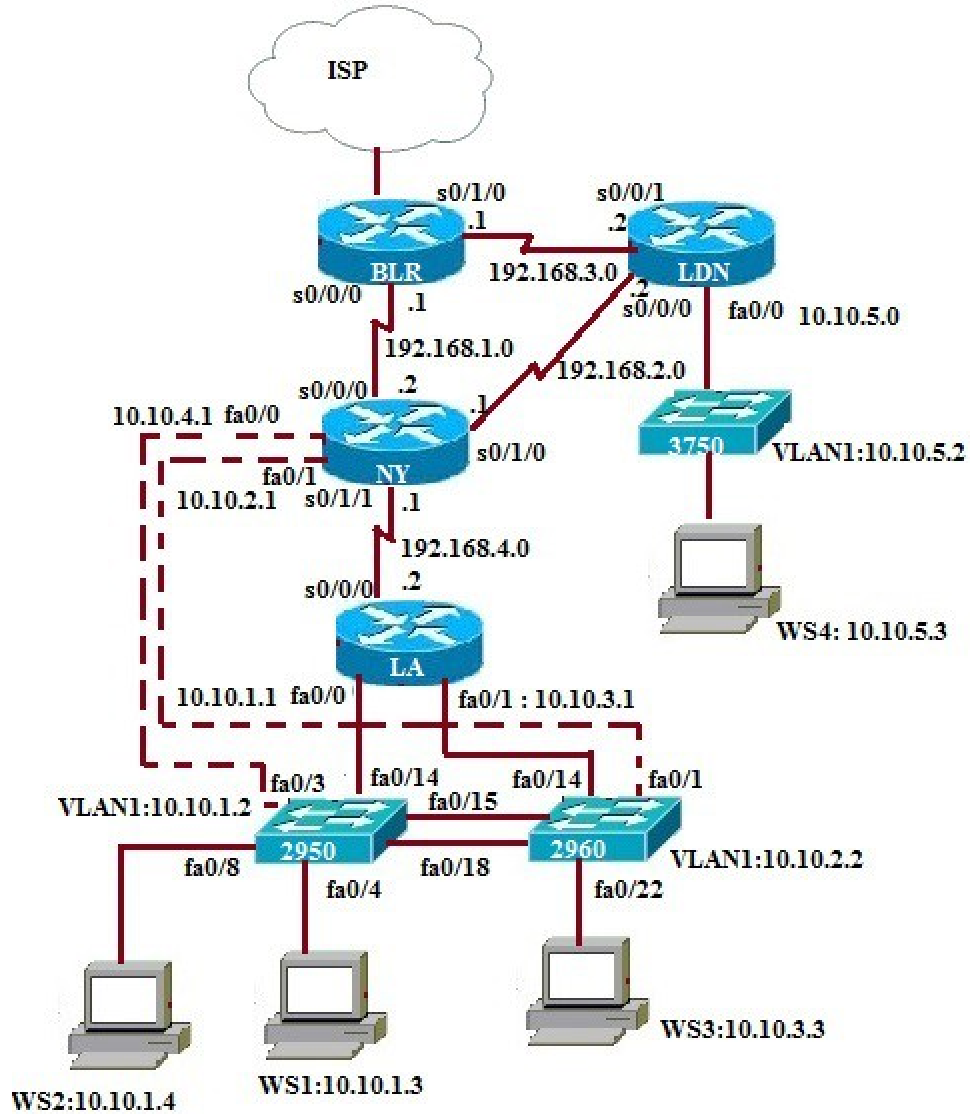
LAB MANUAL FOR CCNA

Version 4.0

CONTENTS:

1. BASIC EXERCISES

Note: *Please refer to the below default network Diagram for all the exercises given in this manual*



1.1: Lab Exercise 1: Entering User EXEC prompt on a Router, and exit

Description: A basic exercise, that shows how to enter into privileged EXEC prompt from user mode prompt, and exit from the same.

Instructions:

1. Enter into privileged mode
2. Get back to the user mode

BLR>
Password:Cisco
BLR>enable
BLR#disable
BLR>

Back

1.2: Lab Exercise 2: Introduction to Basic User Interface

Description: This exercise helps to get familiar with the user mode, privileged mode, CLI and basic commands.

Instructions:

1. Press enter to get the router prompt
2. In the user mode, type the command ? used to view all the commands in user mode
3. Enter into privileged mode
4. In the privileged mode, type the command ? to view all the commands in privileged mode
5. The command show ? displays all the show commands like show access-list, show banner, show cdp, show hosts, show flash, show protocols etc
6.The command show running-config displays the running configuration
7. Press space bar to view more information
8. The command "exit or disable" logs out the router

BLR>
BLR>?
BLR>enable
BLR#
BLR#?
BLR#show ?
BLR#show running-config
BLR#exit
Or
BLR#disable

Back

1.3: Lab Exercise 3: Basic show commands

Description: A basic exercise to get familiar and understand the various show commands available in the privileged mode.

Instructions:

1. Enter into privileged mode
2. Show running-config displays the active configuration in memory. The currently active configuration script running on the router is referred to as the running-config in the router's CLI
3. Show flash memory. Flash memory is a special kind of memory that contains the operating system image file(s) on the router
4. Show history command displays all the past commands still present in router's memory
5. Show protocols command displays the protocols running on your router

6. Show version command displays critical information, such as router platform type, operating system revision, operating system last boot time and file location, amount of memory, number of interfaces, and configuration register
7. Show clock command displays the router's clock
8. Show hosts command displays list of hosts and all their interfaces IP Addresses
9. Show users command displays list of users who are connected to the router
10. Show interfaces command displays detailed information about each interface

BLR>
BLR>enable
BLR#show running-config
BLR#show flash
BLR#show history
BLR#show protocols
BLR#show version
BLR#show clock
BLR#show hosts
BLR#show interfaces

Below is the "show protocols" command output

```
BLR#show protocols
Global values:
  Internet Protocol routing is enabled
FastEthernet0/0 is up, line protocol is up
  Internet address is 192.168.0.130/24
FastEthernet0/1 is administratively down, line protocol is down
Serial0/0/0 is up, line protocol is up
  Internet address is 192.168.1.2/24
Serial0/1/0 is down, line protocol is down
  Internet address is 192.168.3.1/24
Serial0/1/1 is administratively down, line protocol is down
```

Below is the "show version " command output

```
BLR#show version
Cisco IOS Software, 1841 Software (C1841-SPSERVICESK9-M), Version 12.4(15)T17, RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2012 by Cisco Systems, Inc.
Compiled Tue 24-Jan-12 06:54 by prod_rel_team

ROM: System Bootstrap, Version 12.3(8r)T9, RELEASE SOFTWARE (fc1)

BLR uptime is 1 hour, 18 minutes
System returned to ROM by power-on
System image file is "flash:c1841-spservicesk9-mz.124-15.T17.bin"


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

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

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

Cisco 1841 (revision 6.0) with 116736K/14336K bytes of memory.
Processor board ID FTX0952W07B
2 FastEthernet interfaces
1 Serial interface
2 Serial(sync/async) interfaces
DRAM configuration is 64 bits wide with parity disabled.
191K bytes of NVRAM.
255488K bytes of ATA CompactFlash (Read/Write)

Configuration register is 0x2102
```

Below is the “show clock” command output

```
BLR#show clock
*10:03:07.915 UTC Tue Oct 15 2019
BLR#
```

Back

1.4 Short form commands

1. copy running-config startup-config command can be interpreted and used in short form as “copy run start” command.
2. show running-config command can be interpreted and used in short form as “show run” command.
3. show startup-config command can be interpreted and used in short form as “show start” command.
4. copy running-config tftp command can be interpreted and used in short form as "copy run tftp" command.
5. copy tftp startup-config command can be interpreted and used in short form as "copy tftp start" command.

Note: We can also use **UP ARROW** and **DOWN ARROW** keys to get the previously typed command in the simulator.

Back

2. ROUTING IOS FUNDAMENTAL EXERCISES

2.1: Lab Exercise 1: Banner MOTD-Setting message of the day

Description: This exercise helps in understanding the procedure of setting message of the day and the show banner command. Note that the banner is set in a single command line here. You can also use multi-line banner motd command.

Instructions:

1. Enter into privileged mode
2. Enter into global Configuration Mode
3. Set banner to: "Welcome to local host". Starting and ending character of the banner should be "Z" (Do not use quotes)
4. Use show banner command to view the banner that has been set

BLR>enable
BLR#configure terminal
BLR(config)#banner motd Z Welcome to local host Z
BLR(config)#exit
BLR#show running-configuration

```
!
ip http server
no ip http secure-server
!
logging trap warnings
logging facility local3
logging 192.168.1.1
!
!
!
control-plane
!
!
banner motd ^C welcome to local host z
```

[Back](#)

2.2: Lab Exercise 2: Setting Host Name

Description: This basic exercise illustrates the steps required to set a hostname to a router.

Instructions:

1. Enter into privileged mode
2. Enter into global Configuration Mode
3. Set hostname as cisco

BLR>enable
BLR#configure terminal
BLR(config)#hostname cisco
BLR(config)#exit
BLR#show running-config

You can give "show running-config" command to check the output ,where hostname changed to cisco from BLR

```
!
hostname cisco
!
boot-start-marker
boot-end-marker
!
enable secret 5 $1$IyiF$F5Rqt/3aSm.emLCsqCTFb.
enable password CCNA
!
```

[Back](#)

2.3: Lab Exercise 3: Router Interface Configuration

Description: In this lab, you will learn to enable interfaces on a router i.e, configure Serial 0/0/0 and FastEthernet 0/0 interfaces on a router with specified IP Address and Subnet Mask.

Instructions:

1. Enter into privileged mode
2. Enter into global Configuration Mode
3. Set IP Address of Serial 0/0/0 as 192.168.1.2 and Subnet Mask as 255.255.255.5
4. Set IP Address of FastEthernet 0/0 as 192.168.0.130 and Subnet Mask as 255.255.255.0

BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)#exit
BLR(config)#interface fastethernet 0/0
BLR(config-if)#ip address 192.168.0.130 255.255.255.0

By giving “show running-config” command you can view the ip address configured on the interfaces

```
interface FastEthernet0/0
 description Local Network
 ip address 192.168.0.130 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/0/0
 description WAN Link to NY Hub from BLR
 ip address 192.168.1.2 255.255.255.0
!
interface Serial0/1/0
 ip address 192.168.3.1 255.255.255.0
 clock rate 2000000
!
interface Serial0/1/1
 no ip address
 shutdown
 clock rate 2000000
!
```

<Output omitted for bravity>

Back

2.4: Lab Exercise 4: Setting Bandwidth on an interface

Description: Bandwidth refers to the rate at which data is transferred over the communication link. You setup the bandwidth on a given interface (interface serial 0/0/0) to a specified value (64 kbps). You also set the clockrate to 64000. Note that bandwidth is represented in kbps whereas clock rate is entered in bps.

Syntax: bandwidth (interface):

The command bandwidth <kilobits> will set and communicate the bandwidth value for an interface to higher-level protocols.

Ex: bandwidth 64 will set the bandwidth to 64 kbps. Use no form of the command to set the bandwidth to default value.

Instructions:

1. Enter to serial 0/0/0 mode of router BLR
2. Set bandwidth of serial 0/0/0 as 64 kbps
3. Set clockrate as 64000 bps

BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#bandwidth 64
BLR(config-if)#clock rate 64000 - This command applies to only DCE interfaces
BLR(config-if)#exit
BLR(config)#exit
BLR#show interface s 0/0/0
BLR#show interfaces

Below is the show interfaces serial 0/0/0" command output

```
Serial0/0/0 is up, line protocol is up
  Hardware is GT96K with integrated T1 CSU/DSU
  Description: WAN Link to BLR Hub
  Internet address is 192.168.1.2/24
  MTU 1500 bytes, BW 64 Kbit/sec, DLY 20000 usec,
     reliability 255/255, txload 7/255, rxload 11/255
  Encapsulation HDLC, loopback not set
  Keepalive set (10 sec)
  Last input 00:00:00, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Input queue: 1/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/1000/64/0 (size/max total/threshold/drops)
     Conversations  0/1/256 (active/max active/max total)
     Reserved Conversations 0/0 (allocated/max allocated)
     Available Bandwidth 48 kilobits/sec
  5 minute input rate 3000 bits/sec, 5 packets/sec
  5 minute output rate 2000 bits/sec, 5 packets/sec
     1810 packets input, 100486 bytes, 0 no buffer
     Received 183 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     1476 packets output, 79342 bytes, 0 underruns
     0 output errors, 0 collisions, 11 interface resets
 --More--
```

Back

2.5: Lab Exercise 5: Setting Console Password

Not Available in Demo Version

2.6: Lab Exercise 6: Setting Telnet Password

Not Available in Demo Version

2.7: Lab Exercise 7: Setting Auxiliary Password to Router

Not Available in Demo Version

2.8: Lab Exercise 8: Configuring Minimum password length

Not Available in Demo Version

2.9: Lab Exercise 9: Implementing exec-timeout command

Not Available in Demo Version

2.10: Lab Exercise 10: Copy Running Configuration to Startup Configuration

Not Available in Demo Version

2.11: Lab Exercise 11: Router CDP Configuration

Not Available in Demo Version

2.12: Lab Exercise 12: Show CDP Configuration

Not Available in Demo Version

2.13: Lab Exercise 13 : Show CDP Neighbors

Not Available in Demo Version

2.14: Lab Exercise 14: Bringing-up a router Interface

Not Available in Demo Version

2.15: Lab Exercise 15: Set Keepalive Timers

Not Available in Demo Version

2.16: Lab Exercise 16: Set Hostname and MOTD Banner

Not Available in Demo Version

2.17: Lab Exercise 17: Configuring enable and secret pasword and service password-encryption

Not Available in Demo Version

2.18: Lab Exercise 18: Host Table

Not Available in Demo Version

2.19: Lab Exercise 19: Viewing ARP Entries

Not Available in Demo Version

2.20: Lab Exercise 19: Telnet

Not Available in Demo Version

2.21: Lab Exercise 20: TFTP

Not Available in Demo Version

2.22 Lab Exercise 22: Configuring Cisco Routers for Syslog

Not Available in Demo Version

2.23 Lab Exercise 23: Configure and Verify NTP

Not Available in Demo Version

3. EXERCISES ON ROUTING FUNDAMENTALS

3.1: Lab Exercise 1: Introduction to IP

Description: This lab exercise is to learn assigning IP address to routers and pinging between them to test connectivity

Instructions:

1. Connect to router BLR, configure its ip address of serial interfaces
2. Connect to router NY, configure its ip address of serial interfaces.
3. Connect to router LD, configure its ip address of serial interfaces.
4. Use the command "show ip interface brief" to verify that the lines and protocols are up for all NY's interfaces
5. Display NY's running configuration to verify that the IP addresses appear
6. Display detailed IP information about each interface on NY

```
BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)#no shutdown
```

BLR(config-if)#exit
BLR(config)#interface serial 0/1/0
BLR(config-if)#ip address 192.168.3.1 255.255.255.0
BLR(config-if)#no shut
BLR(config-if)#exit

NY>enable
Password:Cisco
NY#configure terminal
NY(config)#interface serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/0
NY(config-if)#ip address 192.168.2.1 255.255.255.0
NY(config-if)#no shutdown

LDN>enable
Password:Cisco
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LDN(config-if)#ip address 192.168.2.2 255.255.255.0
LDN(config-if)#no shutdown
LDN(config-if)#exit
LDN(config)#interface serial 0/0/1
LDN(config-if)#ip address 192.168.3.2 255.255.255.0
LDN(config-if)#no shutdown
LDN(config-if)#exit

NY#ping 192.168.2.2
NY#ping 192.168.3.2
NY#show ip interface brief
NY#show running-config
NY#show ip interface

The sample output of "show ip interface brief" command on router NY is shown below

```
NY#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            10.10.1.1       YES NVRAM  up                    up

FastEthernet0/1            10.10.2.1       YES NVRAM  up                    up

Serial0/0/0                192.168.1.1     YES NVRAM  up                    up

Serial0/1/0                192.168.2.1     YES NVRAM  up                    up

Serial0/1/1                unassigned      YES NVRAM  administratively down down

NY#
```

Back

3.2: Lab Exercise 2: Configuring Static Routes

Description: Configure static route 10.10.1.0 mask 255.255.255.0 with next hop address of 192.168.1.1

Syntax: ip route prefix mask {address|interface} [distance]
prefix mask: It is the ip route prefix and mask for the destination.
address|interface: Use either the next hop router ip or the local router outbound interface used to reach the destination.
distance: It is the administrative distance and an optional parameter.

Instructions:

1. Enter into Global Configuration Mode
2. Disable IP Routing
3. Re-enable IP Routing
4. Configure a static route with destination sub network number as 10.10.1.0 with subnet mask as 255.255.255.0, and IP address of the next-hop router in the destination path to 192.168.1.1

BLR>**enable**
BLR#**configure terminal**
BLR(config)#**no ip routing**
BLR(config)#**ip routing**
BLR(config)#**ip route 10.10.1.0 255.255.255.0 192.168.1.1**

Note: "no ip routing" command used in the above exercise is used to remove any previously configured routing information.

Back

3.3: Lab Exercise 3: Implement and Verfiy Static Routes

Not available in Demo Version

3.4: Lab Exercise 4: Configuring Default Route

Not available in Demo Version

3.5: Lab Exercise 5: Implement and Verify Default Routes

Not available in Demo Version

3.6: Lab Exercise 6: Configuring Loopback Interface

Not available in Demo Version

3.7: Lab Exercise 7: Connectivity Tests with Traceroute

Not available in Demo Version

3.8: Lab Exercise 8: Configuring RIP

Not available in Demo Version

3.9: Lab Exercise 9: Basic EIGRP Routing

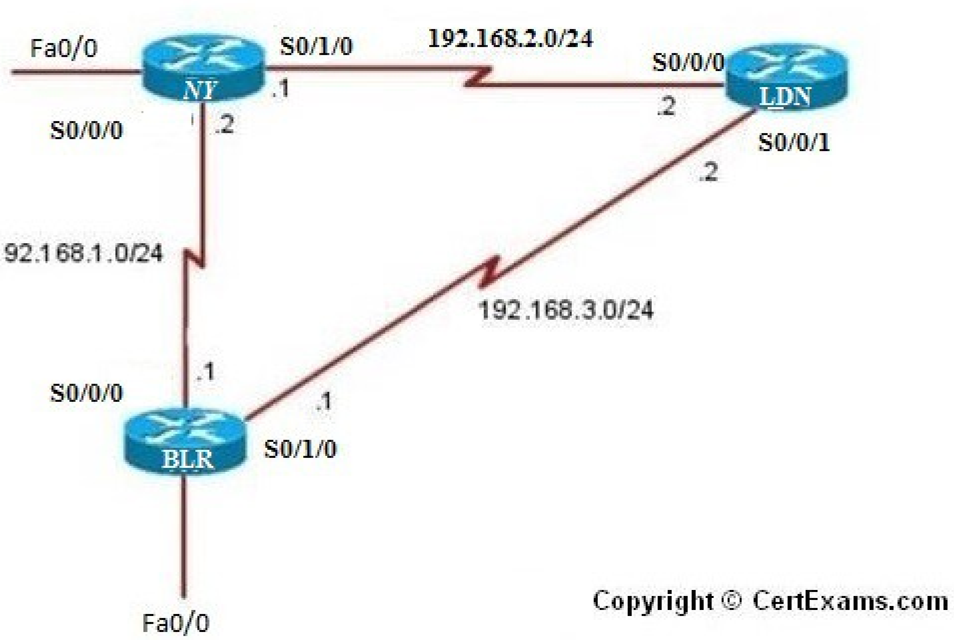
Not available in Demo Version

4. EXERCISES ON RIP/EIGRP Routing Scenarios

4.1: Lab Exercise 1: RIP Routing Configuration Scenario

Description: The purpose of this exercise is to configure RIP on all the devices and test for ping and trace commands.

The router rip command selects RIP as the routing protocol.
The network command assigns a major network number that the router is directly connected to. The RIP routing process associates interface addresses with the advertised network number and begins RIP packet processing on the specified interfaces.



Instructions:

1. Assign the IP address of all the devices as given below
2. Bring all the interfaces to up
3. Configure RIP on all the devices
4. From NY issue a ping and trace command to BLR and LDN

Device	Interface	IP Address	Mask
NY	S0/0/0 S0/1/0	192.168.1.1 192.168.2.1	255.255.255.0 255.255.255.0
BLR	S0/0/0 S0/1/0	192.168.1.2 192.168.3.1	255.255.255.0 255.255.255.0
LDN	S0/0/0 S0/0/1	192.168.2.2 192.168.3.2	255.255.255.0 255.255.255.0

On NY

```
NY>enable
NY#configure terminal
NY(config)#interface serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/0
NY(config-if)#ip address 192.168.2.1 255.255.255.0
NY(config-if)# no shutdown
NY(config-if)#exit
NY(config)#router rip
NY(config-router)#network 192.168.1.0
NY(config-router)#network 192.168.2.0
```

On BLR

```
BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)# no shutdown
BLR(config-if)#exit
BLR(config)#interface serial 0/1/0
BLR(config-if)#ip address 192.168.3.1 255.255.255.0
BLR(config-if)#no shutdown
BLR(config-if)#exit
BLR(config)#router rip
BLR(config-router)#network 192.168.1.0
BLR(config-router)#network 192.168.3.0
```

On LDN

```
LDN>enable
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LDN(config-if)#ip address 192.168.2.2 255.255.255.0
LDN(config-if)# no shutdown
LDN(config-if)#exit
```

LDN(config)#interface serial 0/0/1
LDN(config-if)#ip address 192.168.3.2 255.255.255.0
LDN(config-if)#no shutdown
LDN(config-if)#exit
LDN(config)#router rip
LDN(config-router)#network 192.168.3.0
LDN(config-router)#network 192.168.2.0

On NY:

NY#ping 192.168.3.2
NY#ping 192.168.3.1
NY#trace 192.168.3.2
NY#trace 192.168.3.1

Back

4.2: Lab Exercise 2: Viewing IP RIP Information

Description: The purpose of this exercise is to view important information on IP RIP.
Show ip route command displays the current state of the routing table and this command is to be used in EXEC mode.
Show ip protocols command displays the parameters and current state of the active routing protocol processes and this command is to be used in EXEC mode.

Instructions:

1. Enter global configuration mode, and enable RIP routing on the router
2. Associate network 192.168.1.0 with RIP routing process
3. Issue the command that displays all entries in the Routing Table
4. Type the command that displays information about the IP routing protocols

NY>enable
NY#configure terminal
NY(config)#interface s 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#router rip
NY(config-router)#network 192.168.1.0
NY(config-router)#exit
NY(config)#exit
NY#show ip route
NY#show ip protocols

Below is the show output of “show ip route” command

```
NY#show ip route
Codes: C - connected, S - static, 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
       i - IS-IS, su - IS-IS summary, 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    192.168.4.0/24 is directly connected, Serial0/1/1
     10.0.0.0/24 is subnetted, 2 subnets
C       10.10.1.0 is directly connected, FastEthernet0/0
C       10.10.2.0 is directly connected, FastEthernet0/1
R    192.168.0.0/24 [120/1] via 192.168.1.2, 00:00:24, Serial0/0/0
C    192.168.1.0/24 is directly connected, Serial0/0/0
C    192.168.2.0/24 is directly connected, Serial0/1/0
NY#
```

Below is "show ip protocols" command output where ip protocol configured is RIP.

```
NY#show ip protocols
Routing Protocol is "rip"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Sending updates every 30 seconds, next due in 26 seconds
  Invalid after 180 seconds, hold down 180, flushed after 240
  Redistributing: rip
  Default version control: send version 1, receive any version
    Interface             Send  Recv  Triggered RIP  Key-chain
    FastEthernet0/0       1     1 2
    FastEthernet0/1       1     1 2
    Serial0/0/0           1     1 2
    Serial0/1/0           1     1 2
  Automatic network summarization is in effect
  Maximum path: 4
  Routing for Networks:
    10.0.0.0
    192.168.0.0
    192.168.1.0
    192.168.2.0
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.2.2          120      00:04:29
    192.168.1.2          120      00:00:22
 --More--
  Distance: (default is 120)
```

Back

4.3: Lab Exercise 3: Configuring RIPV2

Not available in Demo Version

4.4: Lab Exercise 4: RIP2 Routes

Not available in Demo Version

4.5: Lab Exercise 5: EIGRP Routing Configuration Scenario

Not available in Demo Version

4.6: Lab Exercise 6: EIGRP Troubleshooting Lab Scenario

Not available in Demo Version

4.7: Lab Exercise 7: EIGRP Show Commands

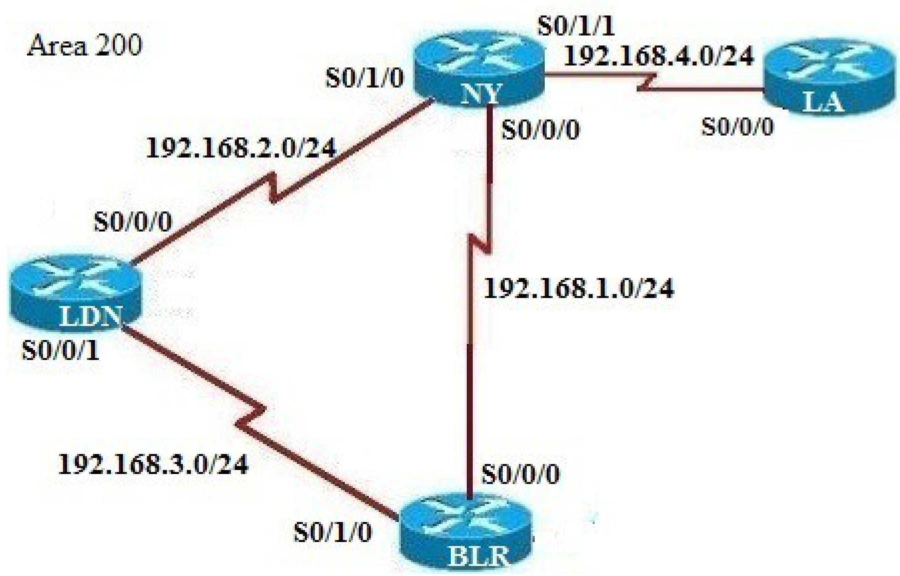
Not available in Demo Version

5. Exercises on OSPF

Note: *Please refer to the below network Diagram for all the exercises in this section*

5.1: Lab Exercise 1: OSPF Configuration in Single Area

Description: In OSPF single area, you configure OSPF network with an area ID. The configuration example uses four routers working in area 200.



IP Address Assignment Table

Device	Interface	IP Address	Mask

NY	S0/0/0 S0/1/0 S0/1/1	192.168.1.1 192.168.2.1 192.168.4.1	255.255.255.0 255.255.255.0 255.255.255.0
LA	S0/0/0	192.168.4.2	255.255.255.0
BLR	S0/0/0 S0/1/0	192.168.1.2 192.168.3.1	255.255.255.0 255.255.255.0
LDN	S0/0/0 S0/0/1	192.168.2.2 192.168.3.2	255.255.255.0 255.255.255.0

Instructions:

1. Based on the given network configuration, use appropriate commands to configure OSPF in networks 192.168.1.0, 192.168.2.0, 192.168.3.0 and 192.168.4.0 within area 200
2. Ping LDN and LA from NY and verify connectivity
3. Ping NY and LDN from LA and verify connectivity

On NY:

```
NY>enable
NY#configure terminal
NY(config)#interface serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)# no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/0
NY(config-if)#ip address 192.168.2.1 255.255.255.0
NY(config-if)# no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/1
NY(config-if)#ip address 192.168.4.1 255.255.255.0
NY(config-if)# no shutdown
NY(config)#router ospf 1
NY(config-router)#network 192.168.1.0 0.0.0.255 area 200
NY(config-router)#network 192.168.2.0 0.0.0.255 area 200
NY(config-router)#network 192.168.4.0 0.0.0.255 area 200
NY(config-router)#exit
NY(config)#exit
NY#
```

On BLR

```
BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)# no shutdown
BLR(config-if)#exit
BLR(config)#interface serial 0/1/0
```


BLR(config-if)#ip address 192.168.3.1 255.255.255.0
BLR(config-if)# no shutdown
BLR(config-if)#exit
BLR(config)#router ospf 1
BLR(config-router)#network 192.168.1.0 0.0.0.255 area 200
BLR(config-router)#network 192.168.3.0 0.0.0.255 area 200
BLR(config-router)#exit
BLR(config)#exit
BLR#

On LDN

LDN>enable
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LDN(config-if)#ip address 192.168.2.2 255.255.255.0
LDN(config-if)# no shutdown
LDN(config-if)#exit
LDN(config)#interface serial 0/0/1
LDN(config-if)#ip address 192.168.3.2 255.255.255.0
LDN(config-if)# no shutdown
LDN(config)#router ospf 1
LDN(config-router)#network 192.168.2.0 0.0.0.255 area 200
LDN(config-router)#network 192.168.3.0 0.0.0.255 area 200
LDN(config-router)#exit
LDN(config)#exit
LDN#

On LA

LA>enable
LA#configure terminal
LA(config)#interface serial 0/0/0
LA(config-if)#ip address 192.168.4.2 255.255.255.0
LA(config-if)# no shutdown
LA(config-if)#exit
LA(config)#router ospf 1
LA(config-router)#network 192.168.4.0 0.0.0.255 area 200
LA(config-router)#exit
LA(config)#exit
LA#

On NY

NY#ping 192.168.3.2
NY#ping 192.168.4.2

On LA

LA#ping 192.168.1.1

LA#ping 192.168.2.2

Back

5.2: Lab Exercise 2: OSPF Troubleshooting Lab Scenario-1

Description: In OSPF single area, you configure OSPF network with an area ID. The configuration example uses four routers working in area 200.

IP Address Assignment Table

Device	Interface	IP Address	Mask
NY	S0/0/0 S0/1/0 S0/1/1	192.168.1.1 192.168.2.1 192.168.4.1	255.255.255.0 255.255.255.0 255.255.255.0
LA	S0/0/0	192.168.4.2	255.255.255.0
BLR	S0/0/0 S0/1/0	192.168.1.2 192.168.3.1	255.255.255.0 255.255.255.0
LDN	S0/0/0 S0/0/1	192.168.2.2 192.168.3.2	255.255.255.0 255.255.255.0

Instructions:

1. Assign IP Addresses on all the devices as per the above table and bring all the interfaces to up state
2. On NY enable OSPF routing with process 1 and area as 200 for the network 192.168.2.0 and 192.168.4.0
3. On BLR enable OSPF routing with process 1 and area as 200 for the network 192.168.1.0 and 192.168.3.0
4. On LDN enable OSPF routing with process 1 and area as 200 for the network 192.168.2.0 and 192.168.3.0
5. On LA enable OSPF routing with process 1 and area as 200 for the network 192.168.4.0
6. Ping NY from BLR, you will see ping failure
7. Ping BLR from LDN, you will see ping success (This implies connectivity failure from BLR to NY)
8. Issue command on NY to see OSPF database
9. You will see that there is no link state entry for network 192.168.1.0, so enable OSPF routing on NY for this network
10. Ping NY from BLR, you will see ping success

Note: You need to assign the IP addresses and make the interfaces up (by issuing no shutdown commands at appropriate interfaces) for all the devices before proceeding with the following commands

On NY:

NY>enable
NY#configure terminal

```
NY(config)#interface serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)# no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/0
NY(config-if)#ip address 192.168.2.1 255.255.255.0
NY(config-if)# no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/1
NY(config-if)#ip address 192.168.4.1 255.255.255.0
NY(config-if)# no shutdown
NY(config)#router ospf 1
NY(config-router)#network 192.168.2.0 0.0.0.255 area 200
NY(config-router)#network 192.168.4.0 0.0.0.255 area 200
NY(config-router)#exit
NY(config)#exit
```

On BLR

```
BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)# no shutdown
BLR(config-if)#exit
BLR(config)#interface serial 0/1/0
BLR(config-if)#ip address 192.168.3.1 255.255.255.0
BLR(config-if)# no shutdown
BLR(config-if)#exit
BLR(config)#router ospf 1
BLR(config-router)#network 192.168.1.0 0.0.0.255 area 200
BLR(config-router)#network 192.168.3.0 0.0.0.255 area 200
BLR(config-router)#exit
BLR(config)#exit
BLR#
```

On LDN

```
LDN>enable
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LDN(config-if)#ip address 192.168.2.2 255.255.255.0
LDN(config-if)# no shutdown
LDN(config-if)#exit
LDN(config)#interface serial 0/0/1
LDN(config-if)#ip address 192.168.3.2 255.255.255.0
LDN(config-if)# no shutdown
LDN(config)#router ospf 1
LDN(config-router)#network 192.168.2.0 0.0.0.255 area 200
LDN(config-router)#network 192.168.3.0 0.0.0.255 area 200
```


LDN(config-router)#exit
LDN(config)#exit
LDN#

On LA

LA>enable
LA#configure terminal
LA(config)#interface serial 0/0/0
LA(config-if)#ip address 192.168.4.2 255.255.255.0
LA(config-if)# no shutdown
LA(config-if)#exit
LA(config)#router ospf 1
LA(config-router)#network 192.168.4.0 0.0.0.255 area 200
LA(config-router)#exit
LA(config)#exit
LA#

BLR#ping 192.168.1.1
LDN#ping 192.168.1.2

On NY

NY#Show ip ospf database
NY#configure terminal
NY(config)#router ospf 1
NY(config-router)#network 192.168.1.0 0.0.0.255 area 200
NY(config-router)#exit
NY(config)#exit
NY#

On BLR:

BLR#ping 192.168.1.1

"Show ip ospf database" command output for device NY is given below

```
NY#show ip ospf database

            OSPF Router with ID (192.31.7.1) (Process ID 1)

                Router Link States (Area 200)

Link ID         ADV Router      Age         Seq#       Checksum Link count
192.31.7.1      192.31.7.1      73          0x80000004 0x00E0DE 4
192.168.1.2     192.168.1.2     125         0x80000001 0x00F713 2
209.165.201.18  209.165.201.18  74          0x80000001 0x00D365 2
NY#
```

Back

5.3: Lab Exercise 3: OSPF Troubleshooting Lab Scenario-2

Not available in Demo Version

5.4: Lab Exercise 4: OSPF Routing Configuration Scenario

Not available in Demo Version

6. Exercises on Access-Lists

6.1: Lab Exercise 1: Creating a Standard Access List

Description: Create an access-list and configure the same according to a given set of rules.

Instructions:

1. Enter into Global Configuration Mode
2. Create an IP access-list to permit traffic from address 192.168.1.0 network and deny all other traffic. Use 1 as IP access-list number.
3. Create an access-list 2 that blocks only the single IP address 192.168.2.2
4. Type the command used for permitting packets from any IP Address. Use Access-list number as 2

NY>**enable**
NY#**configure terminal**
NY(config)#**access-list 1 permit 192.168.1.0**
NY(config)#**access-list 2 deny 192.168.2.2**
NY(config)#**access-list 2 permit any**

Back

6.2: Lab Exercise 2: Applying an Access List to an Interface

Description: Apply access-list 1 to interface Ethernet 0 on R1. Apply the access-list on both incoming and outgoing interfaces.

1. Enter into Interface Configuration Mode.
2. Use no shut down command on interface
3. Assuming that an access-list 1 is created, apply it to the interface Fastethernet0/0 as an inbound access-list
4. Apply an access-list 1 to interface serial 0/0/0 as an outbound access-list

NY>**enable**
NY#**configure terminal**
NY(config)#**interface serial 0/0/0**
NY(config-if)#**no shutdown**
NY(config-if)#**ip access-group 1 in**
NY(config-if)#**ip access-group 1 out**

[Back]

6.3: Lab Exercise 3: View Access List Entries

Description: Configure standard access-list #1 to permit ip 192.168.2.2 and view access-list entries by using appropriate show command.
Instructions:

1. Enter into Global Configuration Mode
2. Create an Access-list that permits traffic from address 192.168.2.2. Use access-list number 1. Exit from the global configuration mode
3. Use the show command to see the Access-list

NY>**enable**
NY#**configure terminal**
NY(config)#**access-list 1 permit 192.168.2.2**
NY(config)#**exit**
NY#**show access-list**

The screenshot of "show access-list" command output is shown below

```
NY#show access-lists
Standard IP access list 1
    10 permit 192.168.2.2
NY#
```

[Back]

6.4: Lab Exercise 4: Standard Access List Scenario Lab 1

Not available in Demo Version

6.5: Lab Exercise 5: Configuring and Verifying Standard Access List

Not available in Demo Version

6.6: Lab Exercise 6: Configuring and Verifying Extended Access List

Not available in Demo Version

6.7: Lab Exercise 7: Configuring and Implementing Extended Access List

Not available in Demo Version

6.8: Lab Exercise 8: Named Access-Lists

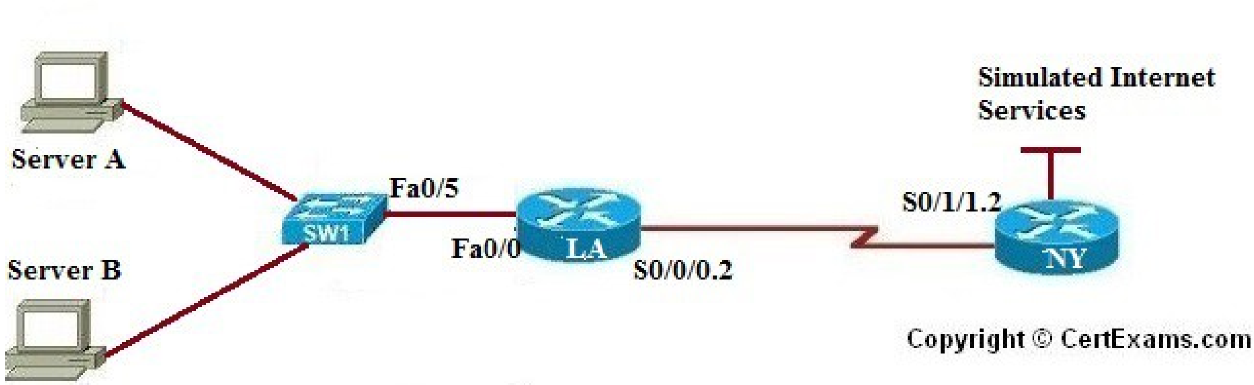
Not available in Demo Version

7. EXERCISES ON NETWORK ADDRESS TRANSLATION

NAT stands for Network Address Translation is used to perform address translation between two networks, which are identified as the inside network and the outside network in NAT terminology. i.e, there are primarily two ways a NAT can be defined in a network.
One is NAT inside, where we define the inside local, and inside global ip addresses; and the other is NAT outside, where we define the outside local, and outside global IP addresses.

Note: Please refer the below Network Diagram and IP Address Assignment Table for all the exercises in this section.

Network Diagram



IP Address Assignment Table

Device	Interface	IP Address	Mask
NY	S0/1/1.2 Loopback0	209.165.201.17 192.31.7.1	255.255.255.252 255.255.255.255
LA	S0/0/0.2 Fa0/0	209.165.201.18 10.10.1.1	255.255.255.252 255.255.255.0
PC-A		10.10.1.3	255.255.255.0
PC-B		10.10.1.4	255.255.255.0

7.1: Lab Exercise 1: NAT Scenario 1

Description: The purpose of this exercise is to configure NAT on the source router (NAT inside source) and test for connectivity by pinging a remote router.

NAT Mapping Table for Inside Source

Inside Local	Inside Global
10.10.1.3	209.165.201.19

10.10.1.4	209.165.201.20

Instructions:

1. Assign IP addresses to all the devices as per the IP address assignment table
2. Enable routing on all routers.
3. Create IP NAT Mapping (Hint: use inside source static command) on LA
4. Define IP NAT Inside and IP NAT Outside interfaces on LA
5. Test for Connectivity by issuing ping command

Three steps are required to configure static NAT:

1. Configure private/public IP address mapping using the ip nat inside source static PRIVATE_IP PUBLIC_IP command
2. Configure the router's inside interface using the ip nat inside command
3. Configure the router's outside interface using the ip nat outside command

```
NY>enable
NY#conf term
NY(config)#interface serial 0/1/1.2
NY(config-subif)#ip address 209.165.201.17 255.255.255.252
NY(config-subif)#no shutdown
NY(config-subif)#exit
NY(config)#router rip
NY(config-router)#network 209.165.201.0
NY(config-router)#exit
```

```
LA>enable
LA#configure terminal
LA(config)#interface fastethernet 0/0
LA(config-if)#ip address 10.10.1.1 255.255.255.0
LA(config-if)#no shutdown
LA(config-if)#exit
LA(config)#interface serial 0/0/0.2
LA(config-subif)#ip address 209.165.201.18 255.255.255.252
LA(config-subif)#no shutdown
LA(config-subif)#exit
LA(config)#router rip
LA(config-router)#network 209.165.201.0
LA(config-router)#network 10.10.1.0
```

```
LA>enable
LA#conf term
LA(config)#ip nat inside source static 10.10.1.3 209.165.201.19
LA(config)#ip nat inside source static 10.10.1.4 209.165.201.20
LA(config)#interface serial 0/0/0.2
LA(config-subif)#ip nat outside
LA(config-subif)#exit
LA(config)#interface fastethernet 0/0
```

LA(config-if)#**ip nat inside**
LA(config-if)#**exit**
LA(config)#**exit**

"show ip nat translations" command output is shown below

```
LA#show ip nat translations
Pro Inside global      Inside local       Outside local      Outside global
--- 209.165.201.19     10.10.1.3          ---                ---
--- 209.165.201.20     10.10.1.4          ---                ---
LA#
```

Here, we are telling the router LA to perform NAT on packets coming into the router on the inside interface Fa0/0. More specifically the router would identify which of these packets have a source IP address of 10.10.1.3 and would change it to 209.165.201.19 before forwarding the packet out the outside interface serial0/0/0.2.

NY#:**ping 209.165.201.19**

Back

7.2: Lab Exercise 2: NAT Scenario 2

Description: The purpose of this lab is to configure NAT on the destination router (NAT outside source) and test for connectivity by pinging a remote router.

NAT Mapping Table for Outside Source

Outside Local	Outside Global
10.10.1.3	209.165.201.3
10.10.1.4	209.165.201.4

Instructions:

1. Assign IP addresses on devices NY and LA as per the IP address assignment table
2. Enable routing on all routers.
3. Create IP NAT Mapping (Hint: use outside source static command) on LA
4. Define IP NAT Inside and IP NAT Outside interfaces on LA

NY>**enable**
NY#**conf term**
NY(config)#**interface serial 0/1/1.2**
NY(config-subif)#**ip address 209.165.201.17 255.255.255.252**
NY(config-subif)#**no shutdown**
NY(config-subif)#**exit**
NY(config)#**router rip**
NY(config-router)#**network 200.165.201.0**
NY(config-router)#**exit**

```
LA>enable
LA#configure terminal
LA(config)#interface fastethernet 0/0
LA(config-if)#ip address 10.10.1.1 255.255.255.0
LA(config-if)#no shutdown
LA(config-if)#exit
LA(config)#interface serial 0/0/0.2
LA(config-subif)#ip address 209.165.201.18 255.255.255.252
LA(config-subif)#no shutdown
LA(config-subif)#exit
LA(config)#router rip
LA(config-router)#network 209.165.201.0
LA(config-router)#network 10.10.1.0
```

```
LA>enable
LA#conf term
LA(config)#ip nat inside source static 10.10.1.3 209.165.201.19
LA(config)#ip nat inside source static 10.10.1.4 209.165.201.20
LA(config)#interface serial 0/0/0.2
LA(config-subif)#ip nat outside
LA(config-subif)#exit
LA(config)#interface fastethernet 0/0
LA(config-if)#ip nat inside
LA(config-if)#exit
LA(config)#exit
```

```
LA>enable
LA#conf term
LA(config)#ip nat outside source static 10.10.1.3 209.165.201.19
LA(config)#ip nat outside source static 10.10.1.4 209.165.201.20
LA(config)#interface serial 0/0/0.2
LA(config-subif)#ip nat outside
LA(config-subif)#exit
LA(config)#interface fastethernet 0/0
LA(config-if)#ip nat inside
LA(config-if)#exit
LA(config)#exit
```

```
NY#:ping 209.165.201.19
```

Back

7.3: Lab Exercise 3: Configuring Dynamic NAT Scenario I

Not available in Demo Version

7.4: Lab Exercise 4: NAT and PAT

Not available in Demo Version

8. Exercises on HSRP

Short Note On HSRP: HSRP is one of the so called FHRP or "First Hop Redundancy Protocols". The other two FHRP protocols that are popularly known are VRRP (Virtual Router Redundancy Protocol) and GLBP (Gateway Load Balancing Protocol). In the labs, we cover HSRP.

Configuring HSRP: HSRP, or Hot Standby Routing Protocol, is a Cisco proprietary protocol that allows two or more routers to work together to represent a single virtual IP address to the end-user. Among the HSRP configured routers, one will work as Active and the others (one or more) work as Standby routers. The Active and Standby routers are determined by a set of rules. Only the virtual IP address that was created within the HSRP configuration along with a virtual MAC address is known to other hosts on the network.

The Active router is elected by considering the priority assigned (higher number means, higher priority). The default priority is 100. If two routers have the same priority, then the router with higher IP address will assume Active router role, and the other acquires Standby router role. Furthermore, if there are more than two routers in the group, the second highest IP address determines the standby router and the other router/routers are in the listen state.

Note: If both routers are set to the same priority, then the first router to come up will be the active router.

The labs provide hands-on experience in configuring HSRP using Cisco routers and verifying the HSRP configuration.

Note: When replying to traceroute command, the IP address of the **physical** interface is used, not the virtual IP address. Similarly, as per Cisco website, when a response for traceroute is received from a hop that runs HSRP, the reply must contain the active physical IP adddress and not the virtual ip address.

8.1: Lab Exercise 1: To enable HSRP on a Router

Description: This lab exercise demonstrates the necessary commands to enable the HSRP on a router.

Instructions: To achieve basic HSRP configuration, following needs to be done.

1. Configure IP address on the fa 0/0 interface of BLR and NY
2. Bring interface up (no shutdown)
3. Configure HSRP group and virtual IP address using the standby command

Configuration to enable HSRP on BLR is as follows

```
BLR>enable
BLR#configure teminal
BLR(config)#interface fastethernet 0/0
BLR(config-if)#ip address 192.168.0.130 255.255.255.0
BLR(config-if)#no shutdown
BLR(config-if)#standby 11 ip 192.168.0.100
```

Configuration to enable HSRP on NY is as follows

NY>enable
NY#configure teminal
NY(config)#interface fastethernet 0/0
NY(config-if)#ip address 10.10.4.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#standby 11 ip 10.10.4.5

The **standby ip** interface configuration command activates HSRP on the configured interface. If an IP address is specified, that address is used as the designated address for the Hot Standby group. If no IP address is specified, the address is learned through the standby function. In this example, HSRP is configured with group "11". This group number can be any number between 0 and 255 (HSRP version 1) and the only requirement is that you must use the same number across devices in the same HSRP group.

Back

8.2: Lab Exercise 2: To disable HSRP on a Router

Description: This lab exercise demonstrates the necessary commands to disable the HSRP on a router.

Instructions:

1. Configure IP address on the fa 0/0 interface of BLR
2. Bring interface up (no shutdown)
3. Configure **no standby** [*group-number*] **ip** [*ip-address*] interface configuration command to disable HSRP.

On BLR

BLR>enable
BLR#configure teminal
BLR(config)#interface fastethernet 0/0
BLR(config-if)#ip address 192.168.0.130 255.255.255.0
BLR(config-if)#no shutdown
BLR(config-if)#no standby 11 ip 192.168.0.100

Back

8.3: Lab Exercise 3: Configuring HSRP Priority , Delay and Preempt

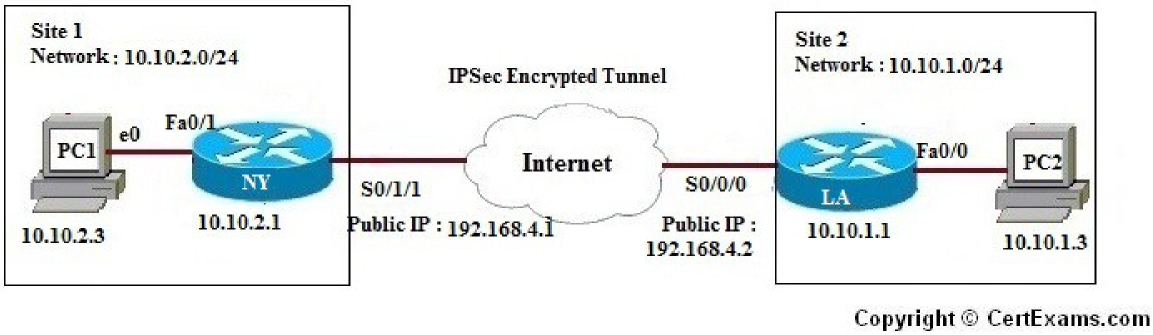
Not available in Demo Version

8.4: Lab Exercise 4: Load Sharing with Multigroup HSRP (MHSRP)

Not available in Demo Version

9. Exercises on VPN(Virtual Private Network)

9.1: Lab Exercise 1: Configuring site-to-site IPSEC VPN tunnel between routers



Description: This lab exercise explains how to setup and configure two routers to create a permanent secure site-to-site VPN tunnel over the Internet, using the IP Security (IPSec) protocol**.**

Instructions:

1. Configure the IP addresses of all the devices and bring the interface up
2. Apply static routing on NY and LA
3. Create interesting traffic on NY and LA
4. Configure IKE Phase 1 ISAKMP policy on NY and LA
5. Configure the IKE Phase 2 IPsec policy on NY and LA

Step by step configuration for routers are given below

On NY

1. Basic Interface configurations

```
NY>enable
NY#configure terminal
NY(config)#interface fa0/1
NY(config-if)#ip address 10.10.2.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#interface serial 0/1/1
NY(config-if)#ip address 192.168.4.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit

NY(config)#ip route 10.10.1.0 255.255.255.0  192.168.4.2
```

2. Configure Phase 1 (ISAKAMP) of IPSec so that a secure tunnel is established between

NY and LA

```
NY(config)#crypto isakmp policy 5
NY(config-isakmp)#hash sha
NY(config-isakmp)#authentication pre-share
NY(config-isakmp)#group 2
NY(config-isakmp)#lifetime 86400
NY(config-isakmp)#encryption 3des
NY(config-isakmp)#exit
```

3. Define a pre shared key for authentication with peer LA by using the following command:

```
NY(config)#crypto isakmp key 0 sim123 address  192.168.4.2
```

4. Configure IPSEC: To configure IPSec we need to do the following

- **Create extended access-list**
- **Create IPSec Transform**
- **Create Crypto Map**
- **Apply crypto map to the public interface**

1. Creating Access -list

```
NY(config)#ip access-list extended vpntraffic
NY(config-ext-nacl)#permit ip 10.10.2.0 0.0.0.255 10.10.1.0 0.0.0.255
NY(config-ext-nacl)#exit
```

2. Create IPSEC Transform (ISAKMP PHASE 2 POLICY)

```
NY(config)#crypto ipsec transform-set trnsset esp-3des esp-md5-hmac
NY(cfg-crypto-trans)#exit
```

3. Create Crypto Map

```
NY(config)#crypto map crmap 10 ipsec-isakmp
NY(config-crypto-map)#set peer 192.168.4.2
NY(config-crypto-map)#set transform-set trnsset
NY(config-crypto-map)#match address vpntraffic
NY(config-crypto-map)#exit
```

4. Apply Crypto Map To The Public Interface

```
NY(config)#interface serial 0/1/1
NY(config- if)#crypto map crmap
NY(config-if)#end
NY#show crypto map
```

NY#show crypto isakmp key
NY#show crypto ipsec transform-set
NY#show crypto isakmp policy

The output of "show crypto map" command is given below

```
NY#show crypto map
Crypto Map "crmap" 10 ipsec-isakmp
        Peer = 192.168.4.2
        Extended IP access list vpntraffic
            access-list vpntraffic permit ip 10.10.2.0 0.0.0.255 10.10.1.0 0.0.0
.255
        Current peer: 192.168.4.2
        Security association lifetime: 4608000 kilobytes/3600 seconds
        PFS (Y/N): N
        Transform sets={
                trnset,
        }
        Interfaces using crypto map crmap:
                Serial0/1/1
```

The output of "show crypto isakmp key" command is given below

```
NY#show crypto isakmp key
Keyring               Hostname/Address                    Preshared Key

default               192.168.4.2                         sim123
NY#
```

The output of "show crypto ipsec transform-set" is given below

```
NY#show crypto ipsec transform-set
Transform set trnset: { esp-3des esp-md5-hmac  }
   will negotiate = { Tunnel,  },
```

The output of "show crypto isakmp policy" is given below

```
NY#show crypto isakmp policy

Global IKE policy
Protection suite of priority 5
        encryption algorithm:   Three key triple DES
        hash algorithm:         Secure Hash Standard
        authentication method:  Pre-Shared Key
        Diffie-Hellman group:   #2 (1024 bit)
        lifetime:               86400 seconds, no volume limit
Default protection suite
        encryption algorithm:   DES - Data Encryption Standard (56 bit keys).
        hash algorithm:         Secure Hash Standard
        authentication method:  Rivest-Shamir-Adleman Signature
        Diffie-Hellman group:   #1 (768 bit)
        lifetime:               86400 seconds, no volume limit
NY#
```

On LA

LA>enable
LA#configure terminal
LA(config)#interface serial 0/0/0
LA(config-if)#ip address 192.168.4.2 255.255.255.0
LA(config-if)#no shutdown

LA(config-if)#exit
LA(config)#interface fastethernet 0/0
LA(config-if)#ip address 10.10.1.1 255.255.255.0
LA(config-if)#no shutdown
LA(config-if)#exit

LA(config)#ip route 10.10.2.0 255.255.255.0 192.168.4.1

LA(config)#crypto isakmp policy 5
LA(config-isakmp)#hash sha
LA(config-isakmp)#authentication pre-share
LA(config-isakmp)#group 2
LA(config-isakmp)#lifetime 86400
LA(config-isakmp)#encryption 3des
LA(config-isakmp)#exit

LA(config)#crypto isakmp key 0 sim123 address 192.168.4.1

LA(config)#ip access-list extended vpntraffic
LA(config-ext-acl)#permit ip 10.10.1.0 0.0.0.255 10.10.2.0 0.0.0.255
LA(config-ext-acl)#exit

LA(config)#crypto ipsec transform-set trnsset esp-3des esp-md5-hmac
LA(cfg-crypto-trans)#exit
LA(config)#crypto map crmap 10 ipsec-isakmp
LA(config-crypto-map)#set peer 192.168.4.1
LA(config-crypto-map)#set transform-set trnsset
LA(config-crypto-map)#match address vpntraffic
LA(config-crypto-map)#exit

LA(config)#interface serial 0/0/0
LA(config- if)#crypto map crmap
LA(config-if)#end
LA#show crypto map
LA#show crypto isakmp key
LA#show crypto ipsec transform-set
LA#show crypto isakmp policy

```
LA#show crypto map
Crypto Map "crmap" 10 ipsec-isakmp
        Peer = 192.168.4.1
        Extended IP access list vpntraffic
            access-list vpntraffic permit ip 10.10.1.0 0.0.0.255 10.10.2.0 0.0.0
.255
        Current peer: 192.168.4.1
        Security association lifetime: 4608000 kilobytes/3600 seconds
        PFS (Y/N): N
        Transform sets={
                trnset,
        }
        Interfaces using crypto map crmap:
                Serial0/0/0
```

```
LA#show crypto map
Crypto Map "crmap" 10 ipsec-isakmp
        Peer = 192.168.4.1
        Extended IP access list vpntraffic
            access-list vpntraffic permit ip 10.10.1.0 0.0.0.255 10.10.2.0 0.0.0
.255
        Current peer: 192.168.4.1
        Security association lifetime: 4608000 kilobytes/3600 seconds
        PFS (Y/N): N
        Transform sets={
                trnset,
        }
        Interfaces using crypto map crmap:
                Serial0/0/0
```

```
LA#show crypto ipsec transform-set
Transform set trnset: { esp-3des esp-md5-hmac  }
   will negotiate = { Tunnel,  },


LA#
```

```
LA#show crypto isakmp policy

Global IKE policy
Protection suite of priority 5
        encryption algorithm:   Three key triple DES
        hash algorithm:         Secure Hash Standard
        authentication method:  Pre-Shared Key
        Diffie-Hellman group:   #2 (1024 bit)
        lifetime:               86400 seconds, no volume limit
Default protection suite
        encryption algorithm:   DES - Data Encryption Standard (56 bit keys).
        hash algorithm:         Secure Hash Standard
        authentication method:  Rivest-Shamir-Adleman Signature
        Diffie-Hellman group:   #1 (768 bit)
        lifetime:               86400 seconds, no volume limit
LA#
```

LA: ping 10.10.2.3
NY#ping 10.10.1.3

Here the interesting traffic means traffic that needs to be encrypted , rest of the traffic goes unencrypted. From Site1's perspective, all the traffic with source address from internal network 10.10.1.0/24 and destination network 10.10.2.0/24 will be regarded as interesting traffic, and vice versa from Site2's perspective.

Back

10. Exercises on DHCP

10.1: Lab Exercise 1: Configuring cisco router as a DHCP Server

Description: This lab exercise demonstrates the required commands for DHCP Server configuration on a cisco router.

Instructions:

1. Issue service dhcp command on router LA that enables and disables the DHCP server feature on router. By default, this is enabled.
2. Create an addressing pool for dhcp.
3. Issue network command that specifies the range of IP addresses to be assigned to clients.
4. Assign the domain-name to the client.
5. In order to resolve Host names to IP addresses, client computers require the IP addresses of DNS (Domain Name Service) servers. Use dns-server command that allows assigning upto 8 DNS server addresses to the client, but however in simulator only 1 address is allowed.
6. Specify the default-router address using default-router command that allows assigning upto **8** default-gateway addresses to the client for this range of addresses.
7**.** Specify the duration of the lease, which if omitted results to default 1 day.

LA>**enable**
LA#**con ter**
LA(config)#**service dhcp**
LA(config)#**ip dhcp pool newpool**
LA(config-dhcp)#**network 192.168.100.0 255.255.255.0**
LA(config-dhcp)#**domain-name xyz.com**
LA(config-dhcp)#**dns-server 192.168.100.2**
LA(config-dhcp)#**default-router 192.168.100.1**
LA(config-dhcp)#**lease 2**
LA(config-dhcp)#**exit**
LA(config)#**exit**
LA#**show ip dhcp pool**

```
LA#show ip dhcp pool

Pool newpool :
 Utilization mark (high/low)    : 100 / 0
 Subnet size (first/next)       : 0 / 0
 Total addresses                : 254
 Leased addresses               : 0
 Pending event                  : none
 1 subnet is currently in the pool :
 Current index        IP address range                    Leased addresses
 192.168.100.1        192.168.100.1    - 192.168.100.254   0
LA#
```


Back

10.2: Lab Exercise 2: DHCP client configuration

Description : This lab exercise demonstrates DHCP client configuration i.e, Configuring an interface on the router to use DHCP to acquire its IP address.

Instructions :

1. Configure DHCP server on LA router.
2. Enter into interface configuration mode on router NY with appropriate commands.
3. Use the command "ip address dhcp" that configures the specified interface to acquire its IP Address from the DHCP server, verify the same using "show ip interface brief" on the router.

```
LA>enable
LA#con ter
LA(config)#service dhcp
LA(config)#ip dhcp pool newpool
LA(config-dhcp)#network 192.168.100.0 255.255.255.0
LA(config-dhcp)#domain-name xyz.com
LA(config-dhcp)#dns-server 192.168.100.2
LA(config-dhcp)#default-router 192.168.100.1
LA(config-dhcp)#lease 2
LA(config-dhcp)#exit
LA(config)#exit
LA#show ip dhcp pool
```

```
NY>enable
NY#configure terminal
NY(config)#interface fastethernet 0/1
NY(config-if)#ip address dhcp
NY(config-if)#exit
NY(config)#exit
NY#show ip interface brief
```

```
NY#show ip interface brief
Interface                  IP-Address      OK? Method Status                Prot
ocol
FastEthernet0/0            10.10.4.1       YES NVRAM  up                    up

FastEthernet0/0.1          unassigned      YES unset  up                    up

FastEthernet0/0.2          unassigned      YES unset  up                    up

FastEthernet0/1            unassigned      YES DHCP   up                    up

Serial0/0/0                192.168.1.1     YES NVRAM  up                    up

Serial0/1/0                192.168.2.1     YES NVRAM  up                    up

Serial0/1/1                192.168.4.1     YES NVRAM  up                    up

Serial0/1/1.2              209.165.201.17  YES NVRAM  up                    up

Loopback0                  192.31.7.1      YES NVRAM  up                    up

Loopback1                  unassigned      YES NVRAM  up                    up
```

Back

11. Exercises on PPP

11.1: Lab Exercise 1: PPP Configuration

Description: This exercise helps to understand how Point to Point Protocol encapsulation works . Configure PPP across a point-to-point network as shown in the network diagram below.

Instructions:

1. Configure for PPP on router BLR Serial 0/0/0
2. Configure "stac" compression on BLR
3. Configure for PPP on router NY serial 0/0/0
4. Configure "stac" compression on NY
5. Verify PPP compression by using show compress command

NY>enable
NY#configure terminal
NY(config)#interface serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#encapsulation ppp
NY(config-if)#compress stac

BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)#encapsulation ppp
BLR(config-if)#compress stac
BLR(config-if)#exit
BLR(config)#exit

BLR#show compress

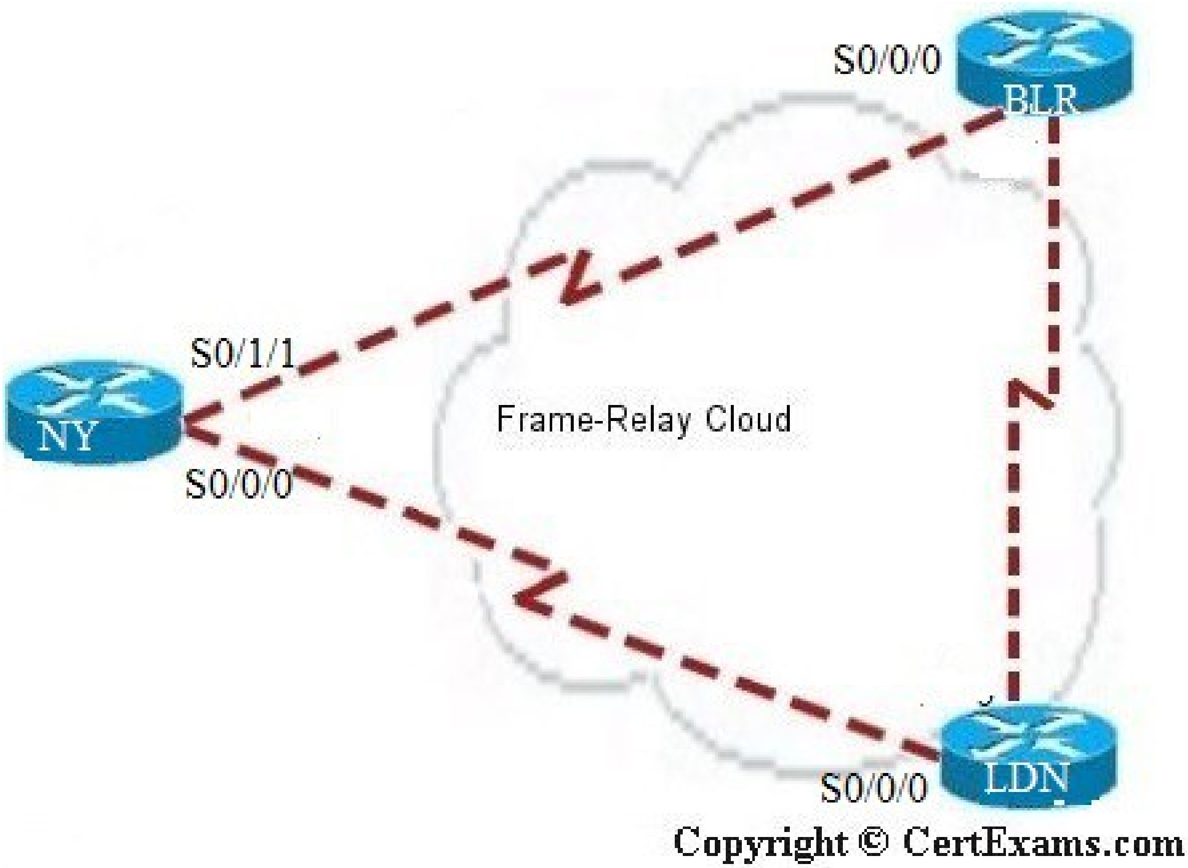
```
BLR#show compress
 Serial0/0/0
         Compression not active
         uncompressed bytes xmt/rcv 0/0
         compressed bytes   xmt/rcv 0/0
         Compressed bytes sent:         0 bytes    0 Kbits/sec
         Compressed bytes recv:         0 bytes    0 Kbits/sec
         1  min avg ratio xmt/rcv 0.000/0.000
         5  min avg ratio xmt/rcv 0.000/0.000
         10 min avg ratio xmt/rcv 0.000/0.000
         no bufs xmt 0 no bufs rcv 0
         resyncs 0
BLR#
```

[Back]

12. Exercises on Frame-Relay

12.1: Lab Exercise 1: Configuring Frame-Relay without sub-interfaces

Description: Configure frame-relay without using sub-interfaces. This configuration example uses full mesh topology.



Note that on a frame-relay network without sub-interfaces, the LMI-type is automatically detected. Similarly, PVC DLCIs are learned through CMS status messages. There is no need to specify the same explicitly. On the otherhand, in a FR network with point-to-point sub-interface configurations, you need to specify the interface-dlci number.

Instructions:

IP Address Assignment Table:

Device-Interface	IP Address/Mask
BLR-S0/0/0 BLR-S0/1/0	192.168.1.1/24 192.168.2.1/24
NY-S0/0/0 NY-S0/1/1	192.168.1.2/24 192.168.4.1/24
LA-S0/0/0 LA-S0/0/1	192.168.2.2/24 192.168.3.2/24

1. Specify frame-relay on S0/0 of Venus
2. Specify frame-relay on S0/0 of Saturn
3. Specify frame-relay on S0/0 of Jupiter

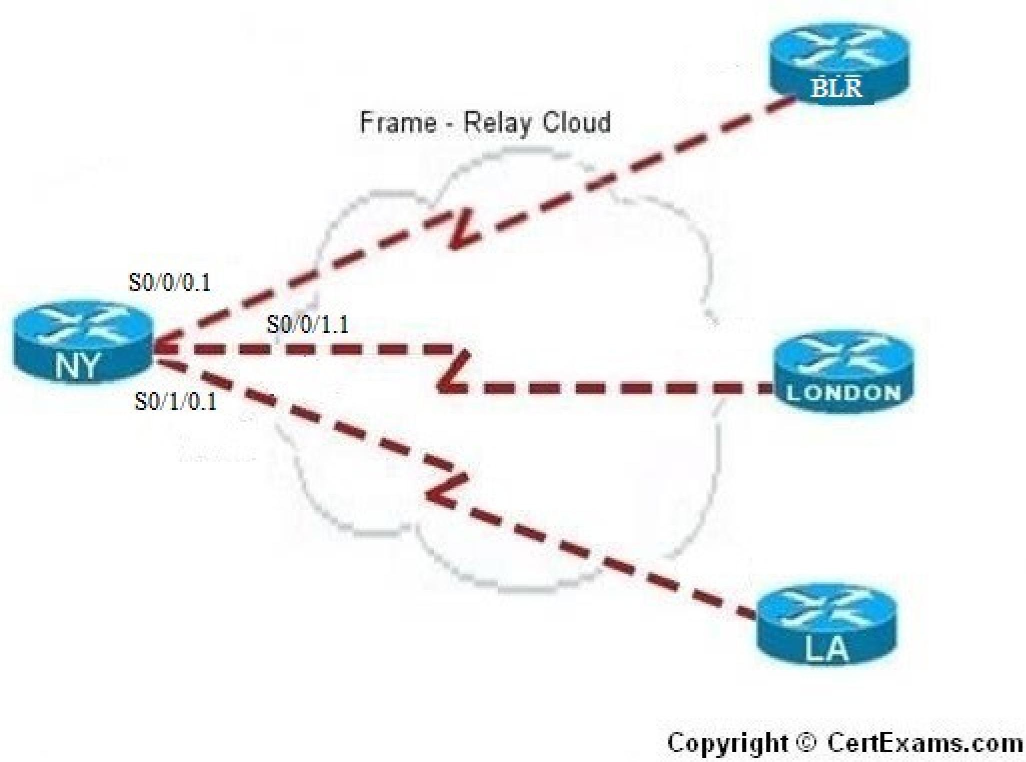
```
BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)# encapsulation frame-relay
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)#exit
BLR(config)#interface serial 0/1/0
BLR(config-if)# encapsulation frame-relay
BLR(config-if)#ip address 192.168.3.1 255.255.255.0
BLR(config-if)#^z
BLR#

NY>enable
NY#configure terminal
NY(config)#interface serial 0/0/0
NY(config-if)#encapsulation frame-relay
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#exit
NY(config)#interface serial 0/1/0
NY(config-if)# encapsulation frame-relay
NY(config-if)#ip address 192.168.3.1 255.255.255.0
NY(config-if)#^z

LDN>enable
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LA(config-if)#encapsulation frame-relay
LDN(config-if)#ip address 192.168.2.2 255.255.255.0
LDN(config-if)#exit
```


LDN(config)#interface serial 0/0/1
LDN(config-if)# encapsulation frame-relay
LDN(config-if)#ip address 192.168.3.2 255.255.255.0
LDN(config-if)#^z
LDN#

Back

12.2: Lab Exercise 2: Configuring Frame-Relay with point-to-point sub-interfaces

Description: Configure frame-relay using point-to-point sub-interfaces. This example uses 4 routers connected together in the form of a star using sub-interfaces.



Note that on a frame-relay network without sub-interfaces, the LMI-type is automatically detected. Similarly, PVC DLCIs are learned through CMS status messages. There is no need to specify the same explicitly. On the otherhand, in a FR network with point-to-point sub-interface configurations, you need to specify the interface-dlci number.

Instructions:

IP Address Assignment Table:

Device-Interface-Sub Interface	IP Address/Mask

NY-S0/0/0.1	192.160.1.1/24
NY-S0/0/1.1	192.160.2.1/24
NY-S0/1/0.1	192.160.3.1/24
BLR-S0/0/0.1	192.160.1.2/24
London-S0/0/0.1	192.160.2.2/24
LA-S0/0/0.1	192.160.3.2/24

Router NY:

1. Enter sub-interface configuration mode for s0/0.1
2. Specify ip address
3. Specify interface-dlci number 62
4. Exit
5. Specify hostname
6. Enter sub-interface configuration mode for s0/1.1
7. Specify ip address
8. Specify interface-dlci number 63
9. Exit
10. Specify hostname
11. Enter sub-interface configuration mode for s1/0.1
12. Specify ip address
13. Specify interface-dlci number 64
14. Exit

Router BLR:

1. Specify hostname
2. Specify frame-relay encapsulation
3. Enter sub-interface configuration mode for s0/0.1
4. Specify ip address
5. Specify interface-dlci number 62
6. Exit

Router London:

1. Specify frame-relay encapsulation
2. Enter sub-interface configuration mode for s0/0.1
3. Specify ip address
4. Specify interface-dlci number 63
5. Exit

Router LA:

1. Specify hostname
2. Specify frame-relay encapsulation
3. Enter sub-interface configuration mode for s0/0.1
4. Specify ip address
5. Specify interface-dlci number 64

6. Exit

```
NY>enable
NY#conf term
NY(config)#interface serial 0/0/0
NY(config-if)#encapsulation frame-relay
NY(config-if)#exit
NY(config)#interface serial 0/0/0.1 point-to-point
NY(config-subif)#ip address 192.160.1.1 255.255.255.0
NY(config-subif)#frame-relay interface-dlci 62
NY(config-subif)#exit
NY(config)#interface serial 0/0/1.1 point-to-point
NY(config-subif)#ip address 192.160.2.1 255.255.255.0
NY(config-subif)#frame-relay interface-dlci 63
NY(config-subif)#exit
NY(config)#interface serial 0/1/0.1 point-to-point
NY(config-subif)#ip address 192.160.3.1 255.255.255.0
NY(config-subif)#frame-relay interface-dlci 64
NY(config-subif)#^z
NY#copy running-config startup-config

BLR>enable
BLR#configure terminal
BLR(config)#interface serial 0/0/0
BLR(config-if)#encapsulation frame-relay
BLR(config-if)#exit
BLR(config)#interface serial 0/0/0.1 point-to-point
BLR(config-subif)#ip address 192.160.1.2 255.255.255.0
BLR(config-subif)#frame-relay interface-dlci 62
BLR(config-subif)#^z
BLR#copy running-config startup-config

LDN>enable
LDN#configure terminal
LDN(config)#interface serial 0/0/0
LDN(config-if)#encapsulation frame-relay
LDN(config-if)#exit
LDN(config)#interface serial 0/0/0.1 point-to-point
LDN(config-subif)#ip address 192.160.2.2 255.255.255.0
LDN(config-subif)#frame-relay interface-dlci 63
LDN(config-subif)#^z
LDN#copy running-config startup-config

LA>enable
LA#configure terminal
LA(config)#interface serial 0/0/0
LA(config-if)#encapsulation frame-relay
LA(config-if)#exit
LA(config)#interface serial 0/0/0.1 point-to-point
LA(config-subif)#ip address 192.160.3.2 255.255.255.0
```

LA(config-subif)#frame-relay interface-dlci 64
LA(config-subif)#^z
LA#copy running-config startup-config

Back

12.3: Lab Exercise 3: Frame-Relay with Show Commands

Not available in Demo Version

13. Exercises on Ipv6

13.1: Lab Exercise 1: Enabling IPv6 on a cisco router

Description: This lab demonstrates the steps required to enable ipv6 on a cisco router.

Instructions:

1. Enter into privileged mode on router NY
2. Enter into global configuration mode.
3. Enter the command "ipv6 unicast-routing" that enables the forwarding of Ipv6 unicast datagrams globally on the router.

```
NY>enable
NY#configure terminal
NY(config)#ipv6 unicast-routing
NY(config)#exit
NY#exit
NY>
```

Note: The first step of enabling IPv6 on a Cisco router is the activation of IPv6 traffic forwarding to forward unicast IPv6 packets between network interfaces. By default, IPv6 traffic forwarding is disabled on Cisco routers.
The "**ipv6 unicast-routing"** command is used to enable the forwarding of IPv6 packets between interfaces on the router.

Back

13.2: Lab Exercise 2: Enabling IPv6 on cisco router interface

Description : This lab demonstrates the steps required to enable ipv6 on a cisco router interface.

Instructions:

1. Enter into privileged mode on router NY
2. Enter into global configuration mode.
3. Enter the command "ipv6 unicast-routing" that enables the forwarding of IPv6 unicast datagrams globally on the router.
4. Enter into interface configuration mode and then use the command "ipv6 enable" to enable ipv6 processing on the interface and the command also automatically configures an IPv6 link-local address on the interface.

```
NY>enable
NY#configure terminal
NY(config)#ipv6 unicast-routing
NY(config)#interface serial 0/0/0
NY(config-if)#ipv6 enable
NY(config-if)#exit
```

NY(config)#exit

Note: To configure a router so that it uses only link local addresses, you only have to give ipv6 enable command. Issuing an ipv6 address command automatically configure link local addresses.

Back

13.3: Lab Exercise 3: Configuring IPv6 on a cisco router interface with IPv6 address in EUI-format

Not available in Demo Version

13.4: Lab Exercise 4: Configuring IPv6 on a cisco router interface with IPv6 address in general form

Not available in Demo Version

13.5: Lab Exercise 5: Configuring loopback interface with IPv6 address

Not available in Demo Version

13.6: Lab Exercise 6: Configuring IPv6 on two router interfaces connected directly and pinging the distant interface using console

Not available in Demo Version

13.7: Lab Exercise 7: Configuring IPv6 static route

Not available in Demo Version

13.8: Lab Exercise 8: Configuring IPv6 static default route

Not available in Demo Version

13.9: Lab Exercise 9: Implement and verify IPv6 static route

Not available in Demo Version

14. Exercises on IPv6 Routing Protocols

14.1: Lab Exercise 1: Enabling RIPng on a cisco router interface

Description: This lab exercise demonstrates enabling RIPng for IPv6 (next-generation RIP protocol) on a router interface.

Instructions:

1. Enter into privileged mode on router NY.
2. Enter into global configuration mode.
3. Enter the command "ipv6 unicast-routing" that enables the forwarding of IPv6 unicast datagrams globally on the router.
4. Enter into interface configuration mode and then use the command "ipv6 rip <name> enable command to enable the specified RIP routing process on an interface.
5. Issue "show ipv6 rip" command that displays information about the configured RIP routing processes.

```
NY>enable
NY#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
NY(config)#ipv6 unicast-routing
NY(config)#interface serial 0/0/0
NY(config-if)#ipv6 rip pname1 enable
NY(config-if)#exit
NY(config)#exit
NY#show ipv6 rip
NY#show ipv6 protocols
```

Note: ipv6 rip <name> enable command enables the specified IPv6 RIP routing process on an interface.
The process name is only significant within the router, and allows you to run more than one RIP process if you want to. Because it is only locally significant, every router can have a different RIP process name without conflict, although we generally don't recommend this, as it can become confusing to manage.

"show ipv6 rip" and "show ipv6 protocols" command output is given below

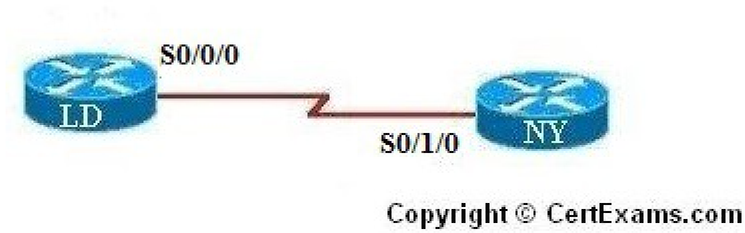
```
NY#show ipv6 rip
RIP process "pname1", port 521, multicast-group FF02::9, pid 181
     Administrative distance is 120. Maximum paths is 16
     Updates every 30 seconds, expire after 180
     Holddown lasts 0 seconds, garbage collect after 120
     Split horizon is on; poison reverse is off
     Default routes are not generated
     Periodic updates 0, trigger updates 0
  Interfaces:
    Serial0/0/0
  Redistribution:
    None
```

```
NY#show ipv6 protocols
IPv6 Routing Protocol is "connected"
IPv6 Routing Protocol is "static"
IPv6 Routing Protocol is "rip pname1"
  Interfaces:
    Serial0/0/0
  Redistribution:
    None
NY#
```

Back

14.2: Lab Exercise 2: Enabling RIPng on two routers and pinging between them

Description: This lab exercise demonstrates testing the connectivity using ping between two routers configured with RIP routing processes.



Instructions:

1. Enter into privileged mode on router London (LD).
2. Enter into global configuration mode.
3. Enter the command "ipv6 unicast-routing" that enables the forwarding of IPv6 unicast datagrams globally on the router.
4. Enter into interface configuration mode and then assign IPv6 address on the interface. and then use the command "ipv6 rip <name> enable command to enable the specified RIP routing process on an interface.
5. Use the command "no shutdown" to start the protocol and issue copy run start config command
6. Enter into privileged mode on router Newyork (NY).
7. Enter into global configuration mode.
8. Enter the command "ipv6 unicast-routing" that enables the forwarding of IPv6 unicast datagrams globally on the router.
9. Enter into interface configuration mode and then assign IPv6 address on the interface. and then use the command "ipv6 rip <name> enable command to enable the specified RIP routing process on an interface.
10. Use the command "no shutdown" to start the protocol and issue copy run start config command
11. Ping LDN from NY and test for connectivity.


```
LDN>enable
LDN#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
LDN(config)#ipv6 unicast-routing
LDN(config)#interface serial 0/0/0
LDN(config-if)#ipv6 address 2001:3abc:d00:4ab:2::1/64
LDN(config-if)#ipv6 rip process1 enable
LDN(config-if)#no shutdown
LDN(config-if)#exit
LDN(config)#exit

NY>enable
NY#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
NY(config)#ipv6 unicast-routing
NY(config)#interface serial 0/1/0
NY(config-if)#ipv6 address 2001:3abc:d00:4ab:2::2/64
NY(config-if)#ipv6 rip process1 enable
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#exit

NY#ping ipv6 2001:3abc:d00:4ab:2::1
```

Back

14.3: Lab Exercise 3: Entering RIPng router configuration mode and setting global parameters on a cisco router

Not available in Demo Version

14.4: Lab Exercise 4: Configuring EIGRPv6 on a router interface

Not available in Demo Version

14.5: Lab Exercise 5: Configuring EIGRPv6 on two routers and pinging between them

Not available in Demo Version

14.6: Lab Exercise 6: Enabling OSPF for IPv6 on a cisco router interface

Not available in Demo Version

14.7: Lab Exercise 7: Configuring OSPF on two router interfaces

Not available in Demo Version

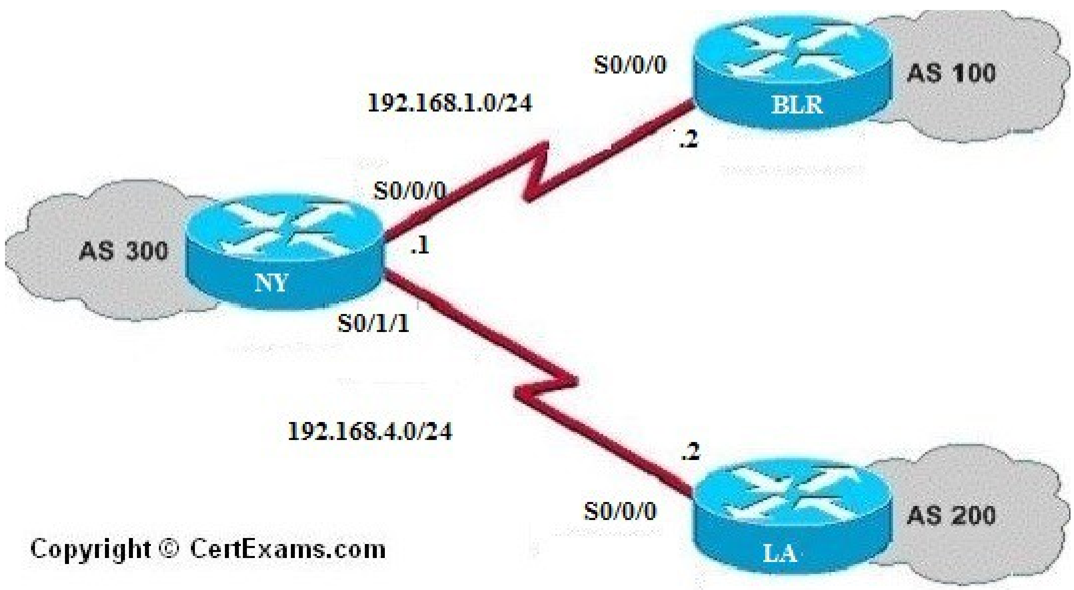
14.8: Lab Exercise 8: General IPv6 configuration on cisco router

Not available in Demo Version

14.9: Lab Exercise 9: Traceroute lab

Not available in Demo Version

15. Exercises on BGP



15.1: Lab Exercise 1 Basic BGP Configuration

Note: This Lab has three sections

I: Basic BGP Configuration

Description: Describes the commands for forming BGP neighbor relationships and advertising networks.

Instructions:

1. Assign the IP addresses to all the devices as per the diagram.
2. Bring all the interfaces to up.

3. Issue network command on all the devices to identify the networks to be advertised by the BGP process.
4. Issue neighbor command on Router NY to identify each neighbor and its AS.

On NY:

```
NY>enable
NY#conf term
NY(config)# int serial 0/0/0
NY(config-if)#ip address 192.168.1.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#int serial 0/1/1
NY(config-if)#ip address 192.168.4.1 255.255.255.0
NY(config-if)#no shutdown
NY(config-if)#exit
NY(config)#router bgp 300
NY(config-router)#network 192.168.4.0
NY(config-router)#network 192.168.1.0
NY(config-router)#exit
NY(config)#exit
NY#
```

On BLR

```
BLR>enable
BLR#conf term
BLR(config)# int serial 0/0/0
BLR(config-if)#ip address 192.168.1.2 255.255.255.0
BLR(config-if)#no shutdown
BLR(config-if)#exit
BLR(config)#router bgp 100
BLR(config-router)#network 192.168.1.0
BLR(config-router)#exit
BLR(config)#exit
BLR#
```

On LA

```
LA>enable
LA#conf term
LA(config)# int serial 0/0/0
LA(config-if)#ip address 192.168.4.2 255.255.255.0
LA(config-if)#no shutdown
LA(config-if)#exit
LA(config)#router bgp 200
LA(config-router)#network 192.168.4.0
LA(config-router)#exit
LA(config)#exit
LA#
```


On NY

NY>enable
NY#conf term
NY(config)#router bgp 300
NY(config-router)# neighbor 192.168.1.2 remote-as 100
NY(config-router)#neighbor 192.168.4.2 remote-as 200
NY(config-router)#exit
NY(config)#exit

II: Managing and Verifying the BGP Configuration

Description: This section explains the common BGP commands used to view the status of BGP neighbor relationships and the routes learned through these relationships.

Instructions:

1.Enter into privileged mode
2.Issue show ip bgp command to display the bgp routing table
3.Issue show ip bgp summary command to display the status of all bgp sessions.
4.Issue show ip bgp neighbor command to displays TCP and BGP connection to neighbors.

On NY

NY>enable
NY#show ip bgp
NY#show ip bgp summary
NY#show ip bgp neighbors

BGP show command output is given below

```
NY#show ip bgp
BGP table version is 3, local router ID is 192.31.7.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
              r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 192.168.1.0      0.0.0.0                  0         32768 i
*> 192.168.4.0      0.0.0.0                  0         32768 i
NY#
```

```
NY#show ip bgp summary
BGP router identifier 192.31.7.1, local AS number 300
BGP table version is 5, main routing table version 5
2 network entries using 234 bytes of memory
2 path entries using 104 bytes of memory
2/1 BGP path/bestpath attribute entries using 248 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 586 total bytes of memory
BGP activity 2/0 prefixes, 2/0 paths, scan interval 60 secs

Neighbor        V    AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.1.2     4   100       0       0        0    0    0 never    Active
192.168.4.2     4   200       0       0        0    0    0 never    Active
NY#
```

```
NY#show ip bgp neighbors
BGP neighbor is 192.168.1.2,  remote AS 100, external link
  BGP version 4, remote router ID 0.0.0.0
  BGP state = Active
  Last read 00:03:00, last write 00:03:00, hold time is 180, keepalive interval
  Message statistics:
    InQ depth is 0
    OutQ depth is 0
                         Sent       Rcvd
    Opens:                  0          0
    Notifications:          0          0
    Updates:                0          0
    Keepalives:             0          0
    Route Refresh:          0          0
    Total:                  0          0
  Default minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  BGP table version 5, neighbor version 0/0
 Output queue size : 0
  Index 1, Offset 0, Mask 0x2
  1 update-group member
                                 Sent       Rcvd
  Prefix activity:               ----       ----
    Prefixes Current:               0          0
    Prefixes Total:                 0          0
    Implicit Withdraw:              0          0
    Explicit Withdraw:              0          0
    Used as bestpath:             n/a          0
    Used as multipath:            n/a          0

                                   Outbound    Inbound
  Local Policy Denied Prefixes:    --------    -------
    Total:                                0          0
  Number of NLRIs in the update sent: max 0, min 0

  Connections established 0; dropped 0
  Last reset never
  No active TCP connection

BGP neighbor is 192.168.4.2,  remote AS 200, external link
  BGP version 4, remote router ID 0.0.0.0
  BGP state = Active
  Last read 00:02:52, last write 00:02:52, hold time is 180, keepalive interval
  Message statistics:
 --More--
         <Output omitted for brevity>
```

III: Resetting neighbors

Description: Describes the methods for resetting BGP neighbor relationships.

Instructions:

1. Enter into router configuration mode
2. Issue clear ip bgp command to reset session between the neighbors .

On NY:

NY>enable
NY#conf term
NY(config)#router bgp 300
NY(config-router)#clear ip bgp 192.168.1.2
NY(config-router)#clear ip bgp *

Back

15.2: Lab Exercise 2: Setting BGP attributes

Description: This lab exercise explains to set the weight and local preference attribute of the

BGP.

Instructions:

1.On NY set BGP weight attribute of the neighbor (BLR) as 200
3.Also set the default local preference of neighbor BLR to 100
4.Verify the configuration of attributes by giving show ip bgp command.

On NY

```
NY>enable
NY#conf term
NY(config)#router bgp 300
NY(config-router)#neighbor 192.168.1.2 weight 200
NY(config-router)#bgp default local-preference 100
NY(config-router)#exit
NY(config)#exit
NY#show ip bgp
```

[Back]

15.3: Lab Exercise 3: Setting the BGP neighbor password

Not available in Demo Version

15.4: Lab Exercise 4: To disable the peer

Not available in Demo Version

15.5: Lab Exercise 5: Basic configuration of a peer group

Not available in Demo Version

15.6: Lab Exercise 6: Configuring Multi Exit Discriminator Metric

Not available in Demo Version

16. Exercises On Route Redistribution

16.1: Lab Exercise 1: Route Redistribution for RIP

Description: This lab exercise demonstrates the command for redistributing EIGRP, OSPF, and Static routes into RIP.

Instructions:

1. Enter into router configuration mode
2. Issue command to redistribute all EIGRP routes into RIP
3. Issue command to redistribute all OSPF routes into RIP
4. Issue command to redistribute all Static routes into RIP

On NY:

```
NY>enable
NY#conf term
NY(config)#router rip
NY(config-router)#redistribute eigrp 100 metric 1
NY(config-router)#redistribute ospf 1 metric 1
NY(config-router)#redistribute static metric 1
NY(config-router)#exit
NY(config)#
```

NOTE: Metric command can also be given in following way (Using the **default-metric** command saves work because it eliminates the need for defining the metric separately for each redistribution.)

```
NY(config)#router rip
NY(config-router)#redistribute eigrp 100
NY(config-router)#redistribute ospf 1
NY(config-router)#redistribute static
NY(config-router)#default-metric 1
```

Back

16.2: Lab Exercise 2: Route Redistribution for EIGRP

Description: This lab exercise demonstrates the command for redistributing RIP, OSPF, and Static routes into EIGRP.

NOTE: EIGRP need five metrics when redistributing other protocols: bandwidth, delay, reliability, load, and MTU

Instructions:

1. Enter into router configuration mode
2. Issue command to redistribute all RIP routes into EIGRP
3. Issue command to redistribute all OSPF routes into EIGRP
4. Issue command to redistribute all static routes into EIGRP.

On NY:

```
NY>enable
NY#conf term
NY(config)#router eigrp 1
NY(config-router)#redistribute rip metric 2000 200 255 1 1500
NY(config-router)#redistribute ospf 1 metric 2000 200 255 1 1500
NY(config-router)#redistribute static metric 2000 200 255 1 1500
NY(config-router)#exit
NY(config)#
```

NOTE: Metric command can also be given in following way (Using the **default-metric** command saves work because it eliminates the need for defining the metric separately for each redistribution.)

```
NY(config)#router eigrp 1
NY(config-router)#redistribute rip
NY(config-router)#redistribute ospf
NY(config-router)#redistribute static
NY(config-router)#default-metric 10000 100 255 1 1500
```

Back

16.3: Lab Exercise 3: Route Redistribution for OSPF

Not available in Demo Version

16.4: Lab Exercise 4: Redistribution between EIGRP and OSPF

Not available in Demo Version

16.5: Lab Exercise 5: Redistribution between RIP and EIGRP

Not available in Demo Version

17. Exercises On MPLS

17.1: Lab Exercise 1: Configuring a Router for MPLS Forwarding and verifying the configuration of MPLS forwarding.

Description: MPLS forwarding on Cisco routers requires that Cisco Express Forwarding be enabled. This lab exercise demonstrates the necessary commands to enable the Cisco Express Forwarding.

Instructions:

1. Enable privileged EXEC mode.
2. Enter into configuration mode
3.Enable the Cisco express forwarding on the router.

BLR>enable
BLR#conf term
BLR(config)#ip cef
BLR(config)#exit

[Back]

17.2: Lab Exercise 2: Enabling MPLS

Description: The following example shows how to configure MPLS hop-by-hop forwarding on the interface.

Instructions:

1. Enable privileged EXEC mode.
2. Enter into configuration mode
3. Enable the Cisco express forwarding on the router
4. Enter into interface configuration mode
5. Configures MPLS hop-by-hop forwarding on the interface.
6. Exit interface configuration mode

BLR>enable
BLR#conf term
BLR(config)#ip cef
BLR(config)#interface s 0/0/0
BLR(config-if)#mpls ip
BLR(config-if)#exit
BLR(config)#exit

Note: Router(config)#mpls ip

The above command configures MPLS hop-by-hop forwarding globally.
The 'mpls ip' command is enabled by default; you do not have to specify this command.Globally enabling MPLS forwarding does not enable it on the router interfaces. You must enable MPLS

forwarding on the interfaces as well as for the router.

Use of the **mpls ip** command on an interface triggers the transmission of discovery Hello messages for the interface. When two platforms are directly connected by multiple packet links, the same label distribution protocol (LDP or TDP) must be configured for all of the packet interfaces connecting the platforms.

Back

17.3: Lab Exercise 3: Configuring MPLS LDP

Not available in Demo Version

17.4: Lab Exercise 4: Configuring MPLS using EIGRP

Not available in Demo Version

17.5: Lab Exercise 5: Configuring MPLS using OSPF

Not available in Demo Version

17.6: Lab Exercise 6: Configuring MPLS using RIP

Not available in Demo Version

17.7: Lab Exercise 7: MPLS Show commands

Not available in Demo Version

18. CISCO SWITCH IOS

18.1 Logging In To The Switch

When Catalyst switches are configured from the CLI that runs on the console or a remote terminal, the Cisco IOS Software provides a CLI called the EXEC. The EXEC interprets the commands that are entered and carries out the corresponding operations.
For security purposes, the EXEC has the following two levels of access to commands:

1. User mode: Typical tasks include those that check the status of the switch, such as some basic show commands.

2. Privileged mode: Typical tasks include those that change the configuration of the switch. This mode is also known as enable mode. If you have the password that gets you to this privileged enable mode, you basically will have access to all possible device configuration commands.
To change from user EXEC mode to privileged EXEC mode, enter the enable command.
The switch then prompts for the enable password if one is configured. Enter the correct enable password. By default, the enable password is not configured.

18.2: Lab Exercise 1: Introduction to switch

Description: A basic exercise to get familiar with the different commands related to switch .

The switch initial startup status can be verified using the below status commands:

Instructions:

1. Connect to switch and you should see the user mode prompt
2. Show version command displays the IOS version of the switch
3. Show interfaces command displays the interfaces of the switch
4. Show running-config displays the running configuration

LA-2950>enable
Password:CCNA
LA-2950#show version
LA-2950#show interfaces
LA-2950#show running-config

Show version: Displays the configuration of the system hardware and the currently loaded IOS software version information , the screenshot of "show version" command is given below.

```
LA-2950#show version
Cisco Internetwork Operating System Software
IOS (tm) C2950 Software (C2950-I6Q4L2-M), Version 12.1(22)EA10a, RELEASE SOFTWAR
E (fc2)
Copyright (c) 1986-2007 by cisco Systems, Inc.
Compiled Tue 24-Jul-07 17:13 by antonino
Image text-base: 0x80010000, data-base: 0x80570000

ROM: Bootstrap program is C2950 boot loader

LA-2950 uptime is 58 minutes
System returned to ROM by power-on
System image file is "flash:/c2950-i6q4l2-mz.121-22.EA10a.bin"

cisco WS-C2950SX-24 (RC32300) processor (revision L0) with 20957K bytes of memor
y.
Processor board ID FOC1018Y288
Last reset from system-reset
Running Standard Image
24 FastEthernet/IEEE 802.3 interface(s)
2 Gigabit Ethernet/IEEE 802.3 interface(s)

32K bytes of flash-simulated non-volatile configuration memory.
Base ethernet MAC Address: 00:17:E0:91:B7:80
Motherboard assembly number: 73-8135-07
Power supply part number: 34-0965-01
Motherboard serial number: FOC10173ULH
Power supply serial number: DAB10072C44
Model revision number: L0
Motherboard revision number: A0
Model number: WS-C2950SX-24
System serial number: FOC1018Y288
Configuration register is 0xF
```

Show running-config: Displays the current active running configuration of the switch. This command requires privileged EXEC mode access. The screenshot of "show running-config" command is given below.

```
LA-2950#show running-config
Building configuration...

Current configuration : 1712 bytes
!
version 12.1
no service pad
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname LA-2950
!
aaa new-model
aaa authentication login default group tacacs+ local
aaa authorization exec default group tacacs+ local
aaa authorization commands 15 default group tacacs+ local
enable secret 5 $1$Jjfn$.rfVfzuQT/Ua9f61PRZXX/
!
username networkadmin privilege 15 secret 5 $1$hAoN$AMieiPvJ7mb0ixrlI04Du.
username netmonitor secret 5 $1$YEmb$Vl8kMjdubiUUK6EexC2OZ/
ip subnet-zero
!
!
spanning-tree mode pvst
no spanning-tree optimize bpdu transmission
spanning-tree extend system-id
!
!
!
!
interface FastEthernet0/1
!
interface FastEthernet0/2
!
interface FastEthernet0/3
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
```

<Output omitted for brevity>

Show interfaces: Displays statistics and status information of all the interfaces on the **switch.**

```
LA-2950#show interfaces
Vlan1 is up, line protocol is up
  Hardware is CPU Interface, address is 0017.e091.b780 (bia 0017.e091.b780)
  Internet address is 10.10.1.2/24
  MTU 1500 bytes, BW 1000000 Kbit, DLY 10 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input 00:00:00, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
  5 minute input rate 1000 bits/sec, 1 packets/sec
  5 minute output rate 11000 bits/sec, 13 packets/sec
     1758 packets input, 314535 bytes, 0 no buffer
     Received 100 broadcasts (0 IP multicast)
     0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 8 ignored
     46340 packets output, 14691341 bytes, 0 underruns
     0 output errors, 2 interface resets
     0 output buffer failures, 0 output buffers swapped out
FastEthernet0/1 is down, line protocol is down (notconnect)
  Hardware is Fast Ethernet, address is 0017.e091.b781 (bia 0017.e091.b781)
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ARPA, loopback not set
  Keepalive set (10 sec)
  Auto-duplex, Auto-speed, media type is 100BaseTX
  input flow-control is unsupported output flow-control is unsupported
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 01:03:33, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
  Queueing strategy: fifo
  Output queue: 0/40 (size/max)
 --More--
[Connection to 10.10.1.2 closed by foreign host]
LDN#
```

<Output omitted for brevity>

Back

18.3: Lab Exercise 2: Switch Console Password Assignment

Description: Lab Exercise explains the concept of configuring switch console password assignment.

Use the line console 0 command, followed by the password and login subcommands, to require login and establish a login password on the console terminal or on a VTY port. By default, login is not enabled on the console or on VTY ports.

Instructions:

1. Enter global configuration mode
2. Enter line sub-configuration mode
3. Set the console password to "consolepass"
4. Exit line configuration mode

LA-2950>enable

LA-2950#configure terminal
LA-2950(config)#line console 0
LA-2950(config-line)#password consolepass
LA-2950(config-line)#exit

By giving “show running-config” command you can view the console password assigned

```
line con 0
 password consolepass
line vty 0 4
 password Cisco
 login
line vty 5 15
 password Cisco
 login
!
 --More--
```

<Output omitted for brevity>

Back

18.4: Lab Exercise 3: Switch VTY password assignment

Not available in Demo Version

18.5: Lab Exercise 4: Switch Setting Privileged Password

Not available in Demo Version

18.6: Lab Exercise 5: Enable Fast Ethernet Interface on a switch

Not available in Demo Version

18.7: Lab Exercise 6: Initial Switch configuration

Not available in Demo Version

18.8: Lab Exercise 7: Basic Switch Interface Configuration

Not available in Demo Version

18.9: Lab Exercise 8: Catalyst Switch Configuration

Not available in Demo Version

19. Exercises on Spanning Tree Protocol

19.1: Lab Exercise 1: Enabling STP

Description: This lab exercise demonstrates the necessary commands to enable and disable spanning tree protocol on a switch.

Instructions:

1. Enter into configuration mode on LA-2950
2. Issue command "spanning-tree vlan <vlan-num> to enable spanning-tree on a specified VLAN
3. Issue no form of the command "spanning-tree vlan <vlan-num> to disable spanning-tree on the VLAN specified.

LA-2950>enable
LA-2950#configure terminal
LA-2950(config)#spanning-tree vlan 1
LA-2950(config)#no spanning-tree vlan 1
LA-2950(config)#exit
LA-2950#

Note: Spanning Tree Protocol (STP) is enabled by default on modern switches. It is possible to disable or enable the Spanning Tree Protocol (STP) when required.

Back

19.2: Lab Exercise 2: Configuring Root Switch

Description : This lab exercise demonstrates the necessary commands to configure the root switch.

Instructions:

1. Enter into configuration mode on LA-2950
2. Issue the command "spanning-tree vlan <vlan-num> root" that modifies the switch priority from the default 32768 to a lower value to allow the switch to become the root switch for VLAN 1
3. Verify the configuration using "show spanning-tree" command.

LA-2950>enable
LA-2950#configure terminal
LA-2950(config)#spanning-tree vlan 1 root
LA-2950(config)#exit
LA-2950#show spanning-tree

Explanation: The command "show spanning-tree" includes information about the following:

1. VLAN number
2. Root bridge priority, MAC address
3. Bridge timers (Max Age, Hello Time, Forward Delay)

Below screenshot displays output from “show spanning-tree”

```
LA-2950#show spanning-tree

VLAN0001
  Spanning tree enabled protocol ieee
  Root ID    Priority    24577
             Address     0017.e091.b780
             This bridge is the root
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec

  Bridge ID  Priority    24577  (priority 24576 sys-id-ext 1)
             Address     0017.e091.b780
             Hello Time   2 sec  Max Age 20 sec  Forward Delay 15 sec
             Aging Time 300

Interface        Role Sts Cost      Prio.Nbr Type
---------------- ---- --- --------- -------- --------------------------------
Fa0/3            Desg FWD 19        128.3    P2p
Fa0/4            Desg FWD 19        128.4    P2p
Fa0/8            Desg FWD 19        128.8    P2p
Fa0/12           Desg FWD 19        128.12   P2p
Fa0/14           Desg FWD 19        128.14   P2p
Fa0/18           Desg FWD 19        128.18   P2p

LA-2950#
```

Back

19.3: Lab Exercise 3: Configuring Port-Priority

Not available in Demo Version

19.4: Lab Exercise 4: Configuring the switch priority of a VLAN

Not available in Demo Version

19.5: Lab Exercise 5: Configuring STP Timers

Not available in Demo Version

19.6: Lab Exercise 6: Verifying STP

20. EXERCISES ON SWITCH CONFIGURATION AND VLAN

20.1: Lab Exercise 1: Basic Switch IP Configuration

Description: The lab exercise explains the concept of configuring IP address on switch

Instructions:

1. Enter user Exec mode
2. Enter privileged Exec mode
3. Assign an ip address 10.10.1.2 255.255.255.0
4. Assign default gateway route 10.10.1.1
5. Exit switch configuration mode

```
LA-2950>enable
LA-2950#configure terminal
LA-2950(config)#interface vlan 1
LA-2950(config-if)#ip address 10.10.1.2 255.255.255.0
LA-2950(config-if)#exit
LA-2950(config)#ip default-gateway 10.10.1.1
LA-2950(config)#end
LA-2950#show running-config
```

Explanation: A default gateway allows devices on a network to communicate with devices on another network. Without it, the network is isolated from the outside. Basically, devices send data that is bound for other networks (one that does not belong to its local IP range) through the default gateway.

LA-2950 , vlan1 interface is configured with ip address as 10.10.1.2 255.255.255.0 and default-gateway as 10.10.1.1

Back

20.2: Lab Exercise 2: Configure and verify port-security on switch

Description: Lab exercise explains the configuration of port-security on switches

Notes: Port security is disabled by default. **switchport port-security** command is used to enable it.
Port security feature does not work on three types of ports.
Trunk ports
Ether channel ports
Switch port analyzer ports

Port security work on host port. In order to configure port security we need to set it as host port. It could be done easily by ***switchport mode access*** command.

Instructions:

1. Move in privilege exec mode

2. Move in global configuration mode
3. Move in interface mode
4. Assign port as host port
5. Enable port security feature on this port
6. Set limit for hosts that can be associated with interface. Default value is 1.
7. Set security violation mode. Default mode is shutdown.
8. Enters a secure MAC address for the interface. You can use this command to enter the maximum number of secure MAC addresses.
9. Enable sticky learning on the interface
10. Verify the configuration by show command "**show port-security**"
11. Also give "**show port-security interface fastethernet** *0/1*"

NY-2960>enable
Password:Cisco
NY-2960#configure terminal
NY-2960(config)#interface fastethernet 0/1
NY-2960(config-if)#switchport mode access
NY-2960(config-if)#switchport port-security
NY-2960(config-if)#switchport port-security maximum 5
NY-2960(config-if)#switchport port-security violation shutdown
NY-2960(config-if)#switchport port-security mac-address 2222.3333.4444
NY-2960(config-if)#switchport port-security mac-address sticky
NY-2960(config-if)#end
NY-2960#show port-security
NY-2960#show port-security interface fastethernet 0/1

Explanation: The "switchport port-security maximum <no. of addresses>" command sets the maximum number of secure MAC addresses for the port (default is 1) . To configure a static entry for the MAC address table, use the mac address-table static command. To delete the static entry, use the no form of this command.
mac address-table static mac-address vlan vlan-id {drop| interface{ethernetslot/port|port-channelnumber[.subinterface-number]} [auto-learn]

In this lab port security is configured on port fa 3/0/1. The switch will learn the MAC address of the device connected to port fa 3/0/1 and will allow only that device to connect to the port in future.

The sample output of "show port-security" and "show port-security interface fastethernet 3/0/1**"** is shown below

```
NY-2960#show port-security
Secure Port  MaxSecureAddr  CurrentAddr  SecurityViolation  Security Action
                (Count)       (Count)          (Count)
---------------------------------------------------------------------------
      Fa0/1              5            2                  0         Shutdown
---------------------------------------------------------------------------
Total Addresses in System (excluding one mac per port)     : 1
Max Addresses limit in System (excluding one mac per port) : 8192
NY-2960#
```

```
NY-2960#show port-security interface fastEthernet 0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Shutdown
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 5
Total MAC Addresses        : 2
Configured MAC Addresses   : 1
Sticky MAC Addresses       : 1
Last Source Address:Vlan   : 001b.d43f.8baf:1
Security Violation Count   : 0

NY-2960#
```

Back

20.3: Lab Exercise 3: Troubleshooting a Switch

Not available in Demo Version

20.4: Lab Exercise 4: Switch Trunking Configuration

Not available in Demo Version

20.5: Lab Exercise 5: Creating and Deleting VLAN's

Not available in Demo Version

20.6: Lab Exercise 6: Configuring VTP on a Switch

Not available in Demo Version

20.7: Lab Exercise 7: Configuring VTP with a VTP Client

Not available in Demo Version

20.8: Lab Exercise 8: Troubleshooting lab with non-matching domains

Not available in Demo Version

20.9: Lab Exercise 9: Troubleshooting lab with trunk functionality

Not available in Demo Version

20.10: Lab Exercise 10: VLANs Scenario

Not available in Demo Version

20.11: Lab Exercise 11: VTP (VLAN Trunking Protocol) Scenario

Not available in Demo Version

20.12: Lab Exercise 12: VLANs and Trunking

Not available in Demo Version

20.13: Lab Exercise 13: Routing between VLANs(Router on a Stick)

Not available in Demo Version