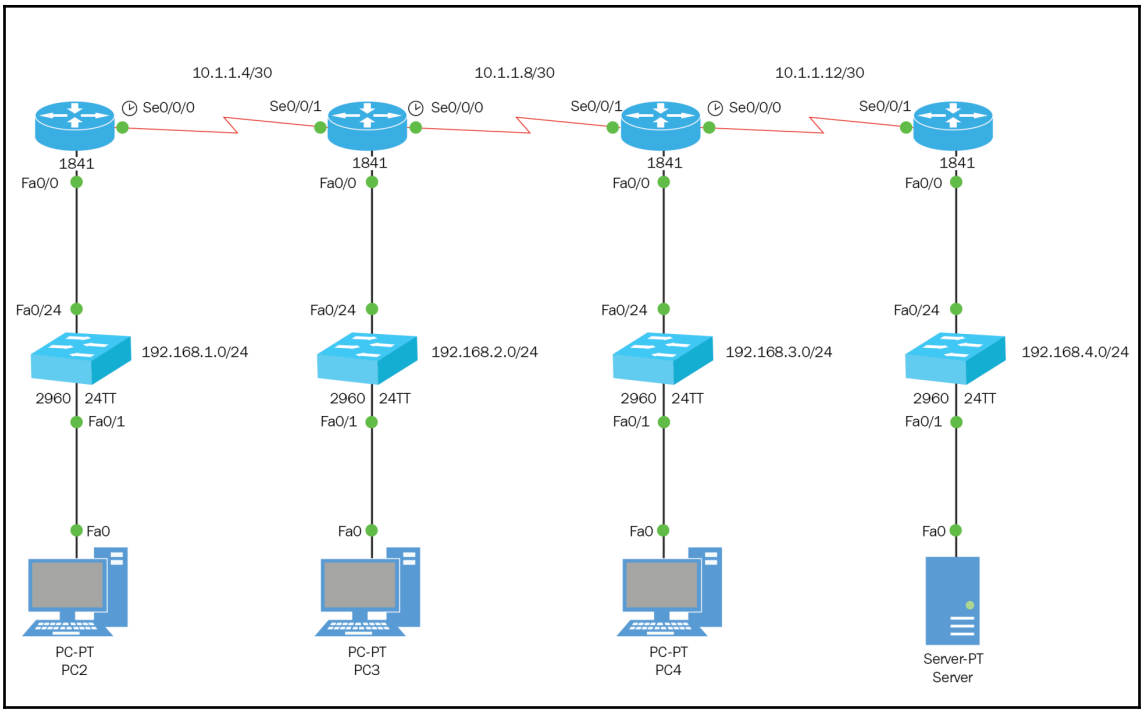
```
R3(dhcp-config)#?
  default-router  Default routers
  dns-server      Set name server
  exit            Exit from DHCP pool configuration mode
  network         Network number and mask
  no              Negate a command or set its defaults
  option          Raw DHCP options
R3(dhcp-config)#default-router 192.168.3.254
R3(dhcp-config)#dns-server 192.168.4.1
R3(dhcp-config)#network 192.168.3.0
% Incomplete command.
R3(dhcp-config)#network 192.168.3.0 255.255.255.0
R3(dhcp-config)#
```

Needs a subnetmask

```
R3(config)#ip dhcp excluded-address ?
  A.B.C.D  Low IP address
R3(config)#ip dhcp excluded-address 192.168.3.200 ?
  A.B.C.D  High IP address
  <cr>
R3(config)#ip dhcp excluded-address 192.168.3.200 192.168.3.254 ?
  <cr>
R3(config)#ip dhcp excluded-address 192.168.3.200 192.168.3.254
R3(config)#
```




```
NTP-Master-Cisco#
NTP-Master-Cisco#sh ntp associations

  address         ref clock       st   when   poll reach  delay  offset   disp
 ~127.127.1.1     .LOCL.           1      4     16   377  0.000   0.000  0.225
*~204.9.54.119    .CDMA.           1     35     64   377  0.000 -80.968  3.040
 * sys.peer, # selected, + candidate, - outlyer, x falseticker, ~ configured
NTP-Master-Cisco#
```




```
R2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#cdp run
R2(config)#int f0/0
R2(config-if)#cdp enable
R2(config-if)#int s0/0/0
R2(config-if)#cdp enable
R2(config-if)#int s0/0/1
R2(config-if)#cdp enable
R2(config-if)#
```

Turn cdp on globally

Turn cdp on within an interface

```
R3#SH CDP NEIGHBOR
Capability Codes: R - Router, T - Trans Bridge, B - Source
Route Bridge
                  S - Switch, H - Host, I - IGMP, r -
Repeater, P - Phone
Device ID    Local Intrfce   Holdtme    Capability   Platform
Port ID
Switch       Fas 0/0          159            S       2960
Fas 0/24
R2           Ser 0/0/1        164            R       C1841
Ser 0/0/0
R4           Ser 0/0/0        165            R       C1841
Ser 0/0/1
R3#
```

```
R3#sh cdp neighbor detail

Device ID: Switch
Entry address(es):
Platform: cisco 2960, Capabilities: Switch
Interface: FastEthernet0/0, Port ID (outgoing port):
FastEthernet0/24
Holdtime: 162

Version :
Cisco IOS Software, C2960 Software (C2960-LANBASE-M), Version
12.2(25)FX, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Wed 12-Oct-05 22:05 by pt_team

advertisement version: 2
Duplex: full
---------------------------

Device ID: R2
Entry address(es):
  IP address : 10.1.1.9
Platform: cisco C1841, Capabilities: Router
Interface: Serial0/0/1, Port ID (outgoing port): Serial0/0/0
Holdtime: 168
```

```
R1(config)#INT S0/0/1
R1(config-if)#NO CDP ENABLE
R1(config-if)#
```

```
R2#sh cdp entry *

Device ID: Switch
Entry address(es):
Platform: cisco 2960, Capabilities: Switch
Interface: FastEthernet0/0, Port ID (outgoing port): FastEthernet0/24
Holdtime: 136

Version :
Cisco IOS Software, C2960 Software (C2960-LANBASE-M), Version 12.2(25)FX, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2005 by Cisco Systems, Inc.
Compiled Wed 12-Oct-05 22:05 by pt_team

advertisement version: 2
Duplex: full
---------------------------

Device ID: R3
Entry address(es):
  IP address : 10.1.1.10
Platform: cisco C1841, Capabilities: Router
Interface: Serial0/0/0, Port ID (outgoing port): Serial0/0/1
Holdtime: 142
```

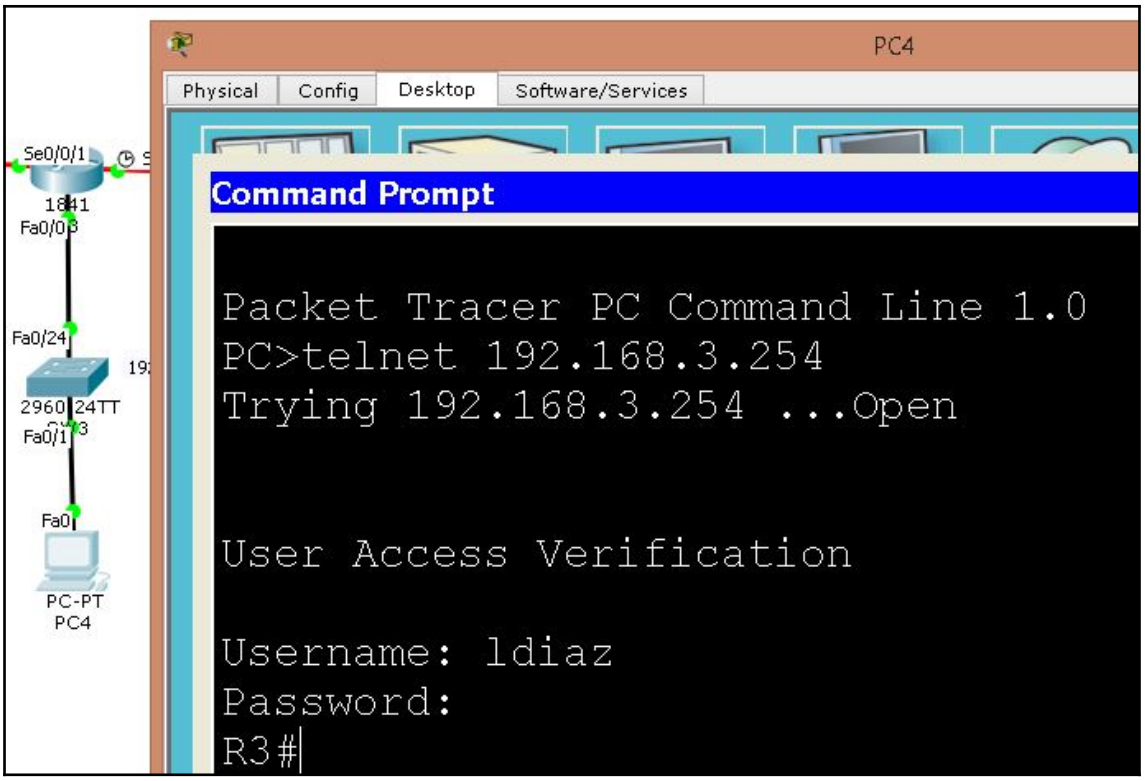
Syntax Description

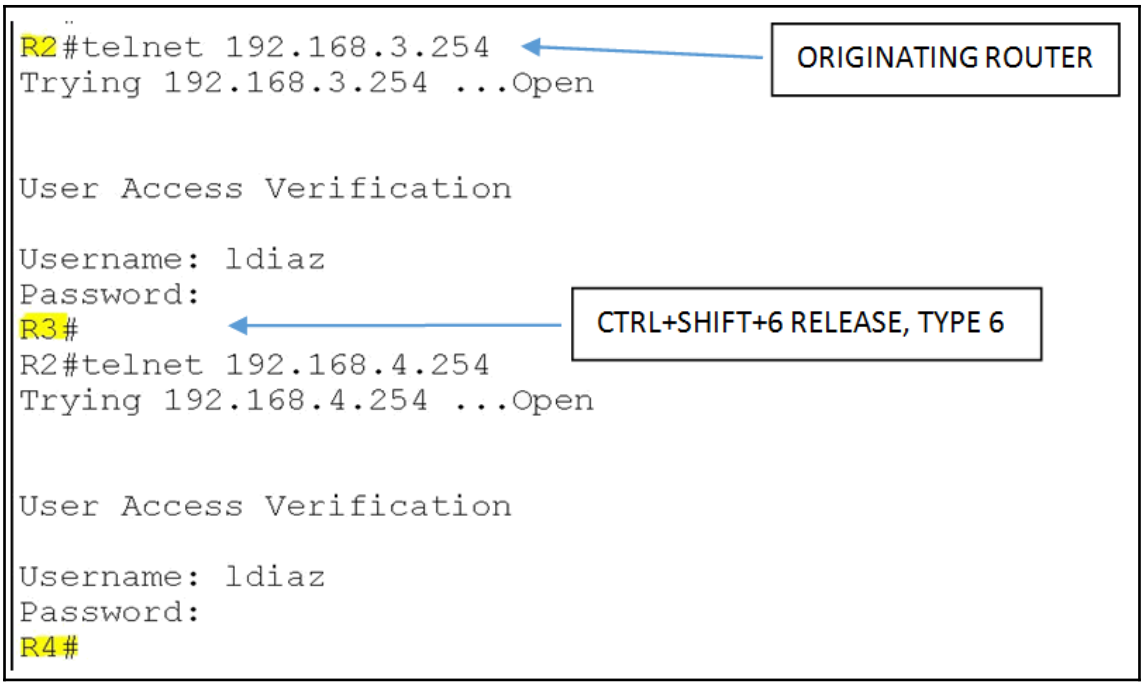
*	Wildcard showing all the CDP neighbors.
entry-name	Name of the neighbor. You can enter an asterisk (*) at the end of an *entry-name*, such as `show cdp entry dev*`, which would show information about the neighbor, device.cisco.com.
protocol	(Optional) Limits the display to information about the protocols enabled on a router.
version	(Optional) Limits the display to information about the version of software running on the router.

```
CORE#SH LLDP NEighbors
Capability codes:
    (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
    (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other
Device ID           Local Intf     Hold-time  Capability      Port ID
STUDENT2            Fa0/23         120        R               Fa0/23
STUDENT             Fa0/24         120        R               Vlan
STUDENT2            Fa0/23         120        R               Vlan
STUDENT             Fa0/24         120        R               Fa0/24

Total entries displayed: 4
```

```
CORE#SH LLDP NEighbors DETAIL
------------------------------------------------
Chassis id: 0001.960E.7917
Port id: Fa0/23
Port Description: FastEthernet0/23
System Name: STUDENT2
System Description:
Cisco IOS Software, C3560 Software (C3560-ADVIPSERVICESK9-M), Version 12.2(37)SE1, RELEASE SOFTWARE (fc1)
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Thu 05-Jul-07 22:22 by pt_team
Time remaining: 90 seconds
System Capabilities: R
Enabled Capabilities: R
Management Addresses - not advertised
Auto Negotiation - supported, enabled
Physical media capabilities:
    100baseT(HD)
    100baseT(FD)
    1000baseT(HD)
Media Attachment Unit type: 10
Vlan ID: 1
```

```
R3(config)#line vty 0 15
R3(config-line)#password cisco
R3(config-line)#login local
R3(config-line)#exit
R3(config)#username ldiaz privilege 15 password 0 cisco
R3(config)#do wr
```


PC4
Physical
Config
Desktop
Software/Services
Command Prompt
Packet Tracer PC Command Line 1.0
PC>telnet 192.168.3.254
Trying 192.168.3.254 ...Open
User Access Verification
Username: ldiaz
Password:
R3#
Se0/0/1
Fa0/24
Fa0/1
Fa0
PC-PT
PC4




```
R2#sh users
    Line       User       Host(s)              Idle       Location
*   0 con 0                idle                 00:00:00
  196 vty 0    ldiaz      10.1.1.10            00:00:31 10.1.1.5
  197 vty 1    ldiaz      idle                 00:04:19 10.1.1.10
```

```
R3(config)#ip host R2 10.1.1.9 10.1.1.6 192.168.2.254
R3(config)#exit
R3#
*Jan 01, 10:27:54.2727: *Jan 01, 10:27:54.2727: %SYS-5-
CONFIG_I: Configured from console by console
R3#ping R2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.9, timeout is 2
seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max
= 7/9/16 ms

R3#
```

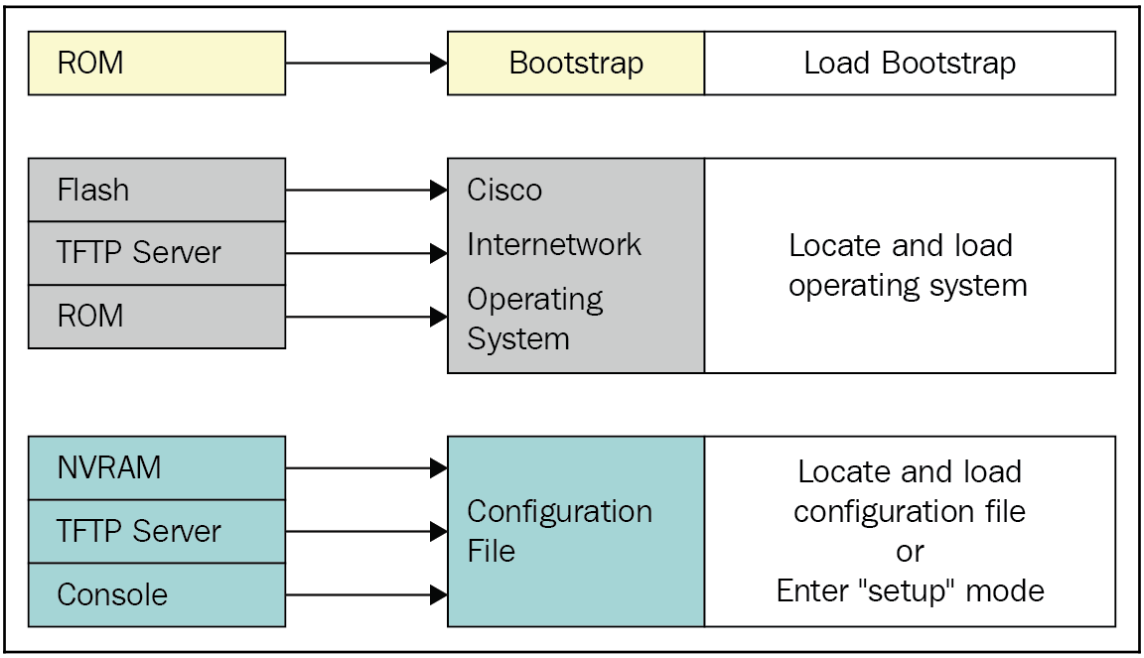


```
R4#debug ?
  aaa            AAA Authentication, Authorization and Accounting
  crypto         Cryptographic subsystem
  custom-queue   Custom output queueing
  eigrp          EIGRP Protocol information
  ephone         ethernet phone skinny protocol
  frame-relay    Frame Relay
  ip             IP information
  ipv6           IPv6 information
  ntp            NTP information
  ppp            PPP (Point to Point Protocol) information
R4#debug
```

```
  ppp            PPP (Point to Point Protocol) information
R4#debug ip rip
RIP protocol debugging is on
R4#RIP: received v2 update from 10.1.1.13 on Serial0/0/1
      10.1.1.4/30 via 0.0.0.0 in 2 hops
      10.1.1.8/30 via 0.0.0.0 in 1 hops
      192.168.1.0/24 via 0.0.0.0 in 3 hops
      192.168.2.0/24 via 0.0.0.0 in 2 hops
      192.168.3.0/24 via 0.0.0.0 in 1 hops
RIP: sending  v2 update to 224.0.0.9 via FastEthernet0/0 (192.168.4.254)
RIP: build update entries
      10.1.1.4/30 via 0.0.0.0, metric 3, tag 0
      10.1.1.8/30 via 0.0.0.0, metric 2, tag 0
      10.1.1.12/30 via 0.0.0.0, metric 1, tag 0
      192.168.1.0/24 via 0.0.0.0, metric 4, tag 0
      192.168.2.0/24 via 0.0.0.0, metric 3, tag 0
      192.168.3.0/24 via 0.0.0.0, metric 2, tag 0
RIP: sending  v2 update to 224.0.0.9 via Serial0/0/1 (10.1.1.14)
RIP: build update entries
      192.168.4.0/24 via 0.0.0.0, metric 1, tag 0
```

```
R4#sh processes
CPU utilization for five seconds: 0%/0%; one minute: 0%; five minutes: 0%
 PID QTy       PC Runtime (ms)     Invoked  uSecs     Stacks TTY Process
   1 Csp 602F3AF0           0        1627       0 2600/3000   0 Load Meter
   2 Lwe 60C5BE00           4         136      29 5572/6000   0 CEF Scanner
   3 Lst 602D90F8        1676         837    2002 5740/6000   0 Check heaps
   4 Cwe 602D08F8           0           1       0 5568/6000   0 Chunk
Manager
   5 Cwe 602DF0E8           0           1       0 5592/6000   0 Pool
Manager
   6 Mst 60251E38           0           2       0 5560/6000   0 Timers
   7 Mwe 600D4940           0           2       0 5568/6000   0 Serial
Backgrou
   8 Mwe 6034B718           0           1       0 2584/3000   0 OIR Handler
   9 Mwe 603FA3C8           0           1       0 5612/6000   0 IPC Zone
Manage
  10 Mwe 603FA1A0           0        8124       0 5488/6000   0 IPC
Periodic Ti
  11 Mwe 603FA220           0           9       0 4884/6000   0 IPC Seat
Manage
  12 Lwe 60406818         124        2003      61 5300/6000   0 ARP Input
  13 Mwe 60581638           0           1       0 5760/6000   0 HC Counter
Time
  14 Mwe 605E3D00           0           2       0 5564/6000   0 DDR Timers
  15 Msp 80164A38           0       79543       0 5608/6000   0 GraphIt
  16 Mwe 802DB0FC           0           2       011576/12000  0 Dialer
```

Chapter 8: Managing Cisco Devices



Hex table

HEX	DECIMAL
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
A	10
B	11
C	12
D	13
E	14
F	15

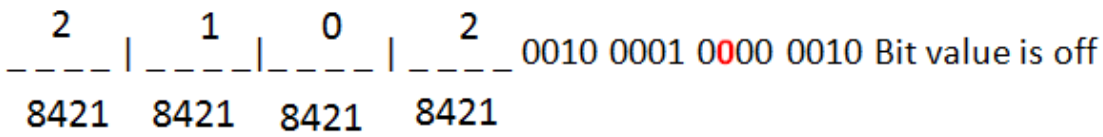
The table to the left is our Hexadecimal table. It lets us know the decimal value of each Hex number. Each Hex number represents four bits and each one of those bits has a specific value.

An example of that would be the following:

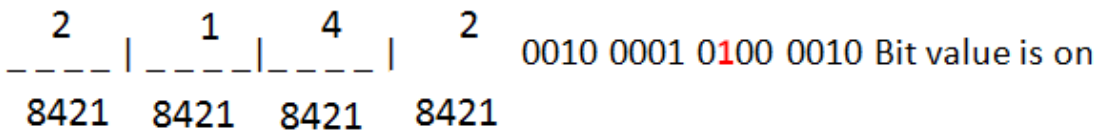
Default Cisco Registry value in Hex: 0x2102
The binary equivalent to that would be the following
0010 0001 0000 0010

Changed Cisco Registry value in Hex: 0x2142
The binary equivalent to that would be the following
0010 0001 0100 0010

Just turn the bits that are on



Just turn the bits that are on




```
R3#show version
Cisco IOS Software, 1841 Software (C1841-ADVIPSERVICESK9-M), Version 12.4(15)T1, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2007 by Cisco Systems, Inc.
Compiled Wed 18-Jul-07 04:52 by pt_team

ROM: System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)

System returned to ROM by power-on
System image file is "flash:c1841-advipservicesk9-mz.124-15.T1.bin"
```

```
Cisco 1841 (revision 5.0) with 114688K/16384K bytes of memory.
Processor board ID FTX0947Z18E
M860 processor: part number 0, mask 49
2 FastEthernet/IEEE 802.3 interface(s)
2 Low-speed serial(sync/async) network interface(s)
191K bytes of NVRAM.
63488K bytes of ATA CompactFlash (Read/Write)

Configuration register is 0x2102
```

```
R3(config)#
R3(config)#config-register 0x2142
R3(config)#exit
R3#
*May 22, 11:06:30.066: *May 22, 11:06:30.066: %SYS-5-CONFIG_I: Configured from console by console
R3#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
```

```
Configuration register is 0x2102 (will be 0x2142 at next reload)
```

```
R2(config)#boot ?
  system  System image file
R2(config)#boot system ?
  WORD    TFTP filename or URL
  flash   Boot from flash memory
  tftp    Boot from a tftp server
R2(config)#boot system
```

```
R2#sh flash

System flash directory:
File  Length    Name/status
  3   33591768  c1841-advipservicesk9-mz.124-15.T1.bin
  2   28282     sigdef-category.xml
  1   227537    sigdef-default.xml
[33847587 bytes used, 30168797 available, 64016384 total]
63488K bytes of processor board System flash (Read/Write)
```

Need file name

```
R2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#boot system flash c1841-advipservicesk9-mz.124-15.T1.bin
R2(config)#exit
R2#
%SYS-5-CONFIG_I: Configured from console by console

R2#copy run start
```

Actual command

```
R2(config)#boot system tftp ?
  WORD  System image filename
R2(config)#boot system tftp c1841-advipservicesk9-mz.124-15.T1.bin ?
  A.B.C.D  Address from which to download the file
  <cr>
R2(config)#boot system tftp c1841-advipservicesk9-mz.124-15.T1.bin 192.168.100.1 ?
  <cr>
R2(config)#boot system tftp c1841-advipservicesk9-mz.124-15.T1.bin 192.168.100.1
R2(config)#
```

```
R2(config)#boot system rom
R2(config)#
R2(config)#
```

```
Self decompressing the image :
################
monitor: command "boot" aborted due to user interrupt
rommon 1 > CONFREG 0X2142
rommon 2 > reset
```

INTERRUPT BOOT SEQUENCE USING CTRL+C KEYBOARD COMMAND

CHANGING REGISTAR

REBOOT ROUTER

```
R1(config)#config-register 0x2102
R1(config)#
```

```
R4#ping 192.168.4.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.4.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/2 ms
```

```
R4#sh flash

System flash directory:
File  Length    Name/status
  3   33591768  c1841-advipservicesk9-mz.124-15.T1.bin
  2   28282     sigdef-category.xml
  1   227537    sigdef-default.xml
[33847587 bytes used, 30168797 available, 64016384 total]
63488K bytes of processor board System flash (Read/Write)
```

```
R4#copy flash tftp
Source filename []? c1841-advipservicesk9-mz.124-15.T1.bin
Address or name of remote host []? 192.168.4.1
Destination filename [c1841-advipservicesk9-mz.124-15.T1.bin]? c1841-R4-
IOS.BIN

Writing c1841-advipservicesk9-
mz.124-15.T1.bin...!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!
[OK - 33591768 bytes]

33591768 bytes copied in 0.922 secs (3825376 bytes/sec)
```

Actual Command

File

R1-confg
asa842-k8.bin
asa923-k8.bin
c1841-R4-IOS.BIN
c1841-advipservicesk9-mz.124-15.T1.bin
c1841-ipbase-mz.123-14.T7.bin

```
R4#copy tftp flash
Address or name of remote host []? 192.168.4.1
Source filename []? c1841-R4-IOS.BIN
Destination filename [c1841-R4-IOS.BIN]? c1841-advipservicesk9-mz.124-15.T1.bin
%Warning:There is a file already existing with this name
Do you want to over write? [confirm]

Accessing tftp://192.168.4.1/c1841-R4-IOS.BIN...
Loading c1841-R4-IOS.BIN from 192.168.4.1:
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 33591768 bytes]

33591768 bytes copied in 0.929 secs (3796552 bytes/sec)
```

```
R4#copy start tftp
Address or name of remote host []? 192.168.4.1
Destination filename [R4-confg]?

Writing startup-config...!!
[OK - 888 bytes]

888 bytes copied in 0.001 secs (888000 bytes/sec)
R4#
```

File
R1-confg
R3-confg
R4-confg

```
R4>
R4>en
R4#copy run start
Destination filename [startup-config]?
Building configuration...
[OK]
R4#
```

```
R4#dir
Directory of flash:/

    5  drw-           0          <no date>  backup
    3  -rw-    33591768          <no date>  c1841-advipservicesk9-
mz.124-15.T1.bin
    2  -rw-       28282          <no date>  sigdef-category.xml
    1  -rw-      227537          <no date>  sigdef-default.xml

64016384 bytes total (30168797 bytes free)
R4#
```

```
R1#dir
Directory of flash:/

    3  -rw-    33591768          <no date>  c1841-advipservicesk9-
mz.124-15.T1.bin
    2  -rw-       28282          <no date>  sigdef-category.xml
    1  -rw-      227537          <no date>  sigdef-default.xml

64016384 bytes total (30168797 bytes free)
R1#mkdir laz
Create directory filename [laz]?
Created dir flash:laz

R1#dir
Directory of flash:/

    3  -rw-    33591768          <no date>  c1841-advipservicesk9-
mz.124-15.T1.bin
    4  drw-           0          <no date>  laz
    2  -rw-       28282          <no date>  sigdef-category.xml
    1  -rw-      227537          <no date>  sigdef-default.xml

64016384 bytes total (30168797 bytes free)
```

```
System Bootstrap, Version 12.3(8r)T8, RELEASE SOFTWARE (fc1)
Initializing memory for ECC
..
c2811 processor with 524288 Kbytes of main memory
Main memory is configured to 64 bit mode with ECC enabled

Readonly ROMMON initialized

Boot process failed...

The system is unable to boot automatically.  The BOOT
environment variable needs to be set to a bootable
image.
rommon 1 >
```

```
rommon 1 > tftpdnld

Missing or illegal ip address for variable IP_ADDRESS
Illegal IP address.

usage: tftpdnld
  Use this command for disaster recovery only to recover an image via TFTP.
  Monitor variables are used to set up parameters for the transfer.
  (Syntax: "VARIABLE_NAME=value" and use "set" to show current variables.)
  "ctrl-c" or "break" stops the transfer before flash erase begins.

  The following variables are REQUIRED to be set for tftpdnld:
          IP_ADDRESS: The IP address for this unit
       IP_SUBNET_MASK: The subnet mask for this unit
     DEFAULT_GATEWAY: The default gateway for this unit
         TFTP_SERVER: The IP address of the server to fetch from
           TFTP_FILE: The filename to fetch

  The following variables are OPTIONAL:
        TFTP_VERBOSE: Print setting. 0=quiet, 1=progress(default), 2=verbose
    TFTP_RETRY_COUNT: Retry count for ARP and TFTP (default=7)
        TFTP_TIMEOUT: Overall timeout of operation in seconds (default=7200)
       TFTP_CHECKSUM: Perform checksum test on image, 0=no, 1=yes (default=1)
       FE_SPEED_MODE: 0=10/hdx, 1=10/fdx, 2=100/hdx, 3=100/fdx, 4=Auto(deflt)

rommon 2 >
```

```
rommon 7 > IP_ADDRESS=10.1.3.253
rommon 8 > IP_SUBNET_MASK=255.255.255.0
rommon 9 > DEFAULT_GATEWAY=10.1.3.254
rommon 10 > TFTP_SERVER=10.1.3.1
rommon 11 > TFTP_FILE=c1841-advipservicesk9-mz.124.15.T1.bin
```

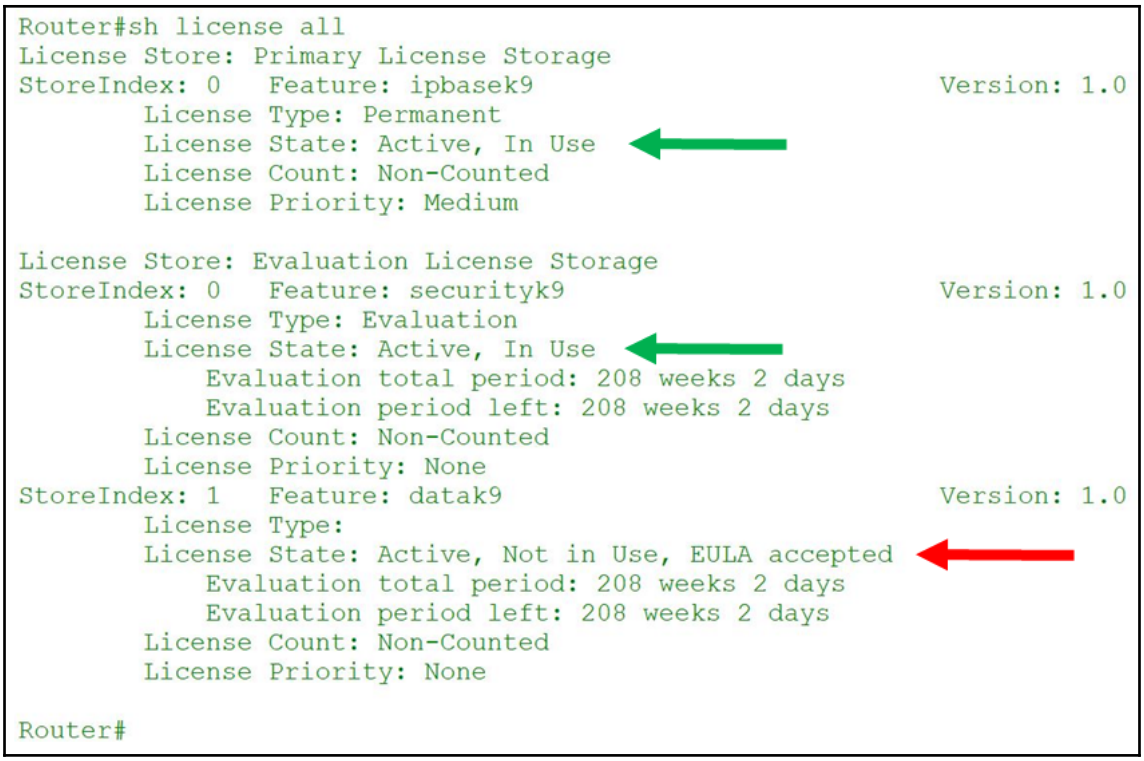
```
Router#sh license udi
Device#    PID                  SN              UDI
-------------------------------------------------------------------------------
*1         CISCO1941/K9         FTX152425DY     CISCO1941/K9:FTX152425DY
Router#
```

```
Router#sh license feature
Feature name              Enforcement  Evaluation  Subscription  Enabled
ipbasek9                  no           no          no            yes
securityk9                yes          yes         no            no
datak9                    yes          no          no            no
```

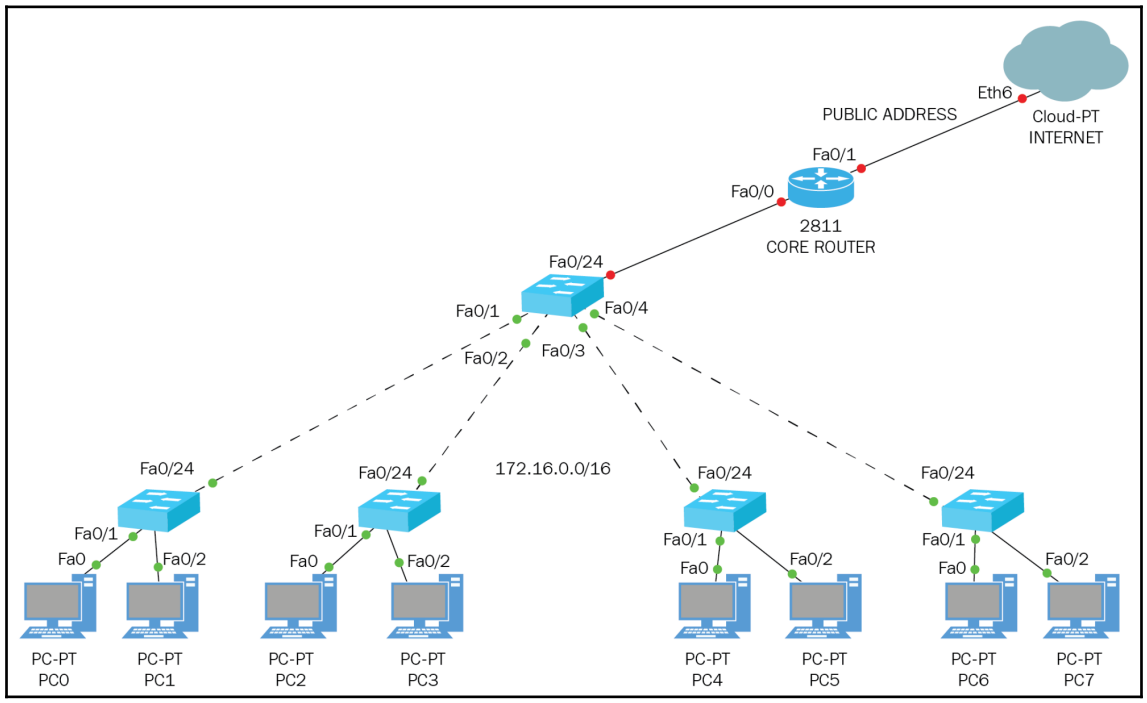
```
Router#sh license all
License Store: Primary License Storage
StoreIndex: 0   Feature: ipbasek9                         Version: 1.0
        License Type: Permanent
        License State: Active, In Use
        License Count: Non-Counted
        License Priority: Medium

License Store: Evaluation License Storage
StoreIndex: 0   Feature: securityk9                       Version: 1.0
        License Type: Evaluation
        License State: Inactive
            Evaluation total period: 208 weeks 2 days
            Evaluation period left: 208 weeks 2 days
        License Count: Non-Counted
        License Priority: None
StoreIndex: 1   Feature: datak9                           Version: 1.0
        License Type:
        License State: Inactive
            Evaluation total period: 208 weeks 2 days
            Evaluation period left: 208 weeks 2 days
        License Count: Non-Counted
        License Priority: None
```

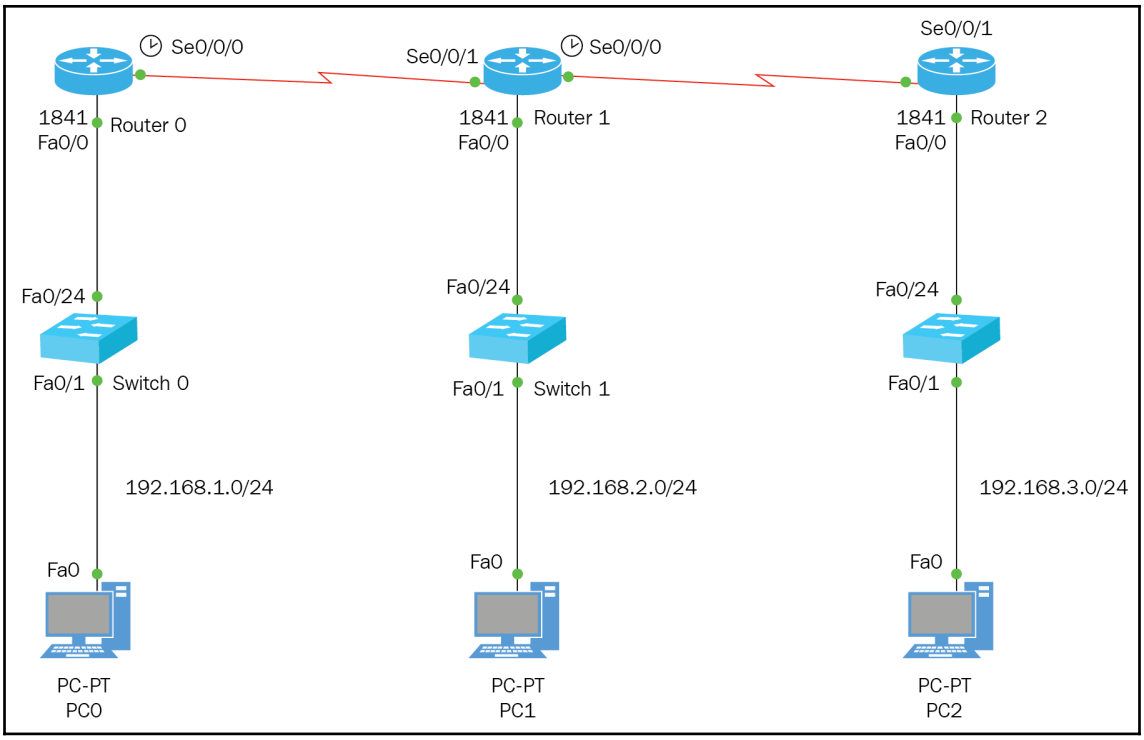
```
Router(config)#license boot module c1900 technology-package securityk9
```

```
ACCEPT? [yes/no]: yes
% use 'write' command to make license boot config take effect on next boot

Router(config)#: %IOS_LICENSE_IMAGE_APPLICATION-6-LICENSE_LEVEL: Module
name = C1900 Next reboot level = securityk9 and License = securityk9

Router(config)#
```


Router#sh license all
License Store: Primary License Storage
StoreIndex: 0 Feature: ipbasek9 Version: 1.0
License Type: Permanent
License State: Active, In Use
License Count: Non-Counted
License Priority: Medium
License Store: Evaluation License Storage
StoreIndex: 0 Feature: securityk9 Version: 1.0
License Type: Evaluation
License State: Active, In Use
Evaluation total period: 208 weeks 2 days
Evaluation period left: 208 weeks 2 days
License Count: Non-Counted
License Priority: None
StoreIndex: 1 Feature: datak9 Version: 1.0
License Type:
License State: Active, Not in Use, EULA accepted
Evaluation total period: 208 weeks 2 days
Evaluation period left: 208 weeks 2 days
License Count: Non-Counted
License Priority: None
Router#

Chapter 9: The IP Routing Process






```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0

R2#
```

CONNECTED TO THE THREE NETWORKS

```
R1(config)#ip route 0.0.0.0 0.0.0.0 s0/0/0
R1(config)#do wr
Building configuration...
[OK]
R1(config)#do sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.4 is directly connected, Serial0/0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0
```

Static route configuration using exit interface,

Gateway of last resort set

Notice the S*

```
R3#CONFIG T
Enter configuration commands, one per line.  End with
R3(config)#IP ROUTE 0.0.0.0 0.0.0.0 S0/0/1
R3(config)#DO SH IP ROUTE
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 1 subnets
C       10.1.1.8 is directly connected, Serial0/0/1
C    192.168.3.0/24 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/1
```

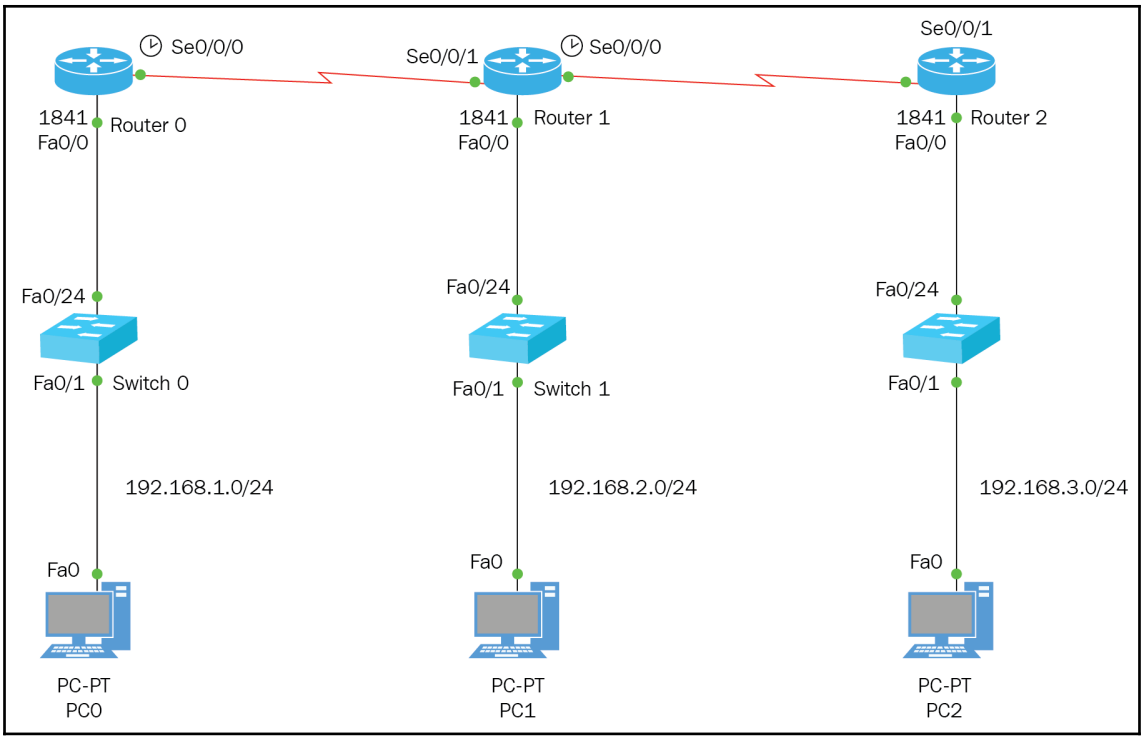
Static route configuration using exit interface,

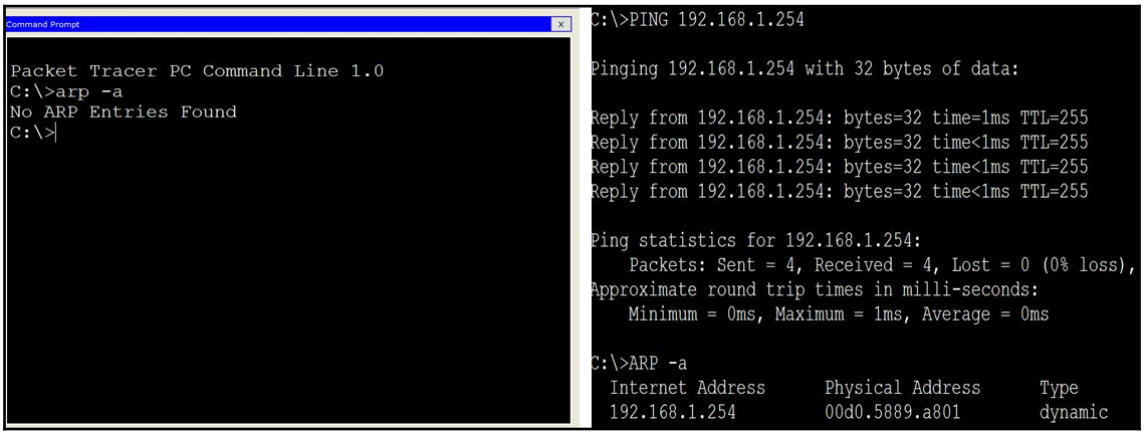
Gateway of last resort set

Notice the S*

```
Packet Tracer PC Command Line 1.0
C:\>ping 192.168.3.1

Pinging 192.168.3.1 with 32 bytes of data:

Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 192.168.3.1:
    Packets: Sent = 4, Received = 0, Lost = 4
(100% loss),

C:\>
```

```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
C    192.168.2.0/24 is directly connected, FastEthernet0/0
```


Se0/0/0
Se0/0/1
Se0/0/0
Se0/0/1
1841
Router 0
Fa0/0
1841
Router 1
Fa0/0
1841
Router 2
Fa0/0
Fa0/24
Fa0/1
Switch 0
Fa0/24
Fa0/1
Switch 1
Fa0/24
Fa0/1
192.168.1.0/24
192.168.2.0/24
192.168.3.0/24
Fa0
Fa0
Fa0
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2

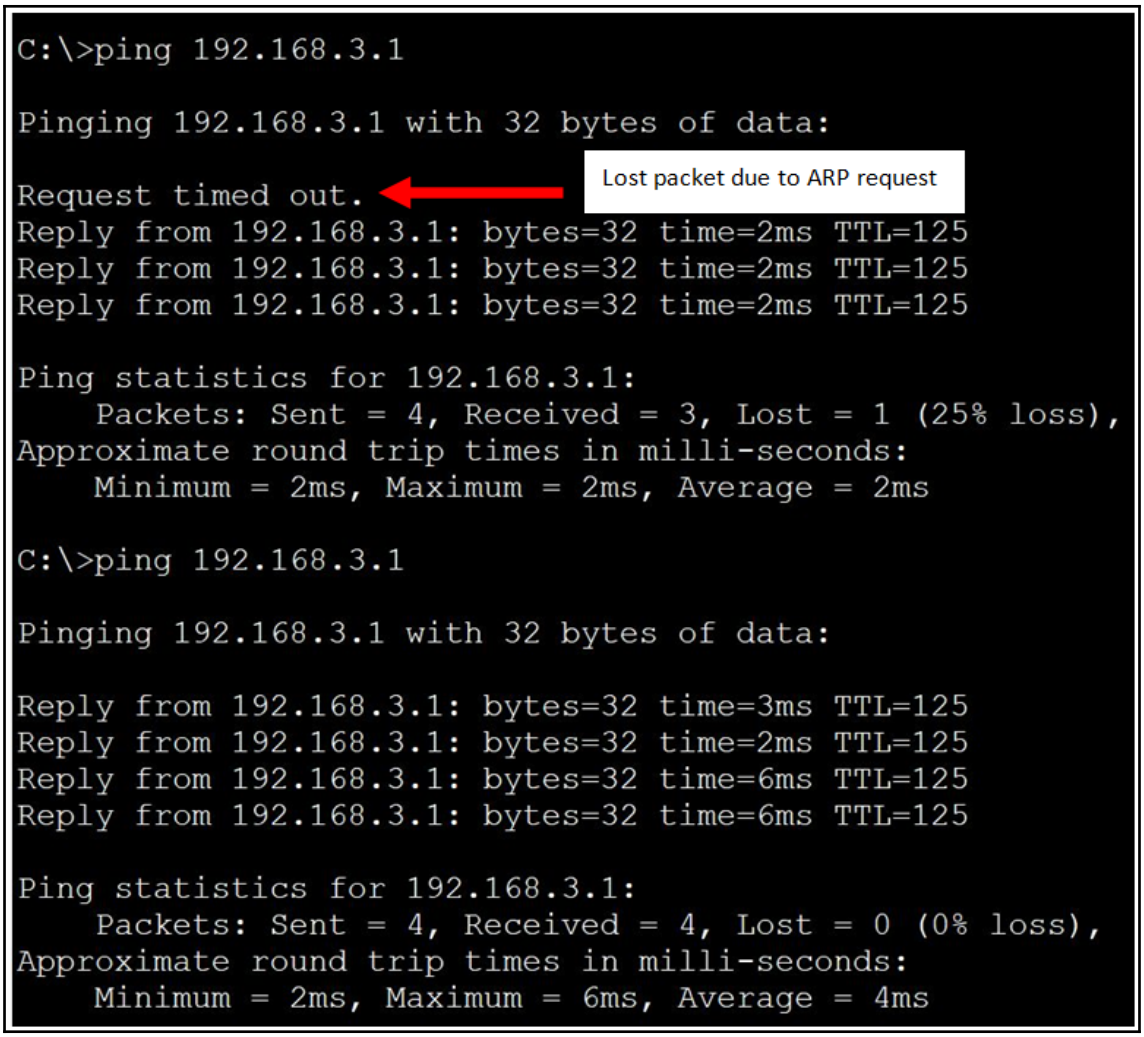

Command Prompt
Packet Tracer PC Command Line 1.0
C:\>arp -a
No ARP Entries Found
C:\>
C:\>PING 192.168.1.254
Pinging 192.168.1.254 with 32 bytes of data:
Reply from 192.168.1.254: bytes=32 time=1ms TTL=255
Reply from 192.168.1.254: bytes=32 time<1ms TTL=255
Reply from 192.168.1.254: bytes=32 time<1ms TTL=255
Reply from 192.168.1.254: bytes=32 time<1ms TTL=255
Ping statistics for 192.168.1.254:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 1ms, Average = 0ms
C:\>ARP -a
Internet Address
Physical Address
Type
192.168.1.254
00d0.5889.a801
dynamic

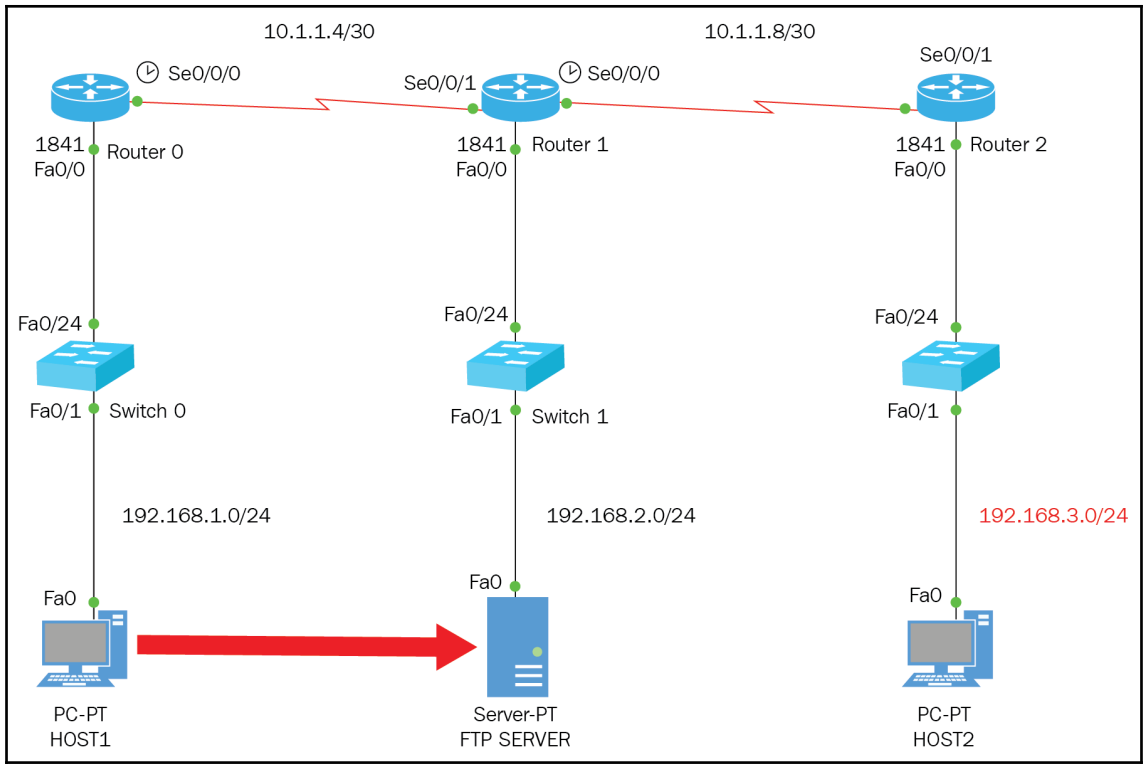
```
R2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#ip route 192.168.1.0 255.255.255.0 s0/0/1 150
R2(config)#ip route 192.168.3.0 255.255.255.0 s0/0/0 150
R2(config)#do wr
Building configuration...
[OK]
R2(config)#
```

This is the AD

```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
S    192.168.1.0/24 is directly connected, Serial0/0/1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
S    192.168.3.0/24 is directly connected, Serial0/0/0

R2#
```

Network Entries


C:\>ping 192.168.3.1
Pinging 192.168.3.1 with 32 bytes of data:
Request timed out.
Lost packet due to ARP request
Reply from 192.168.3.1: bytes=32 time=2ms TTL=125
Reply from 192.168.3.1: bytes=32 time=2ms TTL=125
Reply from 192.168.3.1: bytes=32 time=2ms TTL=125
Ping statistics for 192.168.3.1:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 2ms, Maximum = 2ms, Average = 2ms
C:\>ping 192.168.3.1
Pinging 192.168.3.1 with 32 bytes of data:
Reply from 192.168.3.1: bytes=32 time=3ms TTL=125
Reply from 192.168.3.1: bytes=32 time=2ms TTL=125
Reply from 192.168.3.1: bytes=32 time=6ms TTL=125
Reply from 192.168.3.1: bytes=32 time=6ms TTL=125
Ping statistics for 192.168.3.1:
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
Minimum = 2ms, Maximum = 6ms, Average = 4ms

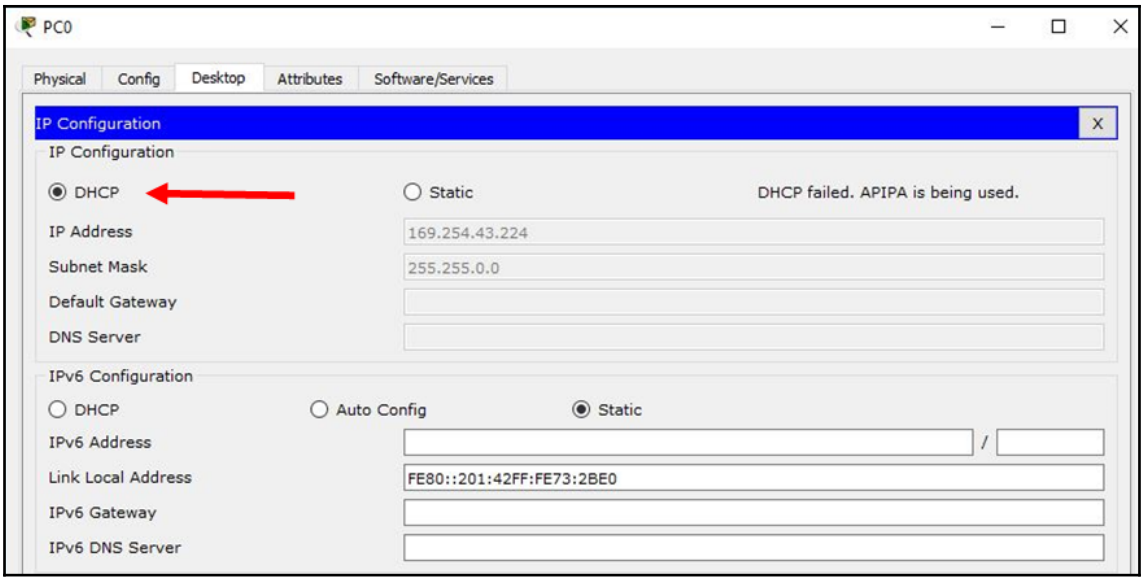


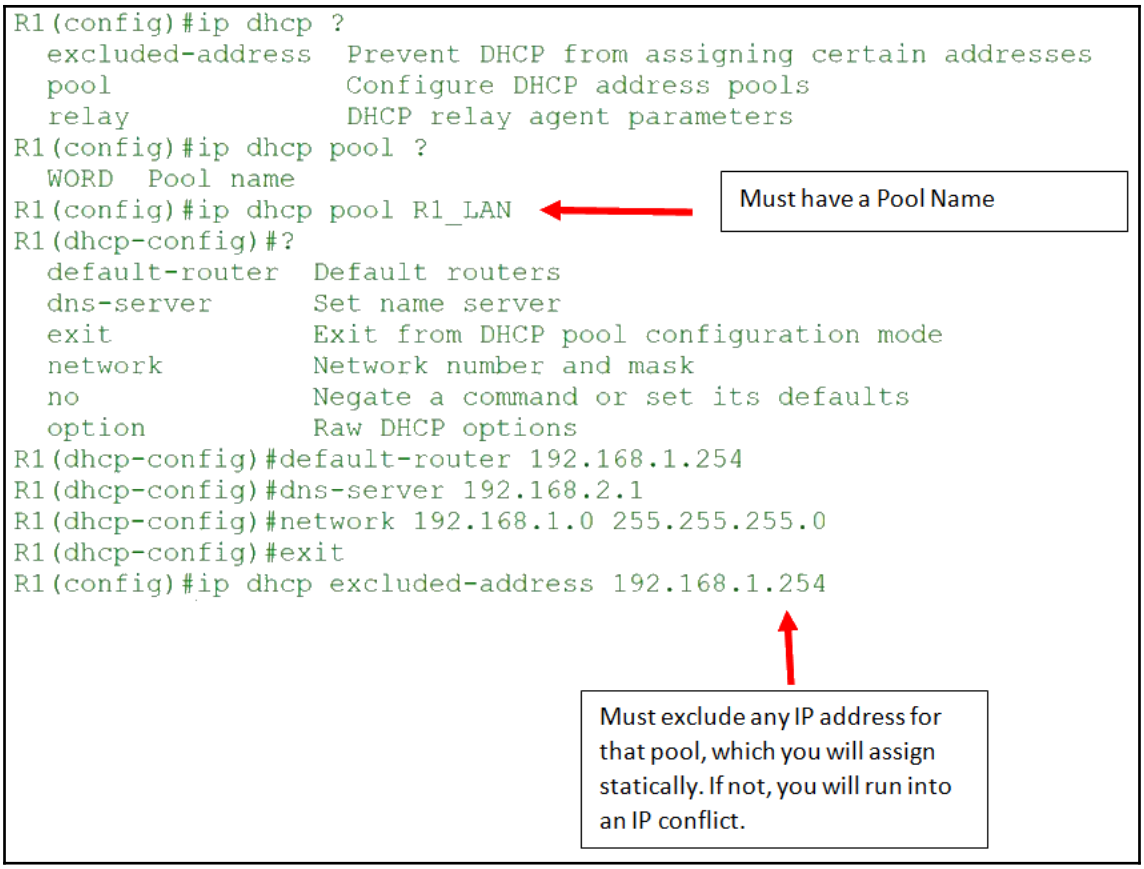

```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
R    192.168.1.0/24 [120/1] via 10.1.1.5, 00:00:15, Serial0/0/1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
R    192.168.3.0/24 [120/1] via 10.1.1.10, 00:00:07, Serial0/0/0

R2#
```

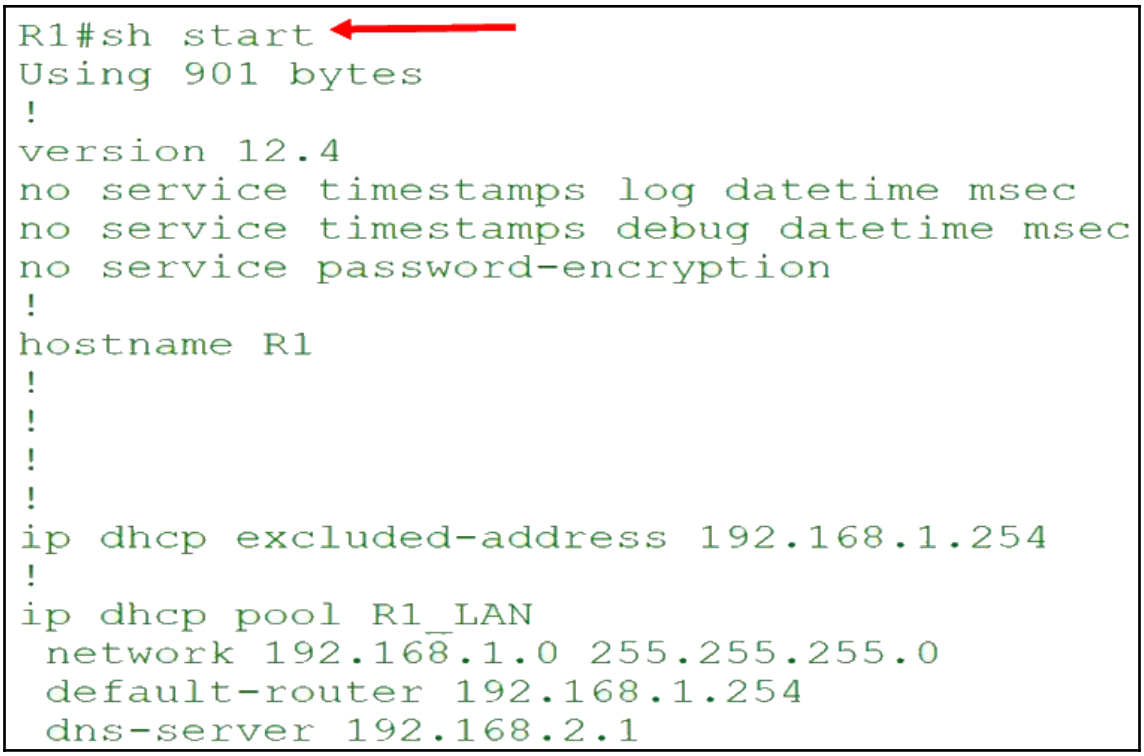
```
R1#sh controllers s0/0/0
Interface Serial0/0/0
Hardware is PowerQUICC MPC860
DCE V.35, clock rate 4000000
idb at 0x81081AC4, driver data structure at
SCC Registers:
General [GSMR]=0x2:0x00000000, Protocol-specific [PSMR]=0x8
Events [SCCE]=0x0000, Mask [SCCM]=0x0000, Status [SCCS]=0x00
Transmit on Demand [TODR]=0x0, Data Sync [DSR]=0x7E7E
Interrupt Registers:
Config [CICR]=0x00367F80, Pending [CIPR]=0x0000C000
Mask   [CIMR]=0x00200000, In-srv  [CISR]=0x00000000
Command register [CR]=0x580
Port A [PADIR]=0x1030, [PAPAR]=0xFFFF
       [PAODR]=0x0010, [PADAT]=0xCBFF
Port B [PBDIR]=0x09C0F, [PBPAR]=0x0800E
       [PBODR]=0x00000, [PBDAT]=0x3FFFD
Port C [PCDIR]=0x00C, [PCPAR]=0x200
       [PCSO]=0xC20,  [PCDAT]=0xDF2, [PCINT]=0x00F
Receive Ring
        rmd(68012830): status 9000 length 60C address 3B6DAC4
        rmd(68012838): status B000 length 60C address 3B6D444
Transmit Ring
 --More--
```

Main reason, is it DTE or DCE so you can put a clock rate on the interface.

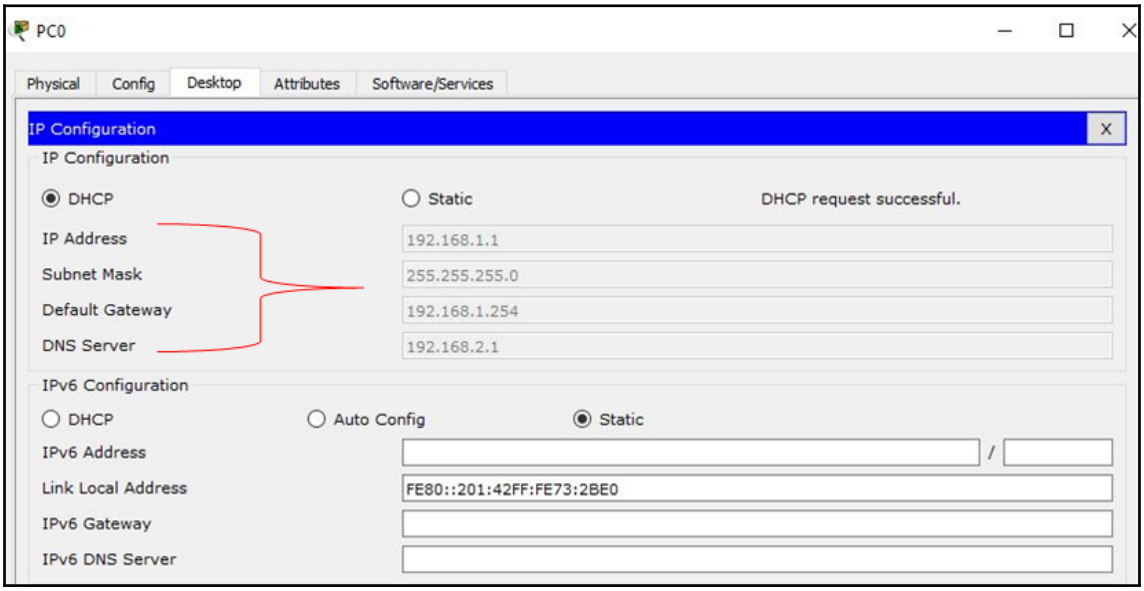
```
R1#sh ip protocols
Routing Protocol is "rip"
Sending updates every 30 seconds, next due in 19 seconds
Invalid after 180 seconds, hold down 180, flushed after 240
Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set
Redistributing: rip
Default version control: send version 2, receive 2
  Interface             Send  Recv  Triggered RIP  Key-chain
  FastEthernet0/0       2     2
  Serial0/0/0           2     2
Automatic network summarization is not in effect
Maximum path: 4
Routing for Networks:
     10.0.0.0
     192.168.1.0
Passive Interface(s):
Routing Information Sources:
     Gateway         Distance      Last Update
     10.1.1.6              120      00:00:05
Distance: (default is 120)
```


PC0
Physical
Config
Desktop
Attributes
Software/Services
IP Configuration
IP Configuration
DHCP
Static
DHCP failed. APIPA is being used.
IP Address
169.254.43.224
Subnet Mask
255.255.0.0
Default Gateway
DNS Server
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::201:42FF:FE73:2BE0
IPv6 Gateway
IPv6 DNS Server


R1(config)#ip dhcp ?
excluded-address Prevent DHCP from assigning certain addresses
pool Configure DHCP address pools
relay DHCP relay agent parameters
R1(config)#ip dhcp pool ?
WORD Pool name
R1(config)#ip dhcp pool R1_LAN
Must have a Pool Name
R1(dhcp-config)#?
default-router Default routers
dns-server Set name server
exit Exit from DHCP pool configuration mode
network Network number and mask
no Negate a command or set its defaults
option Raw DHCP options
R1(dhcp-config)#default-router 192.168.1.254
R1(dhcp-config)#dns-server 192.168.2.1
R1(dhcp-config)#network 192.168.1.0 255.255.255.0
R1(dhcp-config)#exit
R1(config)#ip dhcp excluded-address 192.168.1.254
Must exclude any IP address for that pool, which you will assign statically. If not, you will run into an IP conflict.

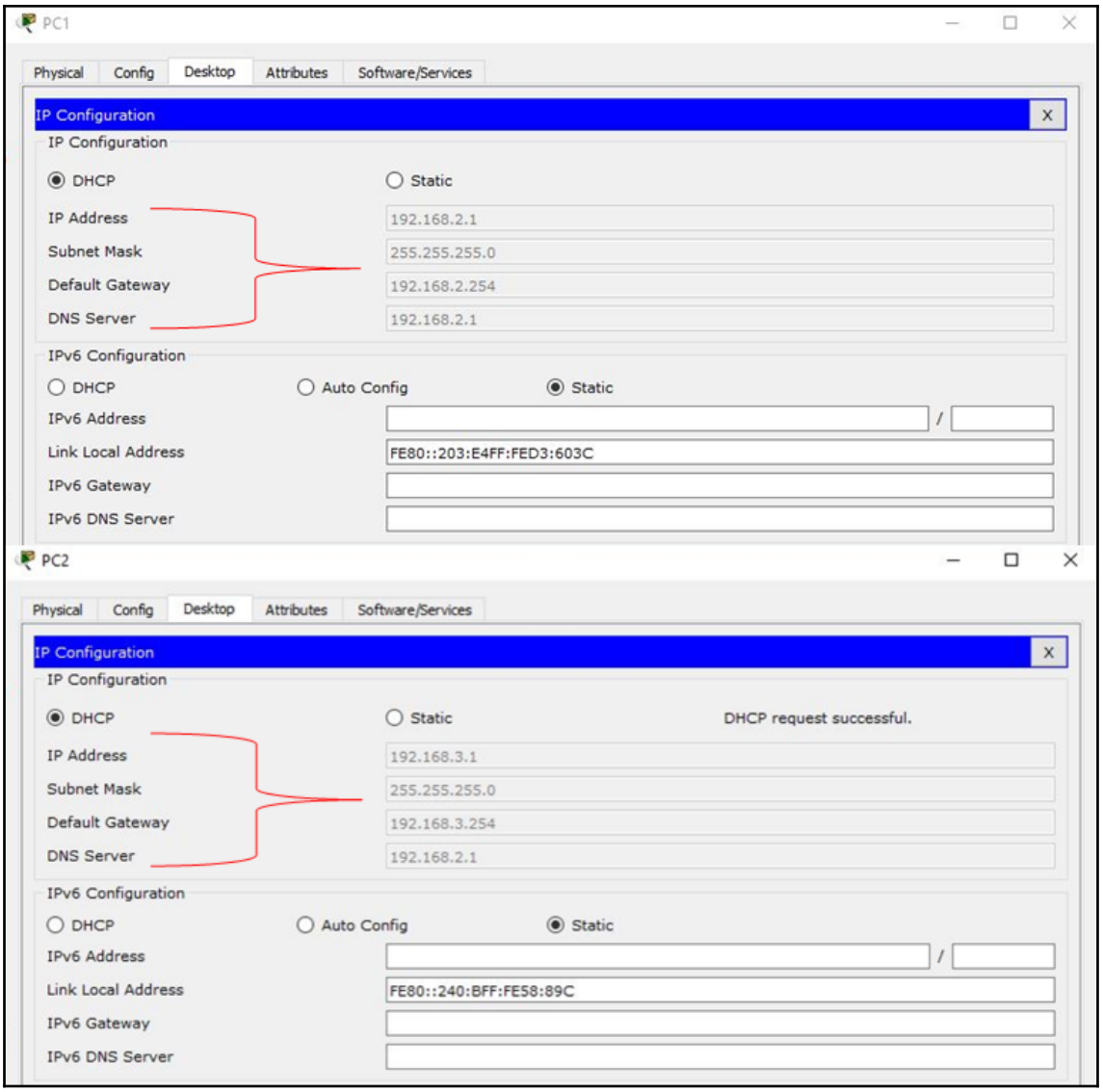

R1#sh start
Using 901 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname R1
!
!
!
!
ip dhcp excluded-address 192.168.1.254
!
ip dhcp pool R1_LAN
network 192.168.1.0 255.255.255.0
default-router 192.168.1.254
dns-server 192.168.2.1

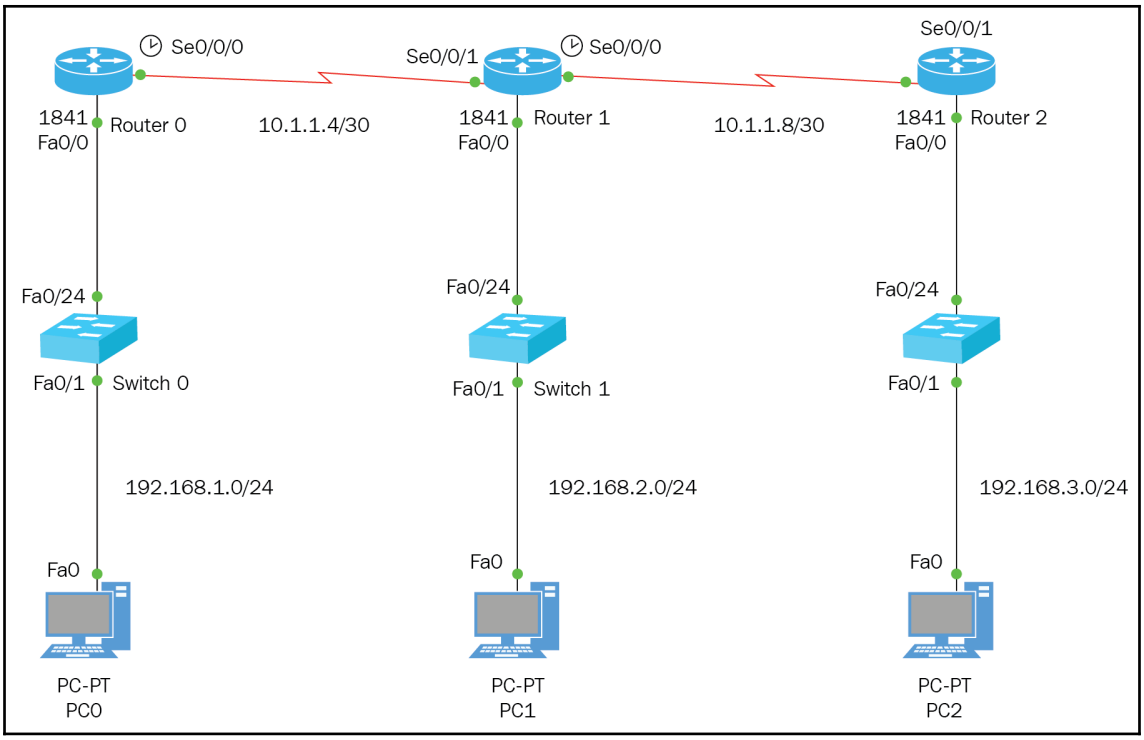
```
R1#sh ip dhcp pool

Pool R1_LAN :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 1
 Excluded addresses             : 1
 Pending event                  : none

 1 subnet is currently in the pool
 Current index        IP address range
Leased/Excluded/Total
 192.168.1.1          192.168.1.1      - 192.168.1.254     1    / 1     /
254
```



```
hostname R1
!
!
!
!
ip dhcp excluded-address 192.168.1.254
ip dhcp excluded-address 192.168.2.254
ip dhcp excluded-address 192.168.3.254
!
ip dhcp pool R1_LAN
 network 192.168.1.0 255.255.255.0
 default-router 192.168.1.254
 dns-server 192.168.2.1
ip dhcp pool R2_LAN
 network 192.168.2.0 255.255.255.0
 default-router 192.168.2.254
 dns-server 192.168.2.1
ip dhcp pool R3_LAN
 network 192.168.3.0 255.255.255.0
 default-router 192.168.3.254
 dns-server 192.168.2.1
```

```
R2#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#int f0/0
R2(config-if)#ip helper-address 10.1.1.5
```


PC1
Physical
Config
Desktop
Attributes
Software/Services
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.2.1
Subnet Mask
255.255.255.0
Default Gateway
192.168.2.254
DNS Server
192.168.2.1
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::203:E4FF:FED3:603C
IPv6 Gateway
IPv6 DNS Server
PC2
Physical
Config
Desktop
Attributes
Software/Services
IP Configuration
IP Configuration
DHCP
Static
DHCP request successful.
IP Address
192.168.3.1
Subnet Mask
255.255.255.0
Default Gateway
192.168.3.254
DNS Server
192.168.2.1
IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
Link Local Address
FE80::240:BFF:FE58:89C
IPv6 Gateway
IPv6 DNS Server



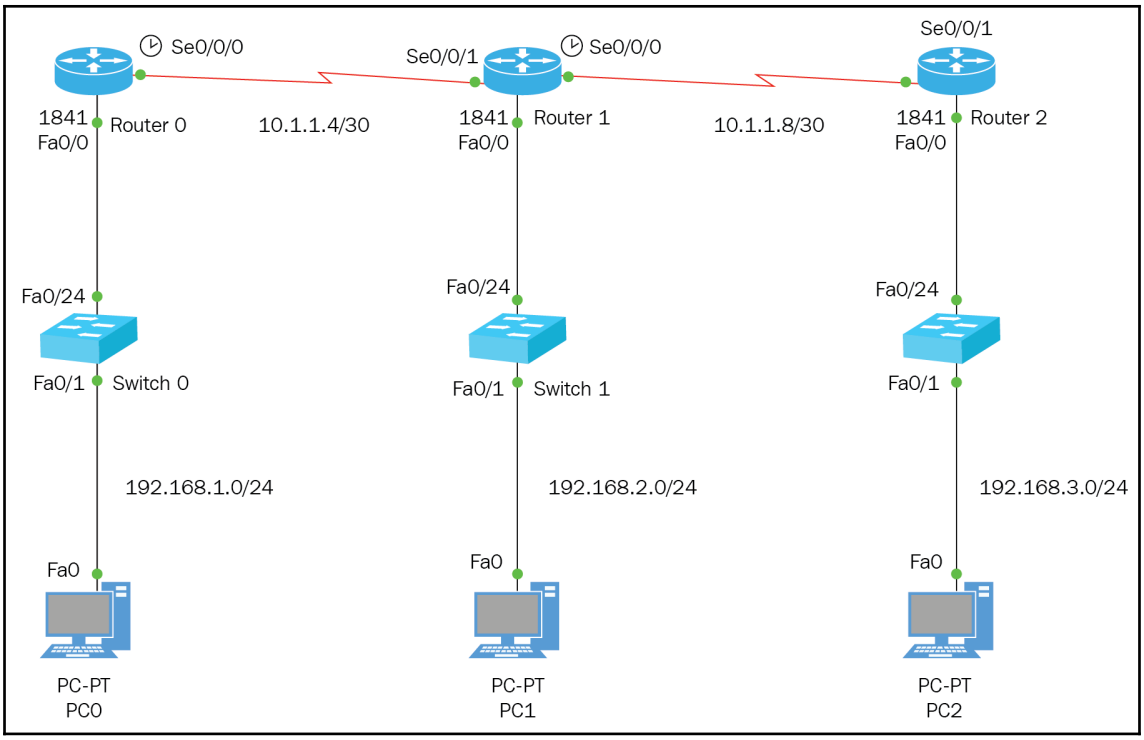

```
R1#CONFIG T
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#IP ROUTE 10.1.1.8 255.255.255.252 S0/0/0 150
R1(config)#IP ROUTE 192.168.2.0 255.255.255.0 S0/0/0 150
R1(config)#IP ROUTE 192.168.3.0 255.255.255.0 S0/0/0 150
R1(config)#
```

```
R2#CONFIG T
Enter configuration commands, one per line.  End with CNTL/Z.
R2(config)#IP ROUTE 192.168.1.0 255.255.255.0 S0/0/1 150
R2(config)#IP ROUTE 192.168.3.0 255.255.255.0 S0/0/0 150
R2(config)#
```

```
R3#CONFIG T
Enter configuration commands, one per line.  End with CNTL/Z.
R3(config)#IP ROUTE 10.1.1.4 255.255.255.252 S0/0/1 150
R3(config)#IP ROUTE 192.168.2.0 255.255.255.0 S0/0/1 150
R3(config)#IP ROUTE 192.168.1.0 255.255.255.0 S0/0/1 150
R3(config)#
```

```
R1#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/0
S       10.1.1.8 is directly connected, Serial0/0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
S    192.168.2.0/24 is directly connected, Serial0/0/0
S    192.168.3.0/24 is directly connected, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0
```

```
R1#ping 192.168.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/6/14 ms

R1#
```




```
R1#sh ip int brief
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.1.254   YES manual up                    up
FastEthernet0/1            unassigned      YES unset  administratively down
down
Serial0/0/0                10.1.1.5        YES manual up                    up
Serial0/0/1                unassigned      YES unset  administratively down
down
Vlan1                      unassigned      YES unset  administratively down
down
R1#
```

```
R1#config t
Enter configuration commands, one per line.  End with CNTL/Z.
R1(config)#router rip
R1(config-router)#ver 2
R1(config-router)#net 10.0.0.0
R1(config-router)#net 192.168.1.0
R1(config-router)#no auto-summary
R1(config-router)#
```

Starts the config of RIP

Class-full boundary address

DO NOT FORGET FOR DV

```
R2#SH IP INT BRIEF
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.2.254   YES manual up                    up
FastEthernet0/1        unassigned      YES unset  administratively down
down
Serial0/0/0            10.1.1.9        YES manual up                    up
Serial0/0/1            10.1.1.6        YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down
down
R2#
```

```
R2(config)#router rip
R2(config-router)#ver 2
R2(config-router)#net 10.0.0.0
R2(config-router)#net 192.168.2.0
R2(config-router)#no auto-summary
R2(config-router)#
```

```
R3#sh ip int brief
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.3.254   YES manual up                    up
FastEthernet0/1        unassigned      YES unset  administratively down
down
Serial0/0/0            unassigned      YES unset  administratively down
down
Serial0/0/1            10.1.1.10       YES manual up                    up
Vlan1                  unassigned      YES unset  administratively down
down
R3#
```

```
R3(config)#router rip
R3(config-router)#ver 2
R3(config-router)#net 10.0.0.0
R3(config-router)#net 192.168.3.0
R3(config-router)#no auto-summary
R3(config-router)#
```

```
R1#SH IP ROUTE
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/0
R       10.1.1.8 [120/1] via 10.1.1.6, 00:00:02, Serial0/0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
R    192.168.2.0/24 [120/1] via 10.1.1.6, 00:00:02, Serial0/0/0
R    192.168.3.0/24 [120/2] via 10.1.1.6, 00:00:02, Serial0/0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/0
```

```
R2#SH IP ROUTE
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
R    192.168.1.0/24 [120/1] via 10.1.1.5, 00:00:16, Serial0/0/1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
R    192.168.3.0/24 [120/1] via 10.1.1.10, 00:00:04, Serial0/0/0

R2#
```

```
R3#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 2 subnets
R       10.1.1.4 [120/1] via 10.1.1.9, 00:00:12, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/1
R    192.168.1.0/24 [120/2] via 10.1.1.9, 00:00:12, Serial0/0/1
R    192.168.2.0/24 [120/1] via 10.1.1.9, 00:00:12, Serial0/0/1
C    192.168.3.0/24 is directly connected, FastEthernet0/0
S*   0.0.0.0/0 is directly connected, Serial0/0/1
```

```
R3#ping 192.168.1.254

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.254, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 5/9/14 ms

R3#
```

```
  ppp           PPP (Point to Point Protocol) information
R4#debug ip rip
RIP protocol debugging is on
R4#RIP: received v2 update from 10.1.1.13 on Serial0/0/1
      10.1.1.4/30 via 0.0.0.0 in 2 hops
      10.1.1.8/30 via 0.0.0.0 in 1 hops
      192.168.1.0/24 via 0.0.0.0 in 3 hops
      192.168.2.0/24 via 0.0.0.0 in 2 hops
      192.168.3.0/24 via 0.0.0.0 in 1 hops
RIP: sending  v2 update to 224.0.0.9 via FastEthernet0/0 (192.168.4.254)
RIP: build update entries
      10.1.1.4/30 via 0.0.0.0, metric 3, tag 0
      10.1.1.8/30 via 0.0.0.0, metric 2, tag 0
      10.1.1.12/30 via 0.0.0.0, metric 1, tag 0
      192.168.1.0/24 via 0.0.0.0, metric 4, tag 0
      192.168.2.0/24 via 0.0.0.0, metric 3, tag 0
      192.168.3.0/24 via 0.0.0.0, metric 2, tag 0
RIP: sending  v2 update to 224.0.0.9 via Serial0/0/1 (10.1.1.14)
RIP: build update entries
      192.168.4.0/24 via 0.0.0.0, metric 1, tag 0
```

```
R1(config)#router rip
R1(config-router)#ver 2
R1(config-router)#passive-interface s0/0/0
R1(config-router)#
```

```
R3(config)#router rip
R3(config-router)#ver 2
R3(config-router)#default-information originate
R3(config-router)#
```

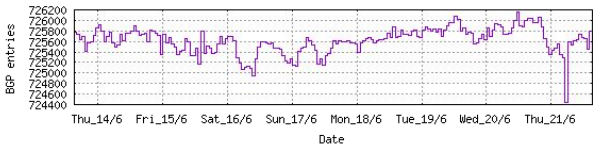
```
R2#sh ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter
area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is 10.1.1.10 to network 0.0.0.0

     10.0.0.0/30 is subnetted, 2 subnets
C       10.1.1.4 is directly connected, Serial0/0/1
C       10.1.1.8 is directly connected, Serial0/0/0
S    192.168.1.0/24 is directly connected, Serial0/0/1
C    192.168.2.0/24 is directly connected, FastEthernet0/0
R    192.168.3.0/24 [120/1] via 10.1.1.10, 00:00:11, Serial0/0/0
R*   0.0.0.0/0 [120/1] via 10.1.1.10, 00:00:11, Serial0/0/0
```

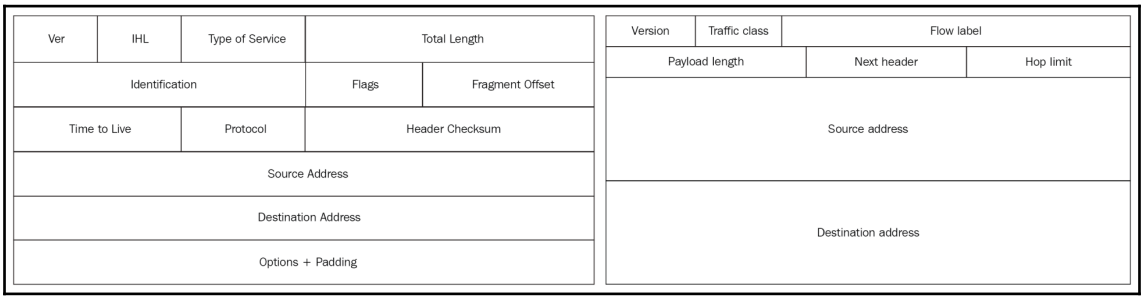
Chapter 10: The IPv6 Protocol

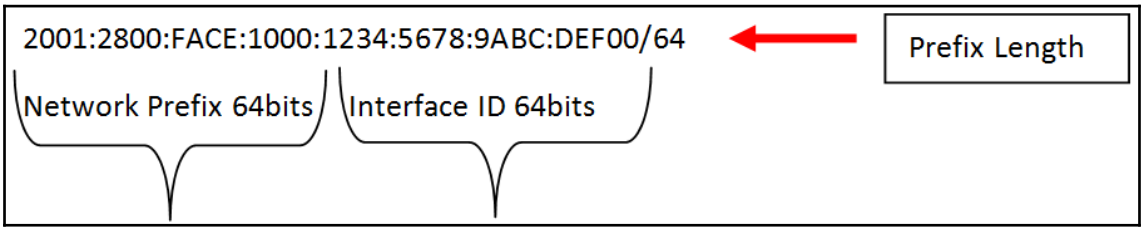
Status Summary

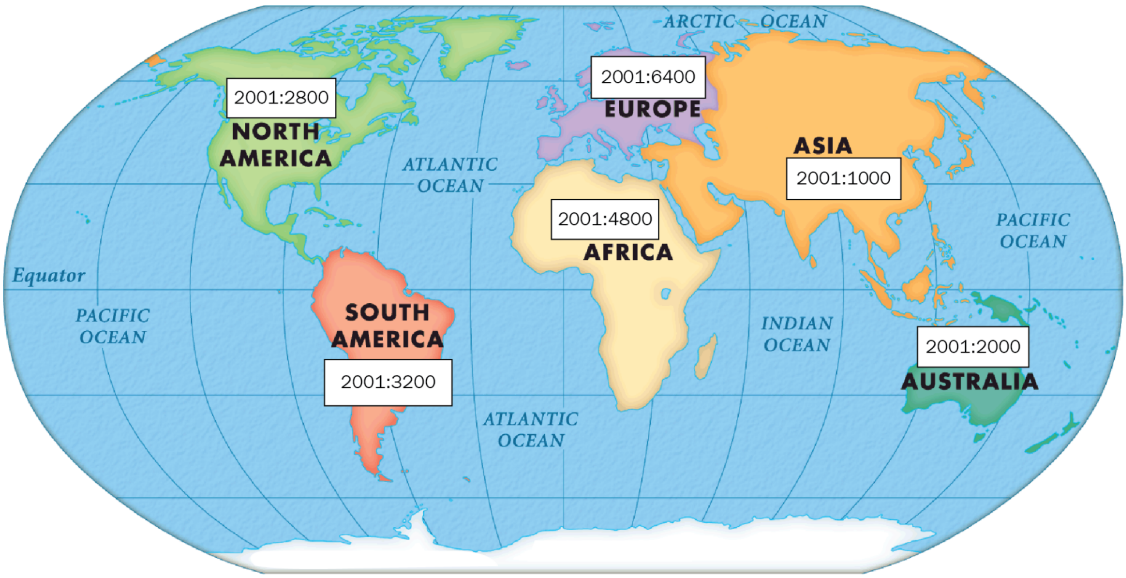
Table History

Date	Prefixes	CIDR Aggregated
14-06-18	725855	392829
15-06-18	725348	394132
16-06-18	725645	394096
17-06-18	725260	390829
18-06-18	725555	390942
19-06-18	725678	391270
20-06-18	725642	390826
21-06-18	725355	391294









Examples:

2001:0ABC:BADD:0020:0000:0DEF:0123:0008 Leading Zero Rule

2001:ABC:BADD:20::DEF:123:8 Much shorter and all I did was take out the zeros in the front "VALID"

2001:0000:0000:0ABC:BADD:0000:0000:0008 Double Colon Rule

2001::ABC:BADD::8 This is not a valid IPv6 address, because you two double colons in the address. "INVALID"

2001:0:0:ABC:BADD::8 This a valid IPv6 address, because we only one double colon and the other blocks we used one zero in each block. "VALID"

```
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
 ipv6 address 2001:3200:BADD:1000::F/56
```

Interface ID

```
interface FastEthernet0/0
 no ip address
 duplex auto
 speed auto
 ipv6 address 2001:3200:1700:1000::/64 eui-64
```

```
R1#sh ipv6 route
IPv6 Routing Table - 3 entries
Codes: C - Connected, L - Local, S - Static, R - RIP, B - BGP
       U - Per-user Static route, M - MIPv6
       I1 - ISIS L1, I2 - ISIS L2, IA - ISIS interarea, IS - ISIS summary
       O - OSPF intra, OI - OSPF inter, OE1 - OSPF ext 1, OE2 - OSPF ext 2
       ON1 - OSPF NSSA ext 1, ON2 - OSPF NSSA ext 2
       D - EIGRP, EX - EIGRP external
C   2001:3200:1700:1000::/64 [0/0]
     via ::, FastEthernet0/0
L   2001:3200:1700:1000:2D0:FFFF:FE7D:9901/128 [0/0]
     via ::, FastEthernet0/0
```

The Padding

Actual MAC of the Interface:
R1#sh int f0/0
FastEthernet0/0 is up, line protocol is up (connected)
Hardware is Lance, address is **00d0.ff7d.9901**

2001:3200:1700:1000:2D0:FFFF:FE7D:9901/128

MAC Address: 00d0.ff7d.9901

Binary of first 2 hex numbers: 0000 0000 The red bit is the 7th bit

After EUI-64 command: 0000:0010 7th converted to a one, which the value is 2

Conclusion: 02d0.ff7d.9901 (Remove the zero from the address) 2d0

MAC Address: aa812:bcbd:5678

Binary of first 2 hex numbers: 1010.1010 The red bit is the 7th bit

After EUI-64 command: 1010.1000 7th converted to a zero, which the value is 0

Conclusion: a0812 Remove the zero from the address) a812

MAC Address: 0b0c:afed:deed

Binary of first 2 hex numbers: 0000.1011 The red bit is the 7th bit

After EUI-64 command: 0000.1001 7th bit converted to a zero, which the value is 0

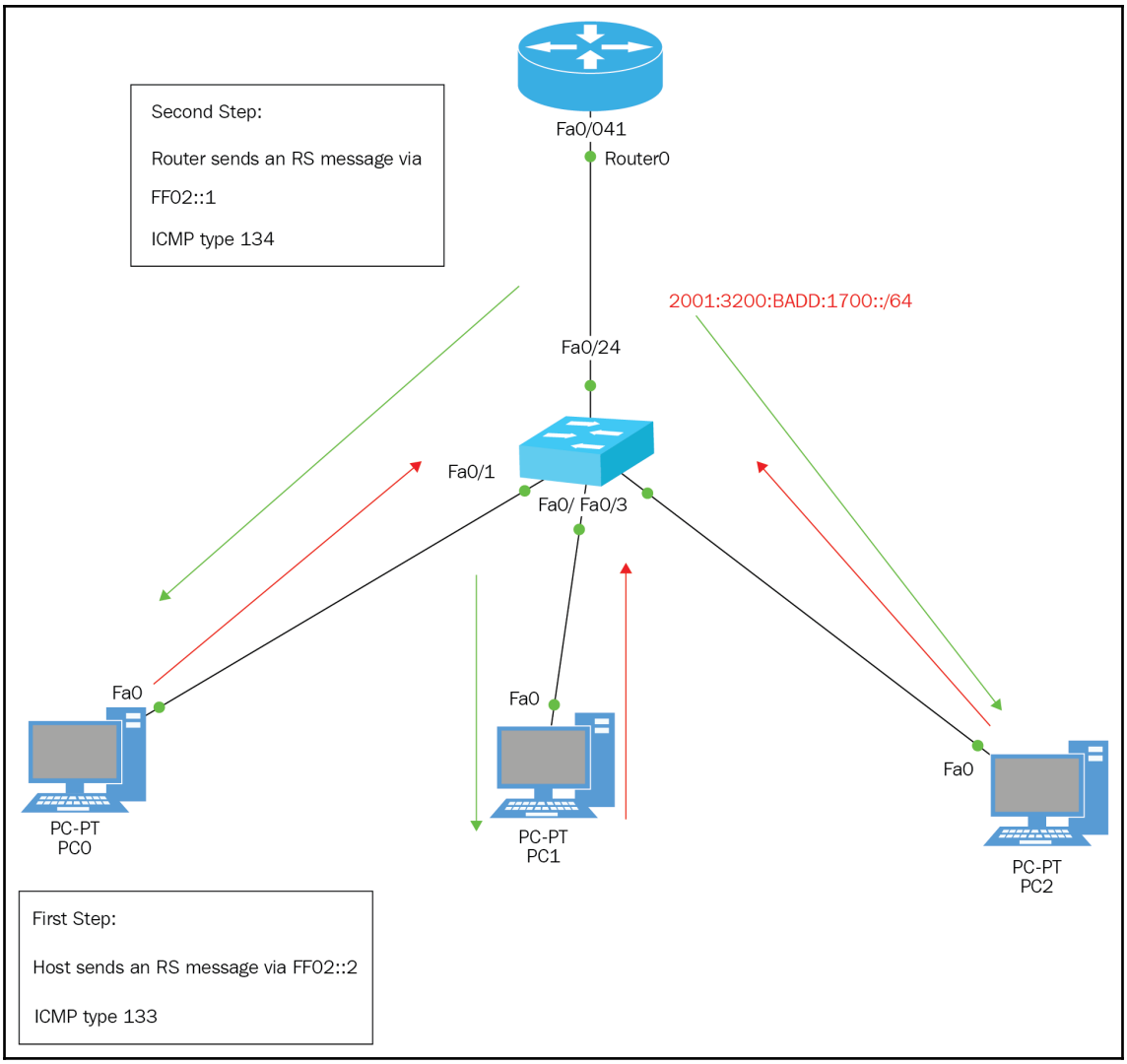
Conclusion: 090c Remove the zero from the address) 90c

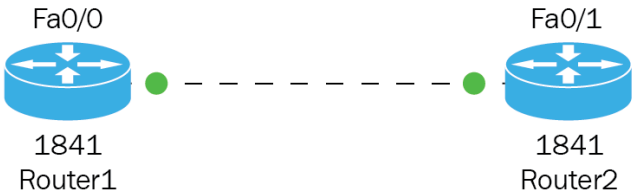
Hex Table

Letter	Value	Binary
A	10	1010
B	11	1011
C	12	1100
D	13	1101
E	14	1110
F	15	1111

Binary to decimal

Binary	Value	Add Binary Bits ON
1010	8421	10
1011	8421	11
1100	8421	12
1101	8421	13
1110	8421	14
1111	8421	15


Second Step:
Router sends an RS message via
FF02::1
ICMP type 134
Fa0/041
Router0
2001:3200:BADD:1700::/64
Fa0/24
Fa0/1
Fa0/ Fa0/3
Fa0
PC-PT
PC0
Fa0
PC-PT
PC1
Fa0
PC-PT
PC2
First Step:
Host sends an RS message via FF02::2
ICMP type 133



r1 (config-if) #ipv6 address autoconfig

r1 (config-if) #do wr

r1#SH IPV INT BRIEF

FastEthernet0/0 [up/up]

FE80::202:17FF:FE15:8801 ←

FastEthernet0/1 [administratively down/down]

Vlan1 [administratively down/down]

R2#SH IPV6 INT BRIEF

FastEthernet0/0 [administratively down/down]

FastEthernet0/1 [up/up]

FE80::230:A3FF:FEB8:5E02 ←

Vlan1 [administratively down/down]

R2#

r1#PING FE80::230:A3FF:FEB8:5E02

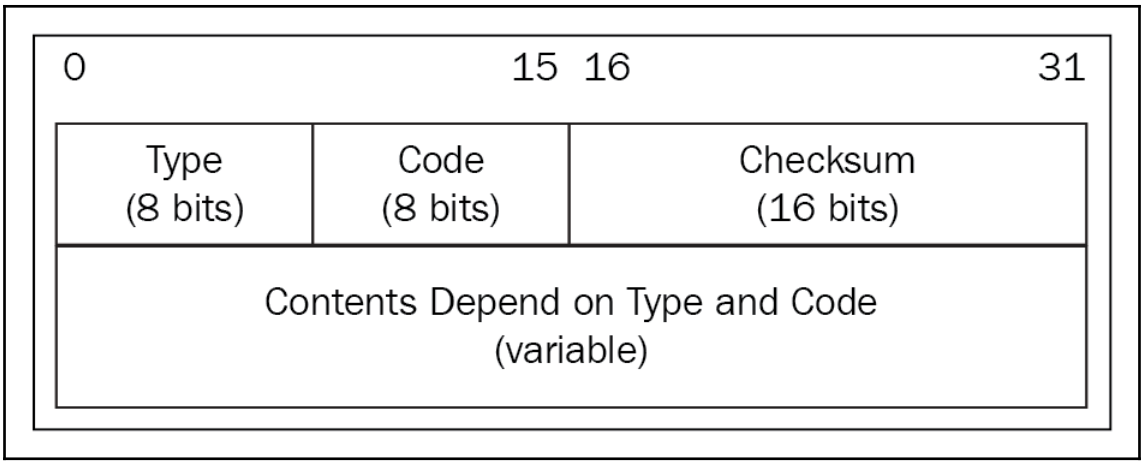
Output Interface: FastEthernet0/0 ←

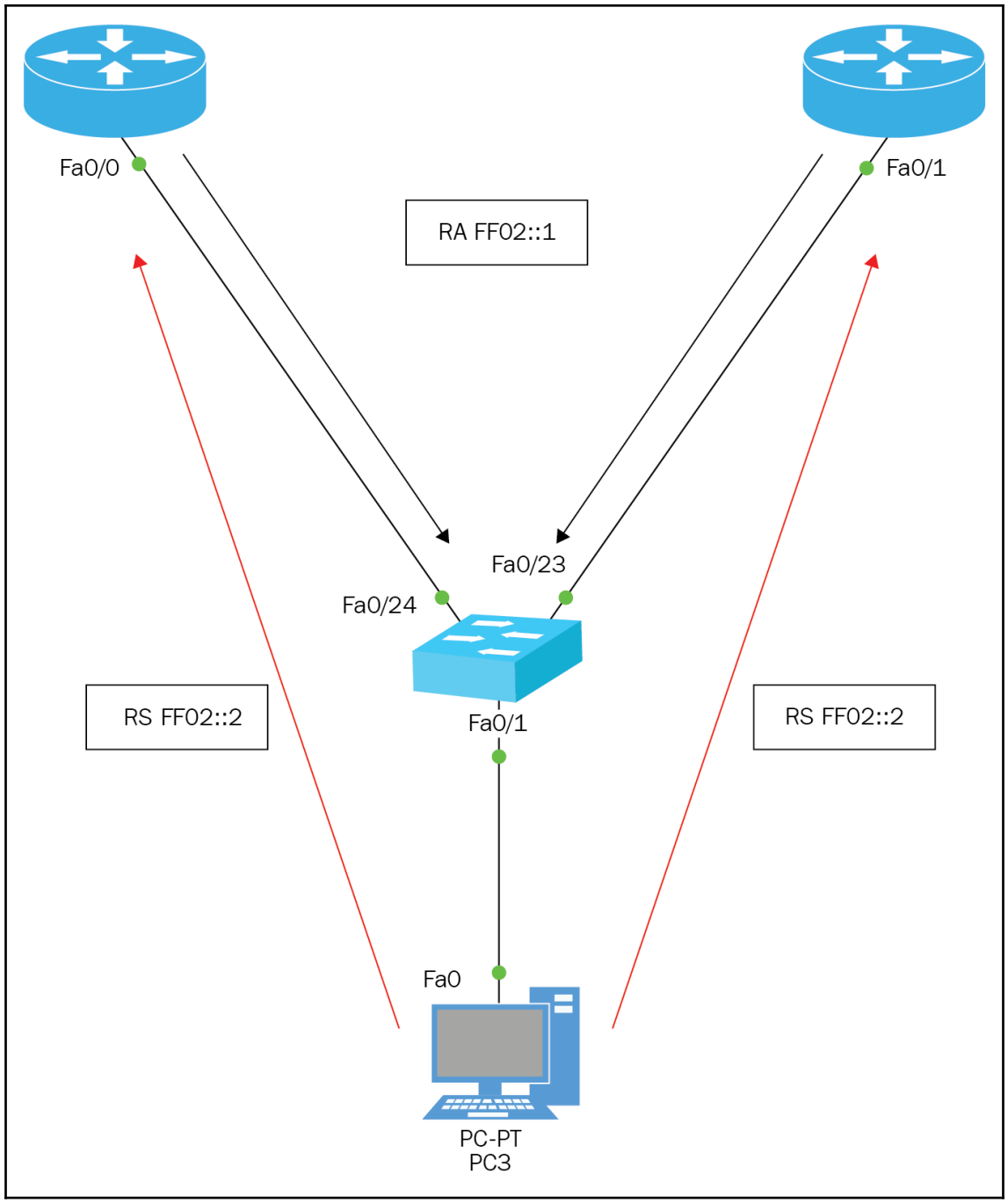
Type escape sequence to abort.

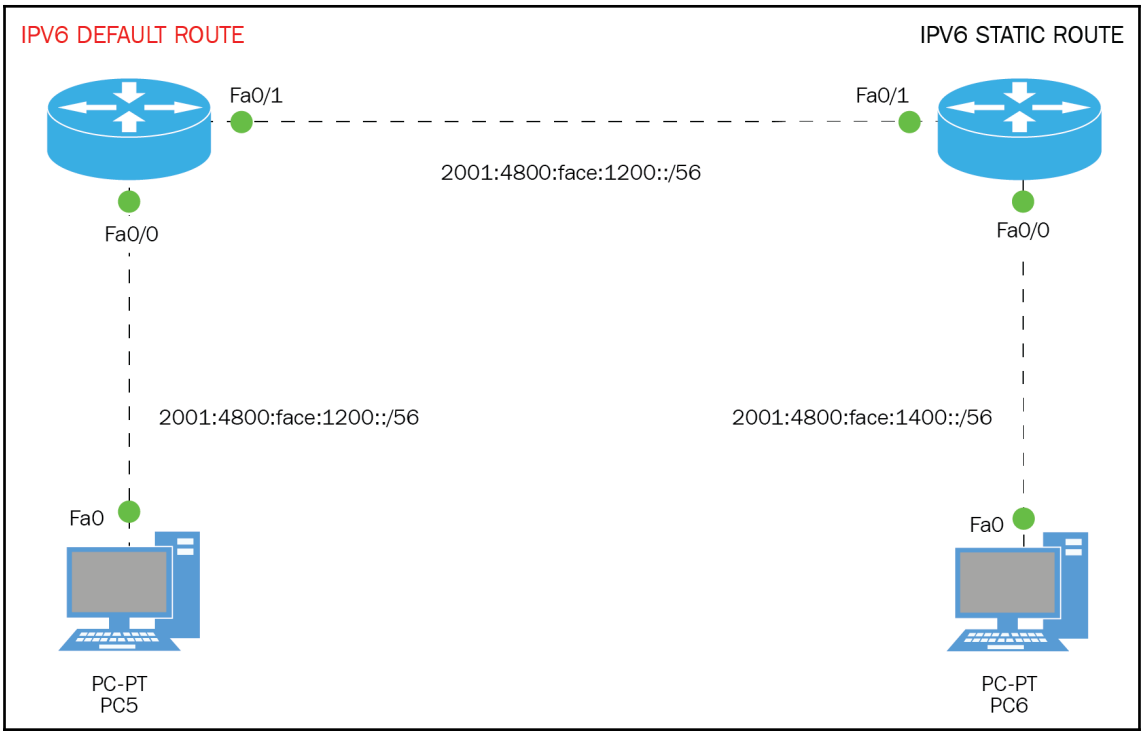
Sending 5, 100-byte ICMP Echos to FE80::230:A3FF:FEB8:5E02, timeout is 2 seconds:

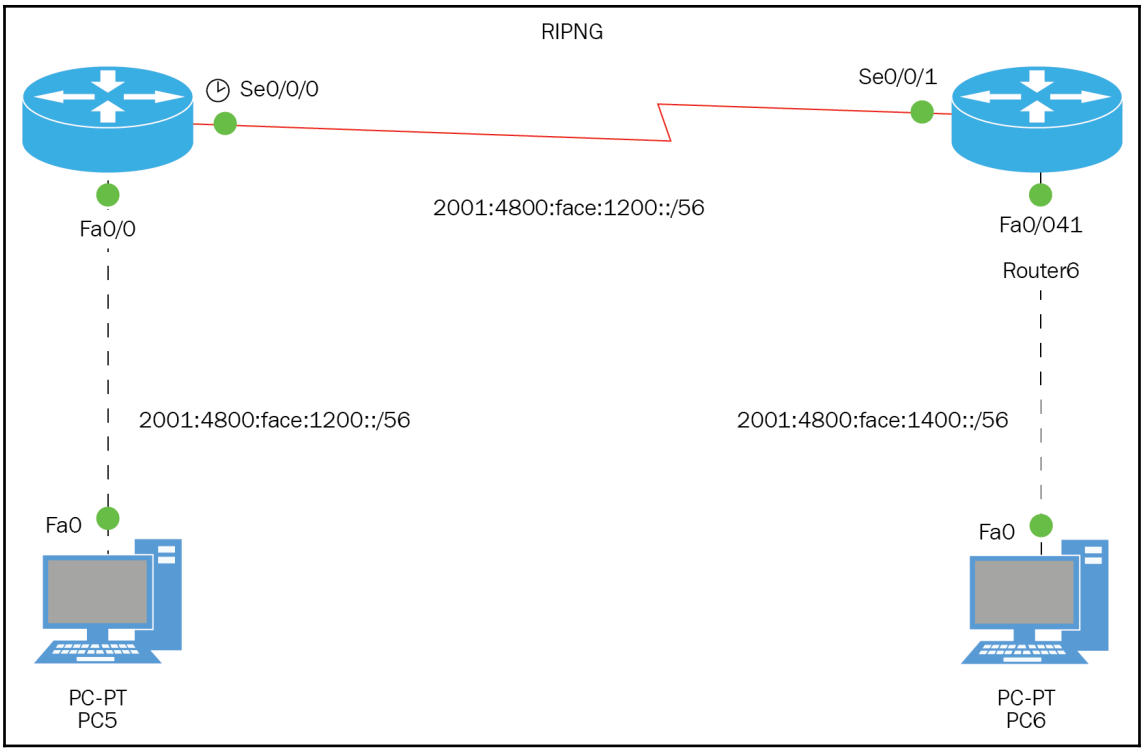
!!!!! ←

Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms


0
15 16
31
Type
(8 bits)
Code
(8 bits)
Checksum
(16 bits)
Contents Depend on Type and Code
(variable)

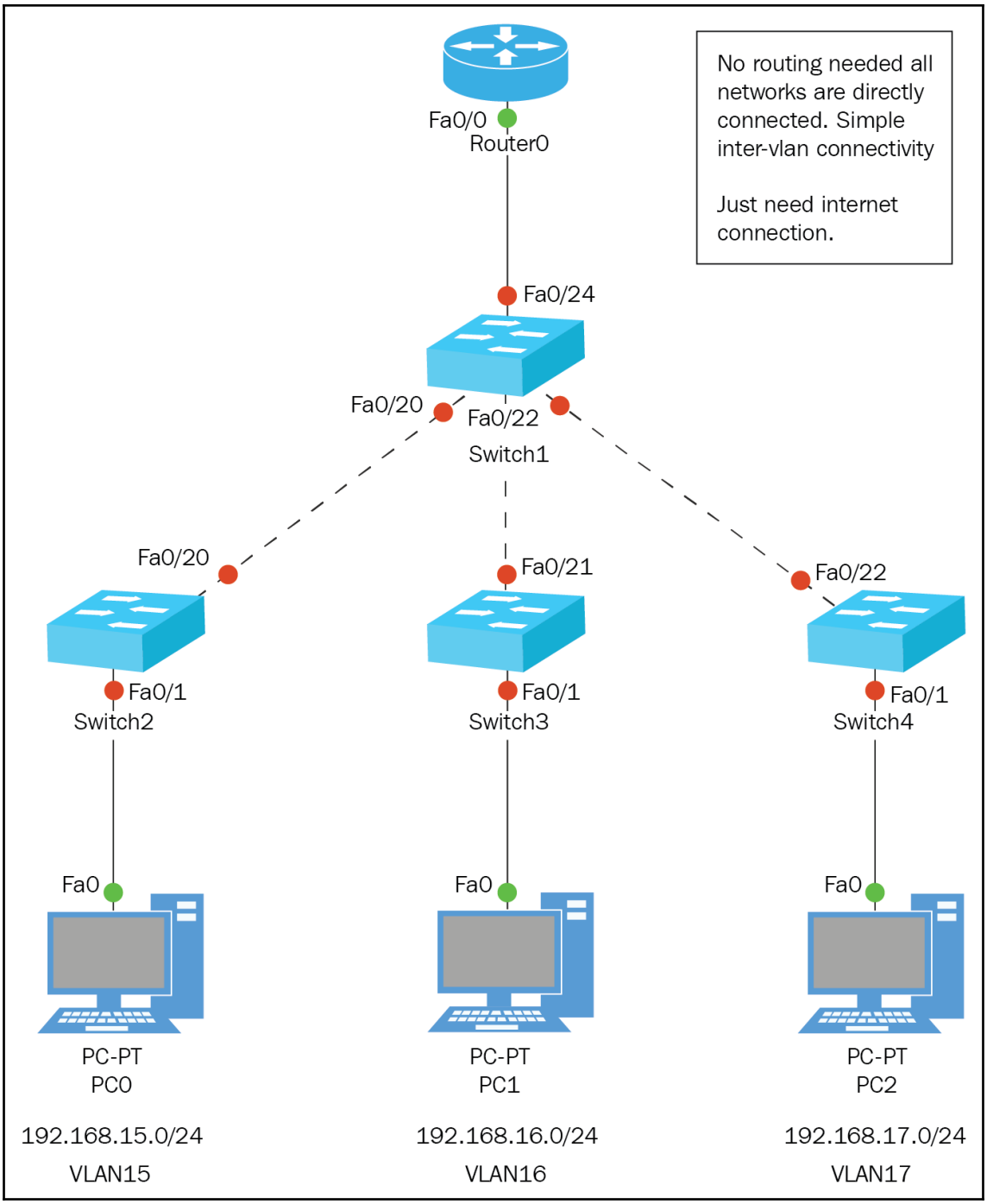

Fa0/0
Fa0/1
RA FF02::1
Fa0/23
Fa0/24
RS FF02::2
RS FF02::2
Fa0/1
Fa0
PC-PT
PC3

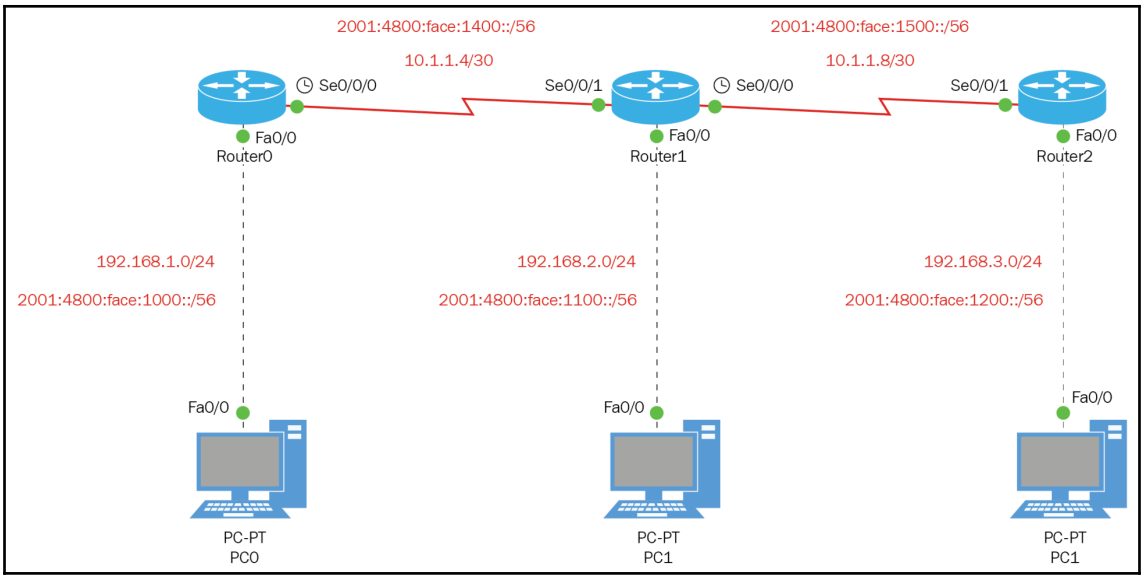

IPV6 DEFAULT ROUTE
IPV6 STATIC ROUTE
Fa0/1
Fa0/1
2001:4800:face:1200::/56
Fa0/0
Fa0/0
2001:4800:face:1200::/56
2001:4800:face:1400::/56
Fa0
Fa0
PC-PT
PC5
PC-PT
PC6

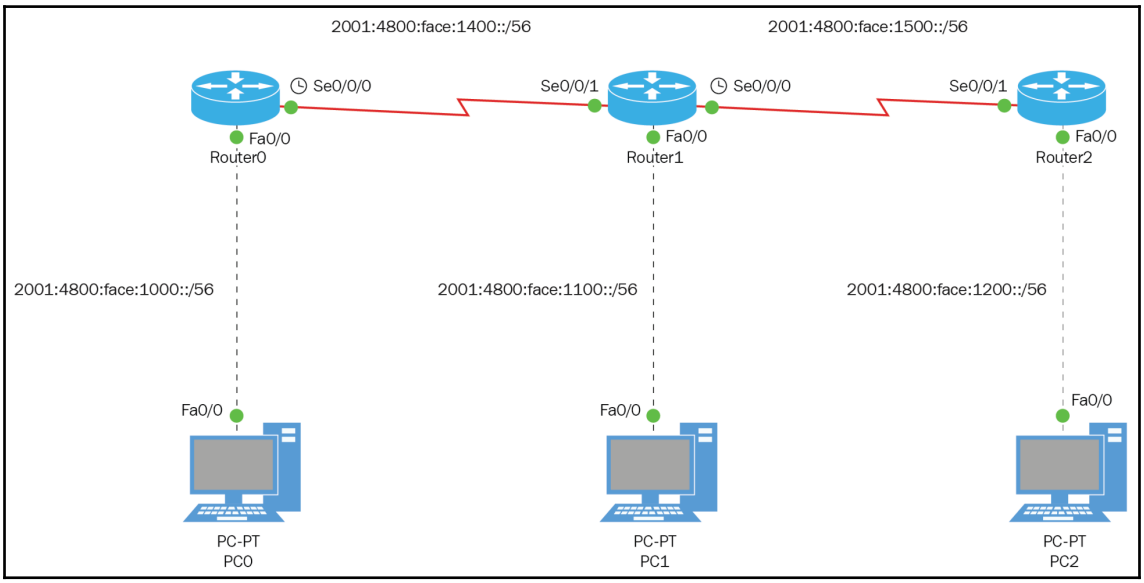

RIPNG
Se0/0/0
Se0/0/1
2001:4800:face:1200::/56
Fa0/0
Fa0/041
Router6
2001:4800:face:1200::/56
2001:4800:face:1400::/56
Fa0
Fa0
PC-PT
PC5
PC-PT
PC6

Chapter 11: Introduction to IPv6 Routing

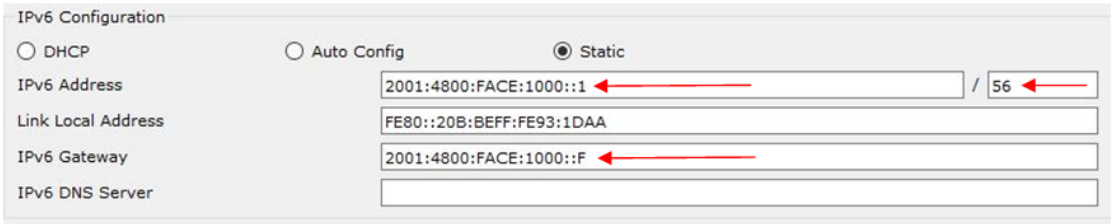
Routing Protocol	Type of Routing	Size of Network	Advantages	Dis-advantages
RIP(IPv4)	Dynamic DV	Small	Easy to configure and uses multicast for updates	Limited to 15 hops and choose the most direct route, not considering Bandwidth or load of that line.
EIGRP(IPv4)	Dynamic DV	Medium/Large	Scalable for larger networks. Excellent for complex networks. Choose best path based on Bandwidth and delay	Limited to 100 hops by default but it can go up to 255. EIGRP use to be proprietary to Cisco Only but that has changed. http://www.cisco.com/go/eigrp
OSPF(IPv4)	Dynamic LS	Enterprise	Extremely scalable for enterprise networks. It is aware of its complete topology, so it can calculate routes much better. No limitations	Due to the algorithm that it uses to calculate routes, it is processor and memory intensive.
RIPng	Dynamic DV	Small	Same as IPv4, , except different configuration	Same as IPv4
EIGRP(IPv6)	Dynamic DV	Medium/Large	Same as IPv4, except different configuration	Same as IPv4
OSPFv3	Dynamic LS	Enterprise	Same as IPv4, except different configuration	Same as IPv4
S routes	Static	Small	Takes up no bandwidth, processing on the router and it is more secure, because you are complete control of the routing process.	Too much administrative overhead, so on a large scale, very hard to administer.


No routing needed all networks are directly connected. Simple inter-vlan connectivity
Just need internet connection.
Fa0/0
Router0
Fa0/24
Fa0/20
Fa0/22
Switch1
Fa0/20
Fa0/21
Fa0/22
Fa0/1
Switch2
Fa0/1
Switch3
Fa0/1
Switch4
Fa0
Fa0
Fa0
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2
192.168.15.0/24
VLAN15
192.168.16.0/24
VLAN16
192.168.17.0/24
VLAN17

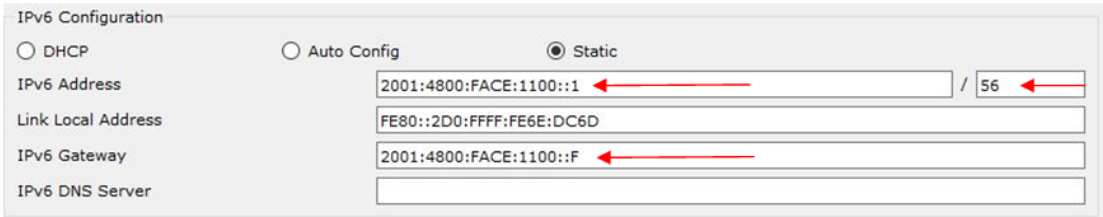

2001:4800:face:1400::/56
2001:4800:face:1500::/56
10.1.1.4/30
10.1.1.8/30
Se0/0/0
Se0/0/1
Se0/0/0
Se0/0/1
Fa0/0
Router0
Fa0/0
Router1
Fa0/0
Router2
192.168.1.0/24
2001:4800:face:1000::/56
192.168.2.0/24
2001:4800:face:1100::/56
192.168.3.0/24
2001:4800:face:1200::/56
Fa0/0
Fa0/0
Fa0/0
PC-PT
PC0
PC-PT
PC1
PC-PT
PC1


2001:4800:face:1400::/56
2001:4800:face:1500::/56
Se0/0/0
Se0/0/1
Se0/0/0
Se0/0/1
Fa0/0
Router0
Fa0/0
Router1
Fa0/0
Router2
2001:4800:face:1000::/56
2001:4800:face:1100::/56
2001:4800:face:1200::/56
Fa0/0
Fa0/0
Fa0/0
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2

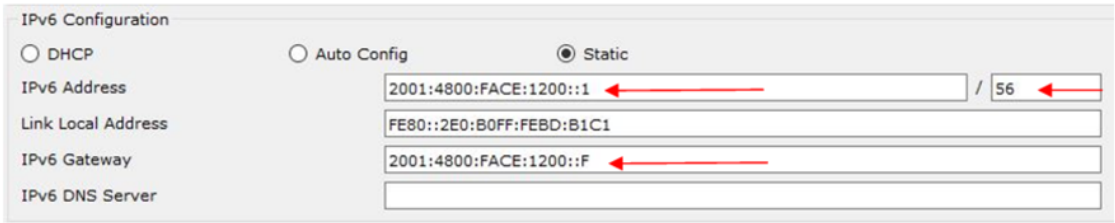
PC0

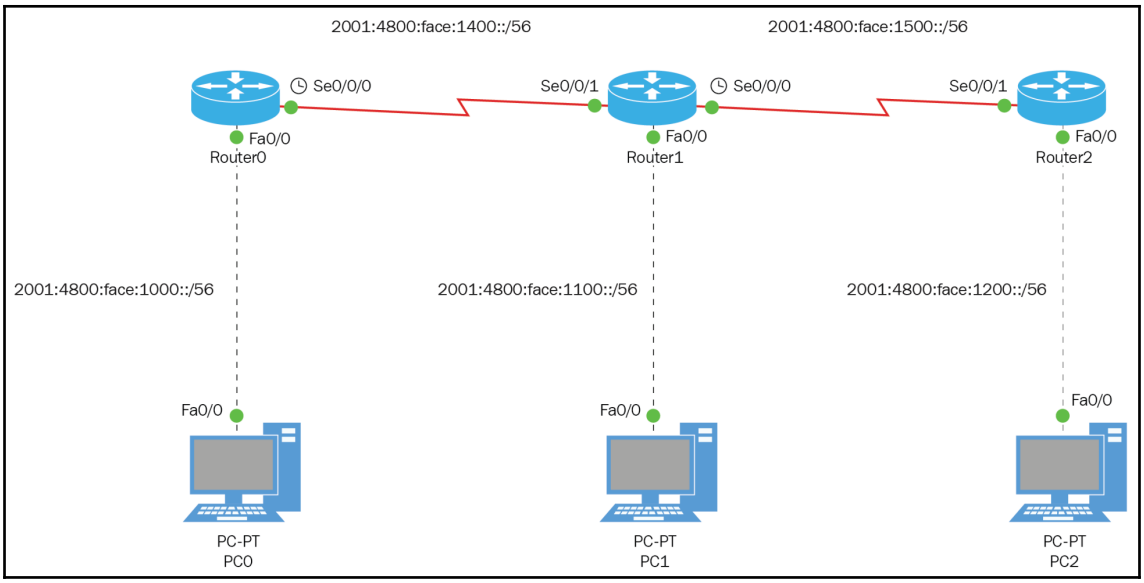

IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
2001:4800:FACE:1000::1
/
56
Link Local Address
FE80::20B:BEFF:FE93:1DAA
IPv6 Gateway
2001:4800:FACE:1000::F
IPv6 DNS Server

PC1

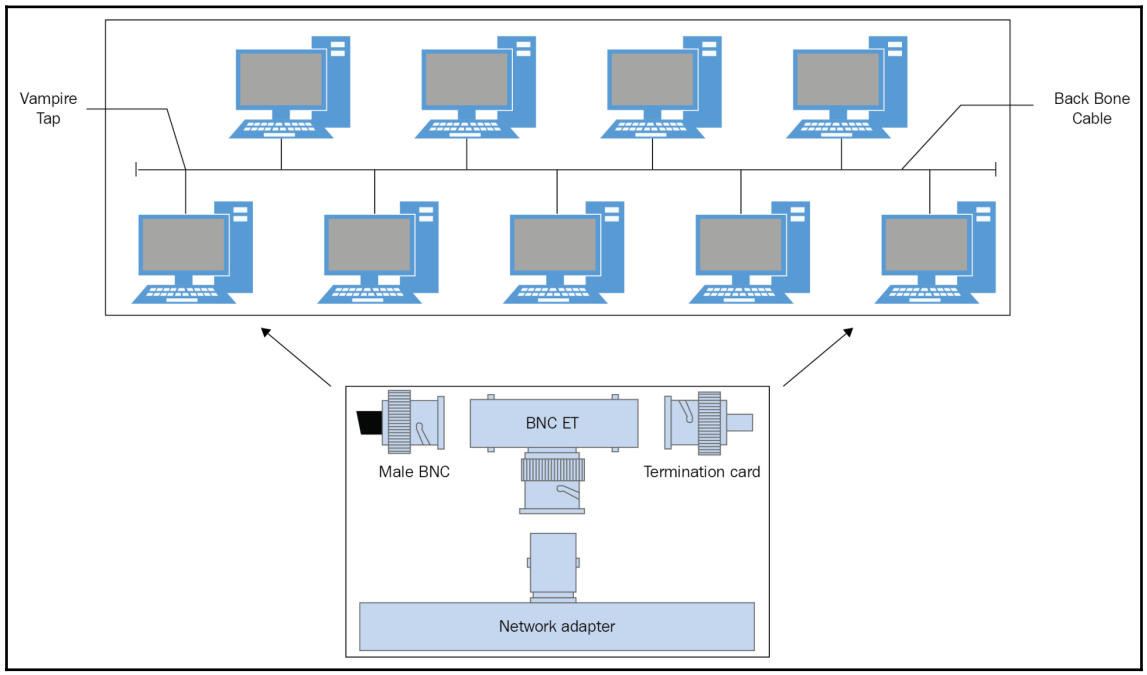

IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
2001:4800:FACE:1100::1
/
56
Link Local Address
FE80::2D0:FFFF:FE6E:DC6D
IPv6 Gateway
2001:4800:FACE:1100::F
IPv6 DNS Server

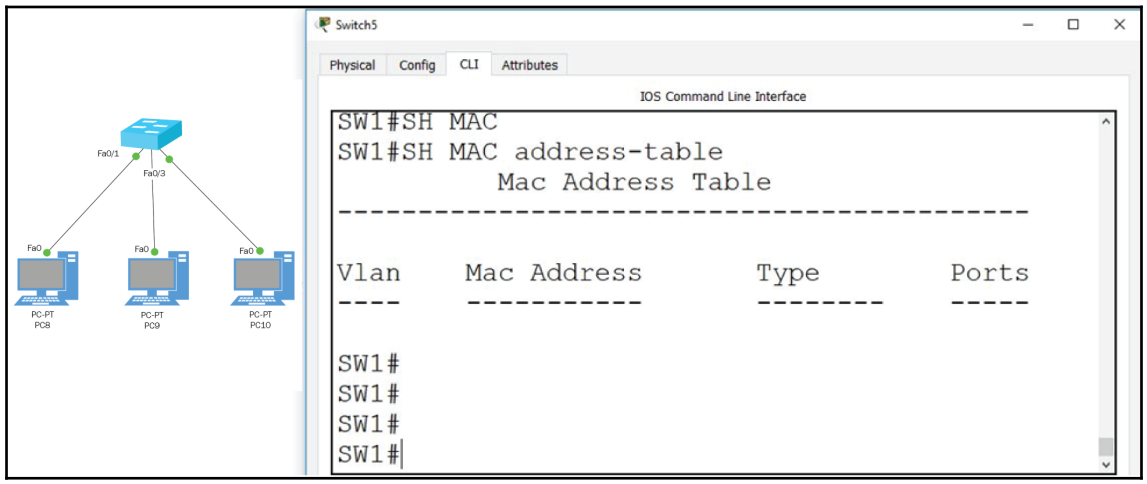
PC2

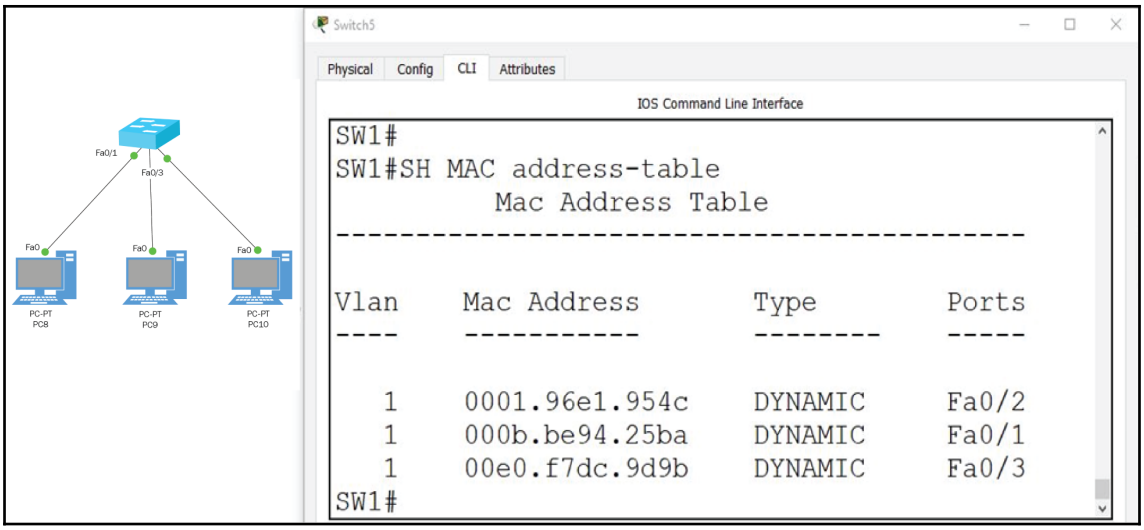

IPv6 Configuration
DHCP
Auto Config
Static
IPv6 Address
2001:4800:FACE:1200::1
/
56
Link Local Address
FE80::2E0:B0FF:FEBD:B1C1
IPv6 Gateway
2001:4800:FACE:1200::F
IPv6 DNS Server

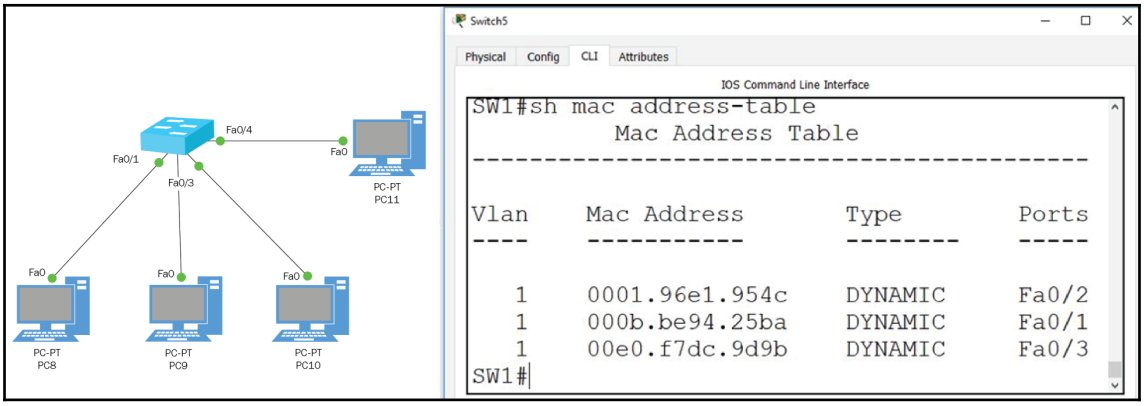

2001:4800:face:1400::/56
2001:4800:face:1500::/56
Se0/0/0
Se0/0/1
Se0/0/0
Se0/0/1
Fa0/0
Router0
Fa0/0
Router1
Fa0/0
Router2
2001:4800:face:1000::/56
2001:4800:face:1100::/56
2001:4800:face:1200::/56
Fa0/0
Fa0/0
Fa0/0
PC-PT
PC0
PC-PT
PC1
PC-PT
PC2

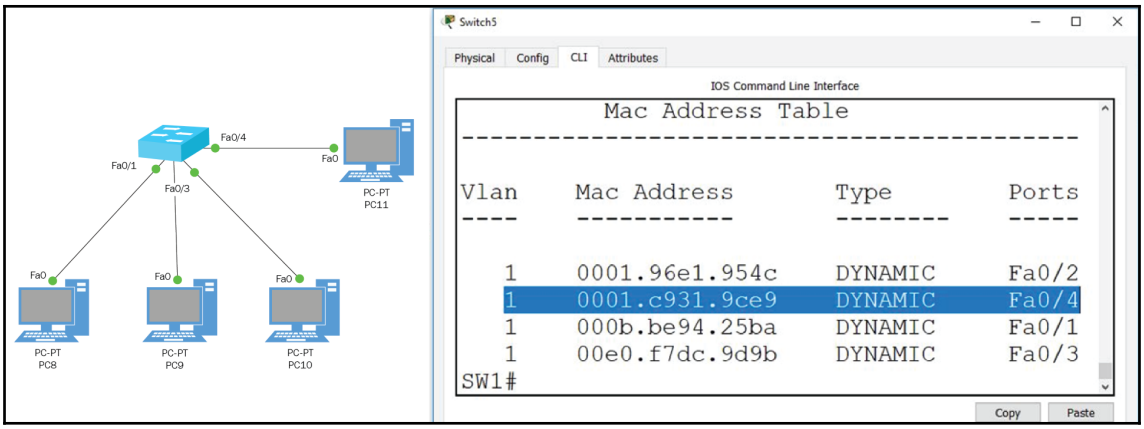
Chapter 12: Switching Services and Configurations

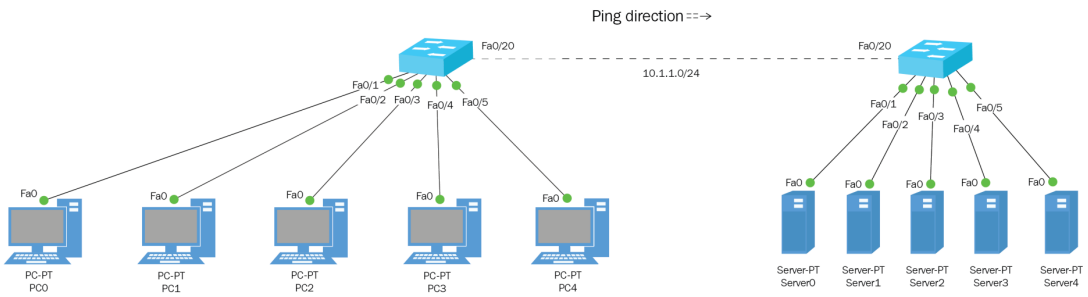





Fa0/1
Fa0/3
Fa0
Fa0
Fa0
PC-PT
PC8
PC-PT
PC9
PC-PT
PC10
Switch5
Physical
Config
CLI
Attributes
IOS Command Line Interface
SW1#
SW1#SH MAC address-table
Mac Address Table
Vlan Mac Address Type Ports
1 0001.96e1.954c DYNAMIC Fa0/2
1 000b.be94.25ba DYNAMIC Fa0/1
1 00e0.f7dc.9d9b DYNAMIC Fa0/3
SW1#


Fa0/4
Fa0/1
Fa0/3
Fa0
PC-PT
PC11
Fa0
Fa0
Fa0
PC-PT
PC8
PC-PT
PC9
PC-PT
PC10
Switch5
Physical
Config
CLI
Attributes
IOS Command Line Interface
SW1#sh mac address-table
Mac Address Table
Vlan Mac Address Type Ports
1 0001.96e1.954c DYNAMIC Fa0/2
1 000b.be94.25ba DYNAMIC Fa0/1
1 00e0.f7dc.9d9b DYNAMIC Fa0/3
SW1#





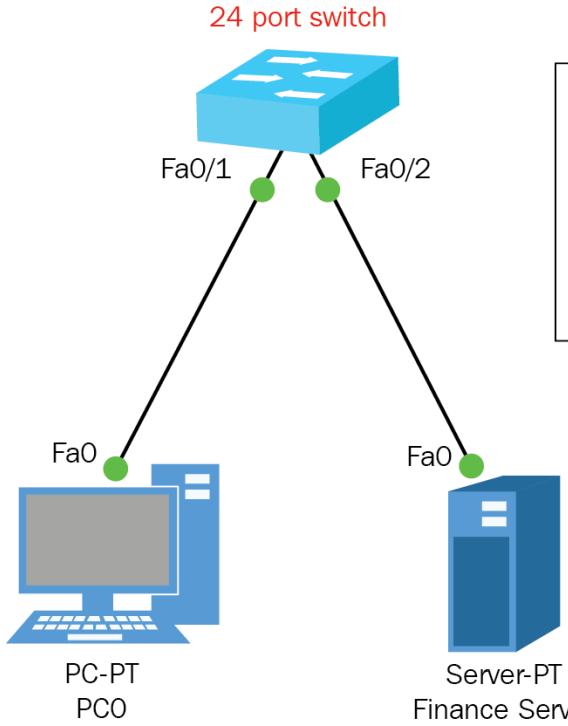
Switch#sh mac address-table
Mac Address Table

Vlan Mac Address Type Ports
---- ----------- -------- -----

The MAC address table is based on pings going to local PC's and the server addresses.

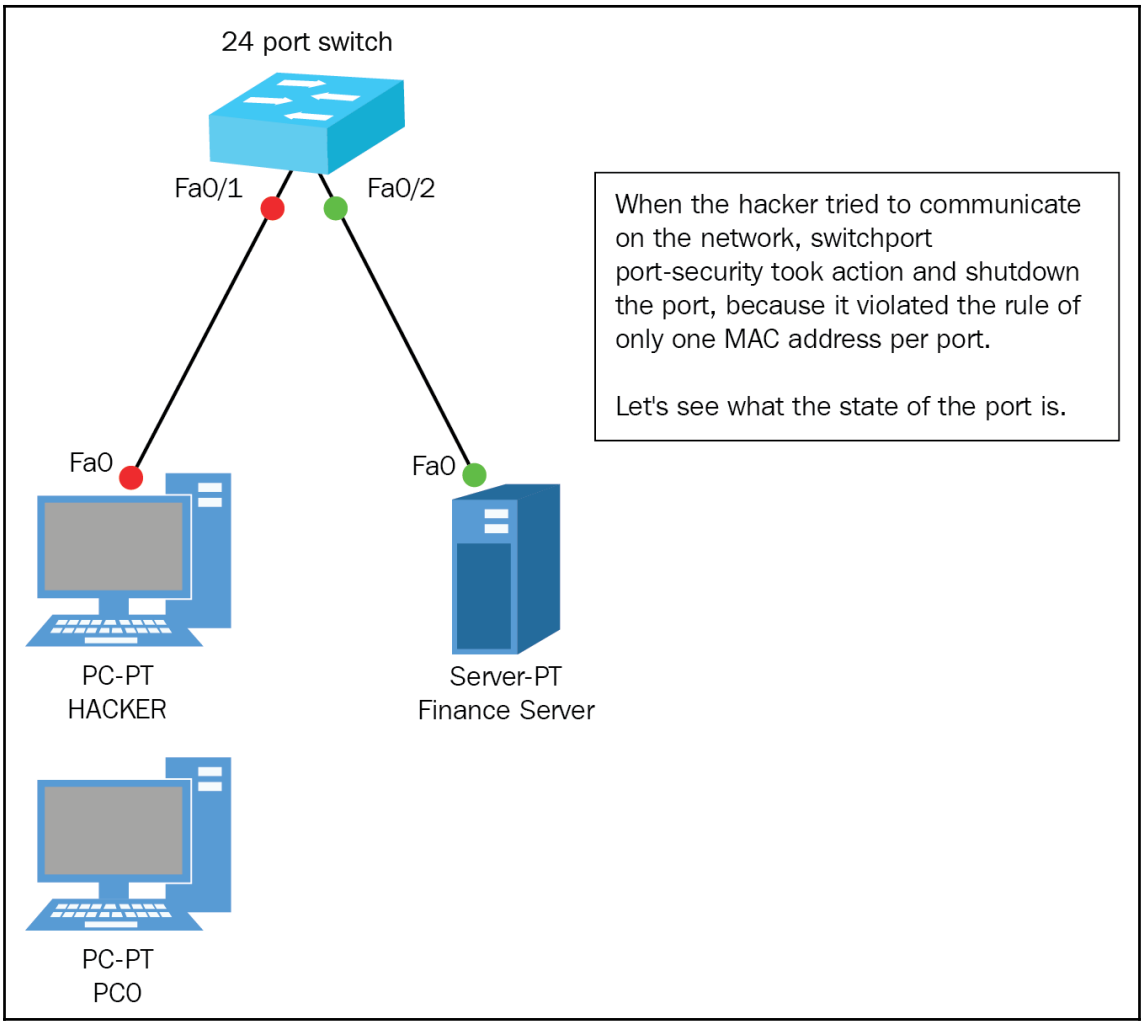
1 0001.631a.de91 DYNAMIC Fa0/2 (PC1)
1 0001.9730.e969 DYNAMIC Fa0/4 (PC3)
1 0005.5ee2.c6b3 DYNAMIC Fa0/20 (SERVER 4)
1 000c.cf3b.6714 DYNAMIC Fa0/20 (SWITCH ON THE RIGHT)
1 0030.a382.4902 DYNAMIC Fa0/5 (PC4)
1 0030.f266.db7b DYNAMIC Fa0/20 (SERVER 2)
1 0030.f2d6.00bd DYNAMIC Fa0/20 (SERVER 0)
1 0060.2f09.c445 DYNAMIC Fa0/20 (SERVER 3)
1 0060.2f5c.eb11 DYNAMIC Fa0/20 (SERVER 1)
1 0060.5c98.777e DYNAMIC Fa0/3 (PC2)
1 00d0.ba60.15ca DYNAMIC Fa0/1 (PC0)

Existing Network



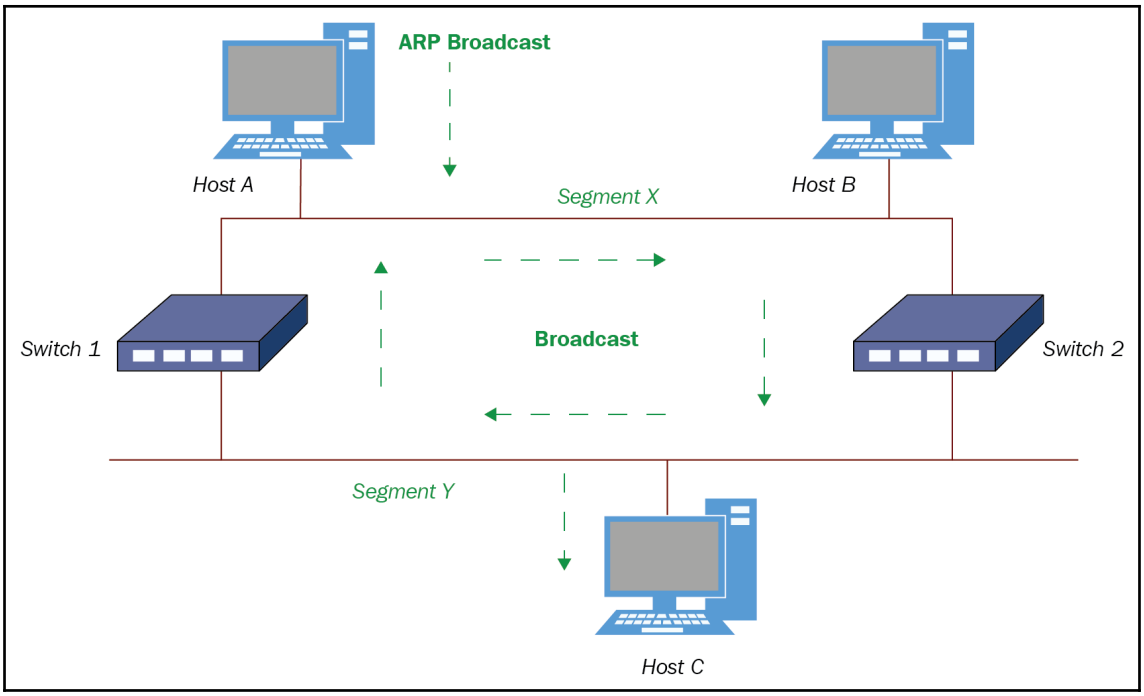
A 24 port Switch only 2 computers on it. We need to secure those ports using switchport security, to only allow those computers to be able to connect to those ports.

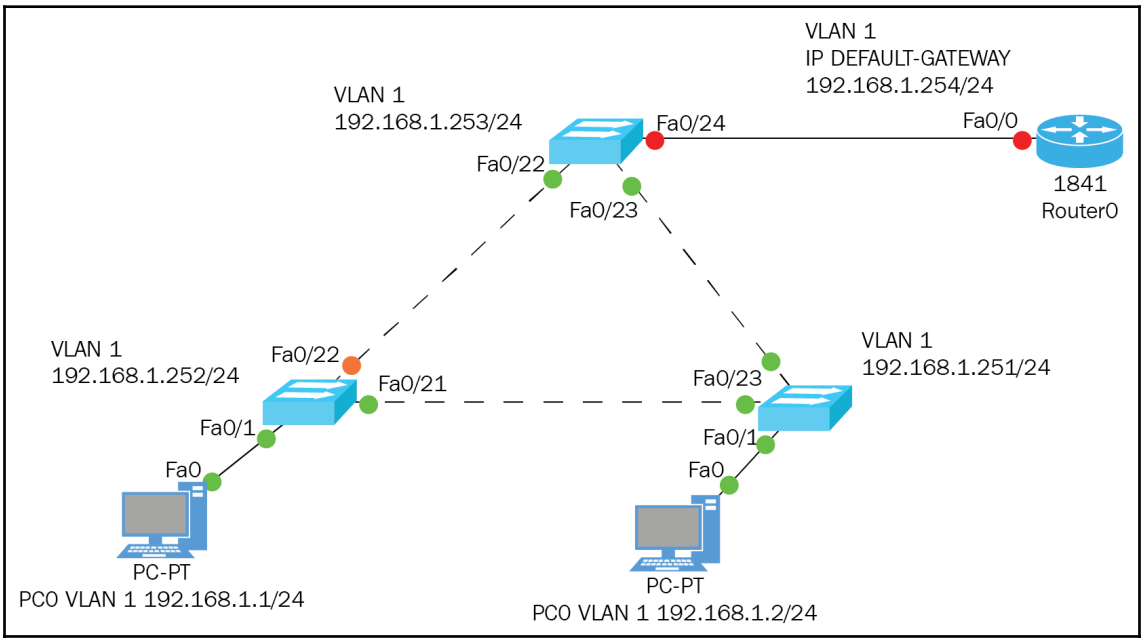
As of right now all is working fine.

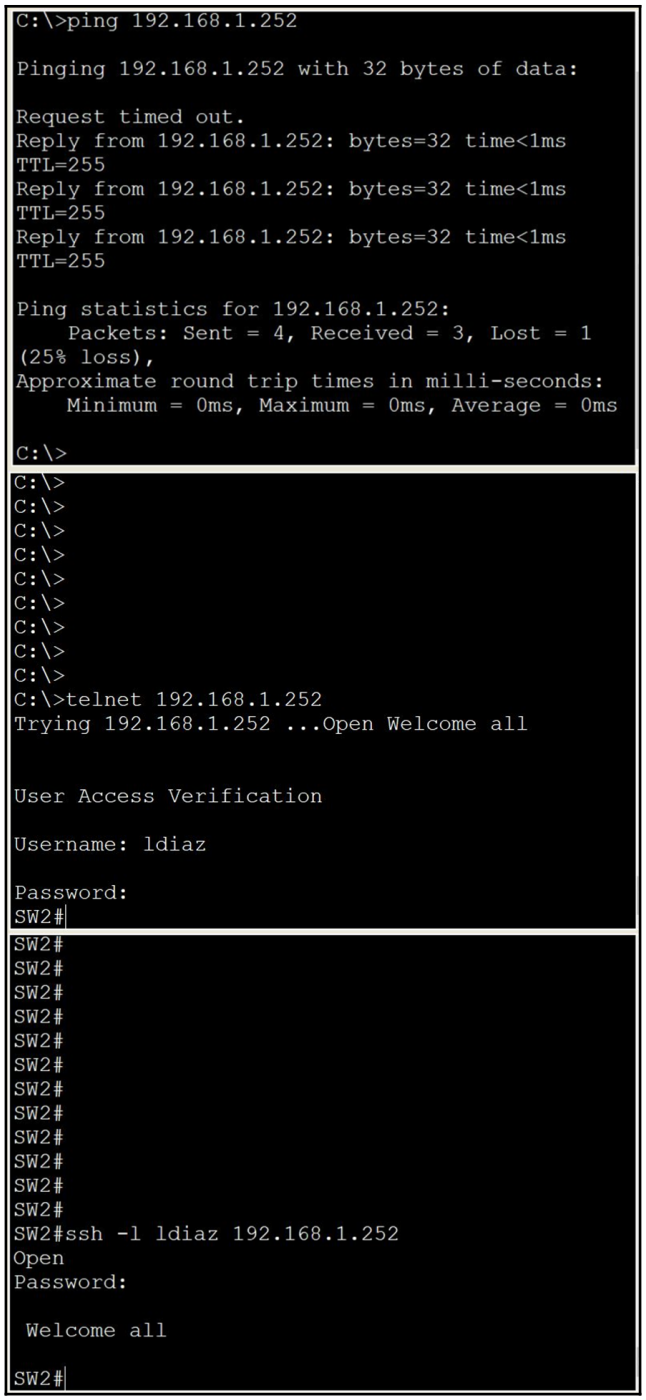


When the hacker tried to communicate on the network, switchport port-security took action and shutdown the port, because it violated the rule of only one MAC address per port.

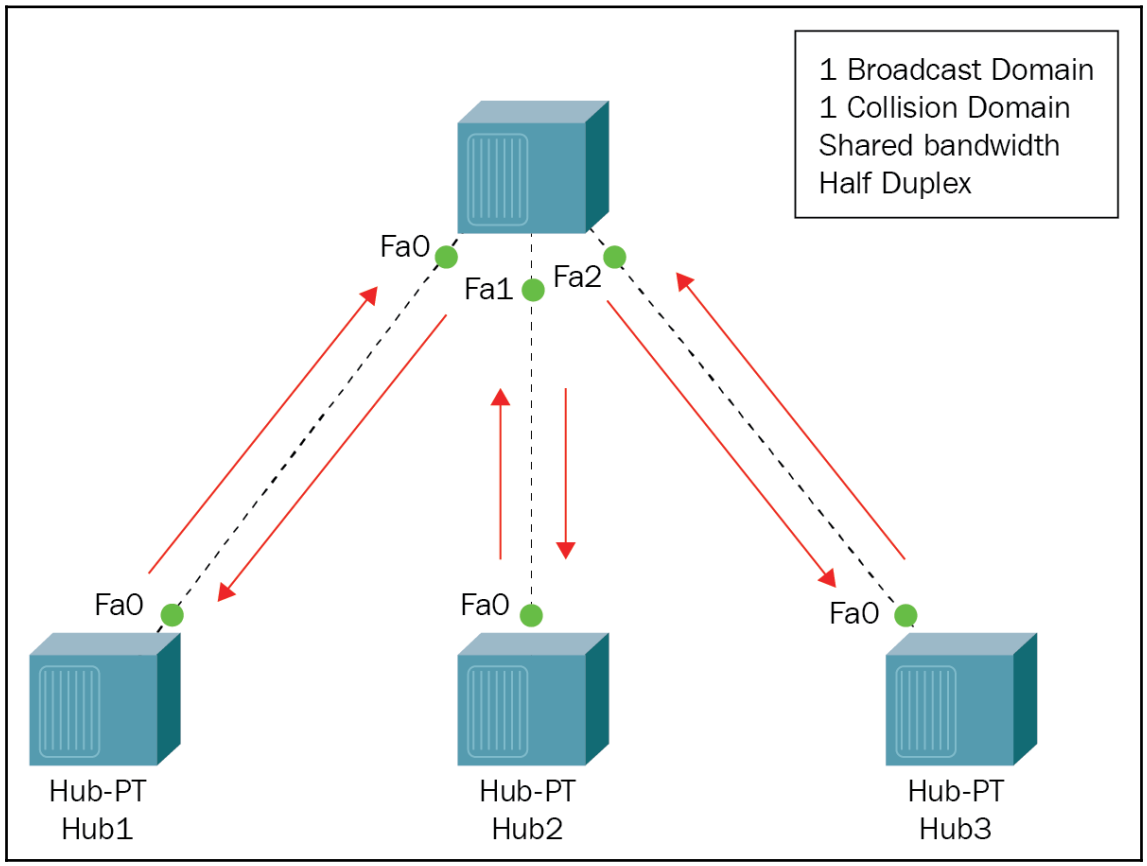
Let's see what the state of the port is.

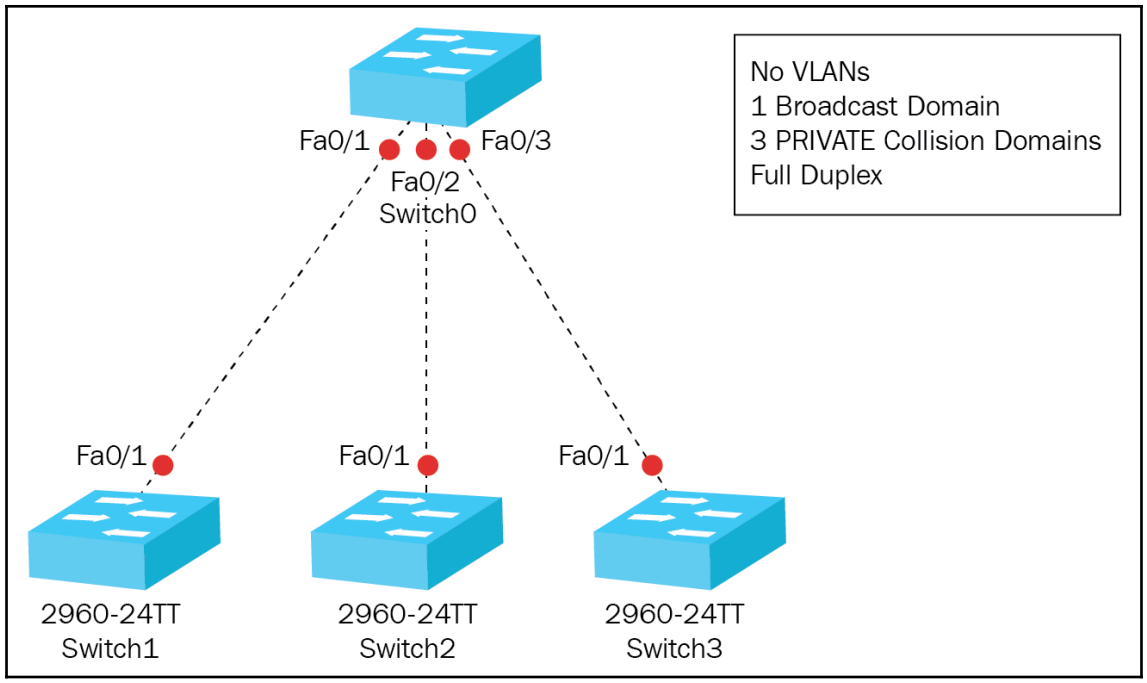

ARP Broadcast
Host A
Host B
Segment X
Switch 1
Broadcast
Switch 2
Segment Y
Host C

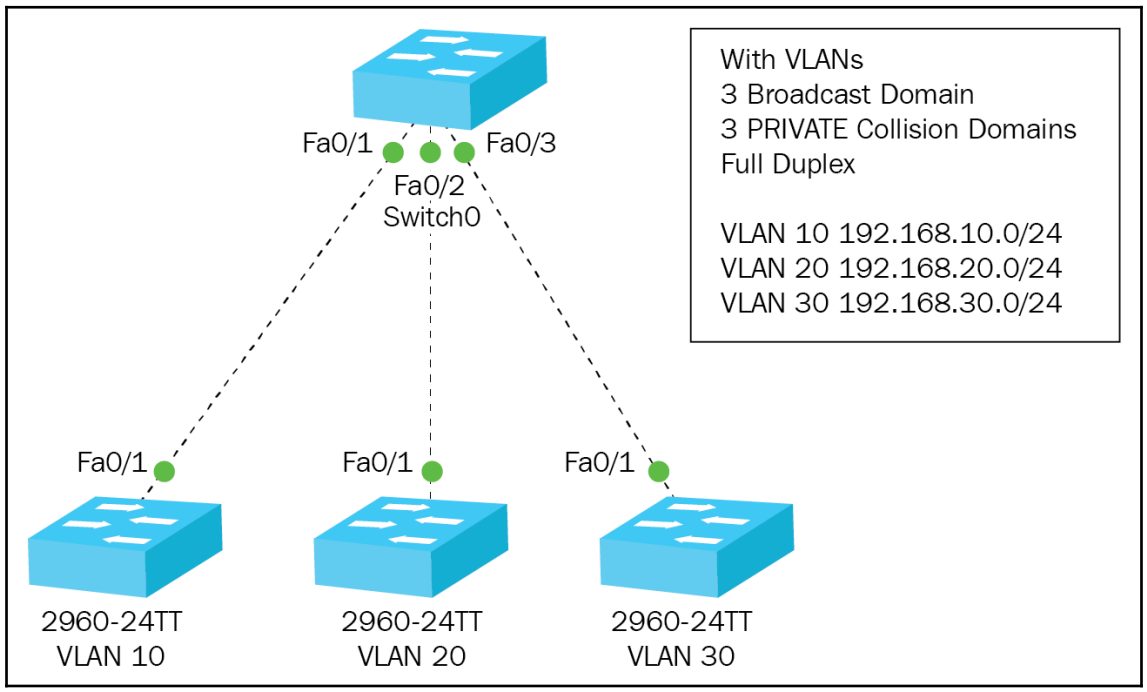

VLAN 1
IP DEFAULT-GATEWAY
192.168.1.254/24
VLAN 1
192.168.1.253/24
Fa0/24
Fa0/0
Fa0/22
Fa0/23
1841
Router0
VLAN 1
192.168.1.252/24
Fa0/22
Fa0/21
Fa0/1
Fa0
PC-PT
PC0 VLAN 1 192.168.1.1/24
VLAN 1
192.168.1.251/24
Fa0/23
Fa0/1
Fa0
PC-PT
PC0 VLAN 1 192.168.1.2/24

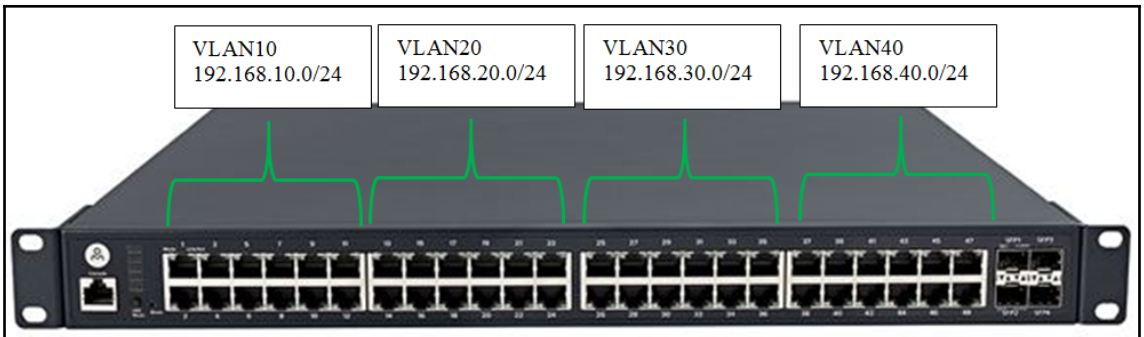

C:\>ping 192.168.1.252
Pinging 192.168.1.252 with 32 bytes of data:
Request timed out.
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Reply from 192.168.1.252: bytes=32 time<1ms TTL=255
Ping statistics for 192.168.1.252:
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
Approximate round trip times in milli-seconds:
Minimum = 0ms, Maximum = 0ms, Average = 0ms
C:\>
C:\>telnet 192.168.1.252
Trying 192.168.1.252 ...Open Welcome all
User Access Verification
Username: ldiaz
Password:
SW2#
SW2#ssh -l ldiaz 192.168.1.252
Open
Password:
Welcome all
SW2#

Chapter 13: VLANs and Inter-VLAN Routing




No VLANs
1 Broadcast Domain
3 PRIVATE Collision Domains
Full Duplex
Fa0/1
Fa0/3
Fa0/2
Switch0
Fa0/1
Fa0/1
Fa0/1
2960-24TT
Switch1
2960-24TT
Switch2
2960-24TT
Switch3

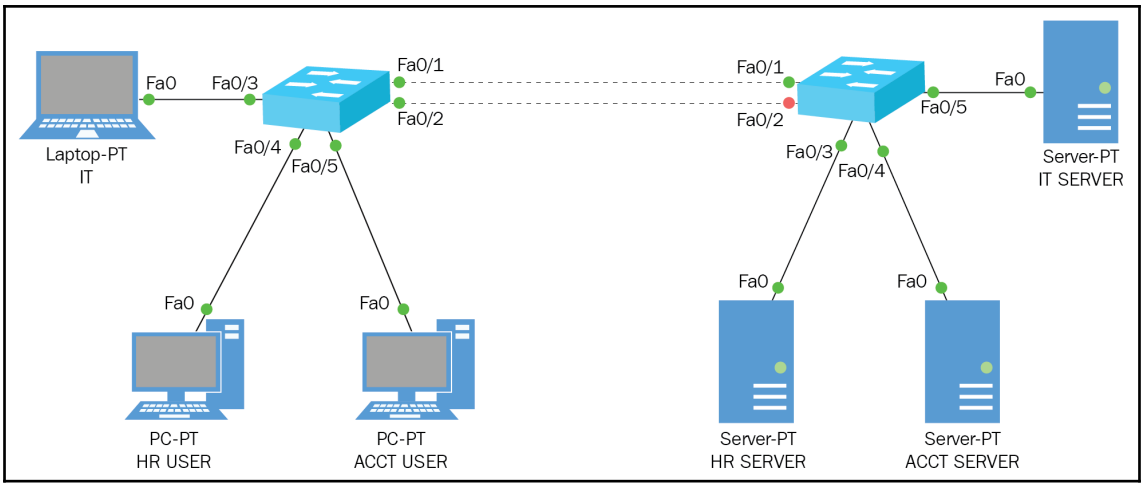

With VLANs
3 Broadcast Domain
3 PRIVATE Collision Domains
Full Duplex
VLAN 10 192.168.10.0/24
VLAN 20 192.168.20.0/24
VLAN 30 192.168.30.0/24
Fa0/1
Fa0/3
Fa0/2
Switch0
Fa0/1
Fa0/1
Fa0/1
2960-24TT
VLAN 10
2960-24TT
VLAN 20
2960-24TT
VLAN 30

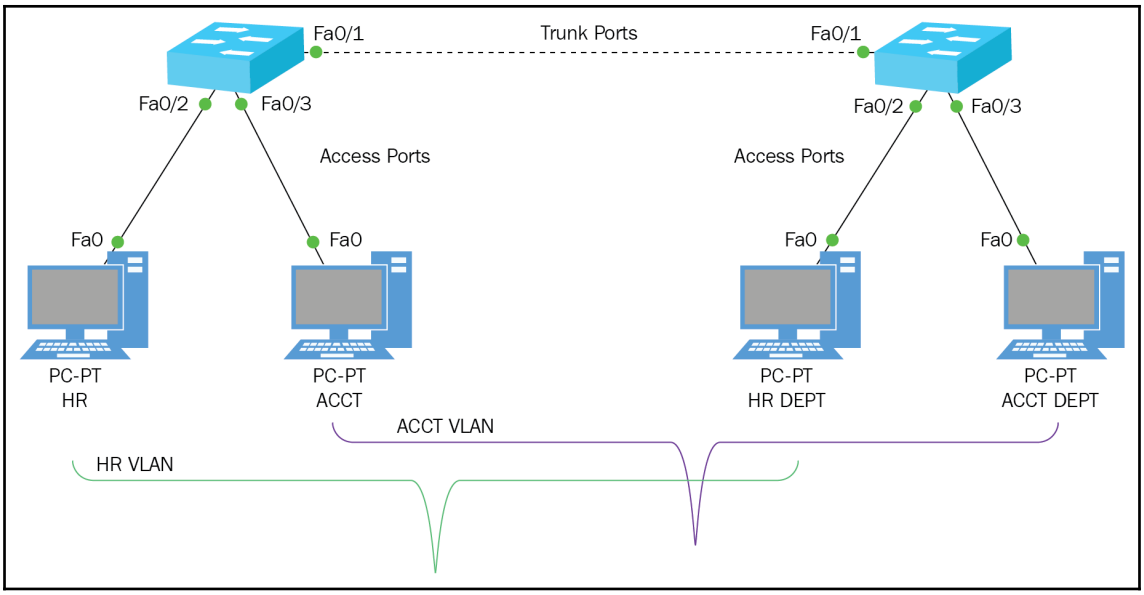


Each VLAN would represent a department, floor, classroom, and so on…

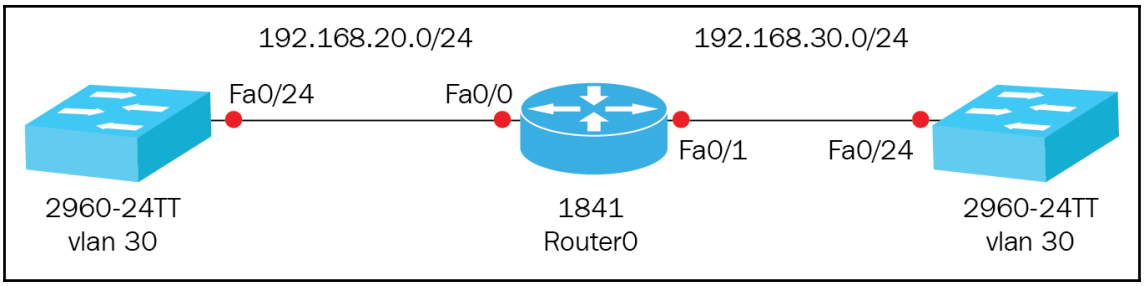
VLAN 10: HR
VLAN 20: FINANCE
VLAN 30: ADDMISSIONS
VLAN 40: FACULTY

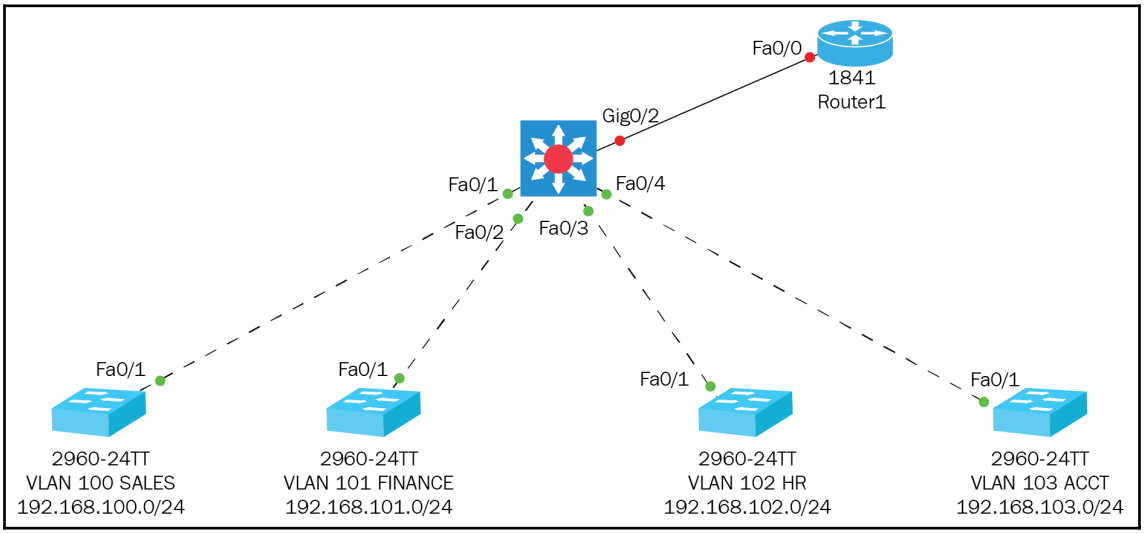
JUST AN EXAMPLE OF WHAT YOU COULD DO





VLAN	Name	Status	Ports
1	default	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5, Fa0/6, Fa0/7, Fa0/8 Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/20, Fa0/21 Fa0/22, Fa0/23, Fa0/24, Gig0/1 Gig0/2
10	HR	active	Fa0/19
80	voice	active	Fa0/19






```
Core(config)#vlan 100
Core(config-vlan)#name sales
Core(config-vlan)#vlan 101
Core(config-vlan)#name finance
Core(config-vlan)#vlan 102
Core(config-vlan)#name hr
Core(config-vlan)#vlan 103
Core(config-vlan)#name acct
Core(config-vlan)#do wr
Building configuration...
[OK]
```

The "wr" command which means write, you cannot do in the CCNA. You must go back to privilege mode and type "copy run start"

Configuring the core router for Inter-vlan communication

```
CORE(config)#INT F0/0
CORE(config-if)#NO SHUT
```

On the physical interface all you need to do is turn it on.

```
CORE(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

CORE(config-if)#INT F0/0.100
CORE(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.100, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.100, changed state to up
```

How you create a sub-interface the number SHOULD match the vlan id.

Encapsulation must match the 802.1q protocol and the number is required to match the vlan id.

```
CORE(config-subif)#ENCAP DOT1Q 100
CORE(config-subif)#IP ADDRESS 192.168.100.254 255.255.255.0
CORE(config-subif)#
CORE(config-subif)#INT F0/0.101
CORE(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.101, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.101, changed state to up

CORE(config-subif)#ENCAP DOT1Q 101
CORE(config-subif)#IP ADDRESS 192.168.101.254 255.255.255.0
CORE(config-subif)#
CORE(config-subif)#INT F0/0.102
CORE(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.102, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.102, changed state to up

CORE(config-subif)#ENCAP DOT1Q 102
CORE(config-subif)#IP ADDRESS 192.168.102.254 255.255.255.0
CORE(config-subif)#
CORE(config-subif)#INT F0/0.103
CORE(config-subif)#
%LINK-5-CHANGED: Interface FastEthernet0/0.103, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0.103, changed state to up

CORE(config-subif)#ENCAP DOT1Q 103
CORE(config-subif)#IP ADDRESS 192.168.103.254 255.255.255.0
CORE(config-subif)#DO WR
Building configuration...
[OK]
CORE(config-subif)#
```

The IP address is the default gateway address for all devices on this network.


```
!
interface Vlan600
mac-address 0060.5c66.3705
ip address 192.168.1.253 255.255.255.0
```

New VLAN was added for the G0/2 interface that goes to the router. We must create a network there also

ping 192.168.101.253 — My gateway address

C:\>ping 192.168.100.253 — VLAN 100 address

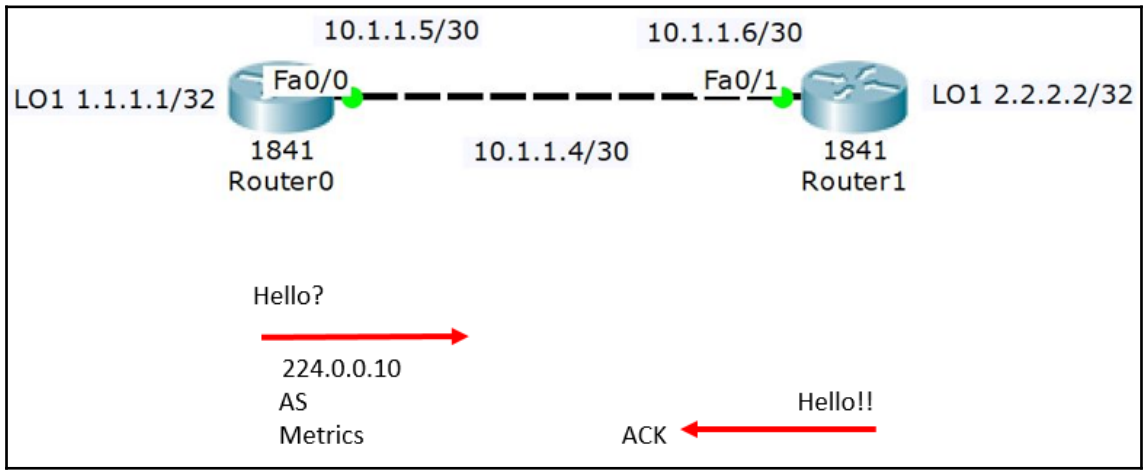
C:\>ping 192.168.102.253 — VLAN 102 address

C:\>ping 192.168.103.253 — VLAN 103 address

C:\>ping 192.168.1.254

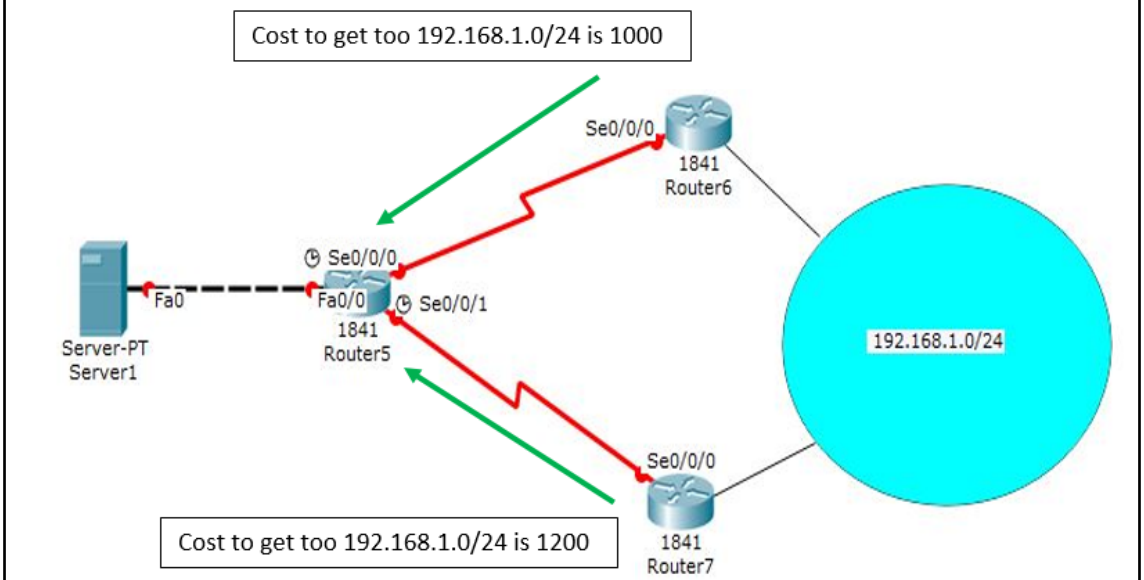
Core Router address

Chapter 14: Introduction to the EIGRP Routing Protocol

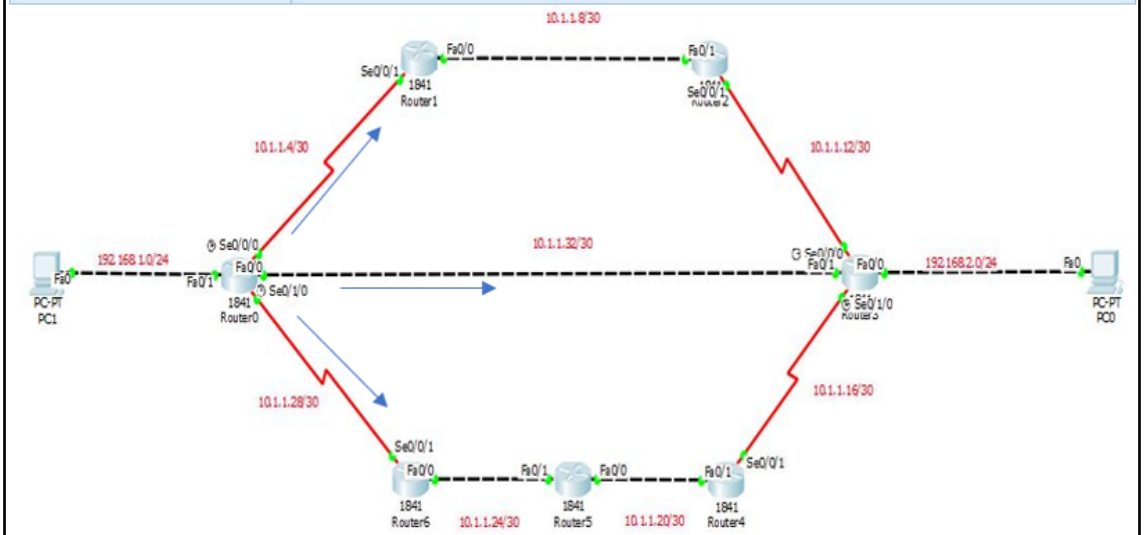



```
R0#debug eigrp packets
EIGRP Packets debugging is on
    (UPDATE, REQUEST, QUERY, REPLY, HELLO, ACK )
R0#
EIGRP: Sending HELLO on Loopback0
  AS 100, Flags 0x0, Seq 4/0 idbQ 0/0 iidbQ un/rely 0/0

EIGRP: Received HELLO on Loopback0 nbr 1.1.1.1
  AS 100, Flags 0x0, Seq 4/0 idbQ 0/0

EIGRP: Packet from ourselves ignored

EIGRP: Sending HELLO on FastEthernet0/0
  AS 100, Flags 0x0, Seq 4/0 idbQ 0/0 iidbQ un/rely 0/0
```

Term	Definition
Reported Distance or Advertised Distance	The RD or AD is the metric of the remote network as your neighbor reports it, but also it is the routing table metric, and it's the second number in the parenthesis in your topology table



Term	Definition
Feasible Distance or FD	Bottom line the FD is the route with the lowest cost or fastest path that is on the routing table



Term	Definition
Feasible successor or FS	The FS is the path that its AD is less than the FD of the current successor and it considered a backup route. In other words, the FS is the path that is slower, and it came in second place
Successor Route	The Successor is the route that will make it to the Routing table, it has the fastest route to the destination network.
Neighbor Table	Keeps the information about adjacent neighbors, if a new neighbor is found the information is kept in the Neighbor table
Topology Table	The topology table has all routes it has learned through the DUAL algorithm, so the Feasible Successor routes and Successor routes will be in the topology table. Since these routes are volatile, the topology table is kept in RAM. The routing table get its information from the topology table.
Reliable Transport Protocol or RTP	The RTP protocol was designed by Cisco, to ensure proper communication between routers configured with EIGRP. Its purpose is to use the multicast and unicast addresses to ensure updates are sent reliably. This process is often called the "Reliable Multicast."

```
R1(config-if)#ip hello-interval ?
eigrp Enhanced Interior Gateway Routing Protocol (EIGRP)
R1(config-if)#ip hello-interval eigrp ?
<1-65535> Autonomous system number
R1(config-if)#ip hello-interval eigrp 100 ?
<1-65535> Seconds between hello transmissions
R1(config-if)#ip hello-interval eigrp 100 15 ?
<cr>
R1(config-if)#ip hello-interval eigrp 100 15
```

Autonomous System

Hello timer in seconds

IP Scheme for PC's

NODE	IP ADDRESS	SUBNET MASK	GATEWAY
PC0	192.168.1.1	255.255.255.0	192.168.1.254
PC1	192.168.1.2	255.255.255.0	192.168.1.254
PC2	192.168.2.1	255.255.255.0	192.168.2.254
PC3	192.168.2.2	255.255.255.0	192.168.2.254
PC4	192.168.3.1	255.255.255.0	192.168.3.254
PC5	192.168.3.2	255.255.255.0	192.168.3.254
PC6	192.168.4.1	255.255.255.0	192.168.4.254
PC7	192.168.4.2	255.255.255.0	192.168.4.254

IP Scheme for Routers

INTERFACE	R1	R2	R3	R4	CIDR
F0/0	192.168.1.254	192.168.2.254	192.168.3.254	192.168.4.254	/24
F0/1	10.1.1.21	10.1.1.25	10.1.1.22	10.1.1.26	/30
S0/0/0	10.1.1.5	10.1.1.10	10.1.1.18	10.1.1.14	/30
S0/0/1	10.1.1.9	10.1.1.17	10.1.1.13	10.1.1.6	/30

R1

```
R1>EN
R1#SH IP INT BRIEF
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.1.254   YES manual up                    up
FastEthernet0/1            10.1.1.21       YES manual up                    up
Serial0/0/0                10.1.1.5        YES manual up                    up
Serial0/0/1                10.1.1.9        YES manual up                    up
```

R2

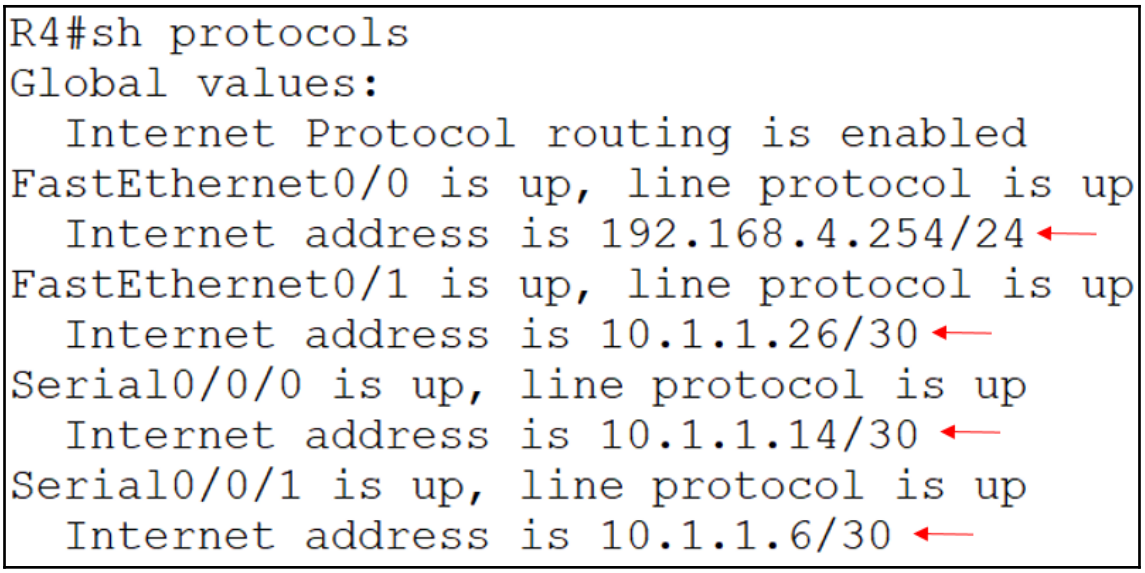
```
R2#SH IP INT BRIEF
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.2.254   YES manual up                    up
FastEthernet0/1            10.1.1.25       YES manual up                    up
Serial0/0/0                10.1.1.10       YES manual up                    up
Serial0/0/1                10.1.1.17       YES manual up                    up
```

R3

```
R3#SH IP INT BRIEF
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.3.254   YES manual up                    up
FastEthernet0/1            10.1.1.22       YES manual up                    up
Serial0/0/0                10.1.1.18       YES manual up                    up
Serial0/0/1                10.1.1.13       YES manual up                    up
```

R4

```
R4#SH IP INT BRIEF
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.4.254   YES manual up                    up
FastEthernet0/1            10.1.1.26       YES manual up                    up
Serial0/0/0                10.1.1.14       YES manual up                    up
Serial0/0/1                10.1.1.6        YES manual up                    up
```


R4#sh protocols
Global values:
Internet Protocol routing is enabled
FastEthernet0/0 is up, line protocol is up
Internet address is 192.168.4.254/24
FastEthernet0/1 is up, line protocol is up
Internet address is 10.1.1.26/30
Serial0/0/0 is up, line protocol is up
Internet address is 10.1.1.14/30
Serial0/0/1 is up, line protocol is up
Internet address is 10.1.1.6/30

R1

router eigrp 100
network 192.168.4.0
network 10.0.0.0
no auto-summary

Using class full boundaries

R2

router eigrp 100
network 192.168.2.0
network 10.0.0.0
no auto-summary

Using class full boundaries

R3

router eigrp 100
network 192.168.3.0
network 10.0.0.0
no auto-summary

Using class full boundaries

R4

router eigrp 100
network 192.168.4.0
network 10.0.0.0
no auto-summary

Using class full boundaries

R1

R1#sh ip route

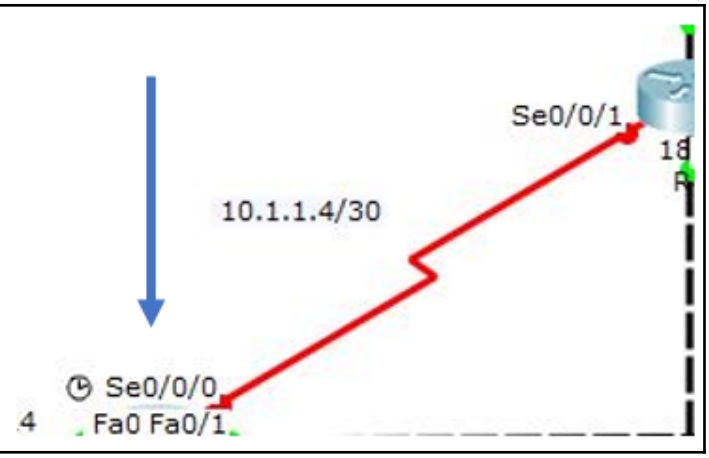
```
Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 6 subnets
C       10.1.1.4 is directly connected, Serial0/0/0
C       10.1.1.8 is directly connected, Serial0/0/1
D       10.1.1.12 [90/2172416] via 10.1.1.22, 00:25:02, FastEthernet0/1
D       10.1.1.16 [90/2172416] via 10.1.1.22, 00:25:10, FastEthernet0/1
C       10.1.1.20 is directly connected, FastEthernet0/1
D       10.1.1.24 [90/2172416] via 10.1.1.10, 00:25:02, Serial0/0/1
                  [90/2172416] via 10.1.1.6, 00:25:01, Serial0/0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
D    192.168.2.0/24 [90/2172416] via 10.1.1.10, 00:25:02, Serial0/0/1
D    192.168.3.0/24 [90/30720] via 10.1.1.22, 00:25:10, FastEthernet0/1
D    192.168.4.0/24 [90/2172416] via 10.1.1.6, 00:25:01, Serial0/0/0
```

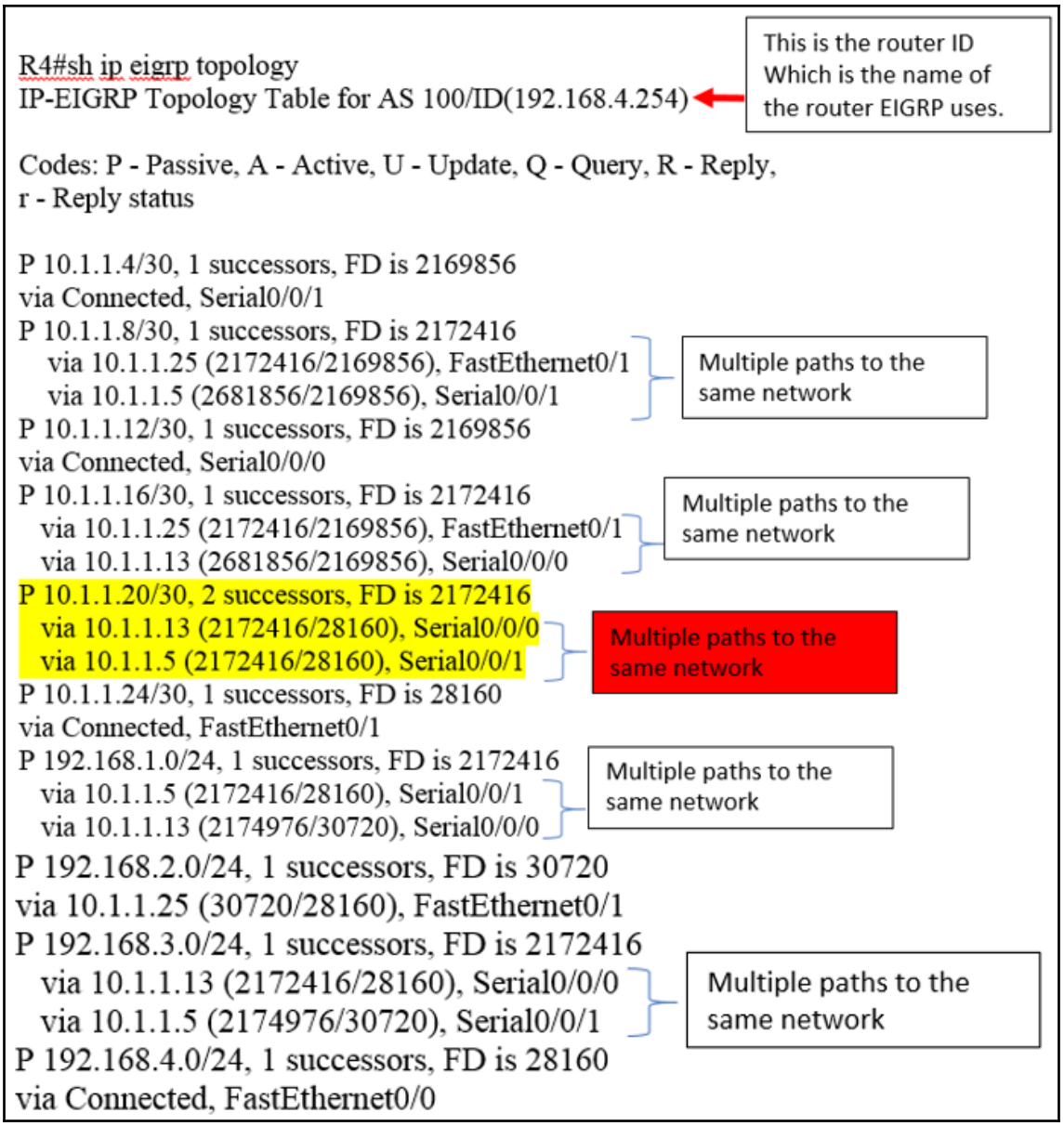
```
R4#sh ip protocols
Routing Protocol is "eigrp 100 "
Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set
Default networks flagged in outgoing updates
Default networks accepted from incoming updates
EIGRP metric weight K1=1, K2=0, K3=1, K4=0, K5=0
EIGRP maximum hopcount 100
EIGRP maximum metric variance 1
Redistributing: eigrp 100
Automatic network summarization is not in effect
Maximum path: 4
Routing for Networks:
192.168.4.0
10.0.0.0
Routing Information Sources:
Gateway Distance Last Update
10.1.1.5 90 117075464
10.1.1.25 90 117075471
10.1.1.13 90 117075493
Distance: internal 90 external 170
```

Let's look:

R1(config)#int s0/0/0

R1(config-if)#shut



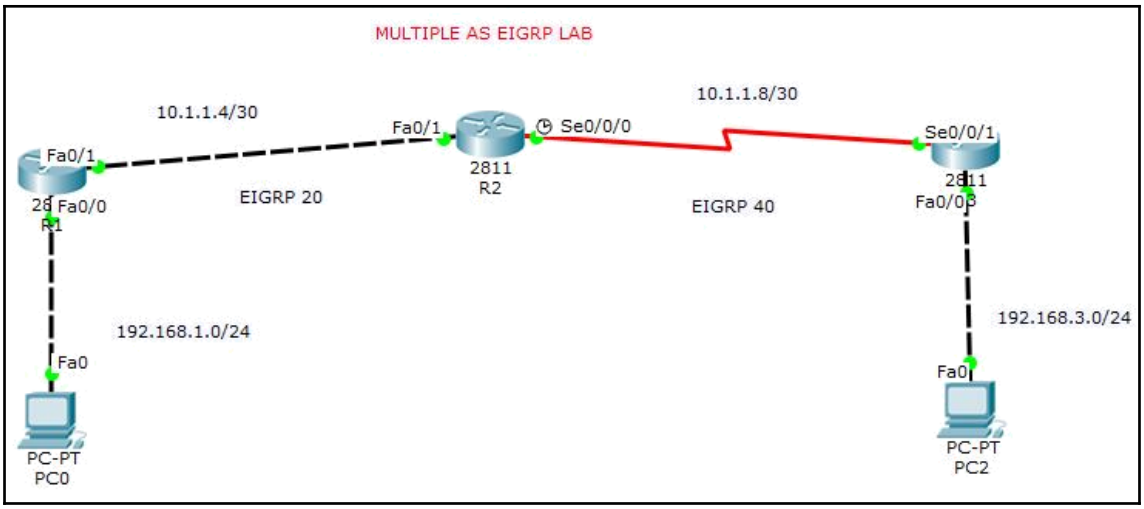

R4#sh ip eigrp topology
IP-EIGRP Topology Table for AS 100/ID(192.168.4.254)
This is the router ID Which is the name of the router EIGRP uses.
Codes: P - Passive, A - Active, U - Update, Q - Query, R - Reply,
r - Reply status
P 10.1.1.4/30, 1 successors, FD is 2169856
via Connected, Serial0/0/1
P 10.1.1.8/30, 1 successors, FD is 2172416
via 10.1.1.25 (2172416/2169856), FastEthernet0/1
via 10.1.1.5 (2681856/2169856), Serial0/0/1
Multiple paths to the same network
P 10.1.1.12/30, 1 successors, FD is 2169856
via Connected, Serial0/0/0
P 10.1.1.16/30, 1 successors, FD is 2172416
via 10.1.1.25 (2172416/2169856), FastEthernet0/1
via 10.1.1.13 (2681856/2169856), Serial0/0/0
Multiple paths to the same network
P 10.1.1.20/30, 2 successors, FD is 2172416
via 10.1.1.13 (2172416/28160), Serial0/0/0
via 10.1.1.5 (2172416/28160), Serial0/0/1
Multiple paths to the same network
P 10.1.1.24/30, 1 successors, FD is 28160
via Connected, FastEthernet0/1
P 192.168.1.0/24, 1 successors, FD is 2172416
via 10.1.1.5 (2172416/28160), Serial0/0/1
via 10.1.1.13 (2174976/30720), Serial0/0/0
Multiple paths to the same network
P 192.168.2.0/24, 1 successors, FD is 30720
via 10.1.1.25 (30720/28160), FastEthernet0/1
P 192.168.3.0/24, 1 successors, FD is 2172416
via 10.1.1.13 (2172416/28160), Serial0/0/0
via 10.1.1.5 (2174976/30720), Serial0/0/1
Multiple paths to the same network
P 192.168.4.0/24, 1 successors, FD is 28160
via Connected, FastEthernet0/0

```
R1#sh ip eigrp topology
IP-EIGRP Topology Table for AS 100/ID(192.168.1.254)

P 10.1.1.4/30, 1 successors, FD is 2169856
via Connected, Serial0/0/0
P 10.1.1.8/30, 1 successors, FD is 2169856
via Connected, Serial0/0/1
P 10.1.1.12/30, 1 successors, FD is 2172416
  via 10.1.1.22 (2172416/2169856), FastEthernet0/1
  via 10.1.1.6 (2681856/2169856), Serial0/0/0
P 10.1.1.16/30, 1 successors, FD is 2172416
  via 10.1.1.22 (2172416/2169856), FastEthernet0/1
  via 10.1.1.10 (2681856/2169856), Serial0/0/1
P 10.1.1.20/30, 1 successors, FD is 28160
 via Connected, FastEthernet0/1
P 10.1.1.24/30, 2 successors, FD is 2172416
 via 10.1.1.10 (2172416/28160), Serial0/0/1
 via 10.1.1.6 (2172416/28160), Serial0/0/0
P 192.168.1.0/24, 1 successors, FD is 28160
via Connected, FastEthernet0/0
P 192.168.2.0/24, 1 successors, FD is 2172416
via 10.1.1.10 (2172416/28160), Serial0/0/1
via 10.1.1.6 (2174976/30720), Serial0/0/0
```

Multiple paths FS

Multiple paths FS

Multiple paths NO FS


MULTIPLE AS EIGRP LAB
10.1.1.4/30
10.1.1.8/30
Fa0/1
Fa0/1
Se0/0/0
Se0/0/1
2811
R2
2811
Fa0/0
EIGRP 20
EIGRP 40
Fa0/0
192.168.1.0/24
192.168.3.0/24
Fa0
Fa0
PC-PT
PC0
PC-PT
PC2

R1

```
R1#sh ip int brief
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            192.168.1.254   YES manual up                    up
FastEthernet0/1            10.1.1.5        YES manual up                    up
```

R2

```
R2#SH IP INT BRIEF
Interface                  IP-Address      OK? Method Status
Protocol
FastEthernet0/0            unassigned      YES unset  administratively down
down
FastEthernet0/1            10.1.1.6        YES manual up                    up
Serial0/0/0                10.1.1.9        YES manual up                    up
```

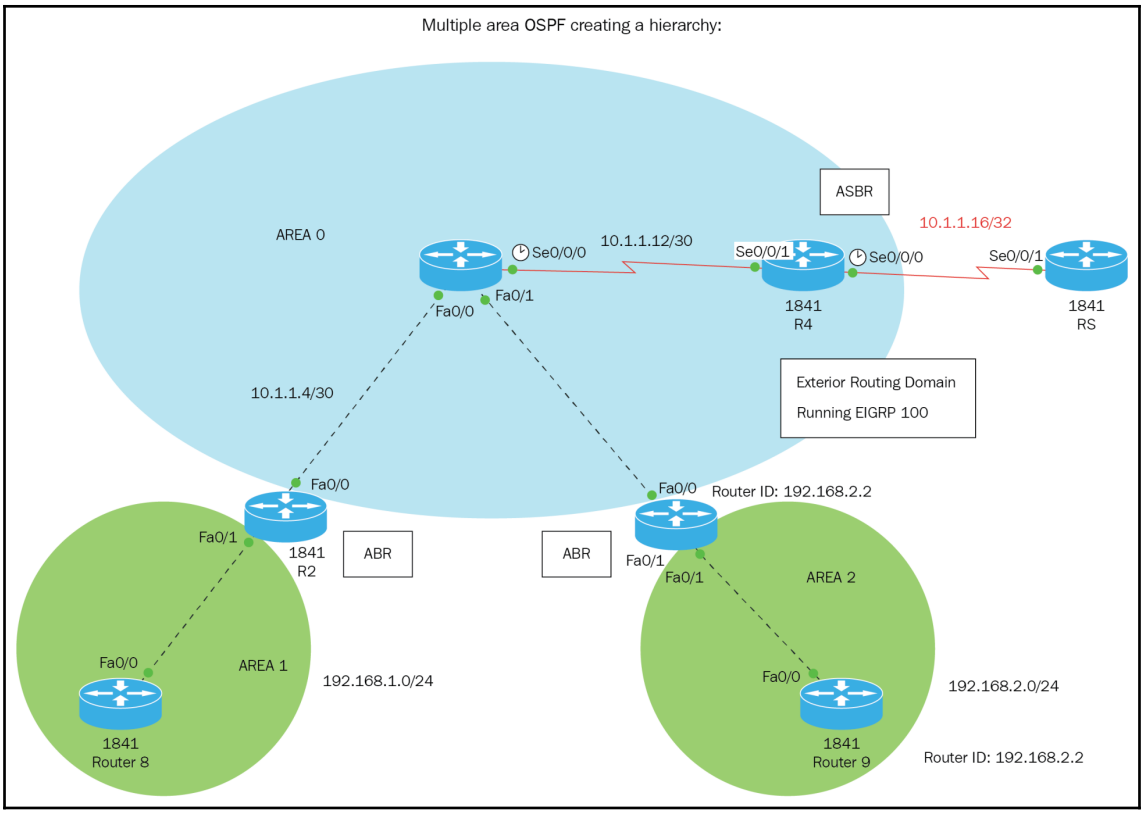
R3

```
R3#SH IP INT BRIEF
Interface              IP-Address      OK? Method Status
Protocol
FastEthernet0/0        192.168.3.254   YES manual up                    up
FastEthernet0/1        unassigned      YES unset  administratively down
down
Serial0/0/0            unassigned      YES unset  administratively down
down
Serial0/0/1            10.1.1.10       YES manual up                    up
```

```
R2#ping 10.1.1.5

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.5, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 0/0/0 ms

R2#ping 10.1.1.10

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.1.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/4/13 ms
```

Chapter 15: The World of Open Shortest Path First (OSPF)

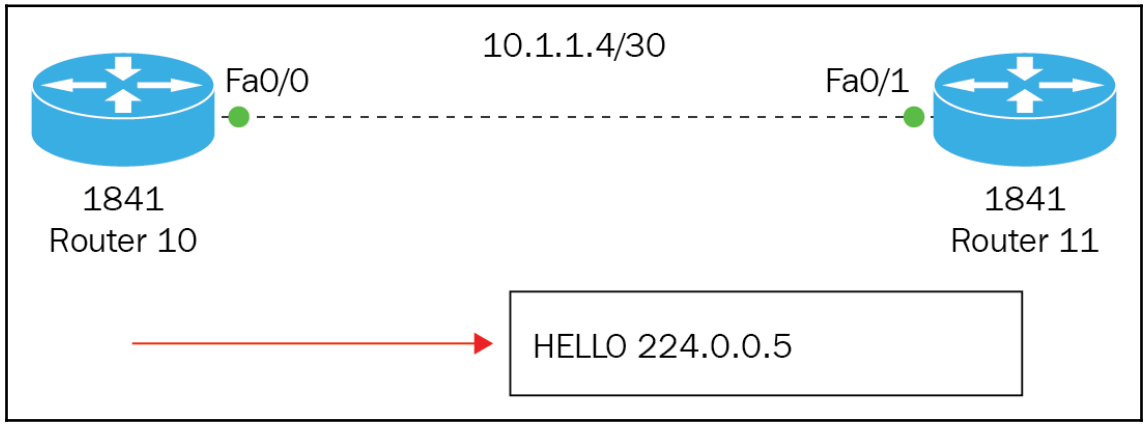
OSPF	IS-IS
Host	End systems or ES
Router	Intermediate Systems (IS)
Link	Circuit
Packet	Protocol Data Unit (PDU)
Designated Router (DR)	Designated IS (DIS)
Backup DR (BDR)	N/A (no BDIS is used)
Link-State Advertisements (LSA)	Link-State PDU (LSP)
Hello Packet	IIH PDU
Database Description (DBD)	Complete Sequence number PDU(CSNP)
Area	Sub domain (area)
Non-Backbone area	Level-1 area
Backbone area	Level-2 Sub domain (backbone)
Area Border Router (ABR)	L1L2 Router
Autonomous System Boundary Router (ASBR)	Any IS



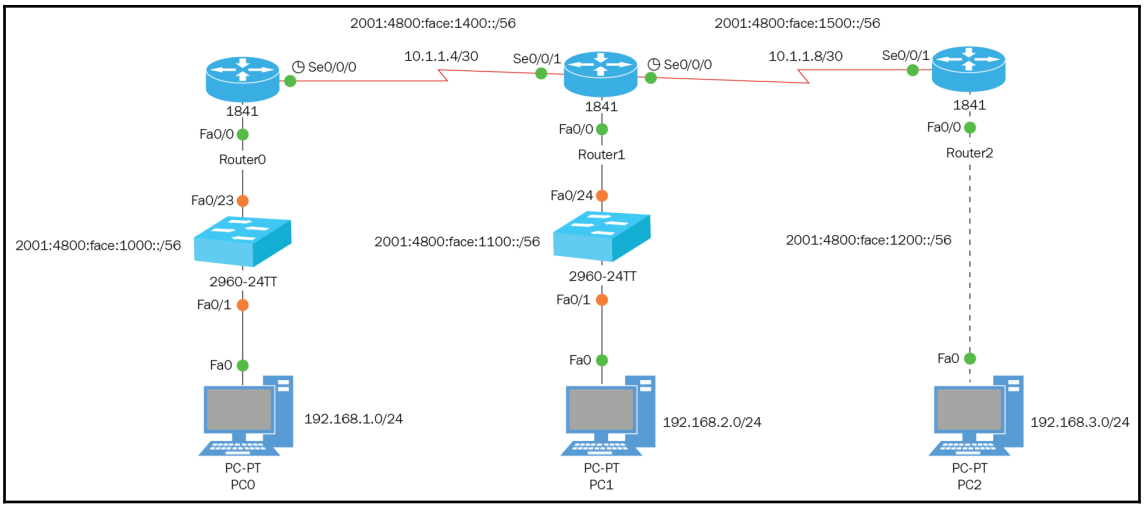
R8#sh ip route

```
Gateway of last resort is not set

     10.0.0.0/30 is subnetted, 4 subnets
O IA    10.1.1.4 [110/2] via 192.168.1.1, 02:20:28, FastEthernet0/0
O IA    10.1.1.8 [110/3] via 192.168.1.1, 02:20:28, FastEthernet0/0
O IA    10.1.1.12 [110/66] via 192.168.1.1, 02:20:28, FastEthernet0/0
O IA    10.1.1.16 [110/130] via 192.168.1.1, 00:29:08, FastEthernet0/0
C    192.168.1.0/24 is directly connected, FastEthernet0/0
O IA 192.168.2.0/24 [110/4] via 192.168.1.1, 02:19:51, FastEthernet0/0
```

```
R5#sh ip route

     10.0.0.0/30 is subnetted, 2 subnets
D       10.1.1.12 [90/2681856] via 10.1.1.17, 00:35:50, Serial0/0/1
C       10.1.1.16 is directly connected, Serial0/0/1
D EX 192.168.1.0/24 [170/2172416] via 10.1.1.17, 00:25:40, Serial0/0/1
D EX 192.168.2.0/24 [170/2172416] via 10.1.1.17, 00:25:40, Serial0/0/1
```



Type	Name	Description
1	Router LSA	The routers publicize presence and lists the links to other routers on the same network.
2	Network LSA	The DR on a broadcast segment lists which routers are joined together by the segment.
3	Summary LSA	ABR takes information it has learned on one of its attached areas and summarizes it before sending it out on other areas.
4	ASBR-Summary LSA	ASBR is where the type 5 LSA originated and would give more detailed information.
5	External LSA	Contains important information about OSPF from other routing processes. They are flooded into all areas except NSSA




```
R1(CONFIG)#INT F0/0
R1(CONFIG-IF)#IP ADDRESS 192.168.1.254 255.255.255.0
R1(CONFIG-IF)#NO SHUT
R1(CONFIG-IF)#INT S0/0/0
R1(CONFIG-IF)#IP ADDRESS 10.1.1.5 255.255.255.252
R1(CONFIG-IF)#CLOCK RATE 4000000
R1(CONFIG-IF)#NO SHUT
R1(CONFIG-IF)#EXIT
R1(CONFIG)#ROUTER OSPF 1
R1(CONFIG-ROUTER)#NETWORK 10.1.1.4 0.0.0.3 AREA 0
R1(CONFIG-ROUTER)#NETWORK 192.168.1.0 0.0.0.255 AREA 0
R1(CONFIG-ROUTER)#EXIT
R1(CONFIG)#EXIT
R1#COPY RUN START
```

```
R2(CONFIG)#INT F0/0
R2(CONFIG-IF)#IP ADDRESS 192.168.2.254 255.255.255.0
R2(CONFIG-IF)#NO SHUT
R2(CONFIG-IF)#INT S0/0/0
R2(CONFIG-IF)#IP ADDRESS 10.1.1.9 255.255.255.252
R2(CONFIG-IF)#CLOCK RATE 4000000
R2(CONFIG-IF)#NO SHUT
R2(CONFIG-IF)#INT S0/0/1
R2(CONFIG-IF)#IP ADDRESS 10.1.1.6 255.255.255.252
R2(CONFIG-IF)#EXIT
R2(CONFIG)#ROUTER OSPF 1
R2(CONFIG-ROUTER)#NETWORK 10.1.1.4 0.0.0.3 AREA 0
R2(CONFIG-ROUTER)#NETWORK 10.1.1.8 0.0.0.3 AREA 0
R2(CONFIG-ROUTER)#NETWORK 192.168.2.0 0.0.0.255 AREA 0
R2(CONFIG-ROUTER)#EXIT
R2(CONFIG)#EXIT
R1#COPY RUN START
```

```
R3(CONFIG)#INT F0/0
R3(CONFIG-IF)#IP ADDRESS 192.168.3.254 255.255.255.0
R3(CONFIG-IF)#NO SHUT
R3(CONFIG-IF)#INT S0/0/1
R3(CONFIG-IF)#IP ADDRESS 10.1.1.10 255.255.255.252
R3(CONFIG-IF)#NO SHUT
R3(CONFIG-IF)#EXIT
R3(CONFIG)#ROUTER OSPF 1
R3(CONFIG-ROUTER)#NETWORK 10.1.1.8 0.0.0.3 AREA 0
R3(CONFIG-ROUTER)#NETWORK 192.168.3.0 0.0.0.255 AREA 0
R3(CONFIG-ROUTER)#EXIT
R3(CONFIG)#EXIT
R3#COPY RUN START
```

```
R1#ping 192.168.3.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.3.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 2/7/12 ms

R1#ping 192.168.2.1

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.2.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/3/7 ms
```

R1#sh ip protocols

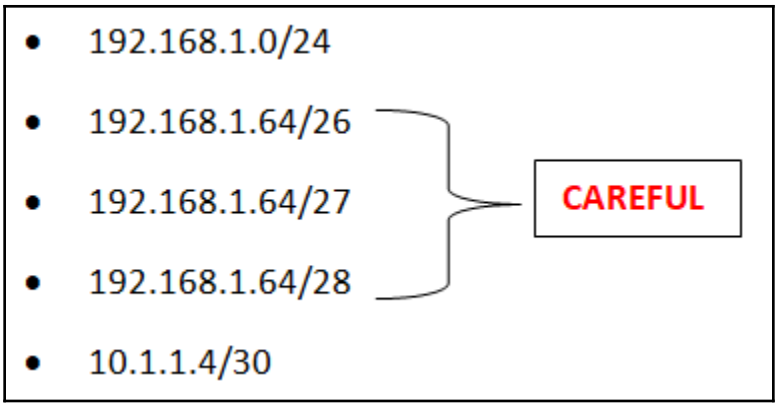
```
Routing Protocol is "ospf 1"
Outgoing update filter list for all interfaces is not set
Incoming update filter list for all interfaces is not set
Router ID 192.168.1.254
Number of areas in this router is 1. 1 normal 0 stub 0 nssa
Maximum path: 4
Routing for Networks:
192.168.1.0 0.0.0.255 area 0
10.1.1.4 0.0.0.3 area 0
Routing Information Sources:
Gateway Distance Last Update
192.168.1.254 110 00:03:20
192.168.2.254 110 00:03:18
192.168.3.254 110 00:03:20
Distance: (default is 110)
```

The highlight text are what you need to pay attention to. The Process ID number, the Router ID, the networks we are routing for and the default AD.

R1#sh ip route

```
Gateway of last resort is 0.0.0.0 to network 0.0.0.0

10.0.0.0/30 is subnetted, 2 subnets
C 10.1.1.4 is directly connected, Serial0/0/0
O 10.1.1.8 [110/128] via 10.1.1.6, 07:38:23, Serial0/0/0
C 192.168.1.0/24 is directly connected, FastEthernet0/0
O 192.168.2.0/24 [110/65] via 10.1.1.6, 07:38:23, Serial0/0/0
O 192.168.3.0/24 [110/129] via 10.1.1.6, 07:38:23, Serial0/0/0
S* 0.0.0.0/0 is directly connected, Serial0/0/0
```

The highlight text is what you need to pay attention to. We are using a default route and the "O", tell us we are learning OSPF routes.


192.168.1.0/24
192.168.1.64/26
192.168.1.64/27
192.168.1.64/28
10.1.1.4/30
CAREFUL

First example is easy

255.255.255.255 Constant
255.255.255.0 Mask
----------Subtract
0 0 0 255 ← this is your wildcard mask

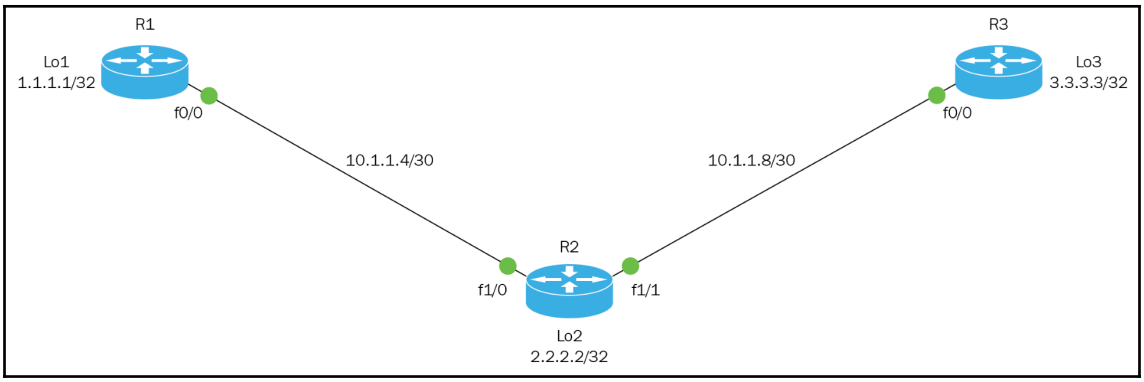
Example 2 – 3 it looks like the same network ID, but look at the mask.

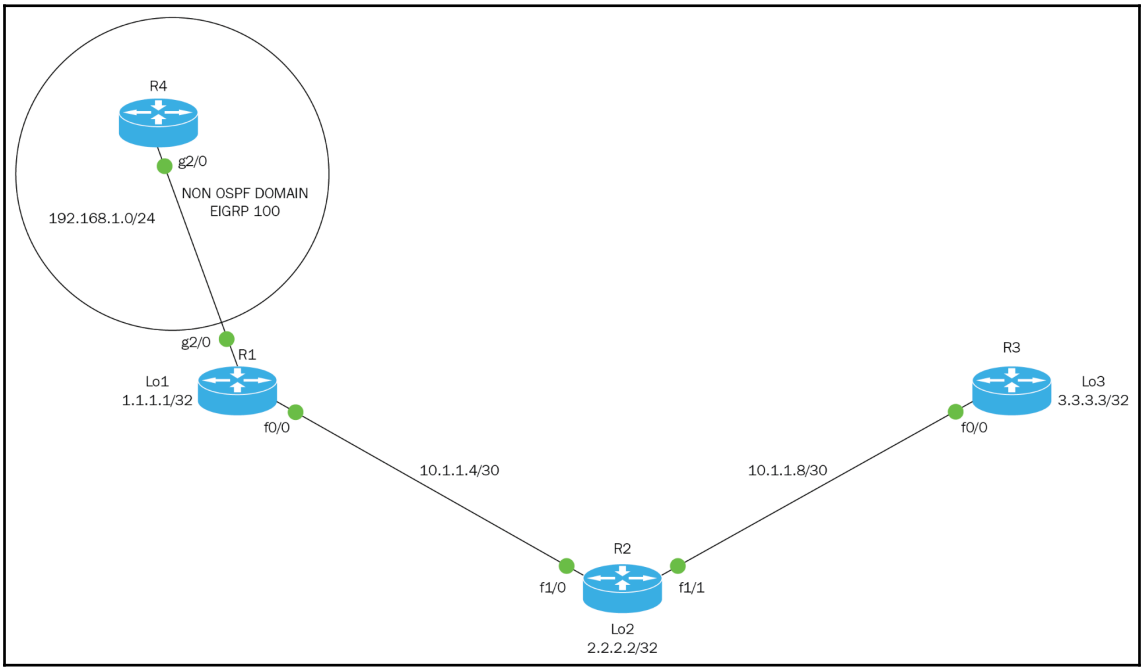
255.255.255.255 Constant
255.255.255.192 **Mask**
----------Subtract
0 0 0 63← This is your wildcard mask

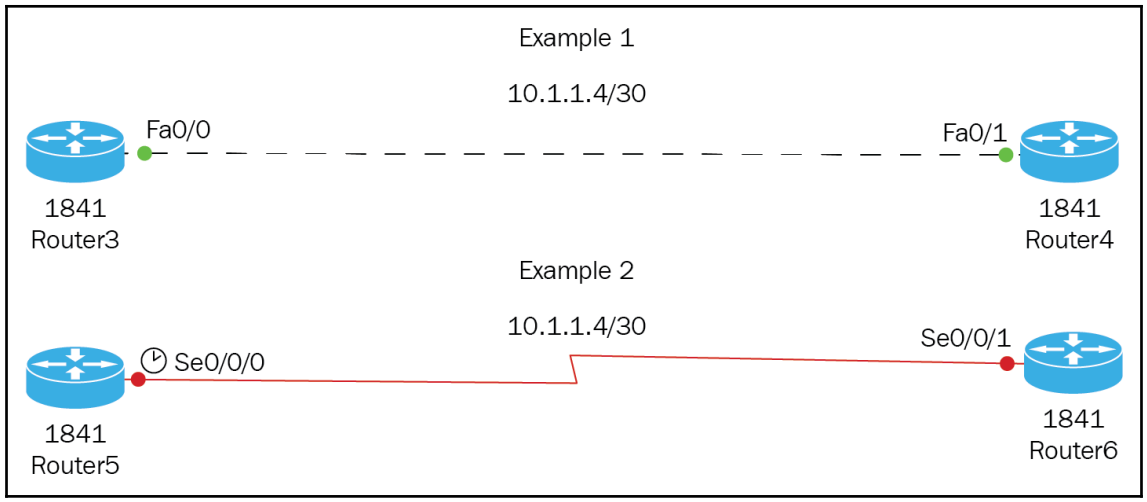
255.255.255.255 Constant
255.255.255.224 **Mask**
----------Subtract
0 0 0 31← This is your wildcard mask

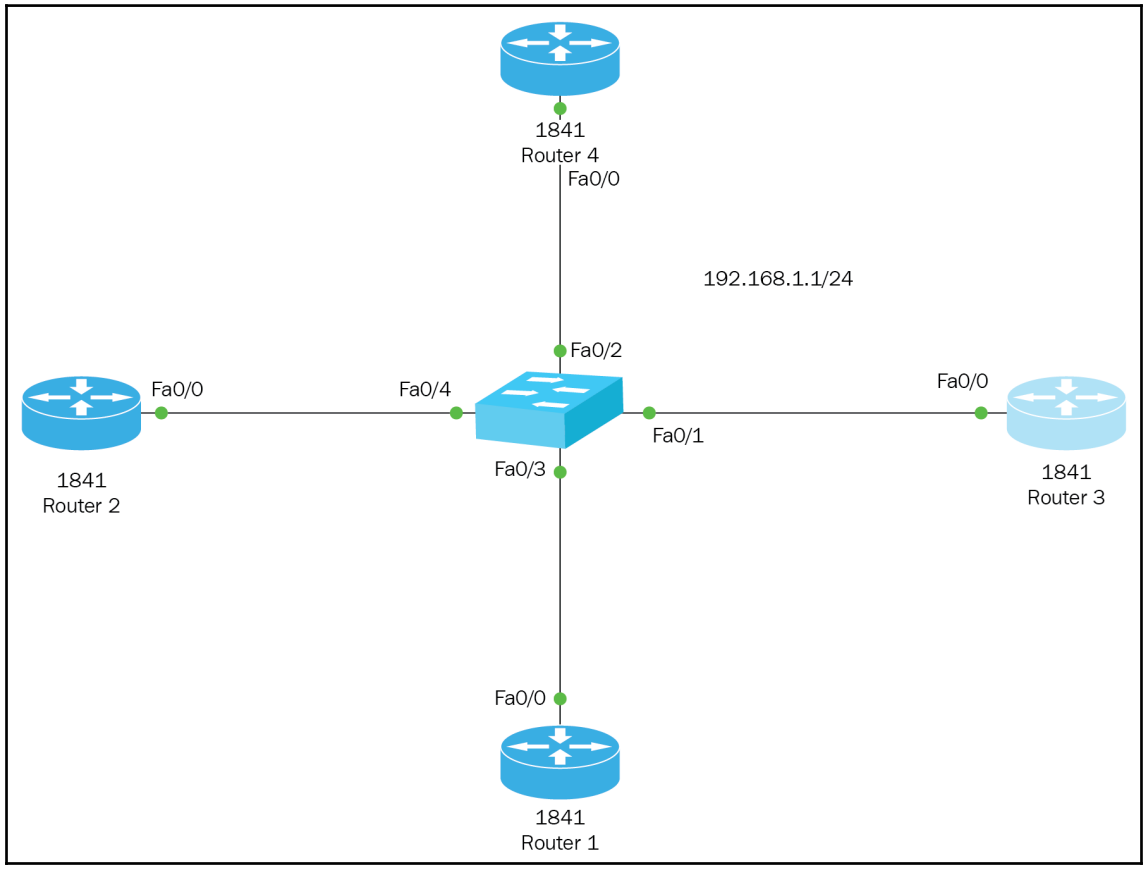
255.255.255.255 Constant
255.255.255.240 **Mask**
----------Subtract
0 0 0 15← This is your wildcard mask

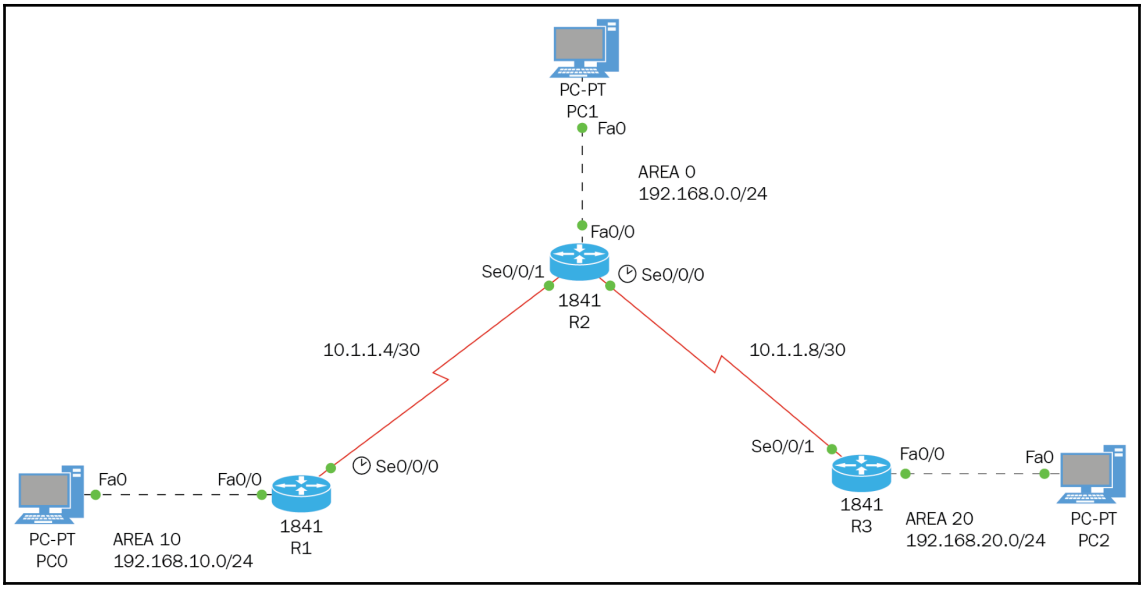
255.255.255.255 Constant
255.255.255.252 Mask
----------Subtract
0 0 0 3 ← this is your wildcard mask.


R1
Lo1
1.1.1.1/32
f0/0
10.1.1.4/30
R3
Lo3
3.3.3.3/32
f0/0
10.1.1.8/30
R2
f1/0
f1/1
Lo2
2.2.2.2/32

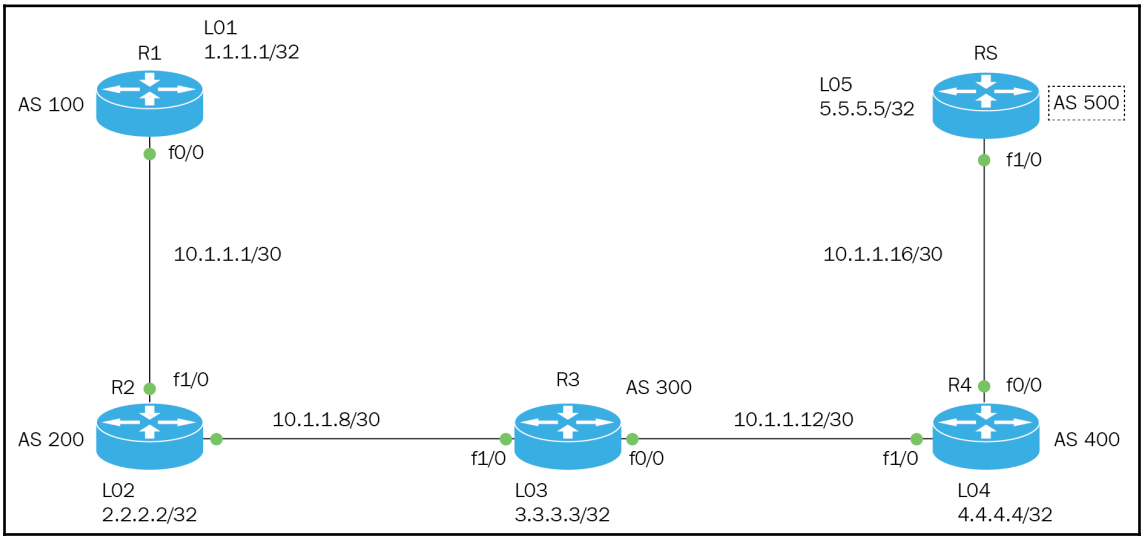

R4
g2/0
NON OSPF DOMAIN
EIGRP 100
192.168.1.0/24
g2/0
R1
Lo1
1.1.1.1/32
f0/0
10.1.1.4/30
R3
Lo3
3.3.3.3/32
f0/0
10.1.1.8/30
R2
f1/0
f1/1
Lo2
2.2.2.2/32

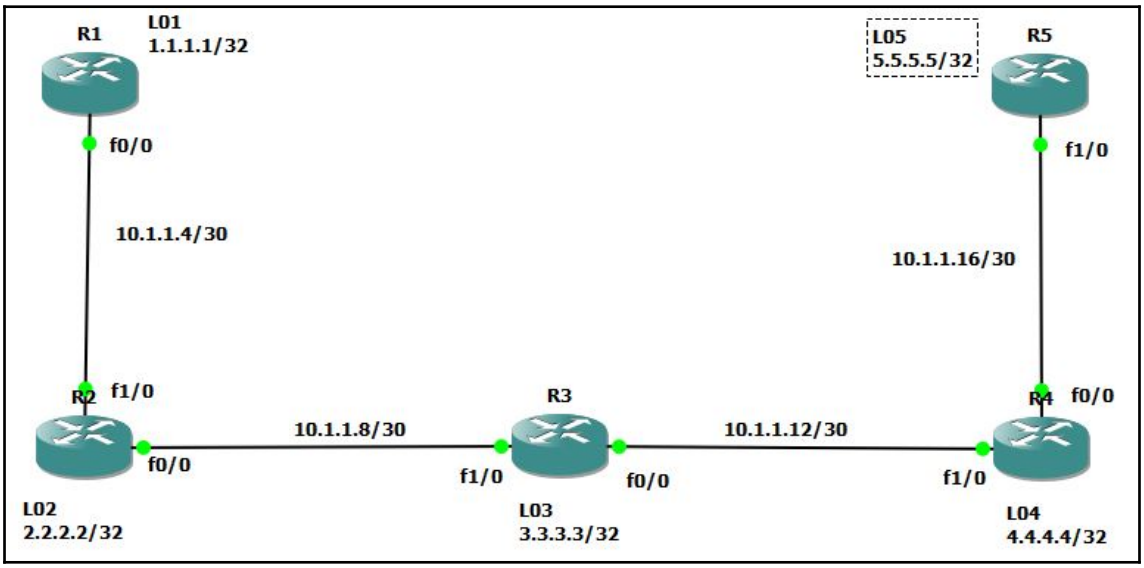

Example 1
10.1.1.4/30
Fa0/0
Fa0/1
1841
Router3
1841
Router4
Example 2
10.1.1.4/30
Se0/0/0
Se0/0/1
1841
Router5
1841
Router6


1841
Router 4
Fa0/0
192.168.1.1/24
Fa0/2
Fa0/0
Fa0/4
Fa0/0
Fa0/1
1841
Router 2
Fa0/3
1841
Router 3
Fa0/0
1841
Router 1

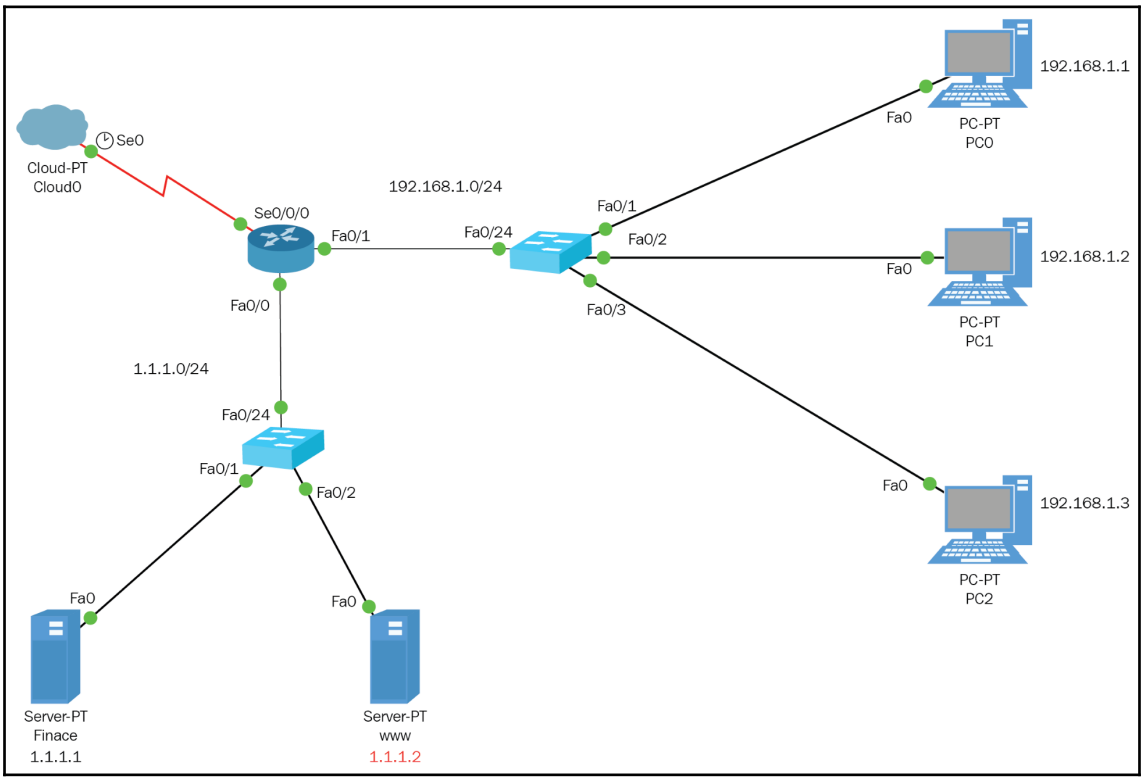

PC-PT
PC1
Fa0
AREA 0
192.168.0.0/24
Fa0/0
Se0/0/1
Se0/0/0
1841
R2
10.1.1.4/30
10.1.1.8/30
Se0/0/1
Fa0/0
Fa0
Fa0
Fa0/0
Se0/0/0
1841
R3
AREA 20
192.168.20.0/24
PC-PT
PC2
PC-PT
PC0
AREA 10
192.168.10.0/24
1841
R1

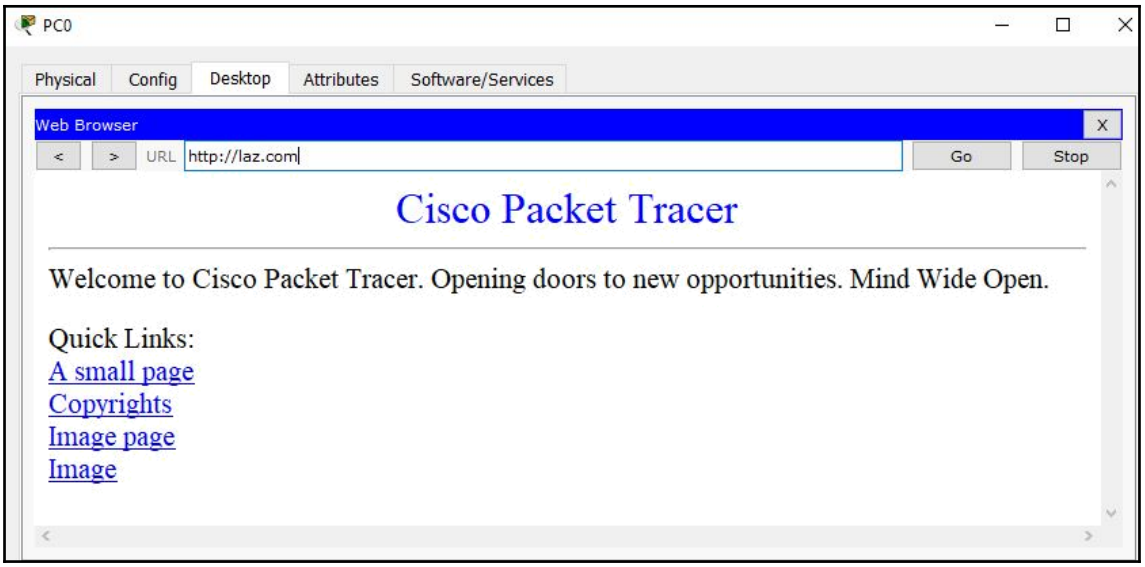
Chapter 16: Border Gateway Protocol

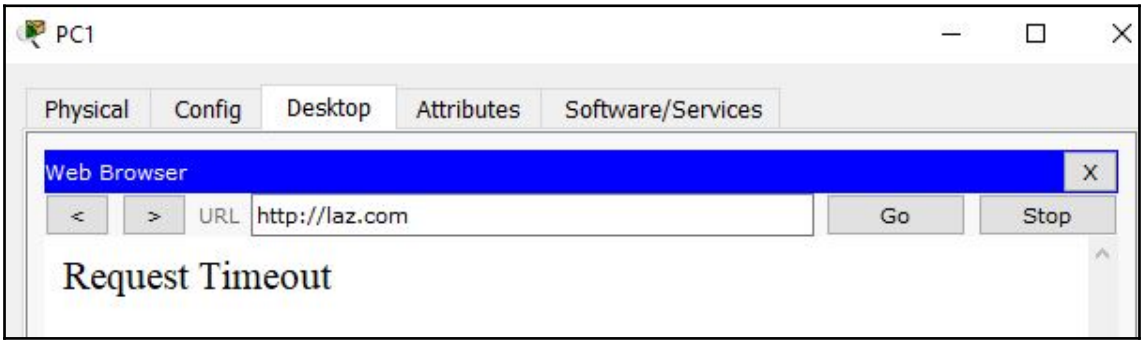




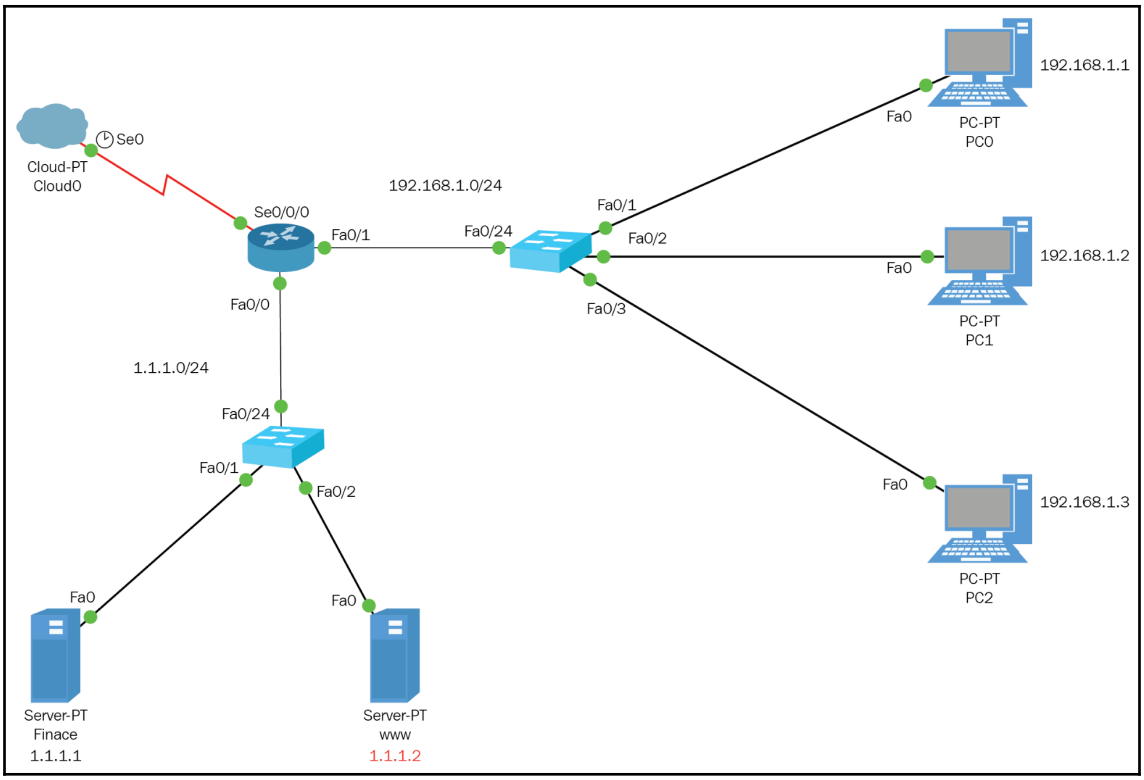
Chapter 17: Access-Control List



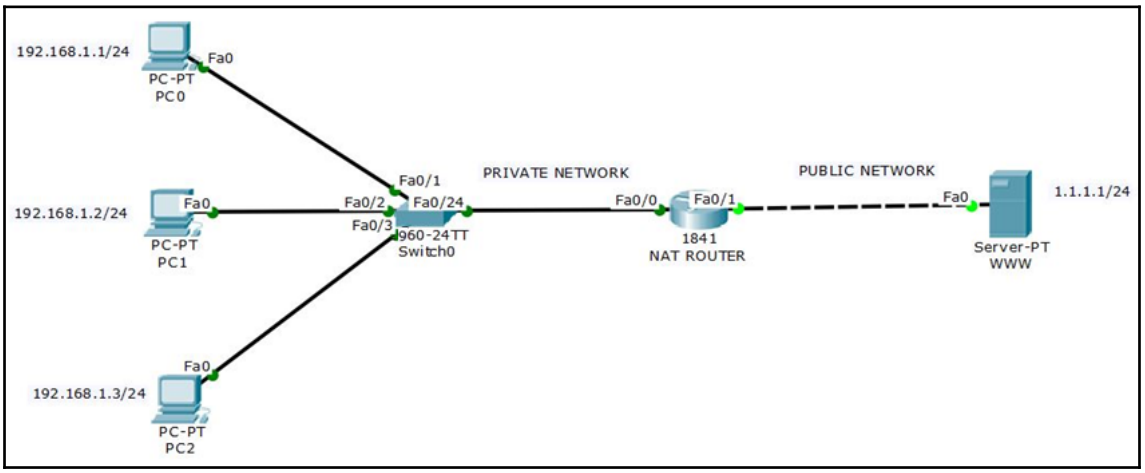





```
Packet Tracer PC Command Line 1.0
C:\>ping 1.1.1.2

Pinging 1.1.1.2 with 32 bytes of data:

Reply from 1.1.1.2: bytes=32 time=1ms TTL=127
Reply from 1.1.1.2: bytes=32 time<1ms TTL=127
Reply from 1.1.1.2: bytes=32 time<1ms TTL=127
Reply from 1.1.1.2: bytes=32 time<1ms TTL=127
```

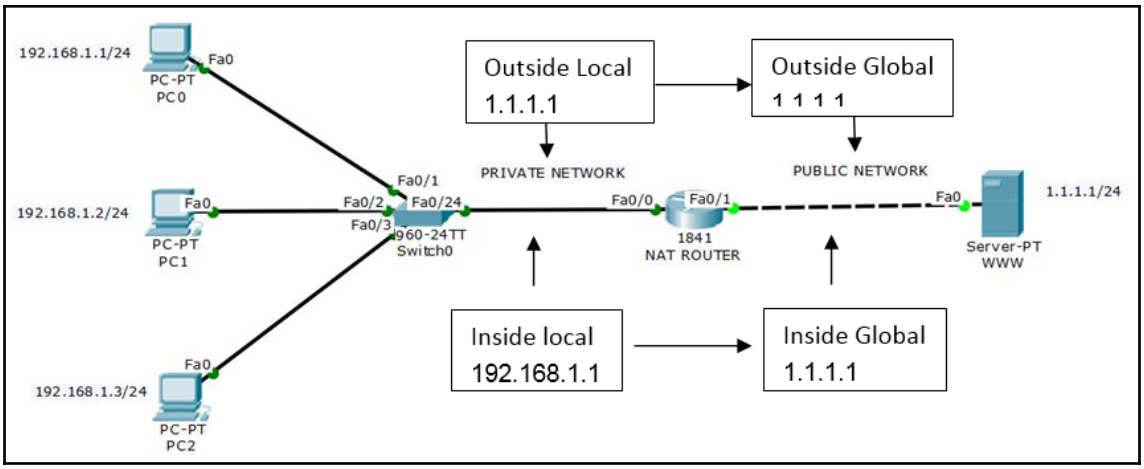

Cloud-PT
Cloud0
Se0
Se0/0/0
Fa0/1
192.168.1.0/24
Fa0/24
Fa0/1
Fa0/2
Fa0/3
Fa0/0
1.1.1.0/24
Fa0/24
Fa0/1
Fa0/2
Fa0
Fa0
Fa0
Fa0
Fa0
PC-PT
PC0
192.168.1.1
PC-PT
PC1
192.168.1.2
PC-PT
PC2
192.168.1.3
Server-PT
Finace
1.1.1.1
Server-PT
www
1.1.1.2

Chapter 18: Network Address Translation

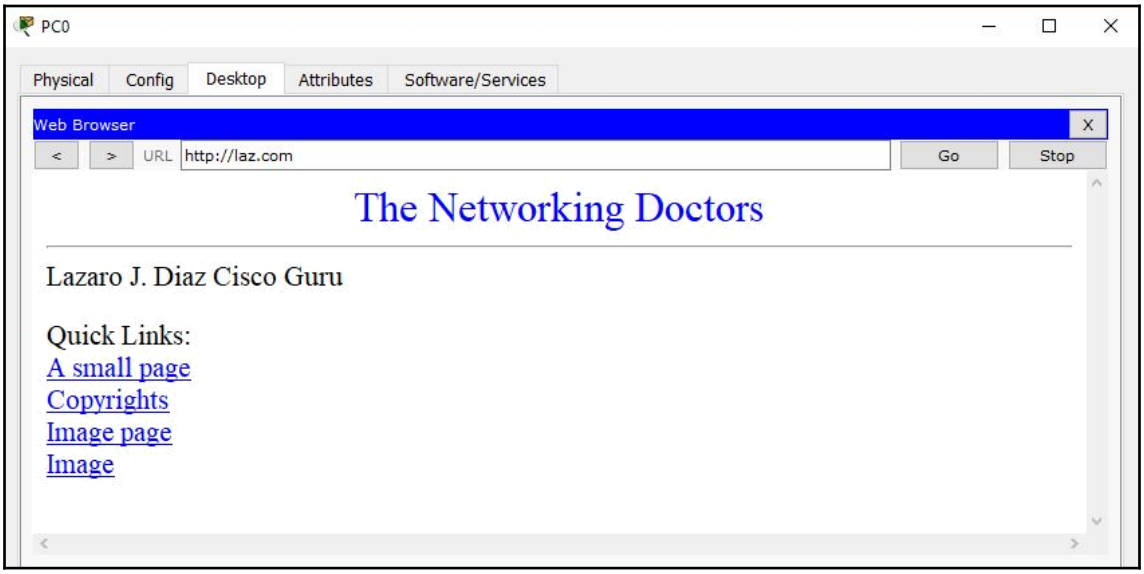


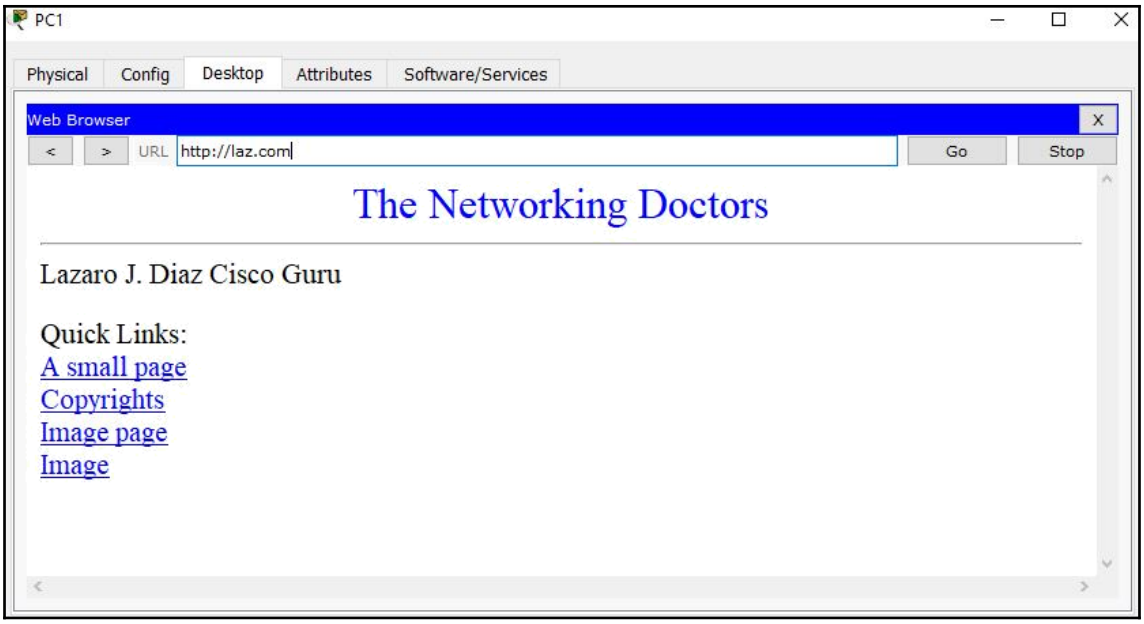

```
NAT_ROUTER(config)#int f0/0
NAT_ROUTER(config-if)#ip nat inside
NAT_ROUTER(config-if)#int f0/1
NAT_ROUTER(config-if)#ip nat outside

NAT_ROUTER(config)#ip nat pool DYNAMIC 1.1.2.1 1.1.3.254 Netmask 255.255.254.0
NAT_ROUTER(config)#access-list 10 permit 1.1.2.0 0.0.3.255
NAT_ROUTER(config)#ip nat inside source list 10 pool DYNAMIC
```

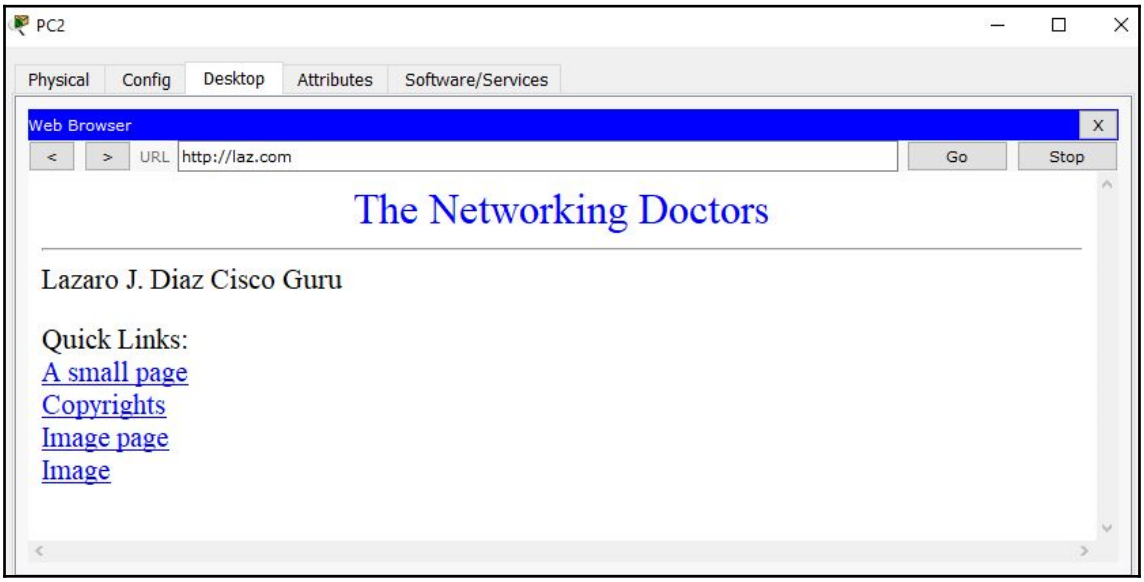
```
NAT_ROUTER(config)#int f0/0
NAT_ROUTER(config-if)#ip nat inside
NAT_ROUTER(config-if)#int f0/1
NAT_ROUTER(config-if)#ip nat outside

NAT_ROUTER(config)#ip nat pool LAZ 1.1.1.254 1.1.1.254 Netmask 255.255.255.0
NAT_ROUTER(config)#access-list 10 permit 192.168.1.0 0.0.0.255
NAT_ROUTER(config)#ip nat inside source list 10 pool LAZ overload
```




```
NAT_ROUTER(config)#int f0/0
NAT_ROUTER(config-if)#ip nat inside
NAT_ROUTER(config-if)#int f0/1
NAT_ROUTER(config-if)#exit
NAT_ROUTER(config)#ip nat pool laz 1.1.1.254 1.1.1.254 netmask 255.255.255.0
NAT_ROUTER(config)#access-list 30 permit 192.168.1.0 0.0.0.255
NAT_ROUTER(config)#ip nat inside source list 30 pool laz overload
NAT_ROUTER(config)#do wr
```



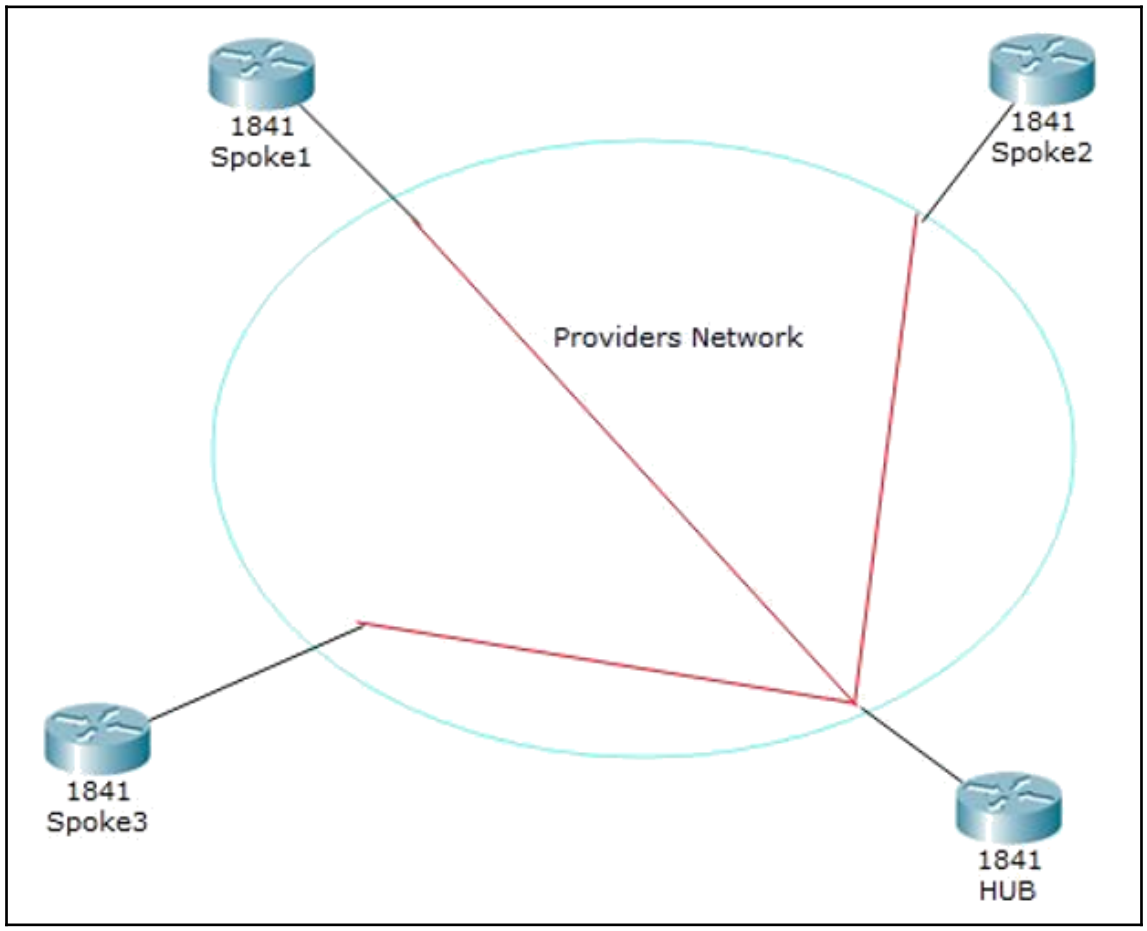

PC1
Physical
Config
Desktop
Attributes
Software/Services
Web Browser
URL
http://laz.com
Go
Stop
The Networking Doctors
Lazaro J. Diaz Cisco Guru
Quick Links:
A small page
Copyrights
Image page
Image

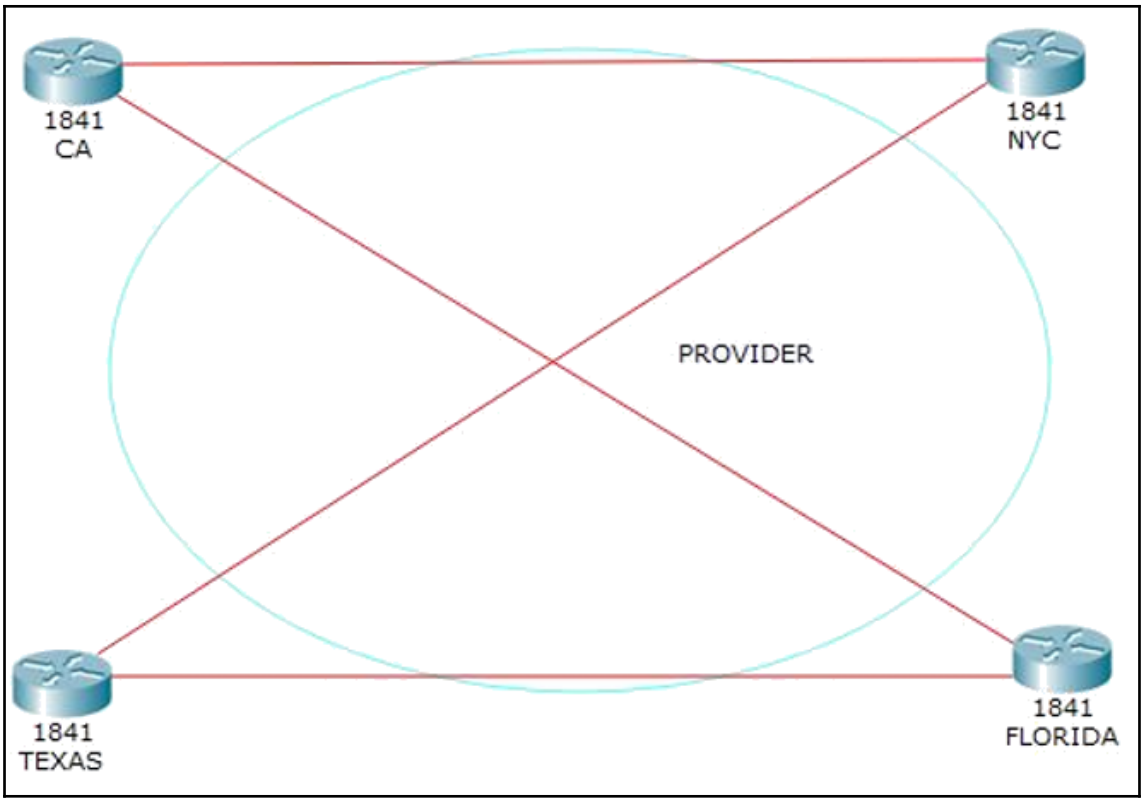

PC2
Physical
Config
Desktop
Attributes
Software/Services
Web Browser
URL
http://laz.com
Go
Stop
The Networking Doctors
Lazaro J. Diaz Cisco Guru
Quick Links:
A small page
Copyrights
Image page
Image

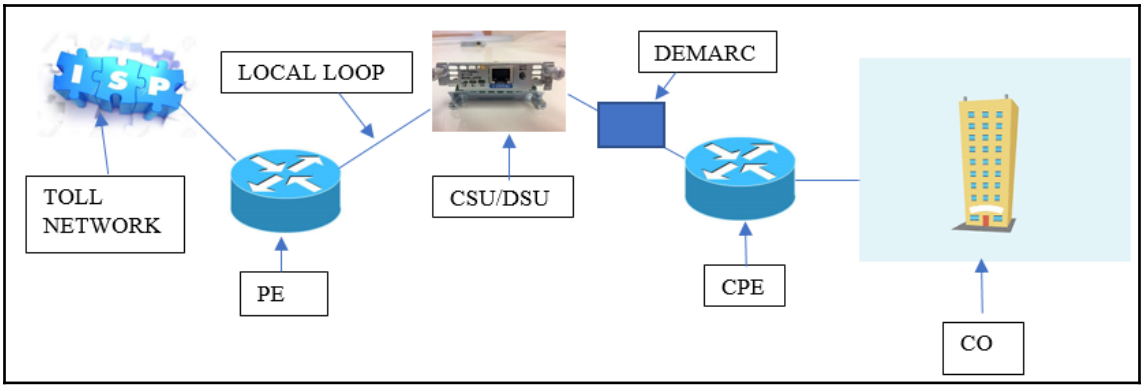
Pro	Inside global	Inside local	Outside local	Outside global
udp	1.1.1.254:1026	192.168.1.2:1026	1.1.1.1:53	1.1.1.1:53
udp	1.1.1.254:1027	192.168.1.1:1027	1.1.1.1:53	1.1.1.1:53
udp	1.1.1.254:1028	192.168.1.3:1028	1.1.1.1:53	1.1.1.1:53
tcp	1.1.1.254:1026	192.168.1.2:1026	1.1.1.1:80	1.1.1.1:80
tcp	1.1.1.254:1027	192.168.1.1:1027	1.1.1.1:80	1.1.1.1:80
tcp	1.1.1.254:1028	192.168.1.3:1028	1.1.1.1:80	1.1.1.1:80

```
NAT_ROUTER#debug ip nat

NAT_ROUTER#NAT: s=192.168.1.3->1.1.1.254, d=1.1.1.1 [98]

NAT_ROUTER#NAT*: s=1.1.1.1, d=1.1.1.254->192.168.1.3 [96]

NAT_ROUTER#NAT: s=192.168.1.3->1.1.1.254, d=1.1.1.1 [99]

NAT_ROUTER#NAT*: s=1.1.1.1, d=1.1.1.254->192.168.1.3 [97]

NAT_ROUTER#NAT: s=192.168.1.3->1.1.1.254, d=1.1.1.1 [100]
NAT_ROUTER#NAT: s=192.168.1.3->1.1.1.254, d=1.1.1.1 [98]

NAT_ROUTER#NAT*: s=1.1.1.1, d=1.1.1.254->192.168.1.3 [96]
```

Chapter 19: Wide Area Networks

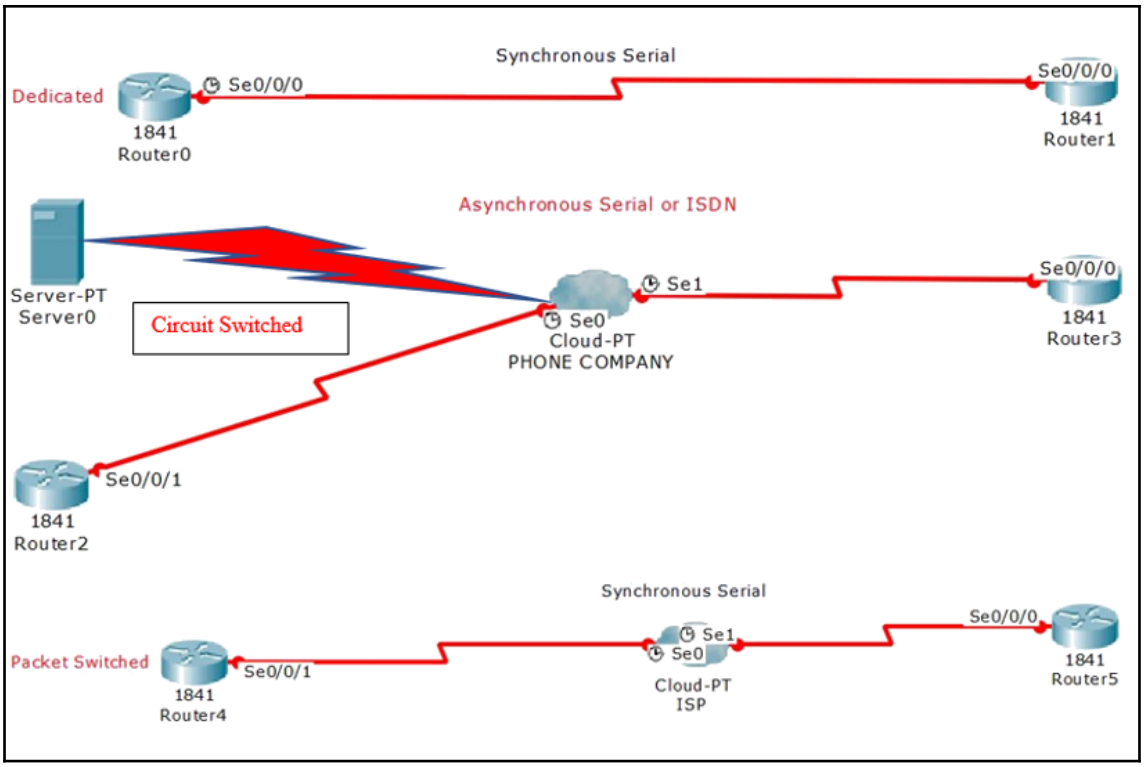


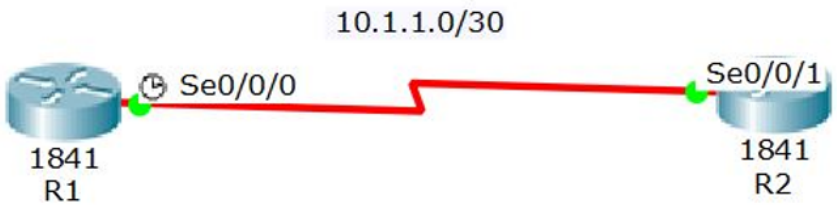

1841
CA
1841
NYC
PROVIDER
1841
TEXAS
1841
FLORIDA


LOCAL LOOP
DEMARC
TOLL
NETWORK
CSU/DSU
PE
CPE
CO

Term	Definition
CPE or Customer Premises Equipment	This is your router, the equipment in your company.
CSU/DSU Channel Service Unit/Data Service Unit	This provides the clocking of the line to the router. This connects to the serial of your router, there are several types of CSU/DSU you can use, but in todays network, we use Ethernet, and this has become obsolete. Keep in mind that for the CCNA certification is still in used, all you need to know if you don't have a clock rate on the DCE portion of your cable, you will not connect to your neighbor router. You will be getting Layer 2 errors such as, line is up down, encapsulation errors, synchronization errors also. Certification only. All routers are DTE
DCE	Data Communication interface on the router, where you would put the clock rate on, if using crossover serial cable.
DTE	Data Terminal Equipment interface on the router, no clocking needed. All devices are DTE, that is why clocking was needed to either an internal or external CSU/DSU was needed. That is not the case now.
Demarcation Point	This is where the provider connects to and there responsibility ends and yours begins.
Local Loop	This connects the closest switching office, which is your provider.
Toll Network	This is a trunk line inside the WAN providers network. Anytime you see a cloud image that is the WAN providers network, which is a collection of routers,
	switches and other networking equipment. All of this is owned by the ISP.
Optical Fiber Converters	This connects to the demarcation point, which will convert optical signals to electrical signals. But again, today we have the capability of running Fiber straight into your home. Routers/Modems have the technology to the conversion of those signals.

Line	Bandwidth
DS0 Digital Signal 0	64Kbps
T1 or DS1	24 DS0 gives you 1.544Mbps
E1 same as T1 but in Europe	30 DS0 gives you 2.048Mbps
T3 or DS3	28 DS1 or 672 DS0 44.736Mbps
OC-3 Optical Carrier	3 DS3 or 2,016 DS0 155.52Mbps
OC-12	4 OC3 8,064 DS0 622.08Mbps
OC-48	4 OC12 32,256 DS0 2488.32Mbps
OC-192	4 OC48 129,024 DS0 9,953.28Mbps
Metro Ethernet (Todays technology)	10Gbits, 40Gbits, 100Gbits, 400Gbits or 400Gbps


Synchronous Serial
Dedicated
Se0/0/0
1841
Router0
Se0/0/0
1841
Router1
Asynchronous Serial or ISDN
Server-PT
Server0
Circuit Switched
Se1
Se0
Cloud-PT
PHONE COMPANY
Se0/0/0
1841
Router3
Se0/0/1
1841
Router2
Synchronous Serial
Packet Switched
1841
Router4
Se0/0/1
Se1
Se0
Cloud-PT
ISP
Se0/0/0
1841
Router5

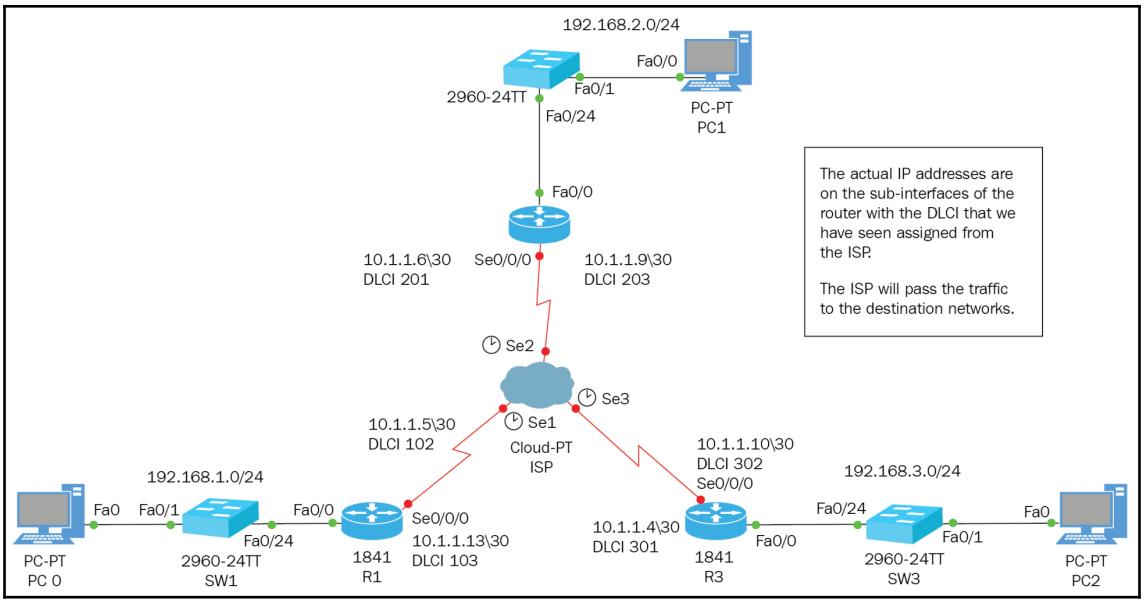


R1#SH INT S0/0/0
Serial0/0/0 is up, line protocol is up (connected)
Hardware is HD64570
Internet address is 10.1.1.5/30
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set, keepalive set (10 sec

R2#SH INT S0/0/1
Serial0/0/1 is up, line protocol is up (connected)
Hardware is HD64570
Internet address is 10.1.1.6/30
MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec,
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation HDLC, loopback not set, keepalive set (10 sec)

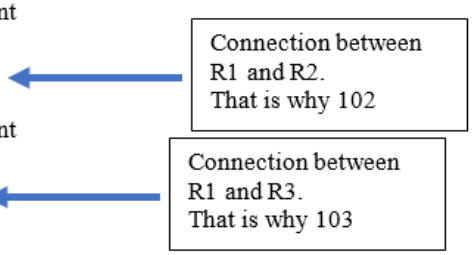
R1(config)#int s0/0/0
R1(config-if)#encap ppp
R1(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to down
R1(config-if)#ppp authentication chap pap

R2(config)#int s0/0/1
R2(config-if)#encap ppp
R2(config-if)#ppp authentication chap pap
R2(config-if)#username R1 password cisco
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1,


192.168.2.0/24
Fa0/0
2960-24TT
Fa0/1
PC-PT
PC1
Fa0/24
Fa0/0
10.1.1.6\30
DLCI 201
Se0/0/0
10.1.1.9\30
DLCI 203
The actual IP addresses are on the sub-interfaces of the router with the DLCI that we have seen assigned from the ISP.
The ISP will pass the traffic to the destination networks.
Se2
Se3
Se1
10.1.1.5\30
DLCI 102
Cloud-PT
ISP
10.1.1.10\30
DLCI 302
Se0/0/0
192.168.1.0/24
192.168.3.0/24
Fa0
Fa0/1
Fa0/0
Fa0/24
Se0/0/0
10.1.1.13\30
DLCI 103
10.1.1.4\30
DLCI 301
Fa0/24
Fa0
Fa0/0
Fa0/1
PC-PT
PC 0
2960-24TT
SW1
1841
R1
1841
R3
2960-24TT
SW3
PC-PT
PC2

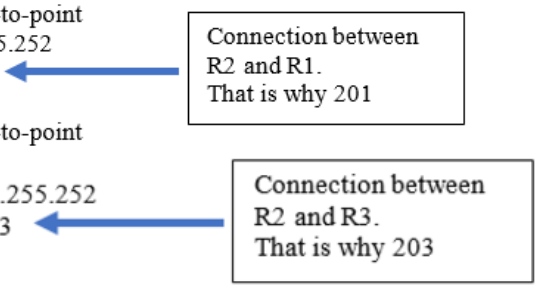
R1

```
interface Serial0/0/0
no ip address
no shut
encapsulation frame-relay

interface Serial0/0/0.102 point-to-point
ip address 10.1.1.5 255.255.255.252
frame-relay interface-dlci 102

interface Serial0/0/0.103 point-to-point
ip address 10.1.1.13 255.255.255.252
frame-relay interface-dlci 103
```



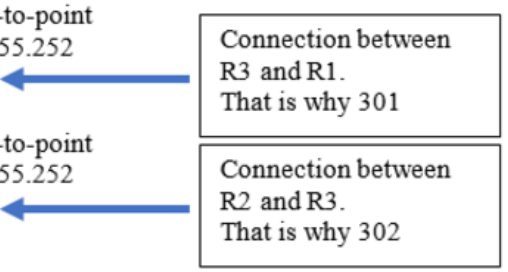
R2

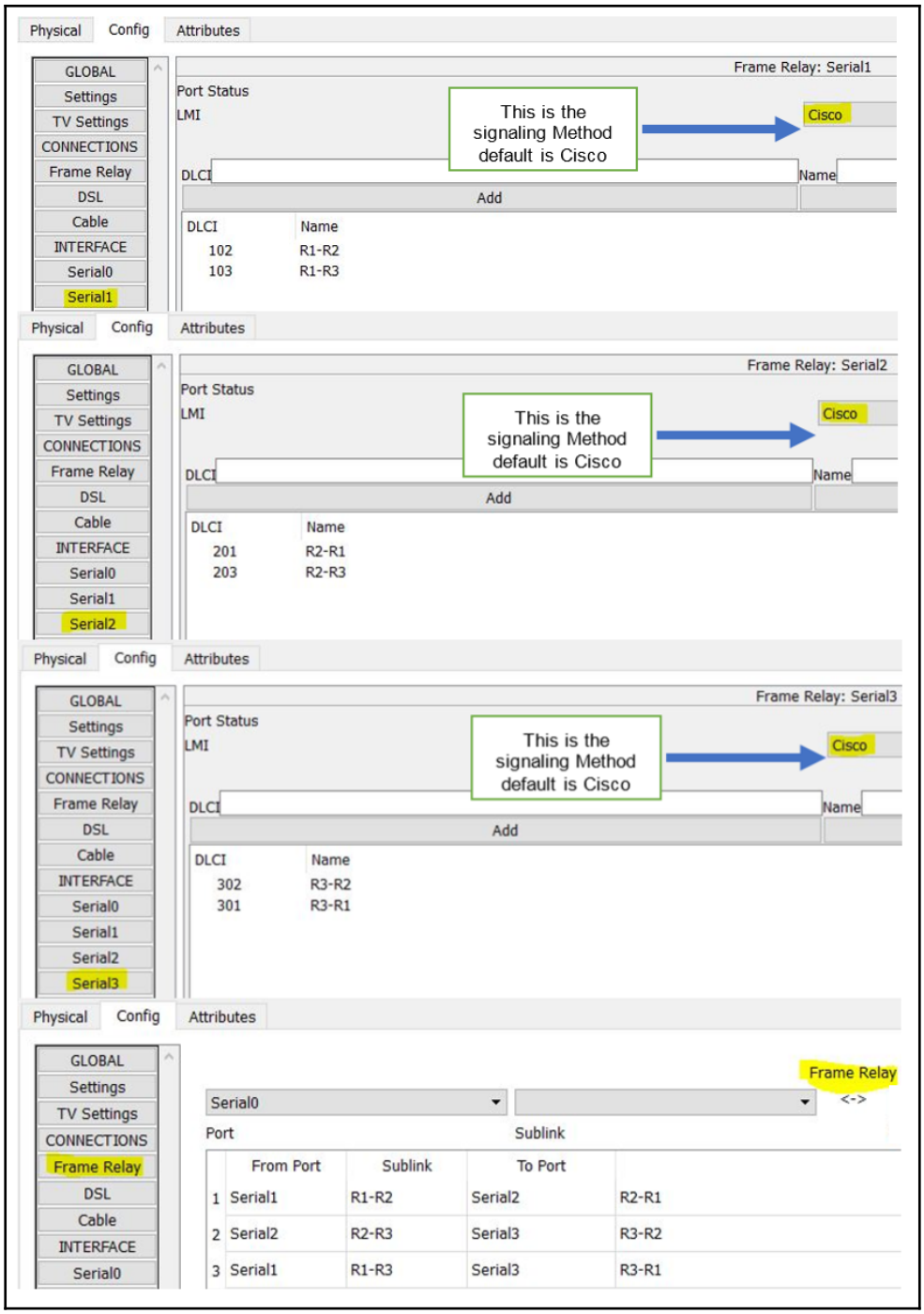
```
interface Serial0/0/0
no ip address
no shut
encapsulation frame-relay

interface Serial0/0/0.201 point-to-point
ip address 10.1.1.6 255.255.255.252
frame-relay interface-dlci 201

interface Serial0/0/0.203 point-to-point

ip address 10.1.1.13 255.255.255.252
frame-relay interface-dlci 203
```



R3

```
interface Serial0/0/0
no ip address
no shut
encapsulation frame-relay

interface Serial0/0/0.301 point-to-point
ip address 10.1.1.14 255.255.255.252
frame-relay interface-dlci 301

interface Serial0/0/0.302 point-to-point
ip address 10.1.1.10 255.255.255.252
frame-relay interface-dlci 302
```

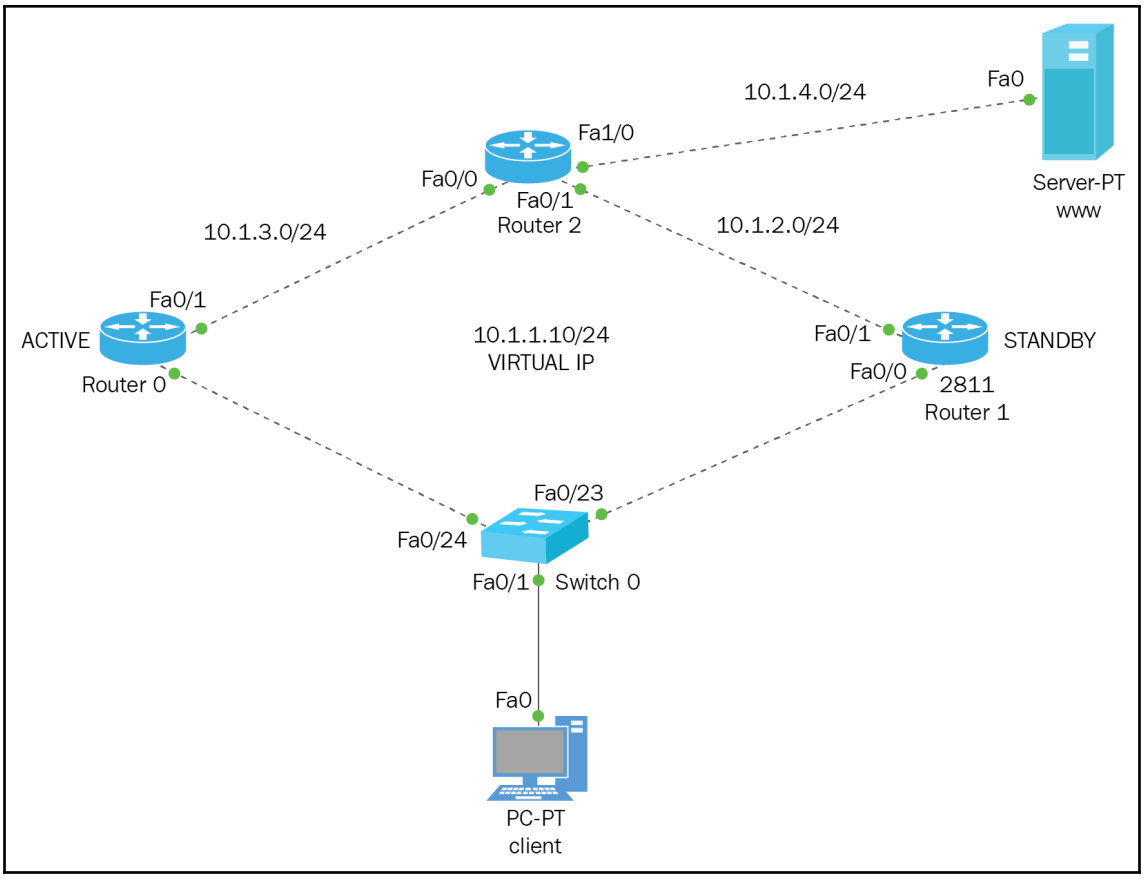



Physical
Config
Attributes
GLOBAL
Settings
TV Settings
CONNECTIONS
Frame Relay
DSL
Cable
INTERFACE
Serial0
Serial1
Frame Relay: Serial1
Port Status
LMI
This is the signaling Method default is Cisco
Cisco
DLCI
Name
Add
DLCI
Name
102
R1-R2
103
R1-R3
Physical
Config
Attributes
GLOBAL
Settings
TV Settings
CONNECTIONS
Frame Relay
DSL
Cable
INTERFACE
Serial0
Serial1
Serial2
Frame Relay: Serial2
Port Status
LMI
This is the signaling Method default is Cisco
Cisco
DLCI
Name
Add
DLCI
Name
201
R2-R1
203
R2-R3
Physical
Config
Attributes
GLOBAL
Settings
TV Settings
CONNECTIONS
Frame Relay
DSL
Cable
INTERFACE
Serial0
Serial1
Serial2
Serial3
Frame Relay: Serial3
Port Status
LMI
This is the signaling Method default is Cisco
Cisco
DLCI
Name
Add
DLCI
Name
302
R3-R2
301
R3-R1
Physical
Config
Attributes
GLOBAL
Settings
TV Settings
CONNECTIONS
Frame Relay
DSL
Cable
INTERFACE
Serial0
Frame Relay
Serial0
<->
Port
Sublink
From Port
Sublink
To Port
1 Serial1 R1-R2 Serial2 R2-R1
2 Serial2 R2-R3 Serial3 R3-R2
3 Serial1 R1-R3 Serial3 R3-R1

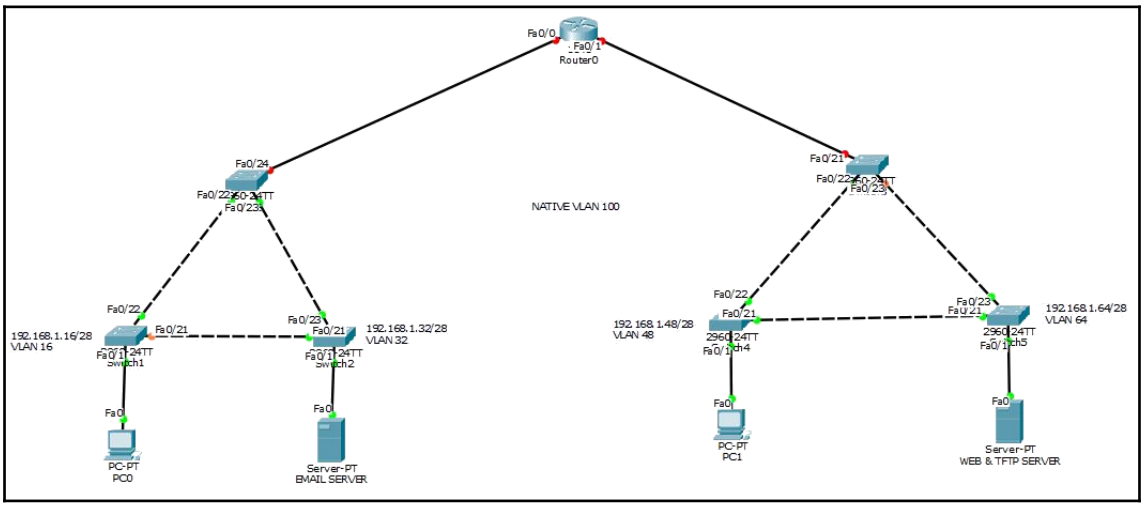
```
R1(config)#int tunnel 0
R1(config-if)#
*Oct 24 04:25:41.799: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Tunnel0, changed state to down
R1(config-if)#tunnel mode gre ip
R1(config-if)#ip address 172.16.1.1 255.255.255.0
R1(config-if)#tunnel source 10.1.1.1
R1(config-if)#tunnel destination 10.1.1.2
R1(config-if)#

*Oct 24 04:28:18.827: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Tunnel0, changed state to up


R2(config)#int tunnel 0
R2(config-if)#ip address
*Oct 24 04:29:55.431: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Tunnel0, changed state to down
R2(config-if)#ip address 172.16.1.2 255.255.255.0
R2(config-if)#tunnel mode gre ip
R2(config-if)#tunnel source 10.1.1.2
R2(config-if)#tunnel destination 10.1.1.1
R2(config-if)#
*Oct 24 04:31:14.759: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Tunnel0, changed state to up
```

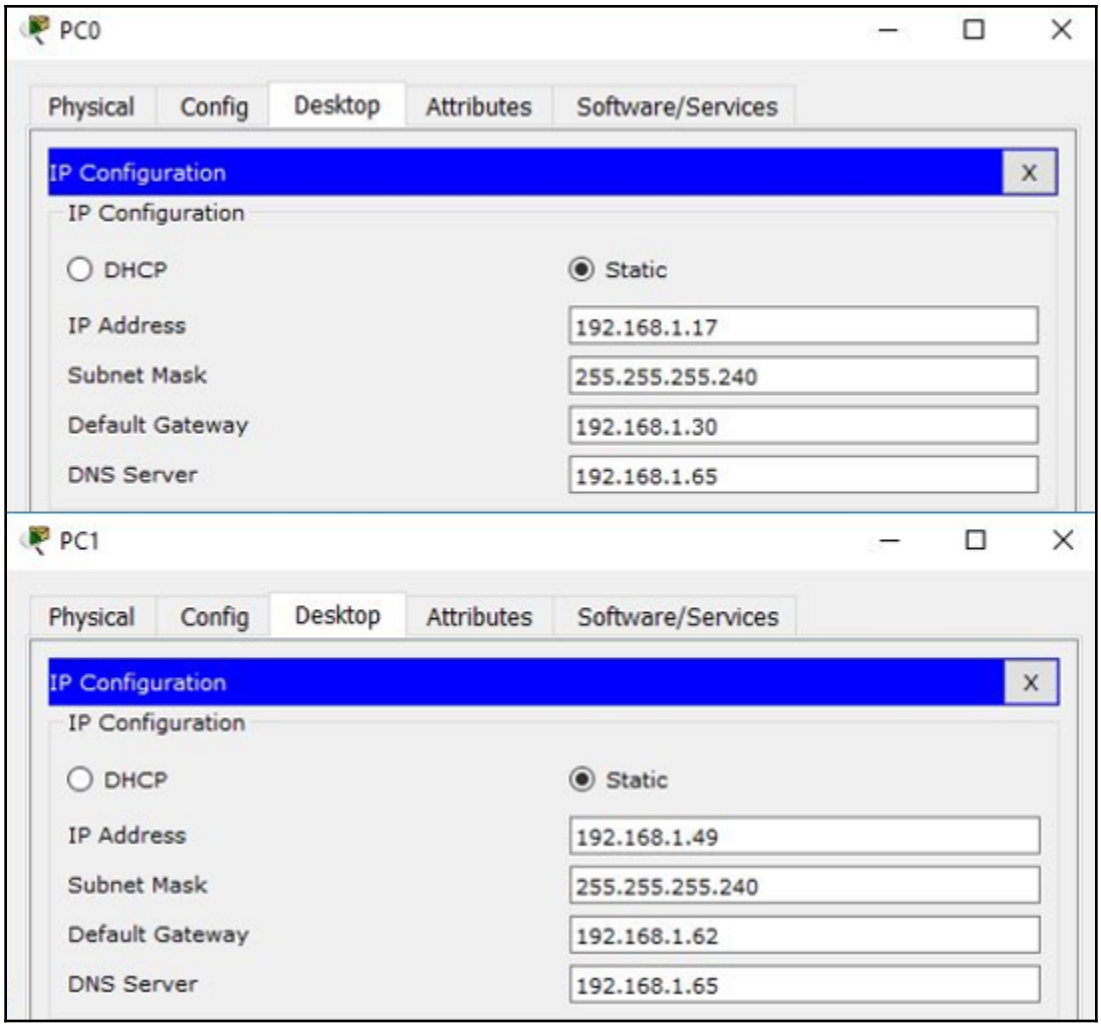
Tunnel IP

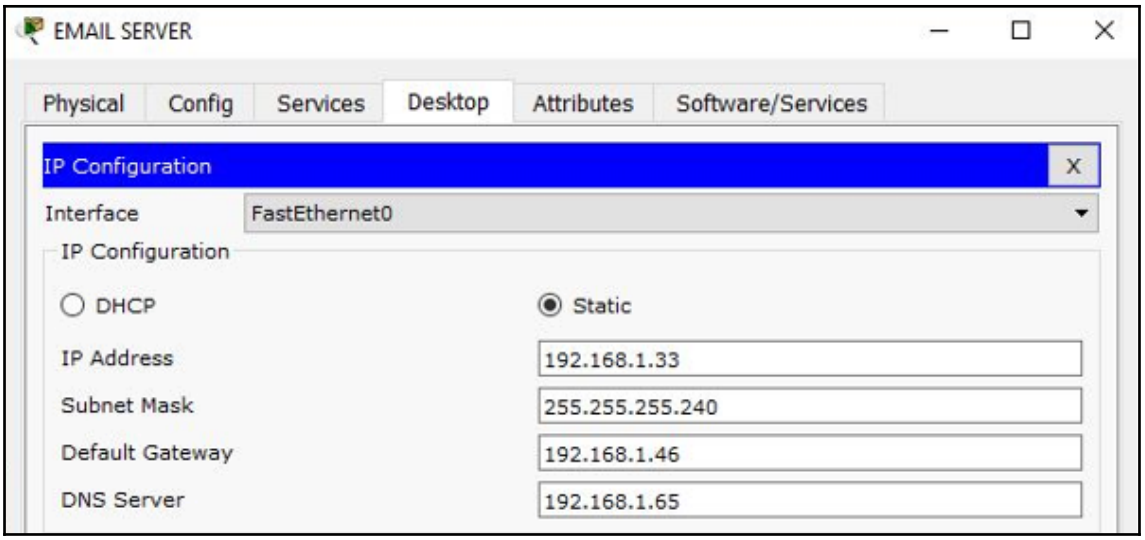
Actual IP address on Physical interface

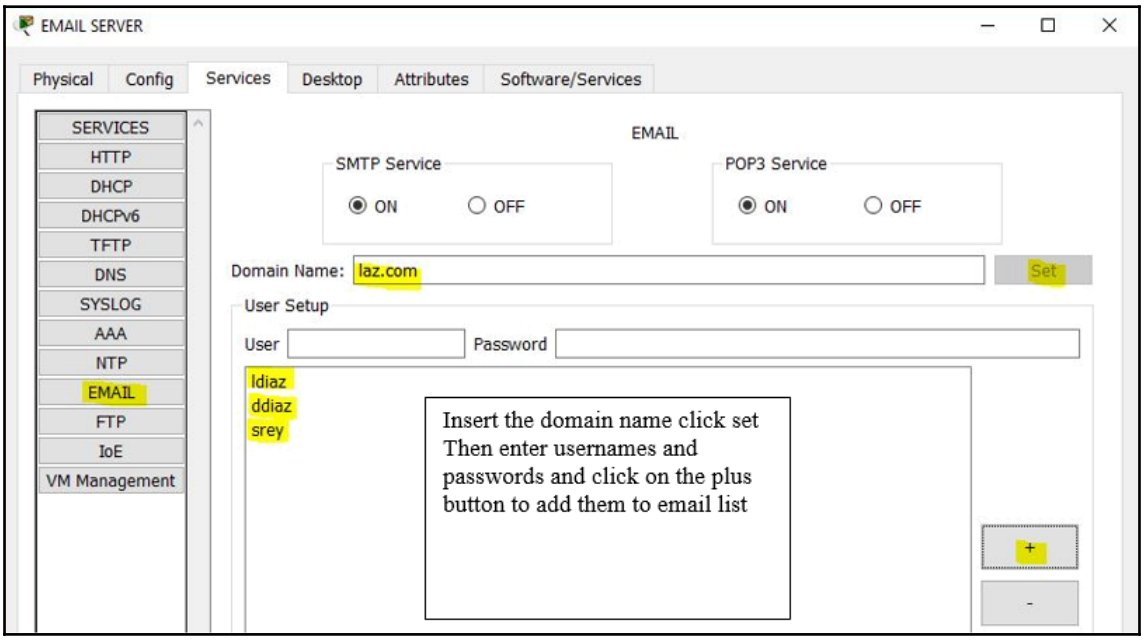

10.1.4.0/24
Fa0
Fa1/0
Fa0/0
Fa0/1
Router 2
Server-PT
www
10.1.3.0/24
10.1.2.0/24
Fa0/1
ACTIVE
Router 0
10.1.1.10/24
VIRTUAL IP
Fa0/1
STANDBY
Fa0/0
2811
Router 1
Fa0/23
Fa0/24
Fa0/1
Switch 0
Fa0
PC-PT
client

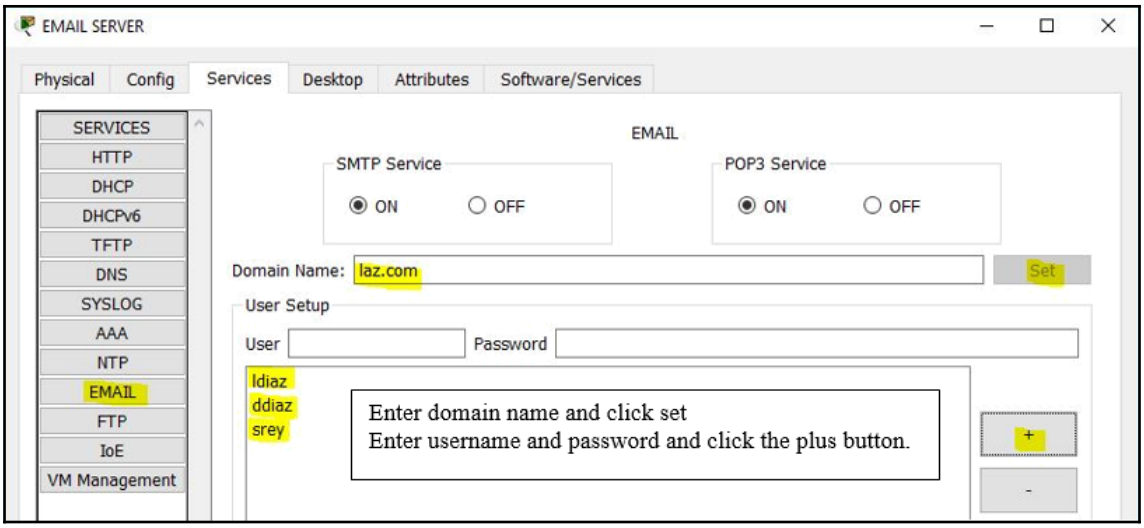
Chapter 20: Advanced Networking Topics

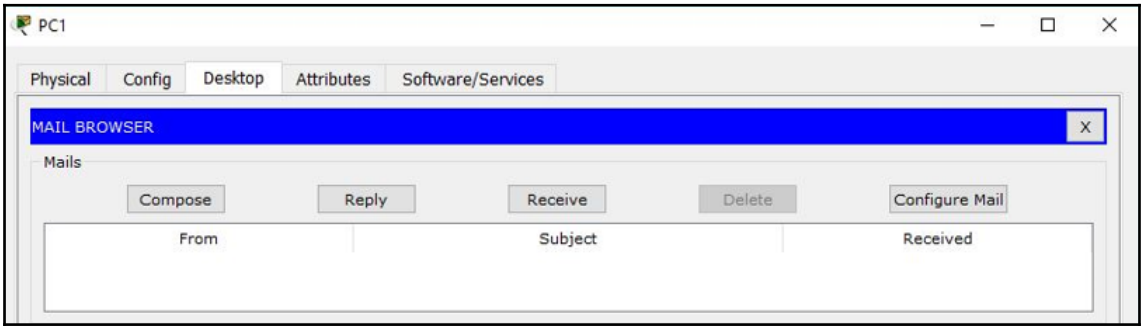


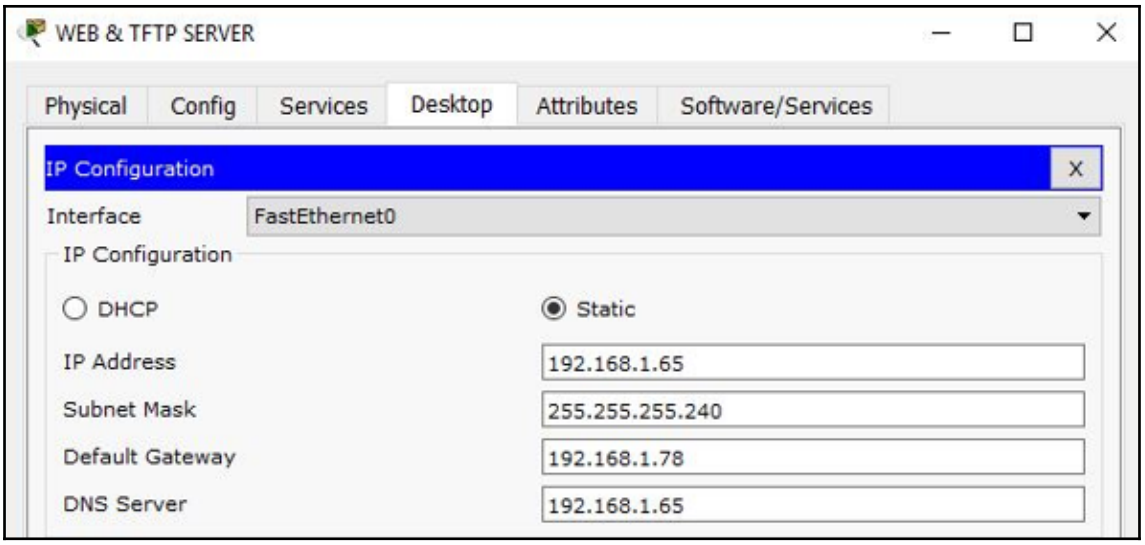

PC0
Physical
Config
Desktop
Attributes
Software/Services
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.1.17
Subnet Mask
255.255.255.240
Default Gateway
192.168.1.30
DNS Server
192.168.1.65
PC1
Physical
Config
Desktop
Attributes
Software/Services
IP Configuration
IP Configuration
DHCP
Static
IP Address
192.168.1.49
Subnet Mask
255.255.255.240
Default Gateway
192.168.1.62
DNS Server
192.168.1.65

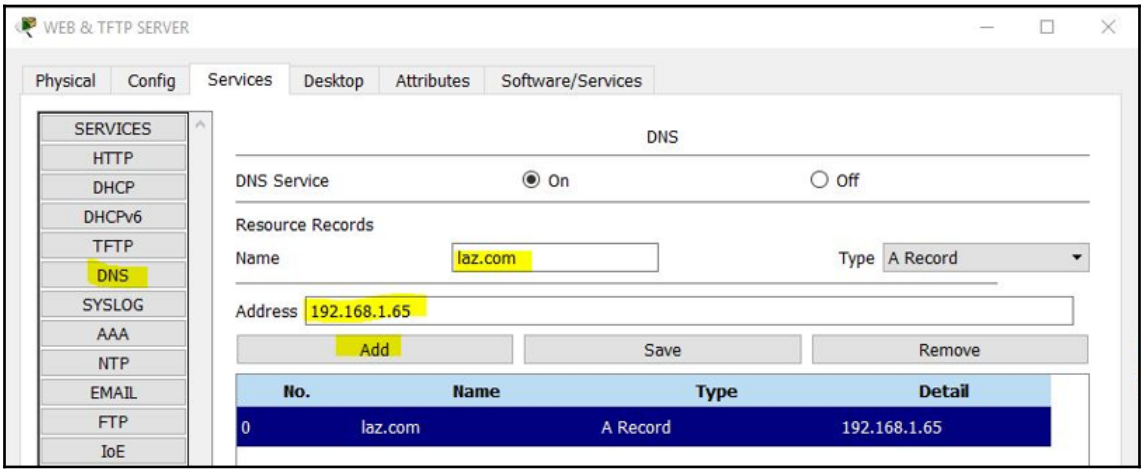

EMAIL SERVER
Physical
Config
Services
Desktop
Attributes
Software/Services
IP Configuration
X
Interface
FastEthernet0
IP Configuration
DHCP
Static
IP Address
192.168.1.33
Subnet Mask
255.255.255.240
Default Gateway
192.168.1.46
DNS Server
192.168.1.65


EMAIL SERVER
Physical
Config
Services
Desktop
Attributes
Software/Services
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
IoE
VM Management
EMAIL
SMTP Service
ON
OFF
POP3 Service
ON
OFF
Domain Name:
laz.com
Set
User Setup
User
Password
ldiaz
ddiaz
srey
Insert the domain name click set
Then enter usernames and
passwords and click on the plus
button to add them to email list
+
-


EMAIL SERVER
Physical
Config
Services
Desktop
Attributes
Software/Services
SERVICES
HTTP
DHCP
DHCPv6
TFTP
DNS
SYSLOG
AAA
NTP
EMAIL
FTP
IoE
VM Management
EMAIL
SMTP Service
ON
OFF
POP3 Service
ON
OFF
Domain Name:
laz.com
Set
User Setup
User
Password
ldiaz
ddiaz
srey
Enter domain name and click set
Enter username and password and click the plus button.
+
-


PC1
Physical
Config
Desktop
Attributes
Software/Services
MAIL BROWSER
Mails
Compose
Reply
Receive
Delete
Configure Mail
From
Subject
Received





Spanning-Tree Protocol Types

Protocol	Standard body	Number of Instances
STP/CST (Common STP)	802.1D	1
PVST+	Cisco	One for every VLAN
RSTP	802.1W	1
Rapid PVST+	Cisco	One for every VLAN

```
CORE1#SH VTP STATUS
VTP Version                     : 2
Configuration Revision          : 6
Maximum VLANs supported locally : 255
Number of existing VLANs        : 8
VTP Operating Mode              : Server
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x34 0x62 0x6F 0x28 0x72 0x57 0x38 0x50
Configuration last modified by 0.0.0.0 at 3-2-93 17:41:34
Local updater ID is 0.0.0.0 (no valid interface found
```

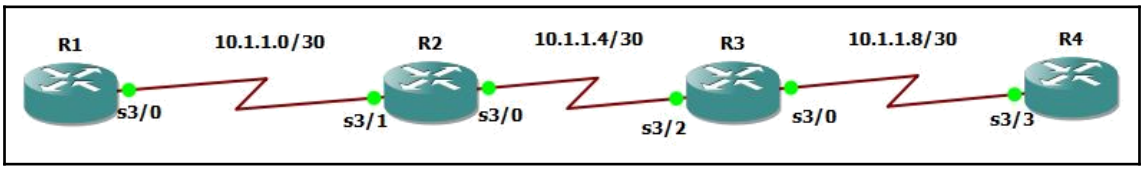
Command to see VTP

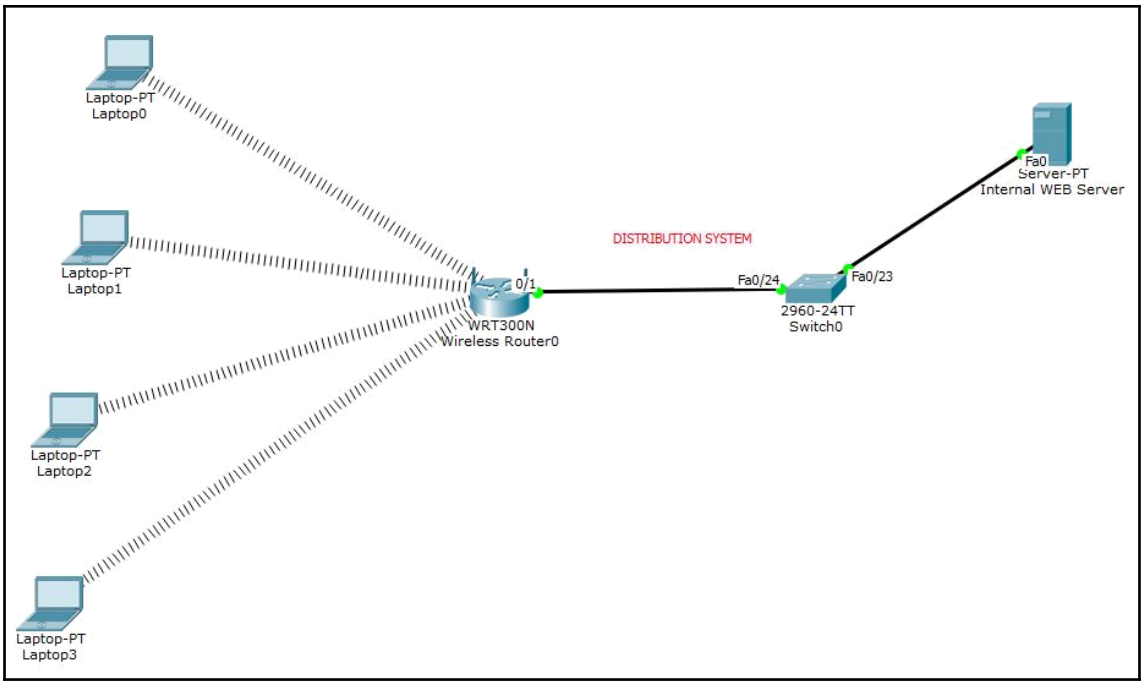
The higher the number, the most current information

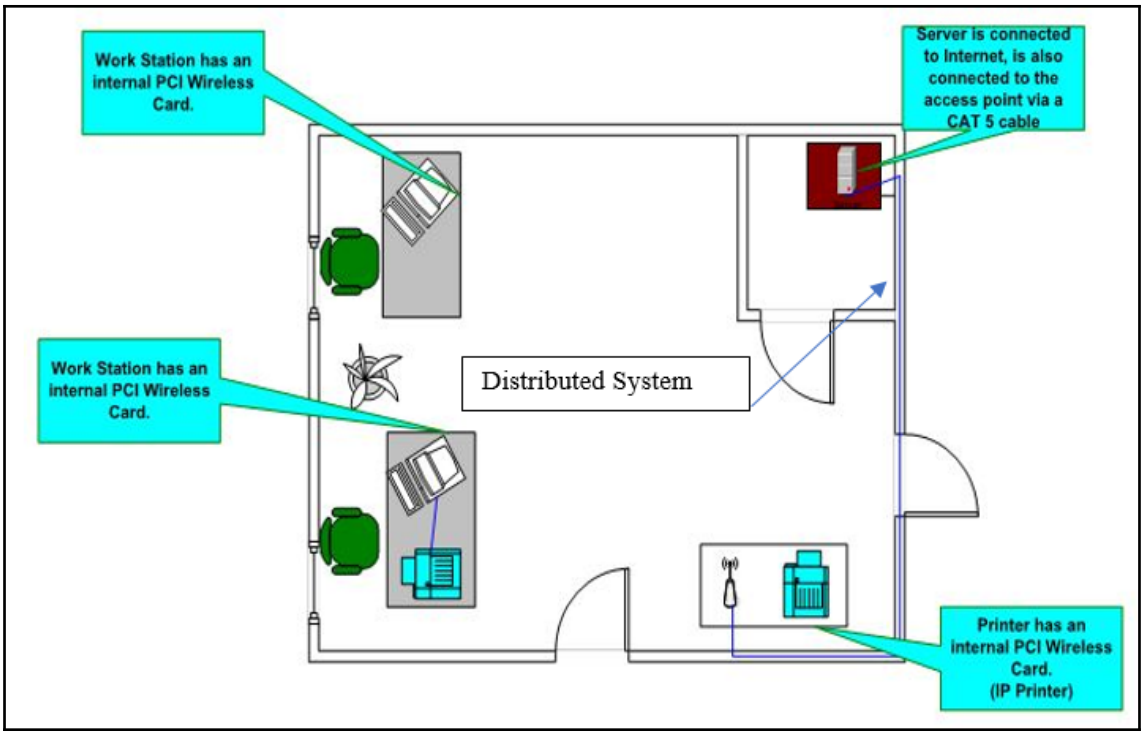
Default on all Catalyst switch

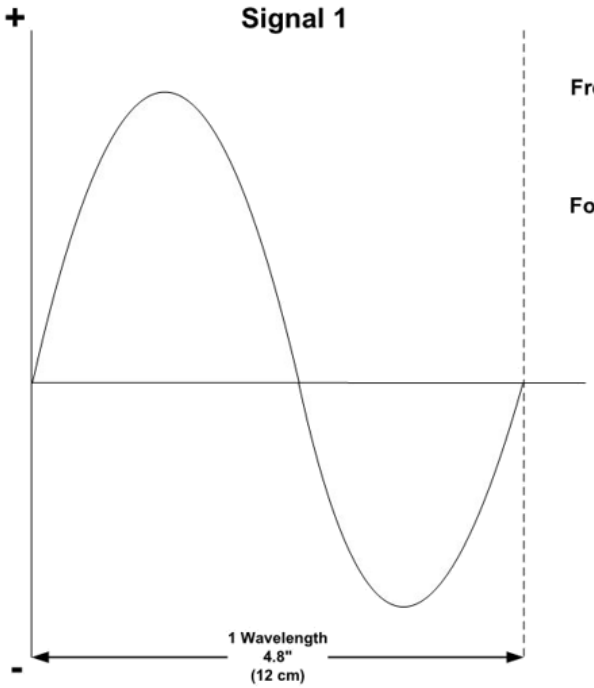
Optional for security reasons

The IP address of the last device that just update your configuration. Very important that you pay attention to this entire output, but specifically the highlighted portion




Laptop-PT
Laptop0
Laptop-PT
Laptop1
Laptop-PT
Laptop2
Laptop-PT
Laptop3
0/1
WRT300N
Wireless Router0
DISTRIBUTION SYSTEM
Fa0/24
Fa0/23
2960-24TT
Switch0
Fa0
Server-PT
Internal WEB Server


Work Station has an internal PCI Wireless Card.
Server is connected to Internet, is also connected to the access point via a CAT 5 cable
Work Station has an internal PCI Wireless Card.
Distributed System
Printer has an internal PCI Wireless Card. (IP Printer)



Signal 1

Frequency = 2,450,000,000 CPS (2450 MHz)
Wavelength = 4.8 inches (12 cm)

Formula To calculate distance of a wavelength

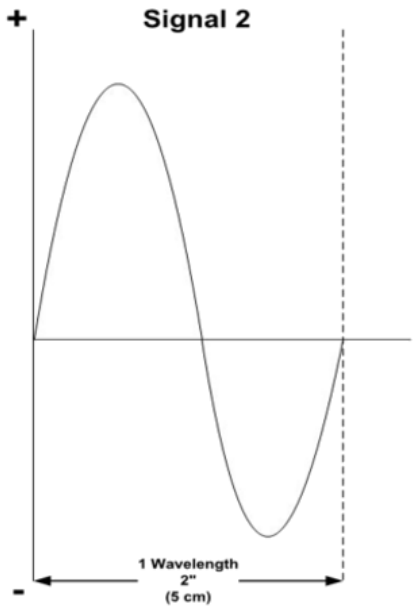
1 Wavelength (in) = 11,811 (Constant) / F (MHZ)

Formula to calculate the constant:

Wavelength (in) = Velocity / Frequency

Wavelength = 186,000 miles (63,360) / F 1,000,000

Wavelength (inches) = 11784 / F MHz



Signal 2

Frequency = 5,775,000,000 CPS (5775 MHz)
Wavelength = 2 inches (5 cm)

Formula To calculate distance of a wavelength

1 Wavelength (cm) = 30.000 (Constant) / F (MHZ)

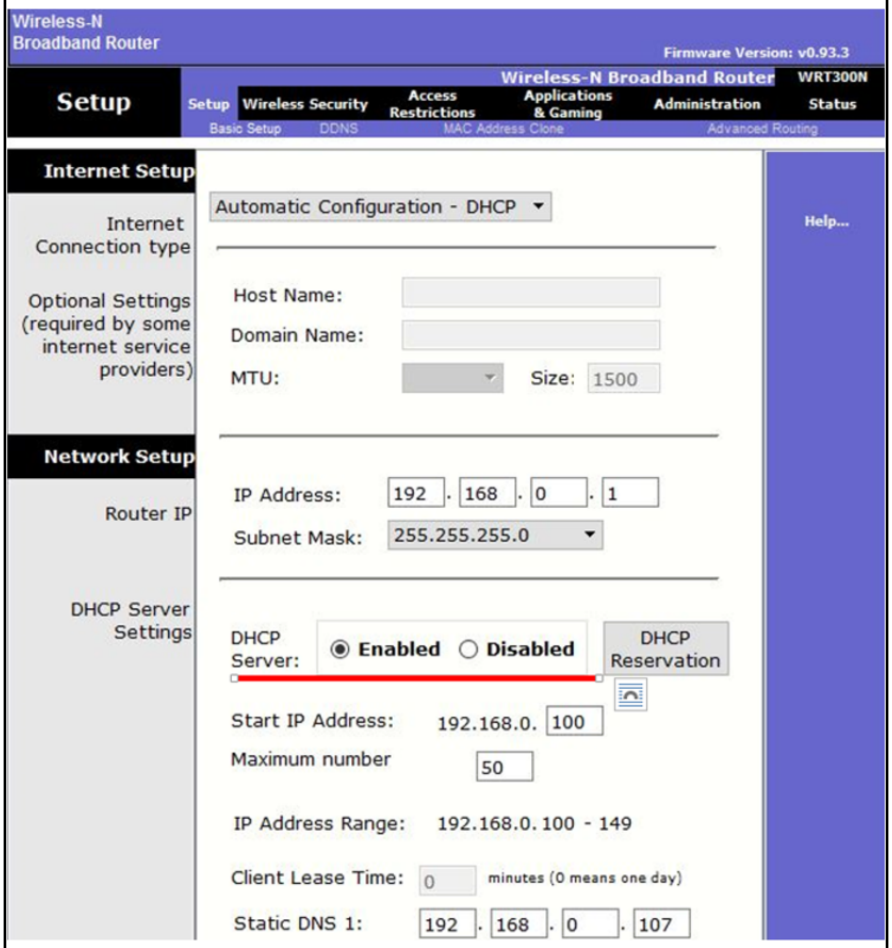
Formula to calculate the constant:

Wavelength (cm) = Velocity / Frequency

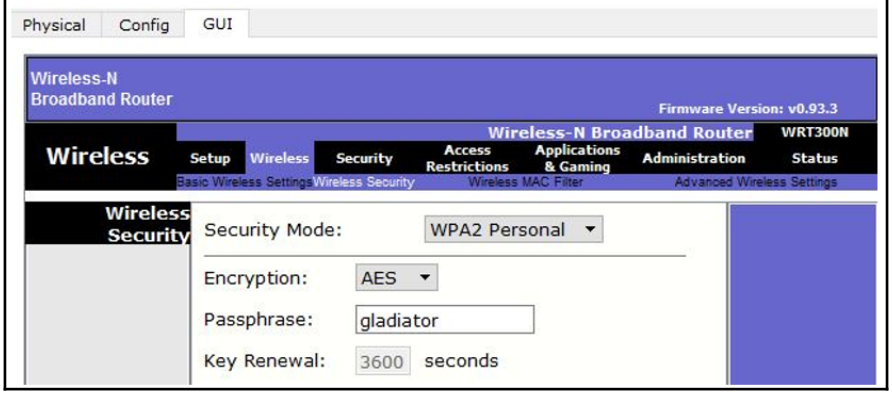
Wavelength = 300000 KM/s (?) / F 1,000,000

Wavelength (cm) = 30.000 / F MHz

The wireless Router



WIRELESS SECURITY:



PC with no wireless Passphrase: