CCNA Pocket Reference

A Product of

BY

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CISCO

Acknowledgment

I acknowledge my parents for giving me education and letting me opt for taking Computer as a hobby (and buying me my ever first computer in 1996), which later on became my profession.

I would specially like to thank my ustaads (Teachers) **Sir, Haroon Ahmed Malik** *CCIE Routing & Switching, Security, Service Provider*. **Sir, Adeel Rizvi** *CCIE Routing & Switching* and **Sir Qasim** *CCNP,* who provided me a chance to prove my skills in Cisco. The major portion of this book was structured and tested in this institute.

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At last I would also like to thank all the people out there on the Internet who have contributed to the Cisco community in what ever possible way.

Waqas Ali Zarar

Preface

Why this manual is written? Has a simple and straight answer: There was a dire need for it. People, which includes professional network administrators and Cisco trainers, had certainly spend some tough time while recalling those commands and procedures which just sometimes go away from the mind. Similarly, in case of a network trouble shoot or a problem hunt, there lacked a proper sequence to follow, which could identify the problems.
This manual is NOT a detailed theory based encyclopedia. For that kind of explanation, please refer to Cisco Documentation (www.cisco.com) or the books from Cisco press, etc. So in short you should not expect explanation of things in this text. This manual is for newbies. This is a reference manual and should be treated as reference only. There might be things which might not work because of your machine or my incorrect explanation. As far as this manual is concerned, all material is related to **CCNA**.

Please feel free to inform me about any errors, suggestions at:
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Waqas Ali Zarar

Disclaimer

The computer technology (rather all technologies) are man made and thus are NOT Perfect. So the author is not responsible for any damage to any machine, software, Living (or dead) soul, caused by the contents of this manual in any possible way.

Table of Contents

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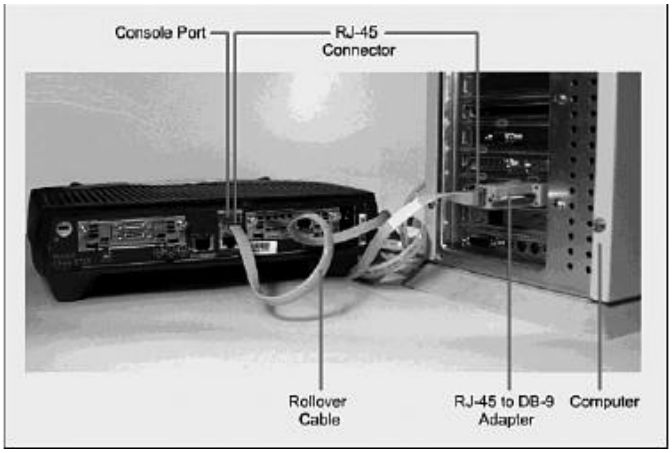
Part 1

Introduction to Cisco Devices

Connecting a RolloverCable to Router or Switch:

Figure shows how to connect a rollover cable from PC to Router or Switch.



Terminal Settings:

The Figure shows the settings that you should configure to have your PC connect to a router or switch.

Serial Cable Types:

Figure shows the DB-60 end of a serial cable that connects to a 2500 series router.

Figure shows the newer smart serial cable that connects to a smart serial port on your router. Smart serial ports are found on modular routers

Fig. shows examples of the male DTE and the female DCE ends that are on the other side of a serial or smart serial cable.

Figure shows USB-to-serial connector to connect with Laptop

Which Cable to Use?

The table shows which cable should be used while wiring your devices together.

If Device A is:	And Device B is:	Cable Type:
Computer COM port	Console of router/switch	Rollover
Computer NIC	Switch	Straight-through
Computer NIC	Computer NIC	Crossover
Switch port	Router's Ethernet port	Straight-through
Switch port	Switch port	Crossover
Router's Ethernet port	Router's Ethernet port	Crossover
Computer NIC	Router's Ethernet port	Crossover
Router's serial port	Router's serial port	Cisco serial DCE/DTE cabl

UTP Wiring Standards:

568A Standard				568B Standard			
Pin	Color	Pair	Description	Pin	Color	Pair	Description
1	White/green	3	RecvData +	1	White/ orange	2	TxData +
2	Green	3	RecvData -	2	Orange	2	TxData -
3	White/ orange	2	Txdata +	3	White/green	3	RecvData +
4	Blue	1	Unused	4	Blue	1	Unused
5	White/blue	1	Unused	5	White/blue	1	Unused
6	Orange	2	TxData -	6	Green	3	RecvData -
7	White/brown	4	Unused	7	White/ brown	4	Unused
8	Brown	4	Unused	8	Brown	4	Unused

Odd pin numbers are always the stripped wires.

- A straight-through cable is one with both ends using the same standards (A or B).
- A crossover cable is one that has 568A on one end and 568B on the other end.

Part 2

Configuring a Router

How to get help

Router # **?**	List all commands available in the current comma mode
Router # **c ?** calendar call clear clock configure connect crypto	Lists all the possible choices that start with the lett
Router # **cl ?** clear clock	Lists all the possible choices that start with the lett
Router # **clock** % Incomplete Command	Tells you that more parameters need to be entered
Router # **clock ?** Set	Shows all subcommands for this command (in this Set, which sets the time and date)
Router # **clock set 19:50:00 14 July 2007 ?** ↵ Enter	Pressing the ↵ Enter key confirms the time and dat configured
Router #	No error message/Incomplete command message means the command was entered successfully.

Router Modes:

Router >	User mode
Router #	Privileged mode (also known as EXEC-level mode)
Router (config) #	Global configuration mode
Router (config-if) #	Interface mode
Router (config-line) #	Line mode
Router (config-router) #	Router configuration mode

enable Command

Router >**enable** Router #	Moves the user from user mode to privileged mode

exit Command

Router # **exit** Or Router > **exit**	Logs a user off
Router (config-if) # **exit** Router(config)#	Moves you back one level
Router (config) # **exit** Router #	Moves you back one level

disable Command

Router # **disable** Router >	Moves you from privileged mode back to user mode

logout Command

Router # **logout**	Performs the same function as **exit**

Setup Mode

Setup mode start automatically if there is no startup configuration present.

Router # **setup**	Enters startup mode from the command line

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Keyboard Help

^	Shows you where you made a mistake in entering a command
Router # **confg t** ^ % Invalid input detected at '^' marker. Router # **config t** Router (config) #	
Ctrl-A	Moves cursor to beginning of line
Esc-B	Moves cursor back one word
Ctrl-B (or ←)	Moves cursor back one character
Ctrl-E	Moves cursor to end of line
Ctrl-F (or →)	Moves cursor forward one character
Esc-F	Moves cursor forward one word
Ctrl-Z	Moves you from any prompt back down to privileged mode
$	Indicates that the line has been scrolled to the left

History Commands

Ctrl-P (or ↑)	Recalls commands in the history buffer in a backward sequen beginning with the most recent command
Ctrl-N (or ↓)	Returns to more recent commands in the history buffer after recalling commands with the C-P key sequence
Router # **terminal history size 25**	Causes the router to now remember the last 25 commands in t buffer. **(Maximum 256, Default 10)**

show Commands

Router # **show version**	Displays information about the current Cisco IOS Software

Shortcuts for Entering Commands

To enhance efficiency and to reduce time, Cisco IOS Software has some shortcuts for entering commands.

Router > **enable** = Router > **enab** = Router > **en**	Entering a shortened form of a command is sufficient as long as th no confusion about which command you are attempting to enter.
Router # **configure terminal** is the same as Router # **config t**	

Using the Tab Key to Complete Commands

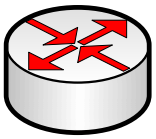
When you are entering a command, you can use the Tab key to complete the command. Enter the first few characters of a command and press the Tab key. If the characters are unique to the command, the rest of the command is entered in for you. This is helpful if you are unsure about the spelling of a command.

Router # **sh** Tab = Router # **show**	By pressing Tab the word will be auto completed

Basic Router Configuration

Configuring a Single Router

Router



Entering Global Configuration Mode

Router >	Limited viewing of configuration. You cannot make changes in this mode.
Router #	You can see the configuration and move to make changes

Configuring a Router Name

This command works on both routers and switches.

Router (config) # **hostname Cisco**	The name can be any word you choose.
Cisco (config) #	

Configuring Passwords

Router (config) # **enable password cisco**	Sets **enable** password
Router (config) # **enable secret corvit**	Sets **enable secret** password
Router (config) # **line console 0**	Enters console line mode
Router (config-line) # **password cisco**	Sets console line mode password to **cisco**
Router (config-line) # **login**	Enables password checking at login

Router (config) # **line vty 0 4**	Enters vty line mode for all five vty lines
Router (config-line) # **password cisco**	Sets vty password to **cisco**
Router (config-line) # **login**	Enables password checking at **login**

Note: The **enable secret password** is encrypted by default. The **enable password** is not. Recommended practice is that you Use only the **enable secret password** command in a router or switch configuration rather than **enable password** command.

Moving Between Interface

Router (config) # **interface fastethernet 0/0**	Moves to Fast Ethernet interface configuration mod
Router (config-if) #	In Fast Ethernet 0/0 configuration mode now
Router (config-if) # **exit**	Moves to global configuration mode
Router (config) # **interface serial 0/0** or Router (config-if) # **interface serial 0/0**	Moves to Serial interface configuration mode Moves directly to Serial 0/0 configuration mode

Configuring a Serial Interface

Router (config) # **interface s0/0**	Moves to serial interface 0/0 configuration mode
Router (config-if) # **ip address 1.1.1.1 255.0.0.0**	Assigns address and subnet mask to interface
Router (config-if) # **clock rate 56000**	Assigns a clock rate for the Interface
Router (config-if) # **encapsulation PPP**	Assign encapsulation to Interface **(default=HDLC)**
Router (config-if) # **no shutdown**	Turns interface on

Note: The clock rate command is used only on a serial interface that has a DCE cable plugged into it. There must be a clock rate set on every serial link between routers.

Configuring a Fast Ethernet Interface

Router (config) # **interface fastethernet 0/0**	Moves to Fast Ethernet 0/0 interface configuratic mode
Router (config-if) # **ip address 200.100.50.100 255.255.255.0**	Assigns address and subnet mask to interface
Router (config-if) # **no shutdown**	Turns interface on

Creating a Message-of-the-Day Banner

Router (config) # **banner motd # Authorized Personnel Only! Please enter your username and password. #** Router (config) #	**#** is known as a delimiting character. The delimiting character must surround the banner message and can be any character so long as it is character used within the body of the message.

Saving Configurations

Router # **copy running-config startup-config**	Saves the running configuration to local **NVRAM**
Router # **copy running-config tftp**	Saves the running configuration remotely to a **TFTP** server

Erasing Configurations

Router # **erase startup-config** Or Router # **write erase**	Deletes the startup configuration file from NVRAM

Note: The running configuration is still in dynamic memory.
Reload the router to clear the running configuration.

show Commands

Router # **show ?**	Lists all **show** commands available in privilege mode
Router # **show interfaces**	Displays statistics for all interfaces
Router # **show interface serial 0/0**	Displays statistics for a specific interface

Router # **show ip interface brief**	Displays a summary of all interfaces, including status and IP address assigned
Router # **show controllers serial 0/0**	Displays statistics for interface hardware. Statistics display if the clock rate is set and if the cable is DCE, DTE,or not attached
Router # **show users**	Displays all users connected to Router.
Router # **show version**	Displays info about loaded IOS version.
Router # **show ip protocols**	Displays status of configured Layer 3 protocols
Router # **show startup-config**	Displays the configuration saved in NVRAM.

The do Command

Router (config) # **do show running-config**	Executes the privileged-level **show running-config** command while in global configuration mode.
Router (config) #	The router remains in global configuration mode after the command has been executed.

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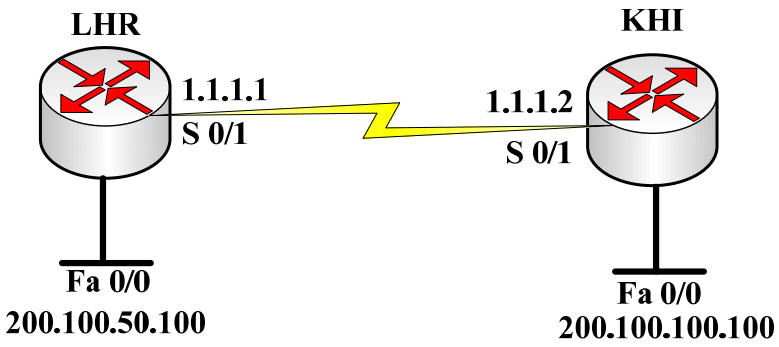
How to Configure 2 Branches



(**Note:** Lab results are produced using Packet Tracer Simulator)

Task to complete in this Lab:

1. Set **host names** of both Routers as shown in figure.
2. Assign IP address to **Serial 0/1** of **LHR** router **1.1.1.1/8**
3. Assign IP address to **Serial 0/1** of **KHI** router **1.1.1.2/8**
4. Assign IP address to **Fast Ethernet 1/0** of **LHR** Router **200.100.50.100/24**
5. Assign IP address to **Fast Ethernet 1/0** of **KHI** Router **200.100.100.100/24**
6. Set encapsulation of **Serial 1/0** on both Routers to **PPP**
7. Set **clock rate** on **DCE** interface.
8. Both Routers must ping each other
9. Configure line console password to **cisco**
10. Configure Secret password to **corvit**
11. Configure line vty password of both Routers to **cisco**
12. Save the configurations
13. Telnet Router **LHR** from your PC

SOLUTION

Configuration of Router-LHR

```
Router > enable
Router # configure terminal
Router (config) # hostname LHR

LHR (config) # interface s 0/1
LHR (config-if) #  ip address 1.1.1.1 255.0.0.0
LHR (config-if) #  no shutdown
LHR (config-if) # encapsulation ppp
LHR (config-if) # clock rate 64000
LHR (config-if) # exit

LHR (config) # interface fa 0/0
LHR (config-if) # ip address 200.100.50.100 255.255.255.0
LHR (config-if) # no shutdown

LHR (config) # line console 0
LHR (config-line) # password cisco
LHR (config-line) # login
LHR (config-line) # exit
LHR (config) # enable secret corvit
LHR (config) # line vty 0 4
LHR (config-line) # password cisco
LHR (config-line) # login
LHR # copy run start
```

Note: You can check which Router has **DCE** interface by ***Show controllers serial 1/0*** command. In this case Router **LHR** has DCE interface.

To view running configurations of Router-LHR:

LHR# show running-config

```
Building configuration...

Current configuration : 551 bytes
!
version 12.2
no service password-encryption
!
hostname LHR

!
enable secret 5 $1$mERr$.R5fYUjt7Oi2oEZwfYOZE0
!

!
interface FastEthernet0/0
 ip address 200.100.50.100 255.255.255.0
 duplex auto
 speed auto
!

 !
interface Serial0/1
 ip address 1.1.1.1 255.0.0.0
 encapsulation ppp
 clock rate 64000
 !
ip classless
 !
 !
 !
 !
 !
line con 0
 password cisco
 login
line vty 0 4
 password cisco
 login
 !
 !
end
```

Configuration of Router-KHI

Router > enable
Router # configure terminal
Router (config) # hostname KHI

KHI (config) # interface s 0/1
KHI (config-if) # ip address 1.1.1.2 255.0.0.0
KHI (config-if) # no shutdown
KHI (config-if) # encapsulation ppp
KHI (config-if) # exit

KHI (config) # interface fa 0/0
KHI (config-if) # ip address 200.100.100.100 255.255.255.0
KHI (config-if) # no shutdown

KHI (config) # line console 0
KHI (config-line) # password cisco
KHI (config-line) # login

KHI (config) # enable secret corvit
KHI (config) # line vty 0 4
KHI (config-line) # password cisco
KHI (config-line) # login

KHI # copy run start

Ping Router KHI from Router LHR

LHR# ping 1.1.1.1

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/28/32 ms
```

The 5 success sign shows that your connectivity is 100 %

Telnet Router LHR from PC

PC> telnet 200.100.50.100

```
PC>telnet 200.100.50.100
Trying 200.100.50.100 ...


User Access Verification

Password:
LHR>
```

Enter Line vty password i.e.; cisco to login Router LHR

To view running configurations of Router-KHI:

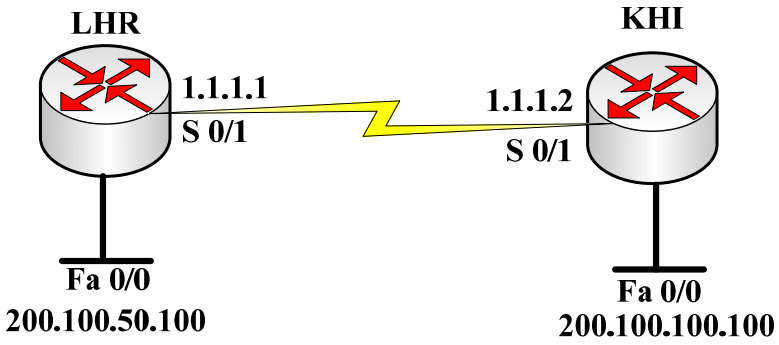
KHI # show run

```
Building configuration...

Current configuration : 534 bytes
!
version 12.2
no service password-encryption
!
hostname KHI
!
enable secret 5 $1$mERr$.R5fYUjt7Oi2oEZwrfYOZE0

!
interface FastEthernet0/0
 ip address 200.100.100.100 255.255.255.0
 duplex auto
 speed auto
!

 !
 interface Serial0/1
  ip address 1.1.1.2 255.0.0.0
  encapsulation ppp
 !
 ip classless
 !
 !
 !
 !
 !
 line con 0
  password cisco
  login
 line vty 0 4
  password cisco
  login
 !
 !
 end
```

Part 3

Routing

Static Routing



(Note: Lab results are produced using Packet Tracer Simulator)

If you try to ping **200.100.100.100** from Router **LHR** or **200.100.50.100** from Router **KHI**. There will be 5 unsuccessful signs because there is no entry for these routes in routing table of both routers. As shown in figure.

For this purpose we will perform routing so that both routers exchange their missing routes. Once routing table is complete you can ping these routes.
When configuring a static route, you can identify where packets should be routed in two ways:

- **The next-hop address**
- **The exit interface**

Both ways are shown in the "Configuration Example

Routing table of Router LHR before static routing.

LHR# show 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

C    1.0.0.0/8 is directly connected, Serial0/0/0
C    200.100.50.0/24 is directly connected, FastEthernet0/0
```

The 3rd route i.e. 200.100.100.0 is missing in Router LHR routing table.

LHR# ping 200.100.100.100

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.100.100.100, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Now create a static route for this missing route on **Router LHR**

Configuration of Router-LHR

LHR(config)# ip route 200.100.100.0 255.255.255.0 1.1.1.2

Missing Address **Next Hop Address**

Routing table of **Router LHR** after creating static route is shown below.

LHR# show 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

C    1.0.0.0/8 is directly connected, Serial0/1
C    200.100.50.0/24 is directly connected, FastEthernet0/0
S    200.100.100.0/24 [1/0] via 1.1.1.2
```

Now try to ping again that route and this time ping will be successful.

LHR# ping 200.100.100.100

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.100.100.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/43/120 ms
```

Routing table of Router KHI before static routing.

KHI# show ip route

```
C    1.0.0.0/8 is directly connected, Serial0/1
C    200.100.100.0/24 is directly connected, FastEthernet0/0
```

The 3rd route i.e. 200.100.50.0 is missing in Router KHI routing table.

KHI# ping 200.100.50.100

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.100.50.100, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Now create a static route for this missing route on **Router KHI**

Configuration of Router-KHI

LHR (config)# ip route 200.100.50.0 255.255.255.0 serial 0/1

Missing Address **Exit Interface**

Routing table of **Router LHR** after creating static route is shown below.

LHR # Show ip route

```
C   1.0.0.0/8 is directly connected, Serial0/1
S   200.100.50.0/24 is directly connected, Serial0/1
C   200.100.100.0/24 is directly connected, FastEthernet0/0
```

Now try to ping again that route and this time ping will be successful.

KHI# ping 200.100.50.100

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 200.100.50.100, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 31/31/32 ms
```

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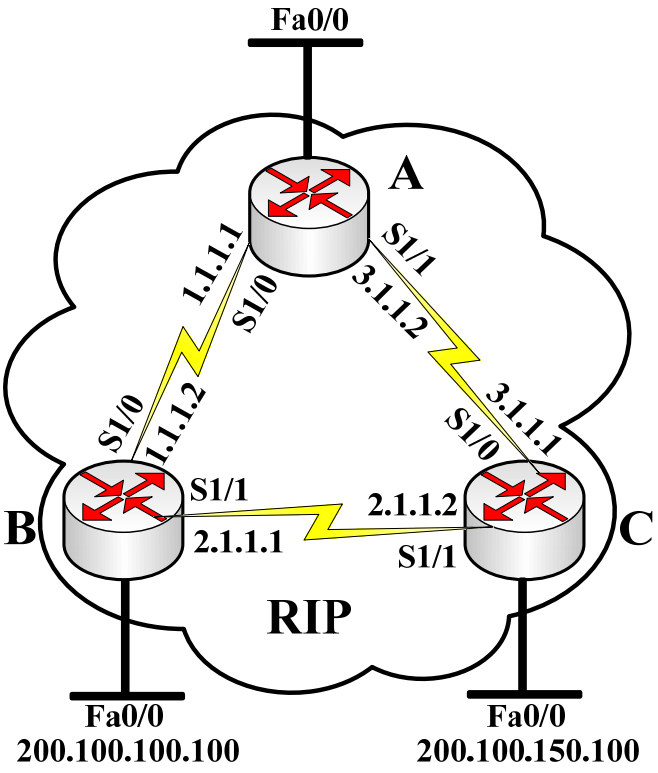
Dynamic Routing

RIP (LAB # 1)



(Note: Lab results are produced using Packet Tracer Simulator)

Basic Configuration of Router-A

A (config) # interface serial 1/0
A (config-if) # ip address 1.1.1.1 255.0.0.0
A (config-if) # no shutdown
A (config-if) # clock rate 64000

A (config) # interface serial 1/1
A (config-if) # ip address 3.1.1.2 255.0.0.0
A (config-if) # no shutdown

A (config) # interface fastethernet 0/0
A (config-if) # ip address 200.100.50.100 255.255.255.0
A (config-if) # no shutdown

Basic Configuration of Router-B

B (config) # interface serial 1/0
B (config-if) # ip address 1.1.1.2 255.0.0.0
B (config-if) # no shutdown

B (config) # interface serial 1/1
B (config-if) # ip address 2.1.1.1 255.0.0.0
B (config-if) # no shutdown
B (config-if) # clock rate 64000

B (config) # interface fastethernet 0/0
B (config-if) # ip address 200.100.100.100 255.255.255.0
B (config-if) # no shutdown

Basic Configuration of Router-C

C (config) # interface serial 1/0
C (config-if) # ip address 3.1.1.1. 255.0.0.0
C (config-if) # no shutdown
C (config-if) # clock rate 64000

C (config) # interface serial 1/1
C (config-if) # ip address 2.1.1.2. 255.0.0.0
C (config-if) # no shutdown

C (config) # interface fastethernet 0/0
C (config-if) # ip address 200.100.150.100 255.255.255.0
C (config-if) # no shutdown

Running RIP on Router-A, B & C

A (config) # router rip
A (config-router) # network 1.0.0.0
A (config-router) # network 3.0.0.0
A (config-router) # network 200.100.50.0

B (config) # router rip
B (config-router) # network 1.0.0.0
B (config-router) # network 2.0.0.0
B (config-router) # network 200.100.100.0

C (config) # router rip
C (config-router) # network 2.0.0.0
C (config-router) # network 3.0.0.0
C (config-router) # network 200.100.150.0

Routing Table of Router-A

A # show ip route

```
C    1.0.0.0/8 is directly connected, Serial1/0
R    2.0.0.0/8 [120/1] via 3.1.1.1, 00:00:28, Serial1/1
               [120/1] via 1.1.1.2, 00:00:18, Serial1/0
C    3.0.0.0/8 is directly connected, Serial1/1
C    200.100.50.0/24 is directly connected, FastEthernet0/0
R    200.100.100.0/24 [120/1] via 1.1.1.2, 00:00:18, Serial1/0
R    200.100.150.0/24 [120/1] via 3.1.1.1, 00:00:09, Serial1/1
```

Note: Routing table of Router-A has been completely converged and network 2.0.0.0 has been reached on Router-A using two different paths

Shutting Down Interface Serial 1/0 of Router-B

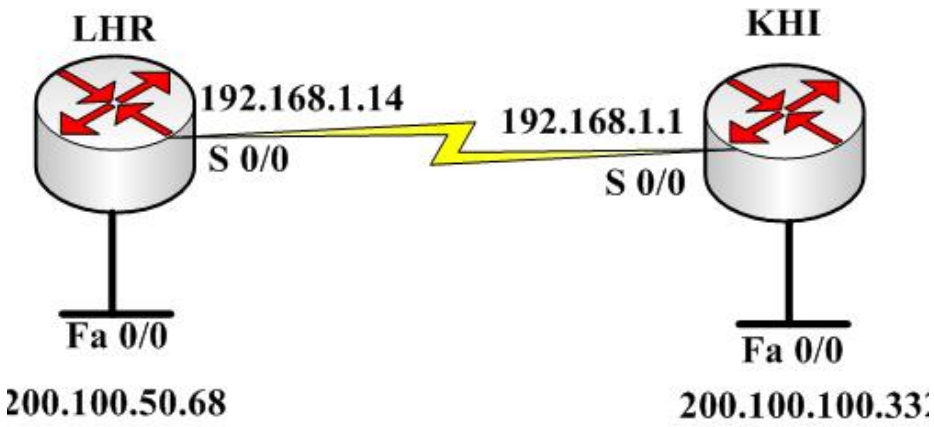
B (config) # interface serial 1/0
B (config-if) # shutdown

A # show ip route

```
R    2.0.0.0/8 [120/1] via 3.1.1.1, 00:00:18, Serial1/1
C    3.0.0.0/8 is directly connected, Serial1/1
C    200.100.50.0/24 is directly connected, FastEthernet0/0
R    200.100.100.0/24 [120/2] via 3.1.1.1, 00:00:18, Serial1/1
R    200.100.150.0/24 [120/1] via 3.1.1.1, 00:00:18, Serial1/1
```

Note: Network 2.0.0.0 has been reached on Router-A using only one path.

RIP(LAB#2)



(Note: Lab results are produced using Packet Tracer Simulator)

Coca Cola recently installed new routers in their office. Complete the network installation by configuring **RIPV2** routing on **LHR & KHI Router.**

Configure the router per the following requirements:

IPv4 addresses must be configured on **Router-LHR** as follows:

- Ethernet network **200.100.50.64/27 –** router has **fourth** assignable host address in subnet.
- Serial network**192.168.1.0/28** – router has **last** assignable host address in subnet
- Routing Protocol is **RIPv2.**

IPv4 addresses must be configured on **Router-KHI** as follows:

- Ethernet network **200.100.50.32/27 –** router has **first** assignable host address in subnet.
- Serial network**192.168.1.0/28** – router has **first** assignable host address in subnet
- Routing Protocol is **RIPv2.**

Configuration of Router-KHI

KHI (config) # interface fastethernet 0/0
KHI (config-if) # ip address 200.100.100.100.33 255.255.255.224
KHI (config-if) # no shutdown

KHI (config) # interface serial 0/1
KHI (config-if) # ip address 192.168.1.1 255.255.255.240
KHI (config-if) # no shutdown
KHI (config-if) # exit

Configuration of Router-LHR

LHR (config) # interface fastethernet 0/0
LHR (config-if) # ip address 200.100.50.68 255.255.225.224
LHR (config-if) # no shutdown

LHR (config) # interface serial 0/1
LHR (config-if) # ip address 192.168.1.14 255.255.255.240
LHR (config-if) # no shutdown

Configuring RIP version 2 on Router-KHI

KHI (config) # router rip
KHI (config-router) # version 2
KHI (config-router) # network 200.100.100.32
KHI (config-router) # network 192.168.1.0

Configuring RIP version 2 on Router-LHR

LHR (config) # router rip
LHR (config-router) # version 2
LHR (config-router) # network 192.168.1.0
LHR (config-router) # network 200.100.50.64

Routing Table of Router-KHI

KHI # show ip route

```
     200.100.50.0/27 is subnetted, 1 subnets
R       200.100.50.64 [120/1] via 192.168.1.14, 00:00:04, Serial0/0
     200.100.100.0/27 is subnetted, 1 subnets
C       200.100.100.32 is directly connected, FastEthernet0/0
     192.168.1.0/28 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial0/0
```

Note: Network 200.100.50.0 has been reached on Router KHI with subnetted network 200.100.50.64

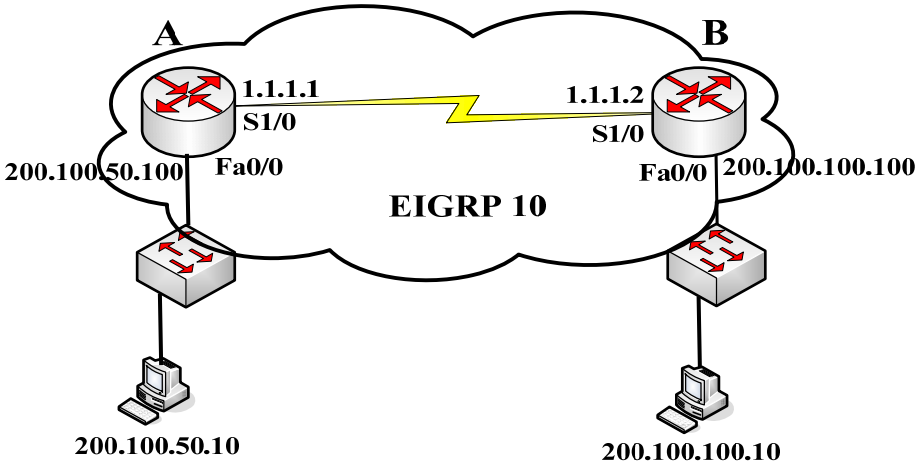
Routing Table of Router-LHR

LHR # show ip route

```
     200.100.50.0/27 is subnetted, 1 subnets
C       200.100.50.64 is directly connected, FastEthernet0/0
     200.100.100.0/27 is subnetted, 1 subnets
R       200.100.100.32 [120/1] via 192.168.1.1, 00:00:15, Serial0/0
     192.168.1.0/28 is subnetted, 1 subnets
C       192.168.1.0 is directly connected, Serial0/0
```

Note: Network 200.100.100.0 has been reached on Router LHR with subnetted network 200.100.100.32

EIGRP



(Note: Lab results are produced using Packet Tracer Simulator)

Basic Configuration of Router-A

A (config) # interface serial 1/0
A (config-if) # ip address 1.1.1.1 255.0.0.0
A (config-if) # no shutdown
A (config-if) # clock rate 64000

A (config) # interface fastethernet 0/0
A (config-if) # ip address 200.100.50.100 255.255.255.0
A (config-if) # no shutdown

Basic Configuration of Router-B

B (config) # interface serial 1/0
B (config-if) # ip address 1.1.1.2 255.0.0.0
B (config-if) # no shutdown

B (config) # interface fastethernet 0/0
B (config-if) # ip address 200.100.100.100 255.255.255.0
B (config-if) # no shutdown

Running EIGRP on Router-A & B

A (config) # router eigrp 10
A (config-router) # network 1.0.0.0
A (config-router) # network 200.100.50.0

B (config) # router eigrp 10
B (config-router) # network 1.0.0.0
B (config-router) # network 200.100.100.0

Routing Table of Router-A

A # show ip route

```
C    1.0.0.0/8 is directly connected, Serial1/0
C    200.100.50.0/24 is directly connected, FastEthernet0/0
D    200.100.100.0/24 [90/2172416] via 1.1.1.2, 00:00:25, Serial1/0
```

Note: Network 200.100.100.0 has been reached on Router A

Routing Table of Router-B

B # show ip route

```
C    1.0.0.0/8 is directly connected, Serial1/0
D    200.100.50.0/24 [90/2172416] via 1.1.1.1, 00:00:20, Serial1/0
C    200.100.100.0/24 is directly connected, FastEthernet0/0
```

Note: Network 200.100.50.0 has been reached on Router B

Now ping PC 200.100.100.10 from PC 200.100.50.10

C:\> ping 200.100.10.10

```
Pinging 200.100.100.10 with 32 bytes of data:

Reply from 200.100.100.10: bytes=32 time=125ms TTL=126
Reply from 200.100.100.10: bytes=32 time=157ms TTL=126
Reply from 200.100.100.10: bytes=32 time=156ms TTL=126
Reply from 200.100.100.10: bytes=32 time=141ms TTL=126

Ping statistics for 200.100.100.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 125ms, Maximum = 157ms, Average = 144ms
```

OSPF

Using Wildcard Masks with OSPF Areas

When compared to an IP address, a wildcard mask identifies which addresses get matched for placement into an area:

- A 0 (zero) in a wildcard mask means to check the corresponding bit in the address for an exact match.
- A 1 (one) in a wildcard mask means to ignore the corresponding bit in the address can be either 1 or 0.

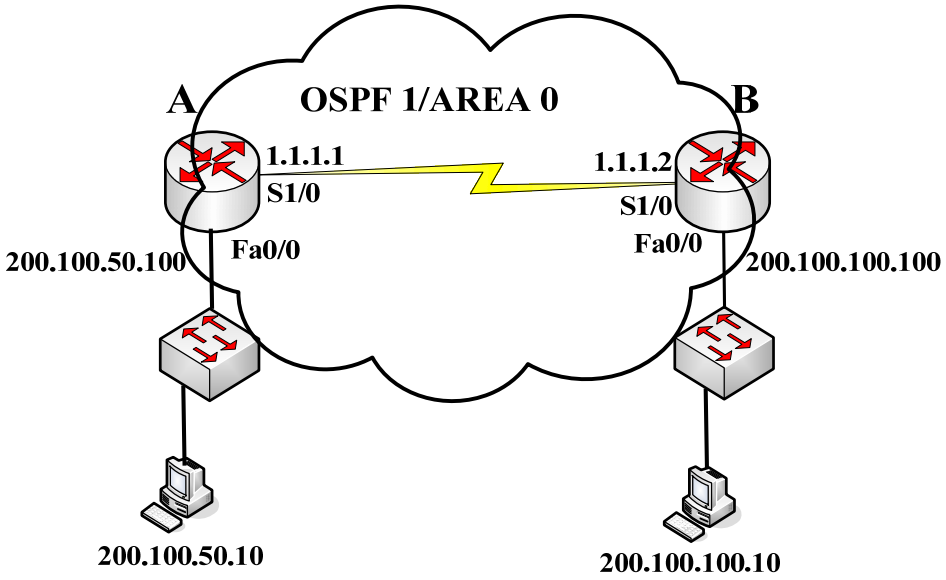
Example 1: 1.0.0.0 0.255.255.255

Example 2: 172.16.0.0 0.0.255.255

Example 3: 200.100.50.0 0.0.0.255

Note: Wild Card Mask is inverse of subnet mask only in case of Network ID.

Single Area OSPF



(Note: Lab results are produced using Packet Tracer Simulator)

Basic Configuration of Router-A

```
A (config) # interface serial  1/0
A (config-if) # ip address 1.1.1.1   255.0.0.0
A (config-if) # no shutdown
A (config-if) # clock rate 64000

A (config) # interface fastethernet   0/0
A (config-if) # ip address  200.100.50.100    255.255.255.0
A (config-if) # no shutdown
```

Basic Configuration of Router-B

```
B (config) # interface serial  1/0
B (config-if) # ip address 1.1.1.2   255.0.0.0
B (config-if) # no shutdown
```

B (config) # interface serial 1/1
B (config-if) # ip address 2.1.1.1 255.0.0.0
B (config-if) # no shutdown
B (config-if) # clock rate 64000

B (config) # interface fastethernet 0/0
B (config-if) # ip address 200.100.100.100 255.255.255.0
B (config-if) # no shutdown

Running OSPF on Router-A & B

A (config) # router ospf 1
A (config-router) # network 1.0.0.0 0.255.255.255 area 0
A (config-router) # network 200.100.50.0 0.0.0.255 area 0

B (config) # router ospf 1
B (config-router) # network 1.0.0.0 0.255.255.255 area 0
B (config-router) # network 200.100.100.0 0.0.0.255 area 0

Routing Table of Router-A

A # show ip route

```
C   1.0.0.0/8 is directly connected, Serial0/1
C   200.100.50.0/24 is directly connected, FastEthernet0/0
O   200.100.100.0/24 [110/65] via 1.1.1.2, 00:01:17, Serial0/1
```

Note: Network 200.100.100.0 has been reached on Router A

Routing Table of Router-B

B # show ip route

```
C   1.0.0.0/8 is directly connected, Serial0/1
O   200.100.50.0/24 [110/65] via 1.1.1.1, 00:00:56, Serial0/1
C   200.100.100.0/24 is directly connected, FastEthernet0/0
```

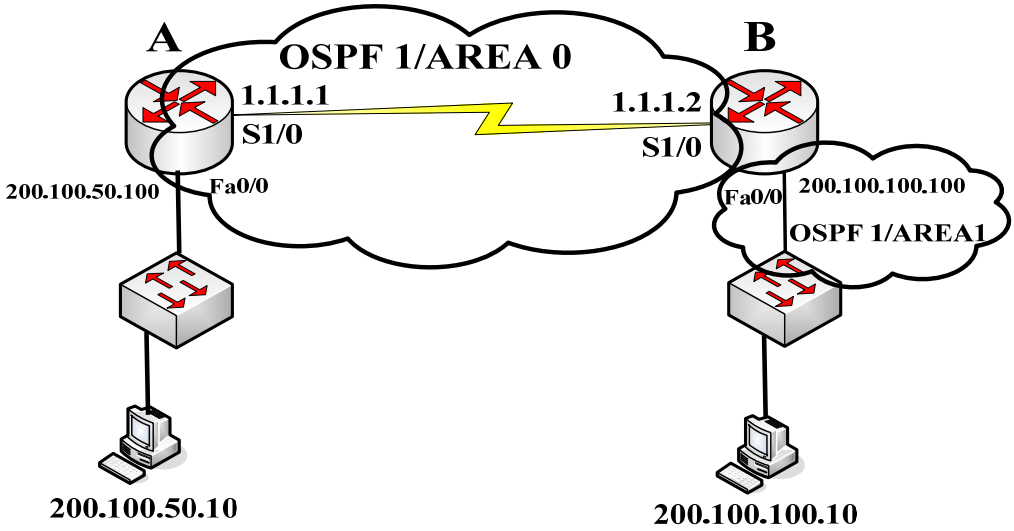
Note: Network 200.100.50.0 has been reached on Router B

Now ping PC 200.100.100.10 from PC 200.100.50.10

C:\> ping 200.100.10.10

```
Pinging 200.100.100.10 with 32 bytes of data:

Reply from 200.100.100.10: bytes=32 time=125ms TTL=126
Reply from 200.100.100.10: bytes=32 time=157ms TTL=126
Reply from 200.100.100.10: bytes=32 time=156ms TTL=126
Reply from 200.100.100.10: bytes=32 time=141ms TTL=126

Ping statistics for 200.100.100.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 125ms, Maximum = 157ms, Average = 144ms
```

Multi Area OSPF



(Note: Lab results are produced using Packet Tracer Simulator)

Basic Configuration of Router-A

```
A (config) # interface serial  1/0
A (config-if) # ip address 1.1.1.1   255.0.0.0
A (config-if) # no shutdown
A (config-if) # clock rate 64000

A (config) # interface fastethernet   0/0
A (config-if) # ip address  200.100.50.100    255.255.255.0
A (config-if) # no shutdown
```

Basic Configuration of Router-B

```
B (config) # interface serial  1/0
B (config-if) # ip address 1.1.1.2   255.0.0.0
B (config-if) # no shutdown
B (config-if) # clock rate 64000

B (config) # interface fastethernet   0/0
B (config-if) # ip address 200.100.100.100   255.255.255.0
B (config-if) # no shutdown
```

Running OSPF on Router-A & B

A (config) # router ospf 1
A (config-router) # network 1.0.0.0 0.255.255.255 area 0
A (config-router) # network 200.100.50.0 0.0.0.255 area 0

B (config) # router ospf 1
B (config-router) # network 1.0.0.0 0.255.255.255 area 0
B (config-router) # network 200.100.100.0 0.0.0.255 area 1

Routing Table of Router-A

A # show ip route

```
C    1.0.0.0/8 is directly connected, Serial0/1
C    200.100.50.0/24 is directly connected, FastEthernet0/0
O IA 200.100.100.0/24 [110/65] via 1.1.1.2, 00:00:06, Serial0/1
```

Note: The Routes which comes across another area in OSPF are shown by OIA and are called **OSPF Inter Area Routes**

Routing Table of Router-B

B # show ip route

```
C    1.0.0.0/8 is directly connected, Serial0/1
O    200.100.50.0/24 [110/65] via 1.1.1.1, 00:00:56, Serial0/1
C    200.100.100.0/24 is directly connected, FastEthernet0/0
```

Note: Network 200.100.50.0 has been reached on Router B

Neighbor Table of Router-A

A # show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
200.100.100.100	0	FULL/ -	00:00:34	1.1.1.2	Serial0/0

Note: Router A has one neighbor with Neighbor ID 200.100.100.100

Neighbor Table of Router-B

B # show ip ospf neighbor

Neighbor ID	Pri	State	Dead Time	Address	Interface
200.100.50.100	0	FULL/ -	00:00:35	1.1.1.1	Serial0/0

Note: Router B has one neighbor with Neighbor ID 200.100.50.100

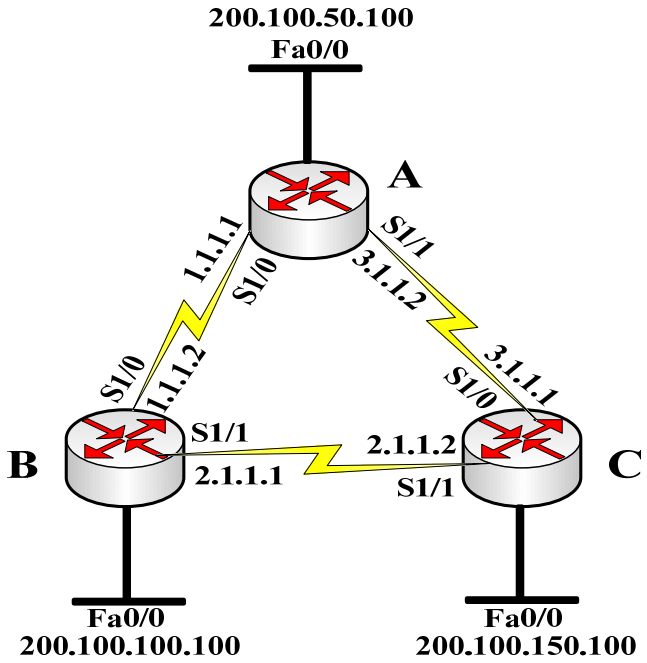
Now ping PC 200.100.100.10 from PC 200.100.50.10

C:\> ping 200.100.10.10

```
Pinging 200.100.100.10 with 32 bytes of data:

Reply from 200.100.100.10: bytes=32 time=125ms TTL=126
Reply from 200.100.100.10: bytes=32 time=157ms TTL=126
Reply from 200.100.100.10: bytes=32 time=156ms TTL=126
Reply from 200.100.100.10: bytes=32 time=141ms TTL=126

Ping statistics for 200.100.100.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 125ms, Maximum = 157ms, Average = 144ms
```

Part 4

Cisco Discovery Protocol



Draw Network Diagram using CDP:

A # show cdp neighbors

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
C	S 0/1	162	R	C2600	S 0/0
B	S 0/0	161	R	C2600	S 0/0

Note: cdp neighbors table shows that there are 2 neighbors of **Router A** i.e.; **Router B & Router C**. **Local Interface** shows interfaces of **Router A,** whereas **Port ID** shows interfaces of neighbor Routers.

Neighbors Detail Information:

A # show cdp neighbors detail

```
Device ID: C
Entry address(es):
  IP address : 3.1.1.1
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/1, Port ID (outgoing port): Serial0/0
Holdtime: 175

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

advertisement version: 2
Duplex: full
---------------------------
Device ID: B
Entry address(es):
  IP address : 1.1.1.2
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/0, Port ID (outgoing port): Serial0/0
Holdtime: 174

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

advertisement version: 2
Duplex: full
```

IP Address to telnet Router C

IP Address to telnet Router B

Note: cdp neighbors detail shows complete information of neighbor Including IP Address and outgoing interface of neighbor.

A # telnet 1.1.1.2

Trying 1.1.1.2 ...

User Access Verification

Password: **Type password of Router B**

B # show cdp neighbors

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
C	S 0/1	162	R	C2600	S 0/1
A	S 0/0	161	R	C2600	S 0/0

Note: cdp neighbors table shows that there are 2 neighbors of **Router B** i.e.; **Router B & Router C**. **Local Interface** shows interfaces of **Router B** whereas **Port ID** shows interfaces of neighbor Routers.

Neighbors Detail Information:

B # show cdp neighbors detail

```
Device ID: C
Entry address(es):
  IP address : 2.1.1.2
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/1, Port ID (outgoing port): Serial0/1
Holdtime: 141

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

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

Device ID: A
Entry address(es):
  IP address : 1.1.1.1
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/0, Port ID (outgoing port): Serial0/0
Holdtime: 145

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

advertisement version: 2
Duplex: full
```

IP Address to telnet Router C

IP Address to telnet Router A

Note: cdp neighbors detail shows complete information of neighbor Including IP Address and outgoing interface of neighbor.

B # telnet 2.1.1.2

Trying 1.1.1.2 ...

User Access Verification

Password: **Type password of Router C**

C # show cdp neighbors

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
A	S 0/0	130	R	C2600	S 0/1
B	S 0/1	125	R	C2600	S 0/1

Note: cdp neighbors table shows that there are 2 neighbors of **Router C** i.e.; **Router A & Router B**. **Local Interface** shows interfaces of **Router B** whereas **Port ID** shows interfaces of neighbor Routers.

Neighbors Detail Information:

C # show cdp neighbors detail

```
Device ID: A
Entry address(es):
  IP address : 3.1.1.2
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/0, Port ID (outgoing port): Serial0/1
Holdtime: 120

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

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

Device ID: B
Entry address(es):
  IP address : 2.1.1.1
Platform: cisco C2600, Capabilities: Router
Interface: Serial0/1, Port ID (outgoing port): Serial0/1
Holdtime: 176

Version :
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang

advertisement version: 2
Duplex: full
```

IP Address to telnet Router A

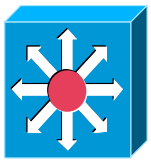
IP Address to telnet Router B

Note: cdp neighbors detail shows complete information of neighbor Including IP Address and outgoing interface of neighbor.

Part 5

Switching

Default Configuration of a Switch



Catalyst 3560

```
Switch # show vtp status
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Server
VTP Domain Name                 :
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

CORVIT
Reaching end to end

Configuring Domain Name

Switch (config) # vtp domain CISCO
Changing VTP domain from NULL to CISCO

Switch # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Server
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x1A 0xFC 0x64 0xDA 0x8E 0xA1 0x8A 0x3B
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

Note: VTP domain CISCO has been configured

VTP (VLAN TRUNKING PROTOCOL)

VTP is a Cisco proprietary protocol that allows for VLAN configuration (addition, deletion, or renaming of VLANs) to be consistently maintained across a common administrative domain.

VTP reduces administration in a switched network. When you configure a new VLAN on one VTP server, the VLAN is distributed through all switches on the domain. This reduces the need to configure the same VLAN everywhere. VTP is a Cisco proprietary protocol that is available on most of the Cisco Catalyst series products.

If you intend to make a switch part of a VTP management domain, each switch must be configured in one of these three possible VTP modes.

- **Server Mode**
- **Client Mode**
- **Transparent Mode**

We will discuss first 2 modes in CCNA. The VTP mode assigned to a switch will determine how the switch interacts with other VTP switches in the management domain.

Server Mode:

Once VTP is configured on a Cisco switch the default mode used is Server Mode. In any given VTP management domain, at least one switch must be in Server Mode. When in Server Mode, a switch can be used to add, delete and modify VLANs, and this information will be passed to all other switches in the VTP management domain.

Client Mode:

When a switch is configured to use VTP Client Mode, it is simply the recipient of any VLANs added, deleted, or modified by a switch in Server Mode within the same management domain . a switch in VTP Client Mode cannot make any changes to VLAN information.

How to Change VTP Mode

Server Mode:

Switch (config) # vtp mode server
Device mode already VTP SERVER.

Client Mode:

Switch (config) # vtp mode client
Setting device to VTP CLIENT mode.

Switch # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 0
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 5
VTP Operating Mode              : Client
VTP Domain Name
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

CORVIT
Reaching end to end

VLANS

VLAN:

A VLAN is a logical local area network (or LAN) that extends beyond a single traditional LAN to a group of LAN segments. Because a VLAN is a logical entity, its creation and configuration is done completely in software. In other words VLAN is a logical grouping of network users and resources connected administratively to defined ports on a switch.
(Reference: http://www.topbits.com/vlan.html)

Why use VLAN?

VLAN is like placing a router to stop broadcasts between each individual VLAN. Routers are like bug poison-they kill broadcasts. Broadcast can't escape through routers and they can't escape a VLAN. Each VLAN becomes its own individual broadcast domain. When a network node or workstation sends out an advertisement or broadcast to the other nodes on a segment, only the nodes assigned to that VLAN to which the node sending the broadcast will receive that broadcast.

Default VLANS

Switch # show vlan

```
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, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gi0/1, Gi0/2
1002 fddi-default                      act/unsup
1003 token-ring-default                act/unsup
1004 fddinet-default                   act/unsup
1005 trnet-default                     act/unsup

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
1002 fddi  101002     1500  -      -      -        -    -        0      0
1003 tr    101003     1500  -      -      -        -    -        0      0
1004 fdnet 101004     1500  -      -      -        ieee -        0      0
1005 trnet 101005     1500  -      -      -        ibm  -        0      0
```

Note: VLAN 1, 1002, 1003, 1004 & 1005 are default VLANs.

CORVIT
Reaching end to end

How to Create VLAN

How to Create VLAN

Switch (config) # vlan 2
VTP VLAN configuration is not allowed when device is in client mode.

Switch (config-vlan) # end

Switch # show vlan

```
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, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gig0/1, Gig0/2
2    VLAN0002                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
1002 enet  101002     1500  -      -      -        -    -        0      0
1003 enet  101003     1500  -      -      -        -    -        0      0
1004 enet  101004     1500  -      -      -        -    -        0      0
1005 enet  101005     1500  -      -      -        -    -        0      0
```

Switch # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 1
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 6
VTP Operating Mode              : Server
VTP Domain Name                 :
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

Note: Default VLANs are 5 but after creating VLAN 2 total no of VLANs are 6

Switch (config) # vlan 4-6
Switch (config-vlan) # exit

Switch (config) # vlan 7-9,10
Switch (config-vlan) # exit

Switch # show vlan

```
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, Fa0/19, Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23, Fa0/24
                                                 Gig0/1, Gig0/2
2    VLAN0002                          active
4    VLAN0004                          active
5    VLAN0005                          active
6    VLAN0006                          active
7    VLAN0007                          active
8    VLAN0008                          active
9    VLAN0009                          active
10   VLAN0010                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
4    enet  100004     1500  -      -      -        -    -        0      0
5    enet  100005     1500  -      -      -        -    -        0      0
6    enet  100006     1500  -      -      -        -    -        0      0
7    enet  100007     1500  -      -      -        -    -        0      0
8    enet  100008     1500  -      -      -        -    -        0      0
9    enet  100009     1500  -      -      -        -    -        0      0
10   enet  100010     1500  -      -      -        -    -        0      0
1002 enet  101002     1500  -      -      -        -    -        0      0
1003 enet  101003     1500  -      -      -        -    -        0      0
1004 enet  101004     1500  -      -      -        -    -        0      0
1005 enet  101005     1500  -      -      -        -    -        0      0
```

Switch # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 8
Maximum VLANs supported locally : 1005
Number of existing VLANs        :13
VTP Operating Mode              : Server
VTP Domain Name                 :
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

Note: Default VLANs are 5 but after creating 8 VLANs total no of VLANs are 13

Switchport Modes

The option for the switchport mode command are as follows:

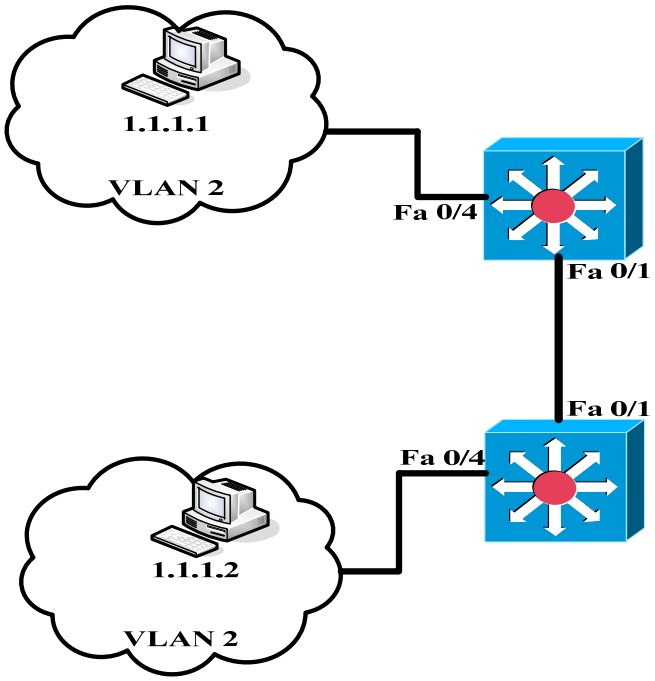
TRUNK

Configures the port to permanent trunk mode and negotiates with the connected device on the other side to convert the link to trunk mode. If multiple trunk encapsulations are available, the encapsulation must be chosen before this command will work.

Access

Disables port trunk mode and negotiates with the connected device to convert the link to non trunk. This port will belong to only the configured access VLAN.

LAB Simulation



Task to complete in this simulation:

1. Configure host names of switches as **A** and **B**
2. Set VTP domain as CISCO on both switches
3. Set VTP mode of switch A as server
4. Set VTP mode of switch B as client
5. Create vlan 2 and vlan 3 on Switch A
6. Create trunk link b/w Switch **A** and Switch **B** on Fa 0/1
7. Assign port Fa 0/4 of both switches to vlan 2.
8. Conclude result by ping from Switch **A** to Switch **B**

Configuration of Switch-A

```
Switch (config) #  hostname A
A (config) #  vtp domain CISCO
Changing VTP domain from NULL to CISCO

A (config) # vtp mode server
Device mode already VTP SERVER.
```

Creating Trunk on Switch-A

A (config) # interface fastethernet 0/1
A (config-if) # switchport trunk encapsulation dot1q
A (config-if) # switchport mode trunk

Configuration of Switch-B

Switch (config) # hostname B
B (config) # vtp domain CISCO
Changing VTP domain from NULL to CISCO

B (config) # vtp mode client
Setting device to VTP CLIENT mode.

Creating Trunk on Switch-A

B(config) # interface fastethernet 0/1
B (config-if) # switchport trunk encapsulation dot1q
B (config-if) # switchport mode trunk

Verify Trunk Link

Switch # show interfaces trunk

Port	Mode	Encapsulation	Status	Native vlan
Fa0/1	on	802.1q	trunking	1

Port	Vlans allowed on trunk
Fa0/1	1-1005

Port	Vlans allowed and active in management domain
Fa0/1	1,1002,1003,1004,1005

Port	Vlans in spanning tree forwarding state and not pruned
Fa0/1	1,1002,1003,1004,1005

Creating VLANs on Switch-A

A(config)# vlan 2
A (config-vlan) # exit

A(config)# vlan 3

Verification of VLANs on Switch-A

A # show vlan

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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, Fa0/19, Fa0/20, Fa0/21
                                                 Fa0/22, Fa0/23, Fa0/24, Gig0/1
                                                 Gig0/2
2    VLAN0002                          active
3    VLAN0003                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
3    enet  100003     1500  -      -      -        -    -        0      0
1002 enet  101002     1500  -      -      -        -    -        0      0
1003 enet  101003     1500  -      -      -        -    -        0      0
1004 enet  101004     1500  -      -      -        -    -        0      0
1005 enet  101005     1500  -      -      -        -    -        0      0
```

Note: VLAN 2 & VLAN 3 has been created on Switch-A

A # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 2
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 7
VTP Operating Mode              : Server
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

Note: Default VLANs are 5 but after creating 2 VLANs total no of VLANs are 7

Verification of VLANs on Switch-B

B # show vlan

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    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, Fa0/19, Fa0/20, Fa0/21
                                                 Fa0/22, Fa0/23, Fa0/24, Gig0/1
                                                 Gig0/2
2    VLAN0002                          active
3    VLAN0003                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active

VLAN Type  SAID       MTU   Parent RingNo BridgeNo Stp  BrdgMode Trans1 Trans2
---- ----- ---------- ----- ------ ------ -------- ---- -------- ------ ------
1    enet  100001     1500  -      -      -        -    -        0      0
2    enet  100002     1500  -      -      -        -    -        0      0
3    enet  100003     1500  -      -      -        -    -        0      0
1002 enet  101002     1500  -      -      -        -    -        0      0
1003 enet  101003     1500  -      -      -        -    -        0      0
1004 enet  101004     1500  -      -      -        -    -        0      0
1005 enet  101005     1500  -      -      -        -    -        0      0
```

Note: VLAN 2 & VLAN 3 has been propagated on Switch-B

B # show vtp status

```
VTP Version                     : 2
Configuration Revision          : 2
Maximum VLANs supported locally : 1005
Number of existing VLANs        : 7
VTP Operating Mode              : Client
VTP Domain Name                 : CISCO
VTP Pruning Mode                : Disabled
VTP V2 Mode                     : Disabled
VTP Traps Generation            : Disabled
MD5 digest                      : 0x7D 0x5A 0xA6 0x0E 0x9A 0x72 0xA0 0x3A
Configuration last modified by 0.0.0.0 at 0-0-00 00:00:00
Local updater ID is 0.0.0.0 (no valid interface found)
```

Note: No of VLANs on Switch-B are same as on Switch-A. As Switch-B is in client mode which shows that Switch-A has propagated its VLAN database on Sitch-B

Assigning Membership to Interface on Switch-A

A (config) # interface fastethernet 0/4
A (config-if) # switchport mode access
A (config-if) # switchport access vlan 2

A # show vlan

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/2, Fa0/3, 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
                                                 Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                 Fa0/23, Fa0/24, Gig0/1, Gig0/2
2    VLAN0002                          active    Fa0/4
3    VLAN0003                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

Note: Interface FastEthernet 0/1 has been assigned to VLAN 2

Assigning Membership to Interface on Switch-B

B (config) # interface fastethernet 0/4
B (config-if) # switchport mode access
B (config-if) # switchport access vlan 2

B # show vlan

```
VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/2, Fa0/3, 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
                                                 Fa0/19, Fa0/20, Fa0/21, Fa0/22
                                                 Fa0/23, Fa0/24, Gig0/1, Gig0/2
2    VLAN0002                          active    Fa0/4
3    VLAN0003                          active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

Note: Interface FastEthernet 0/1 has been assigned to VLAN 2

Verification by ping 1.1.1.1 & 1.1.1.2

```
PC>ping 1.1.1.2

Pinging 1.1.1.2 with 32 bytes of data:

Reply from 1.1.1.2: bytes=32 time=125ms TTL=128
Reply from 1.1.1.2: bytes=32 time=107ms TTL=128
Reply from 1.1.1.2: bytes=32 time=78ms TTL=128
Reply from 1.1.1.2: bytes=32 time=79ms TTL=128

Ping statistics for 1.1.1.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 78ms, Maximum = 125ms, Average = 97ms
```

Note: ping will be successful as 1.1.1.1 & 1.1.1.2 are in same vlan

Port Security

Configure Port Security on Fa0/4 of Switch

A (config) # interface fastethernet 0/1
A (config-if) # switchport port-security
Enables port security on the interface.

A (config-if) # switchport port-security maximum 4
A (config-if) # switchport port-security mac-address 1234.5678.90ab
Sets a specific secure MAC address 1234.5678.90ab.

A (config-if) # switchport port-security violation shutdown
Configures port security to shut down the interface if a security violation occurs.

Verifying Switch Port Security

A # show port-security interface fastethernet 0/4

```
Port Security : Enabled
Port Status : error disable
Violation Mode : Shutdown
Aging Time : 0 mins
Aging Type : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses : 1
Total MAC Addresses : 1
Configured MAC Addresses : 1
Sticky MAC Addresses :
Last Source Address : 1234.5678.90ab
Security Violation Count : 1
```

Spanning Tree Protocol (STP)

Spanning-Tree Protocol is a link management protocol that provides path redundancy while preventing undesirable loops in the network. For an Ethernet network to function properly, only one active path can exist between two stations.

BPDU

Bridges must communicate with one another to execute the STP, and they accomplish this by sending configuration messages in the form of Bridge Protocol Data Unit (BPDUs). After every 2 seconds STP sends BPDUs out every port of the bridge.

Here is some of the information provided in BPDU:

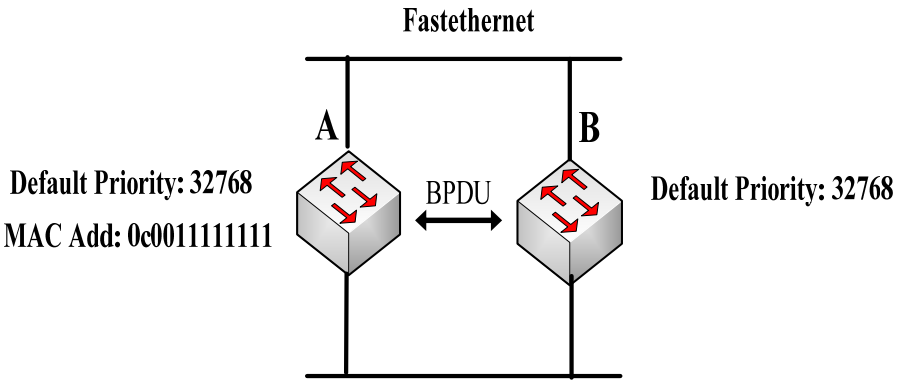
Root ID – The lowest Bridge ID (BID) in the topology.
Cost of Path – Cost of all links from the transmitting switch to the root bridge.
BID – Bid of the transmitting switch.
Port ID – Transmitting switch Port ID.
STP Timer Values – Max age, hello time, forward delay

Root Bridge

- Reference point
- One root per VLAN
- Maintains topology
- Propagates timers

STP uses the concept of root bridge, root ports and designated ports to establish a loop-free path through the network. The first step in creating the loop-free path through the network. The root bridge is the reference point that all switches use to establish forwarding paths that will avoid loops in the layer 2 network.

Selection of Root Bridge

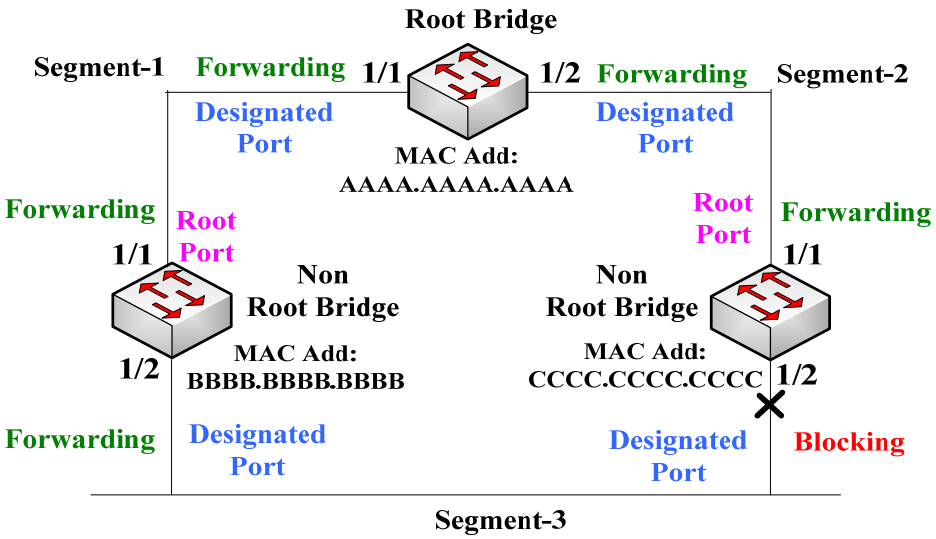


BPDUs are exchanged b/w switches and the analysis of the BID and root ID information from those BPDUs determines which bridge is selected as the root bridge.

In the example shown, both switches have the same priority for the same VLAN. The switch with the lowest MAC address will, therefore be elected as root bridge. In the example, Switch-A is the root bridge for VLAN1, with a BID of 0x8001:0c0011111111.

Port Roles

- One root bridge per network/Vlan
- One root port per non-root bridge
- One designated port per segment



Spanning Tree Mechanism

There are four port roles in spanning tree:

Root Port
This port exists on nonroot bridges and is the switch port with the best path to the root bridge. Root ports forward traffic toward the root bridge. Only one root port is allowed per bridge.

Designated Port
This port exists on root and non root bridges. For root bridges, all switch ports are designated ports. For nonroot bridges, a designated port is the switch port that will receive and forward frames toward the root bridges as needed. Only one designated port is allowed per segment. If multiple switches exist on the same segment, an election process determines the designated switch, and the corresponding switch port begins forwarding frames for segment.

Non Designated Port
The non designated port is a switch port that is not forwarding (blocking) data frames and not populating the MAC address table with the source addresses of frames seen on that segment.

Disable Port
The disabled port is a switch port that is shut down.

Spanning Tree Port States

Blocking
A port in the blocking state does not participate in frame forwarding. After initialization, a BPDU is sent to each port in the switch. A switch initially assumes it is the root until it exchanges BPDUs with other switches. This exchange establishes which switch in the network is really the root. If only one switch resides in the network, no exchange occurs, the forward delay timer expires, and the ports move to the listening state.

Learning
The listening state is the first transitional state a port enters after the blocking state, when Spanning-Tree Protocol determines that the port should participate in frame forwarding. Learning is disabled in the listening state.

Learning State
A port in the learning state is preparing to participate in frame forwarding. This is the second transitional state through which a port moves in anticipation of frame forwarding. The port enters the learning state from the listening state through the operation of Spanning-Tree Protocol.

Forwarding State
A port in the forwarding state forwards frames and also sends and receives BPDUs. The port enters the forwarding state from the learning state through the operation of Spanning-Tree Protocol.

Disabled State

A port in the disabled state does not participate in frame forwarding or the operation of Spanning-Tree Protocol. A port in the disabled state is virtually nonoperational.

Root Port Election

The switch looks at the following components in the BPDU to determine which switch ports will forward data and which switch ports will block data:

a. **Lowest path cost**
b. **Lowest sender BID**
c. **Lowest sender port ID**

The switch looks at the path cost first to determine which port is receiving the lowest-cost path. The path is calculated on the basis of link speed and the number of links the BPDU traversed. Id a port has the lowest cost, that port is eligible to be placed in forwarding mode. All other ports that are receiving BPDUs continue in blocking mode.

If the path cost and sender BID are equal, as with parallel links b/w two switches, the switch goes to the port ID as a "**tiebreaker**". The port with the lowest port ID forwards data frames, and all other ports continue to block data frames.

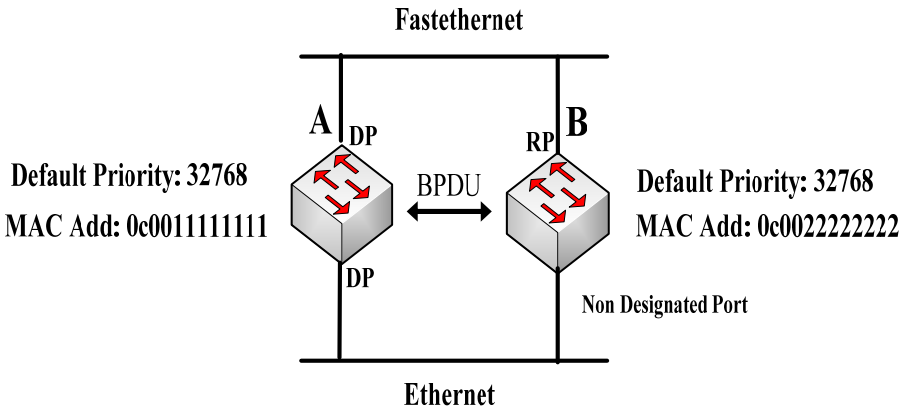
Spanning Tree Path Cost

Link Speed	Cost (Revised IEEE Spec)
10 Gbps	2
1 Gbps	4
100 Mbps	19
10 Mbps	100

A **path cost** value is given to each port. The cost is typically based on a guideline established as part of 802.1d. According to the original specification, cost is 1,000 Mbps (1 gigabit per second) divided by the bandwidth of the segment connected to the port. Therefore, a 10 Mbps connection

would have a cost of (1,000/10) 100 as shown in table. The lowest path is considered to be the best path.

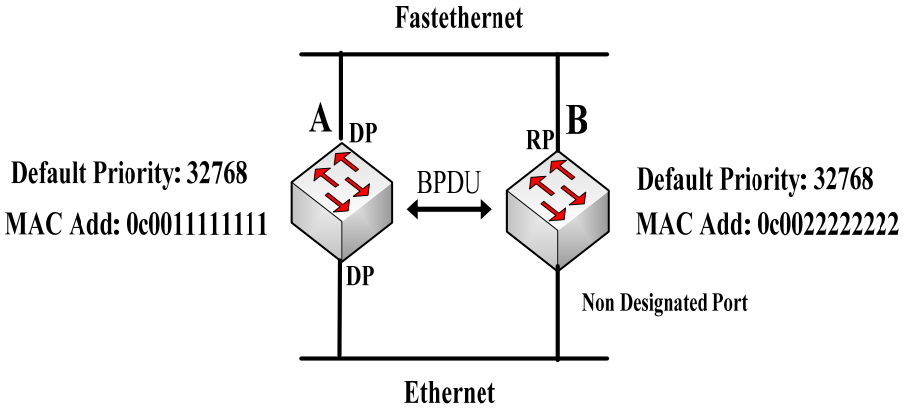
STP Root Port Election



- SW-A is the root bridge.
- SW-B will elect a root port.

Switch_B receives a BPDU from the root bridge (Switch-A) on its switch port Fastethernet segment and another BPDU on its switch port Ethernet segment. The root path cost in both cases is zero.
The local path cost on the Fastethernet switch port is 19, whereas the local path cost on the Ethernet switch port is 100. As a result, the switch port on the Fastethernet segment has the lowest path cost to the root bridge and is elected the root port for switch_B.

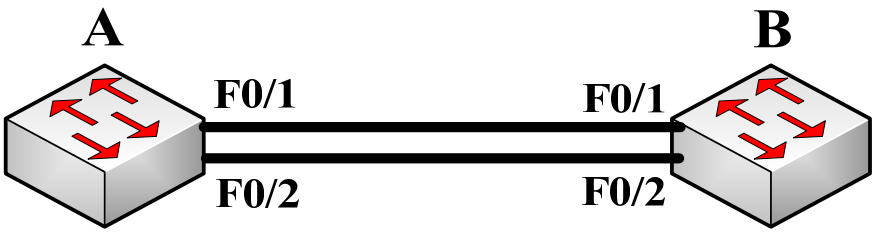
STP Designated Port Election



STP selects one designated port per segment to forward traffic. Other switch ports on the segment become non designated ports and continue blocking. The switch port on the segment
with the lowest path cost to the root bridge is elected as the designated port. If multiple switch ports on a switch have the same path cost and are connecting to the same neighbor switch, then the switch port with the lowest sender port ID becomes the designated port.

Because ports on the root bridge all have a root path cost of zero so all ports on the root bridge are designated ports.

Verification of Root Bridge



A # show spanning-tree

```
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C74D.1094
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.C74D.1094
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/1            Desg LSN 19        128.1    P2p
```

Note: Switch-A has become Root Bridge for VLAN 1. Interface Fa0/1 of Switch-A is in listening state as is needs 50 sec to go in forwarding state from blocking state.

A # show spanning-tree

```
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C74D.1094
             This bridge is the root
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0001.C74D.1094
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Desg FWD 19        128.2    P2p
Fa0/1            Desg FWD 19        128.1    P2p
```

Note: After 50 sec Interface Fa0/1 of Switch-A is in forwarding state.

B# show spanning-tree

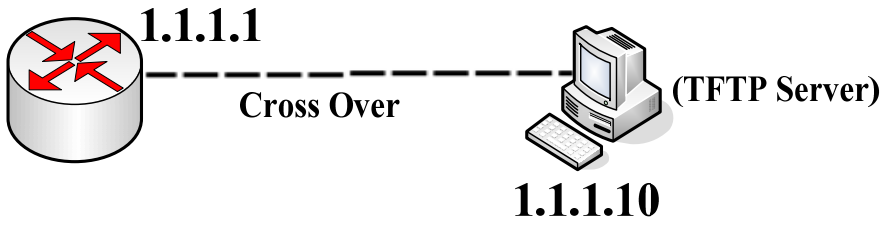
```
VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    32769
             Address     0001.C74D.1094
             Cost        19
             Port        1(FastEthernet0/1)
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    32769  (priority 32768 sys-id-ext 1)
             Address     0002.4A61.0B14
             Hello Time  2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time  20

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/2            Altn BLK 19        128.2    P2p
Fa0/1            Root FWD 19        128.1    P2p
```

Note: According to the output of spanning tree on Switch-A & Switch-B we can conclude that:

- Switch-A is the **Root Bridge**.
- Interfaces Fa0/1 & Fa0/2 of Switch-A are in **Designated** state.
- Port Fa0/1 of Switch-B is **Root** port as its port number is smaller
- Port Fa0/2 of Switch-B is in **Blocking** State.

Part 6

Backing Up the Cisco IOS

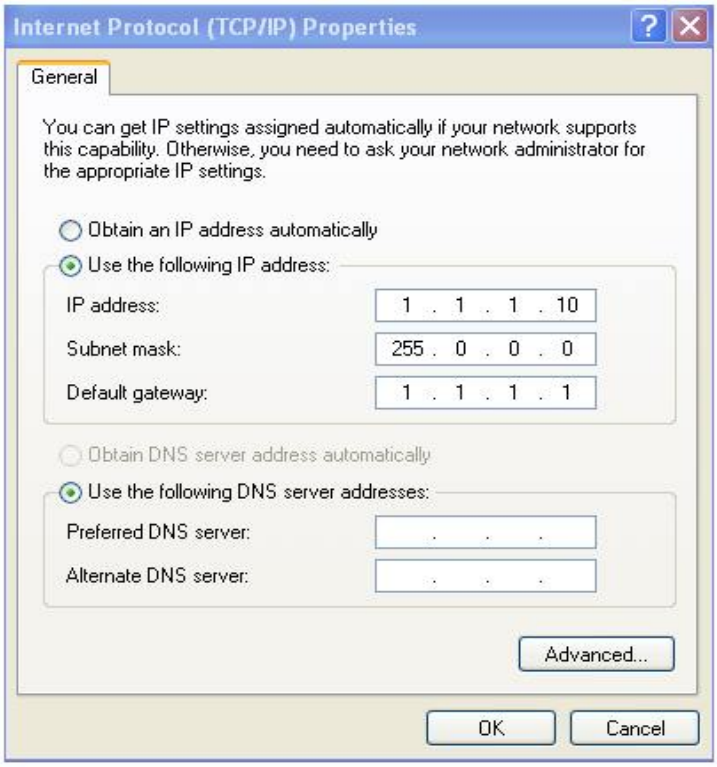


Configuration on Router

Router (config) # interface fastethernet 0/0
Router (config-if) # ip address 1.1.1.1 255.0.0.0
Router (config-if) # no shutdown

Configuration on TFTP Server

Run TFTP service on your PC it will start providing TFTP services. Now simply assign IP address to TFTP server as shown in fig.



Verifying Connectivity b/w Router and TFTP Server!!!

Router # ping 1.1.1.10

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.10, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 31/34/47 ms
```

Router # show flash

```
System flash directory:
File  Length   Name/status
  1   50938004 c2800nm-advipservicesk9-mz.124-15.T1.bin
[50938004 bytes used, 13078380 available, 64016384 total]
63488K bytes of processor board System flash (Read/Write)
```

Router # copy flash tftp

```
Address or name of remote host []? 1.1.1.10
Source filename []? c2800nm-advipservicesk9-mz.124-15.T1.bin
Destination filename [c2800nm-advipservicesk9-mz.124-15.T1.bin]? cisco-2800

Loading c2800nm-advipservicesk9-mz.124-15.T1.bin from 1.1.1.10: !!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
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!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!
[OK - 50938004 bytes]

50938004 bytes copied in 36.882 secs (100140 bytes/sec)
```
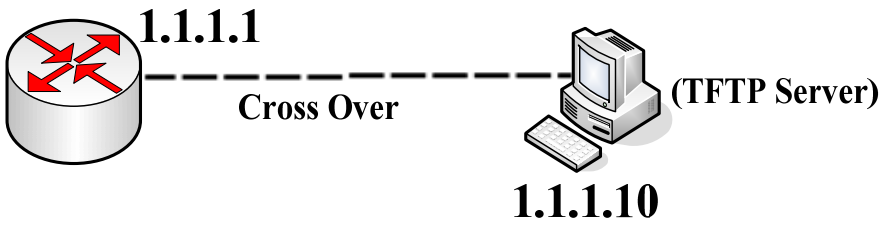

Note: IOS of Router has been copied to TFTP server.

Upgrading the Cisco IOS



Router # copy tftp flash

```
Address or name of remote host []? 1.1.1.10
Source filename []? c2600-i-mz.122-28.bin
Destination filename [c2600-i-mz.122-28.bin]? cisco-2600

Loading c2600-i-mz.122-28.bin from 1.1.1.10: !!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 5571584 bytes]

5571584 bytes copied in 3.312 secs (385451 bytes/sec)
```

Router # show flash

```
System flash directory:
File  Length   Name/status
  7   5571584  c2600-i-mz.122-28.bin
  8   5571584  cisco-2600
[11143168 bytes used, 52873216 available, 64016384 total]
63488K bytes of processor board System flash (Read/Write)
```

Note: Router has now two IOS in its Flash. (i.e; Dual Booted)

Changing Bootup Sequence

Router (config) # boot system flash cisco-2600
Router # write
Router # reload

Note: After reloading Router will boot from cisco-2600

Router # show version

```
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2005 by cisco Systems, Inc.
Compiled Wed 27-Apr-04 19:01 by miwang
Image text-base: 0x8000808C, data-base: 0x80A1FECC

ROM: System Bootstrap, Version 12.1(3r)T2, RELEASE SOFTWARE (fc1)
Copyright (c) 2000 by cisco Systems, Inc.
ROM: C2600 Software (C2600-I-M), Version 12.2(28), RELEASE SOFTWARE (fc5)

System returned to ROM by reload
System image file is "flash:cisco-2600.bin"

X.25 software, Version 3.0.0.
2 FastEthernet/IEEE 802.3 interface(s)
32K bytes of non-volatile configuration memory.
16384K bytes of processor board System flash (Read/Write)

Configuration register is 0x2102
```

CORVIT
Reaching end to end

Part 7

Password Recovery Procedure

Step 1:

Boot the router and interrupt the boot sequence as soon as text appears on the screen.

Press Ctrl - Break

Step 2:

Change the configuration register to ignore contents of NVRAM.
> o/r 0x2142

Step 3:

Reload the router.
> i

Step 4:

Enter privileged mode. (Do not enter setup mode.)
Router > enable

Step 5:

Change the password.
Router # configure terminal
Router (config) # enable secret new

Step 6:

Reset the configuration register back to its default value.
Router (config) # config-register 0x2102

Step 7:

Save the configuration.
Router # copy run start

Step 8:
Verify the configuration register.

Router # show version

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

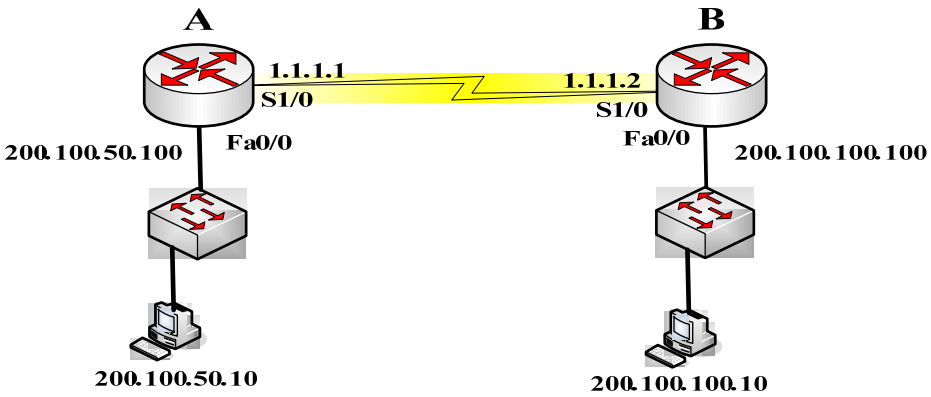
Step 9:

Reload the Router
Router # reload

Part 8

Network Security

Standard Access List



Method-1

Define Standard Access List on Router-B

B (config) # access-list 1 deny host 1.1.1.1
B (config) # access-list 1 permit any

Apply Standard Access List:

B (config) # interface s 1/0
B (config-if) # ip access-group 1 in

Now try to ping Router-B from Router-A
A # ping 1.1.1.2

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

Note: You are not able to ping Router-B from Router-A

Now try to Telnet Router-B from Router-A

A # telnet 1.1.1.2

Trying 1.1.1.2 ...

[Connection to 1.1.1.2 closed by foreign host]

Note: You are not able to telnet Router-B from Router-A
Standard Access List blocked every type of traffic

Method-2

Define Standard Access List on Router-B

B (config) # access-list 1 deny 1.1.1.1 0.0.0.0 (where 0.0.0.0 is source wildcard mask)
B (config) # access-list 1 permit any

Wildcard mask

Apply Standard Access List:

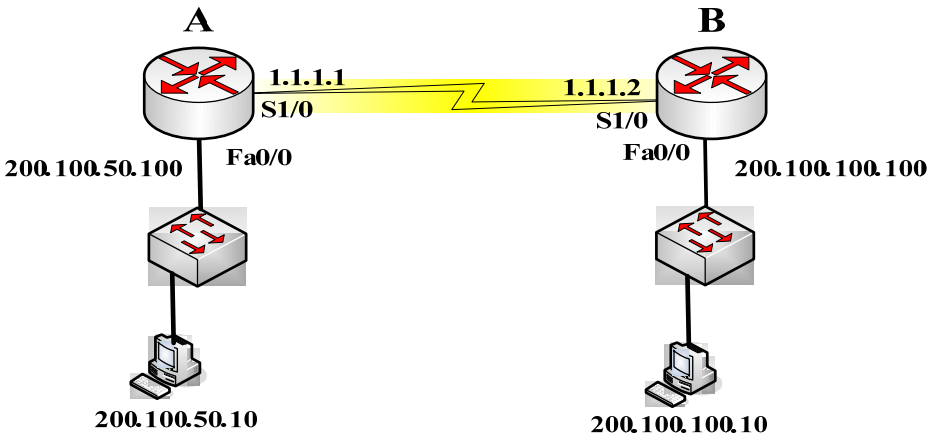
B (config) # interface s 1/0
B (config-if) # ip access-group 1 in

Now try to ping Router-B from Router-A
A # ping 1.1.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

Note: You are not able to ping Router-B from Router-A

Extended Access List



Method-1

Define Standard Access List on Router-B

B (config) # access-list 101 deny tcp host 1.1.1.1host 1.1.1.2 eq telnet
B (config) # access-list 101permit ip any any

Apply Standard Access List:

B (config) # interface s 1/0
B (config-if) # ip access-group 101 in

Now try to ping Router-B from Router-A
A # ping 1.1.1.2

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 16/25/32 ms
```

Note: ping from Router-A to Router-B is successful
As we only deny telnet In Extended Access List.

Now try to Telnet Router-B from Router-A

A # telnet 1.1.1.2

Trying 1.1.1.2 ...

[Connection to 1.1.1.2 closed by foreign host]

Note: You are not able to telnet Router-B from Router-A
Extended Access List can block a specific traffic.

Method-2

Define Standard Access List on Router-B

B (config) # access-list 101 deny icmp 1.1.1.1 0.0.0.0 1.1.1.2 0.0.0.0 echo
B (config) # access-list 101 permit ip any any

Wildcard mask

Apply Standard Access List:

B (config) # interface s 1/0
B (config-if) # ip access-group 101 in

Now try to ping Router-B from Router-A
A # ping 1.1.1.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

Note: You are not able to ping Router-B from Router-A
As we deny icmp packets on Router-B

Now try to Telnet Router-B from PC

Telnet Router-B from PC attached with Router-A

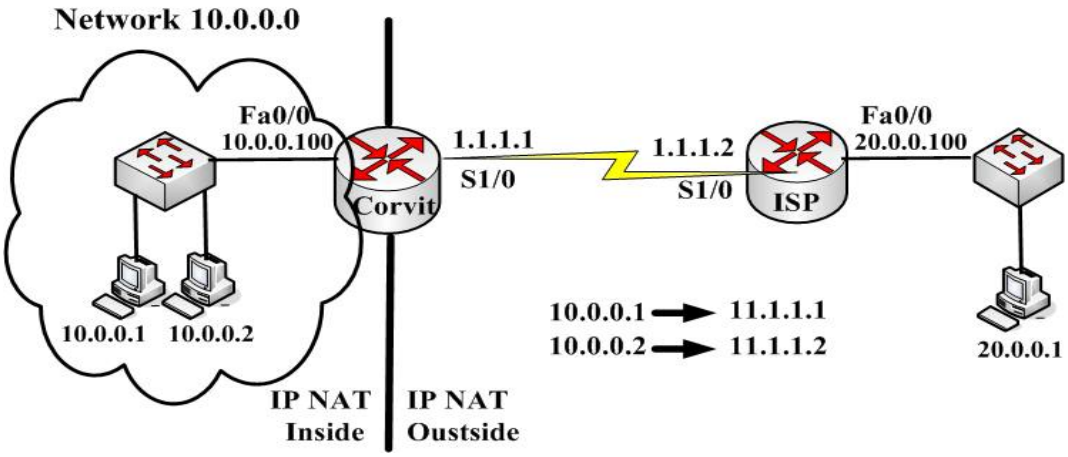
```
PC>telnet 1.1.1.2
Trying 1.1.1.2 ...


User Access Verification

Password:
B>enable
Password:
B#
```

Note: Telnet is successful as we deny only ICMP traffic by Extended Access List

Part 9

Network Address Translation

Static NAT



One Private to One Permanent Public Address Translation

Enable the inside NAT on Router-Corvit

Corvit (config) # int Fa 0/0
Corvit (config-if) # ip nat inside

Enable the outside NAT on Router-Corvit

Corvit (config) # int S 1/0
Corvit (config-if) # ip nat outside

Configure the static Nat on Router-Corvit

Corvit (config) # ip nat inside source static 10.0.0.1 11.1.1.1
Corvit (config) # ip nat inside source static 10.0.0.2 11.1.1.2

Corvit # show ip nat translations

Pro	Inside global	Inside local	Outside local	Outside global
---	11.1.1.1	10.0.0.1	---	---
---	11.1.1.2	10.0.0.2	---	---

Corvit # debug ip nat

IP NAT debugging is on

Verification:-

Go to PC 10.0.0.1 and Ping 20.0.0.1

NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[0]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[0]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[0]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[0]

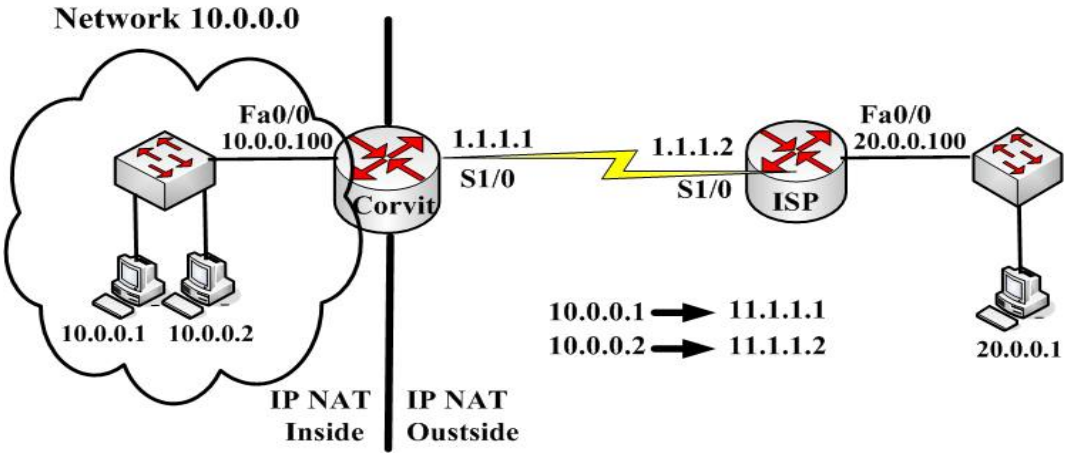
Note: Debugging result shows that ip address 10.0.0.1 is translated into 11.1.1.1

Go to PC 10.0.0.2 and Ping 20.0.0.1

NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[0]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[0]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[0]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[0]

Note: Debugging result shows that ip address 10.0.0.2 is translated into 11.1.1.2

Dynamic NAT



One Private to One Public Address Translation

The task of this Lab is to configure a Dynamic Nat

1. **Enable Nat on interface**
2. **Define a Pool of public Addresses**
3. **Access-list**
4. **Dynamic Source Translation**

Enable the inside NAT on Router-Corvit

```
Corvit (config) # int Fa 0/0
Corvit (config-if) # ip nat inside
```

Enable the outside NAT on Router-Corvit

```
Corvit (config) # int S 1/0
Corvit (config-if) # ip nat outside
```

Define Access List on Router-Corvit

```
Corvit (config) # access-list 1 permit 10.0.0.1  0.0.0.0
Corvit (config) # access-list 1 permit 10.0.0.2  0.0.0.0
```

Define Pool of Public IPs on Router-Corvit

```
Corvit (config) # ip nat pool corvit 11.1.1.1  11.1.1.2  prefix-length  8
```

Call Access List into Public IPs Pool on Router-Corvit

Corvit (config) # ip nat inside source list 1 pool corvit

Corvit # debug ip nat

IP NAT debugging is on

Verification:-

Go to PC 10.0.0.1 and Ping 20.0.0.1

```
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[1]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[1]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[1]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[1]
```

Note: Debugging result shows that ip address 10.0.0.1 is translated into 11.1.1.1

Go to PC 10.0.0.2 and Ping 20.0.0.1

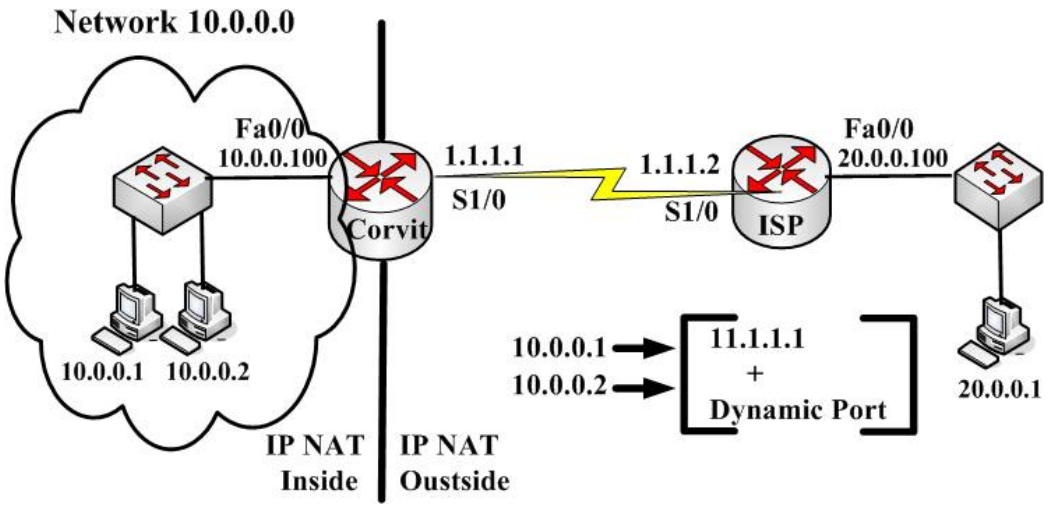
```
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[2]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[2]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[2]
NAT: s=10.0.0.2->11.1.1.2, d=20.0.0.1[2]
```

Note: Debugging result shows that ip address 10.0.0.2 is translated into 11.1.1.2

Corvit # show ip nat translations

Pro	Inside global	Inside local	Outside local	Outside global
---	11.1.1.1	10.0.0.1	---	---
---	11.1.1.2	10.0.0.2	---	---

Overload NAT (PAT)



The task of this Lab is to configure a Dynamic Nat

1. **Enable Nat on interface**
2. **Define a Pool of public Addresses**
3. **Access-list**
4. **Dynamic Source Translation using PAT**

Enable the inside NAT on Router-Corvit

```
Corvit (config) # int Fa 0/0
Corvit (config-if) # ip nat inside
```

Enable the outside NAT on Router-Corvit

```
Corvit (config) # int S 1/0
Corvit (config-if) # ip nat outside
```

Define Access List on Router-Corvit

```
Corvit (config) # access-list 1 permit 10.0.0.1  0.0.0.0
Corvit (config) # access-list 1 permit 10.0.0.2  0.0.0.0
```

Define Pool of Public IPs on Router-Corvit

```
Corvit (config) # ip nat pool corvit 11.1.1.1  11.1.1.2  netmask 8
```

Call Access List into Public IPs Pool on Router-Corvit

Corvit (config) # ip nat inside source list 1 pool corvit

Corvit # debug ip nat
IP NAT debugging is on

Verification:-

Go to PC 10.0.0.1 and Ping 20.0.0.1

```
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[13]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[14]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[15]
NAT: s=10.0.0.1->11.1.1.1, d=20.0.0.1[16]
```

Note: Debugging result shows that ip address 10.0.0.1 is translated into 11.1.1.1

Go to PC 10.0.0.2 and Ping 20.0.0.1

```
NAT: s=10.0.0.2->11.1.1.1, d=20.0.0.1[17]
NAT: s=10.0.0.2->11.1.1.1, d=20.0.0.1[18]
NAT: s=10.0.0.2->11.1.1.1, d=20.0.0.1[19]
NAT: s=10.0.0.2->11.1.1.1, d=20.0.0.1[20]
```

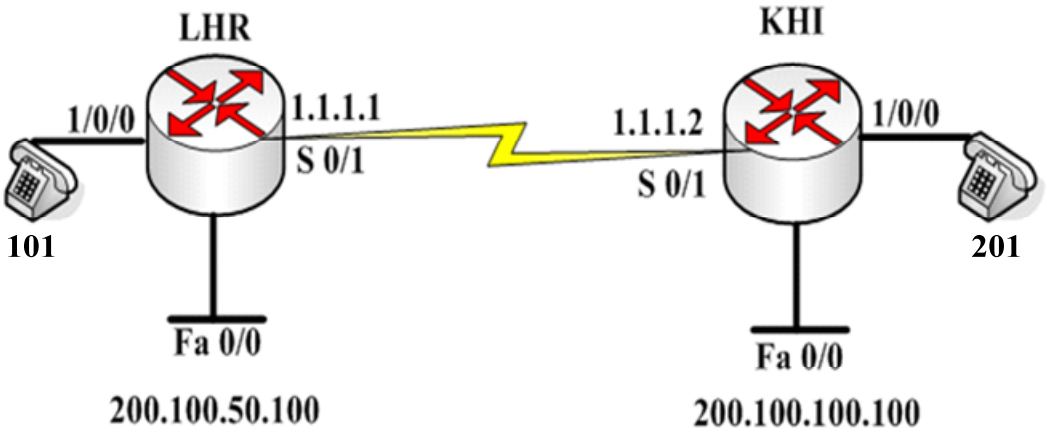
Note: Debugging result shows that ip address 10.0.0.2 is translated into 11.1.1.1

Corvit # show ip nat translations

Pro	Inside global	Inside local	Outside local	Outside global
icmp	11.1.1.1:69	10.0.0.1:69	20.0.0.1:69	20.0.0.1:69
icmp	11.1.1.1:70	10.0.0.1:70	20.0.0.1:70	20.0.0.1:70
icmp	11.1.1.1:15	10.0.0.2:15	20.0.0.1:15	20.0.0.1:15
icmp	11.1.1.1:16	10.0.0.2:16	20.0.0.1:16	20.0.0.1:16
tcp	11.1.1.1:1026	10.0.0.2:1026	20.0.0.100:23	20.0.0.100:23

Note: NAT table shows that both private address are translated Into 1 public address with dynamic port numbers

Part 10
Voice Over IP



Configuration of POTS on Router-LHR

LHR (config) # dial-peer voice 1 POTS
LHR (config-dial-peer) # destination-pattern 101
LHRt (config-dial-peer) # port 1/0/0

Configuration of VOIP on Router-LHR

LHR (config) # dial-peer voice 1 VOIP
LHR(config-dial-peer) # destination-pattern 201
LHR (config-dial-peer) # session target ipv4:1.1.1.2

Configuration of POTS on Router-KHI

KHI (config) # dial-peer voice 1 POTS
KHI (config-dial-peer) # destination-pattern 201
KHI (config-dial-peer) # port 1/0/0

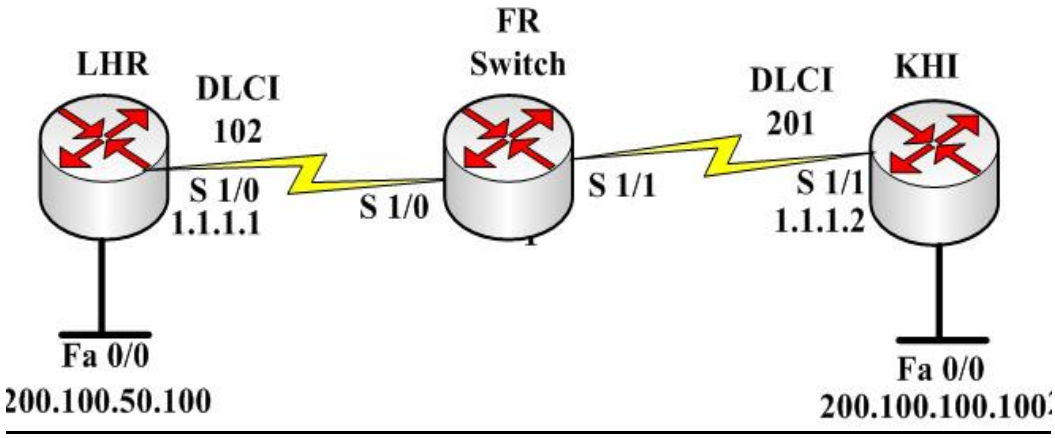
Configuration of VOIP on Router-LHR

KHI (config) # dial-peer voice 1 VOIP
KHI (config-dial-peer) # destination-pattern 101
KHI (config-dial-peer) # session target ipv4:1.1.1.1

Note: Now dial 201 from Router-LHR to call Router-KHI

Part 11

Frame Relay



Configuration on Router-LHR

```
LHR (config) # int s 1/0
LHR (config-if) # ip address 1.1.1.1  255.0.0.0
LHR (config-if) # encapsulation frame-relay
LHR (config-if) # frame-relay lmi-type ansi
LHR (config-if) # frame-relay map ip 1.1.1.2   102
```

Configuration on Router-KHI

```
KHI (config) # int s 1/1
KHI (config-if) # ip address 1.1.1.2  255.0.0.0
KHI (config-if) # encapsulation frame-relay
KHI (config-if) # frame-relay lmi-type ansi
KHI (config-if) # frame-relay map ip 1.1.1.1    201
```

Configuration on Frame Relay Switch

```
FR (config) # frame-relay switching
FR (config) # int s 1/0
FR (config-if) # no ip address
FR (config-if) # encapsulation frame-relay
FR (config-if) # frame-relay lmi-type ansi
FR (config-if) # frame-relay intf-type dce
FR (config-if) # clock rate 64000
FR (config-if) # frame-relay route 102 interface serial  1/1 201
FR (config-if) # exit

FR (config) # int s 1/1
FR (config-if) # no ip address
FR (config-if) # encapsulation frame-relay
FR (config-if) # frame-relay lmi-type ansi
FR (config-if) # frame-relay intf-type dce
FR (config-if) # clock rate 64000
FR (config-if) # frame-relay route 201 interface serial  1/0  102
```

Note: Now ping 1.1.1.2 from 1.1.1.1. The ping will be successful as both routers are directly connected