



Course Title: CONNECTING NETWORKS

Course Level: PG/PE2

Course Code:

Credit Units: 4

L	T	P/ S	SW/F W	TOTAL CREDIT UNITS
2	-	2	2	4

Course Objectives: The objective of the course is:

- To introduce the networking concepts and technologies for connecting geographically distant network
- To judiciously use packet-switching or circuit switched networks for IPv6
- To understand the congestion and its control using frame- relay
- To connect the various segments of teleworkers using VPN
- To secure an organization and its router by applying ACLs using IPv6
- Troubleshoot the IPv6 network
- Developing the skills necessary to plan and implement small networks across a range of applications

Pre-requisites: Data Communication & Computer Networks

Student Learning Outcomes: The student will be able to:

- Plan and effectively manage any WAN network using PPP , Frame Relay or VPN
- Deploy and effectively manage the security for the given network and Frame security policy
- Explain the major techniques involved, and networks & systems issues for the design and implementation of networking of inter and intra WAN networks.
- Describe the key components and technologies such as NAT, DHCP involved and to gain hands-on experiences in building the network.
- Analyze the cause of congestion and related factors for Quality of Service
- Enhance the perform by troubleshooting
- Assist in Transition from IPV4 to IPV6

Course Contents/Syllabus:

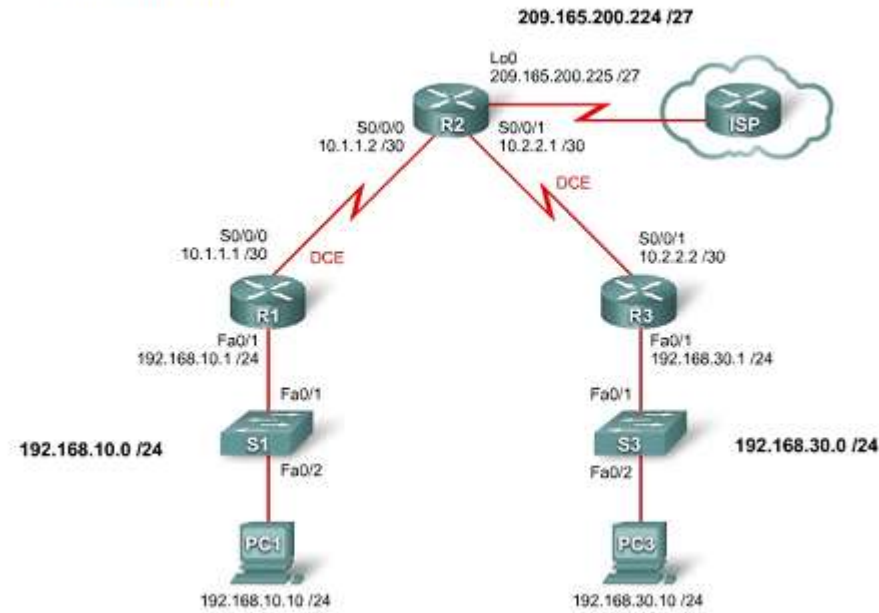
	Weightage (%)
<u>Module I: Hierarchical Network Design ad WAN Technologies</u>	15%
Enterprise Network Design: Network Requirements, Structured Engineering principles; Design of the Networks: Network Hierarchy, The Access Layer, Distribution Layer; Two-Tier Collapsed Core Design; Case Study: Cisco Enterprise Architecture; WAN Technologies: Purpose of WANs and WAN Operations; SW: Study any Emerging Network Architectures and Select a WAN Technology that is suitable for the Enterprise	
<u>Module II: Point to Point Connections and Frame Relay</u>	25%
Point To Point Protocols: Serial Point to Point Overview, Configure PPP; Basic Frame Relay Concepts, Configuring Frame Relay, Advanced Frame Relay Concept, Configuring Advanced Frame Relay Concept SW: Troubleshooting PPP and Frame Relay Networks	
<u>Module III: Network Address Translation</u>	20%
NAT Characteristics: Benefits and Drawbacks; Static NAT and Dynamic NAT; Configure PAT Using CLI; Configuration of Port Forwarding using CLI; Configuration of NAT in IPv6 SW: Trouble shooting NAT	
<u>Module IV: Broadband Solutions and Securing Site-to Site Connectivity</u>	20%
Business Requirement for Teleworker Services, Broadband Services; Configuring xDSL Connectivity: PPPoE Overview, Configuring PPPoE; Virtual Private Networks: Benefits and Drawbacks; Site to Site GRE Tunnels; introducing IPsec; Remote Access	
<u>Module V: Network Monitoring</u>	20%
Network Monitoring using Syslog, SNMP, Netflow; Troubleshooting with Systems Approach, Network Documentation; Troubleshooting Process; Troubleshooting Tools; Symptoms and Causes of Network SW: Troubleshooting IP Connectivity	

List of Practicals:

List of Practical – Accessing the WAN

1. Basic PPP Configuration Lab

Topology Diagram



Addressing Table

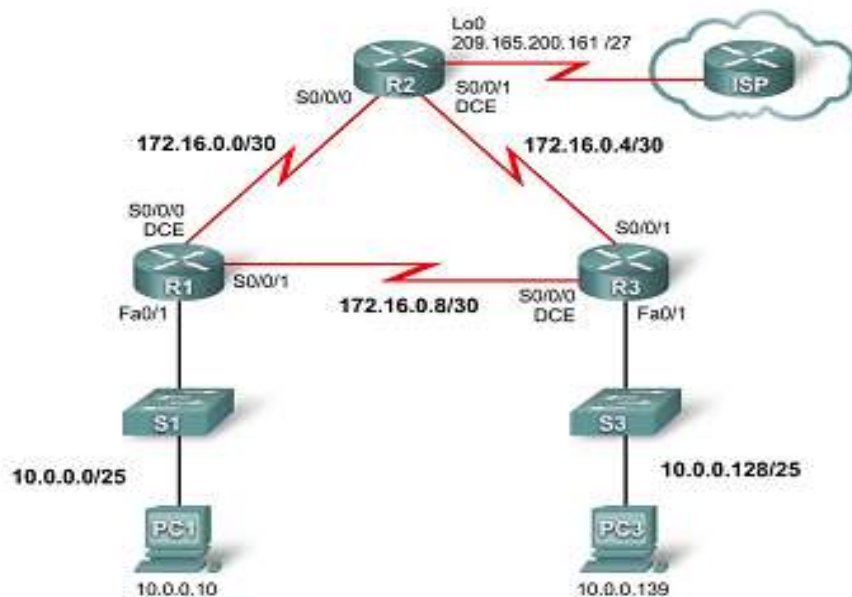
Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/1	192.168.10.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	N/A
R2	Lo0	209.165.200.225	255.255.255.224	N/A
	S0/0/0	10.1.1.2	255.255.255.252	N/A
R3	Fa0/1	192.168.30.1	255.255.255.0	N/A
	S0/0/1	10.2.2.2	255.255.255.252	N/A
PC1	NIC	192.168.10.10	255.255.255.0	192.168.10.1
PC3	NIC	192.168.30.10	255.255.255.0	192.168.30.1

- Cable a network according to the topology diagram.
- Erase the startup configuration and reload a router to the default state.
- Perform basic configuration tasks on a router.
- Configure and activate interfaces.

- Configure OSPF routing on all routers.
- Configure PPP encapsulation on all serial interfaces.
- Learn about the debug ppp negotiation and debug ppp packet commands.
- Learn how to change the encapsulation on the serial interfaces from PPP to HDLC.
- Intentionally break and restore PPP encapsulation.
- Configure PPP PAP and CHAP authentication.
- Intentionally break and restore PPP PAP and CHAP authentication.

2. Challenge PPP Configuration

Topology Diagram



Addressing Table

Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/1	10.0.0.1	255.255.255.128	N/A
	S0/0/0	172.16.0.1	255.255.255.252	N/A
	S0/0/1	172.16.0.9	255.255.255.252	N/A
R2	Lo0	209.165.200.161	255.255.255.224	N/A
	S0/0/0	172.16.0.2	255.255.255.252	N/A
	S0/0/1	172.16.0.5	255.255.255.252	N/A
R3	Fa0/1	10.0.0.129	255.255.255.128	N/A

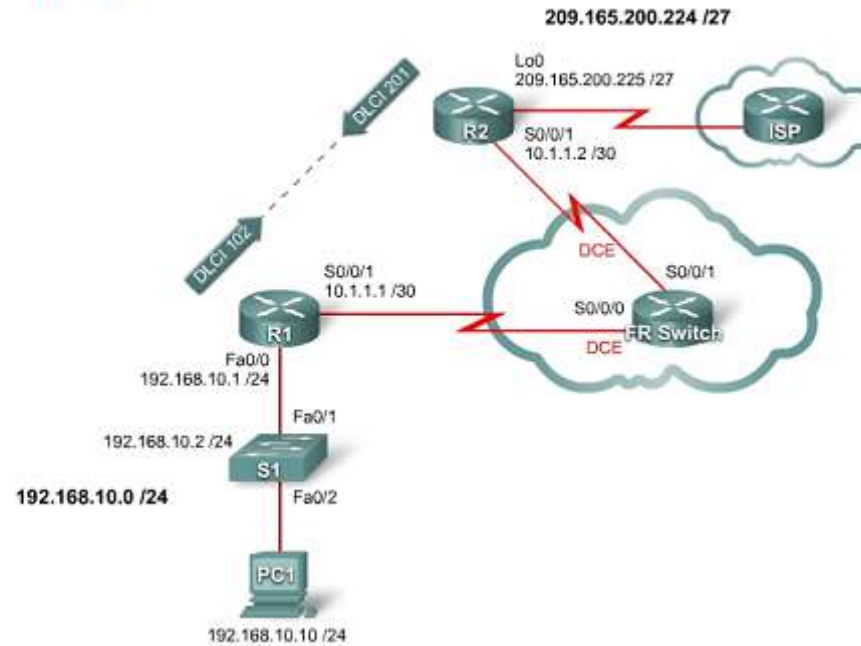
	S0/0/0	172.16.0.10	255.255.255.252	N/A
	S0/0/1	172.16.0.6	255.255.255.252	N/A
PC1	NIC	10.0.0.10	255.255.255.128	10.0.0.1
PC3	NIC	10.0.0.139	255.255.255.128	10.0.0.129

- Cable a network according to the topology diagram.
 - Erase the startup configuration and reload a router to the default state.

- Perform basic configuration tasks on a router.
- Configure and activate interfaces.
- Configure OSPF routing on all routers.
- Configure PPP encapsulation on all serial interfaces.
- Change the encapsulation on the serial interfaces from PPP to HDLC.
- Intentionally break and restore PPP encapsulation.
- Configure PPP CHAP authentication.
- Intentionally break and restore PPP CHAP authentication.

3. Basic Frame Relay

Topology Diagram



Addressing Table

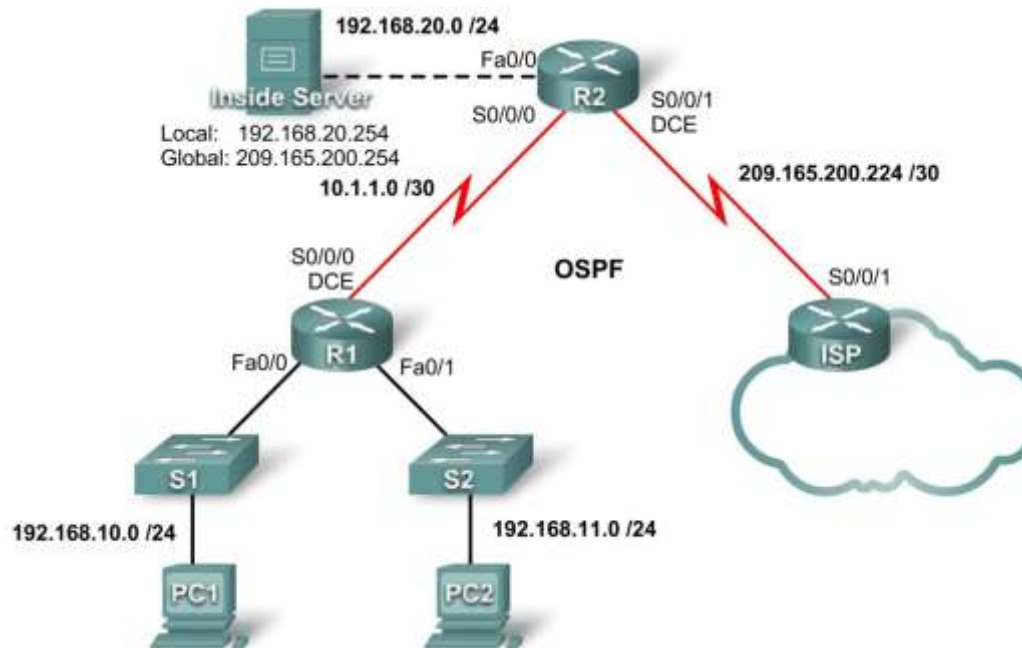
Device	Interface	IP Address	Subnet Mask	Default Gateway
R1	Fa0/0	192.168.10.1	255.255.255.0	N/A
	S0/0/1	10.1.1.1	255.255.255.252	N/A
R2	S0/0/1	10.1.1.2	255.255.255.252	N/A
	Lo 0	209.165.200.225	255.255.255.224	N/A
S1	VLAN1	192.168.10.2	255.255.255.0	192.168.10.1
PC1	NIC	192.168.10.10	255.255.255.0	192.168.10.1

- Cable a network according to the topology diagram.
- Erase the startup configuration and reload a router to the default state.

- Perform basic configuration tasks on a router.
- Configure and activate interfaces.
- Configure EIGRP routing on all routers.
- Configure Frame Relay encapsulation on all serial interfaces.
- Configure a router as a Frame Relay switch.
- Understand the output of the show frame-relay commands.
- Learn the effects of the debug frame-relay lmi command.
- Intentionally break and restore a Frame Relay link.
- Change the Frame Relay encapsulation type from the Cisco default to IETF.
- Change the Frame Relay LMI type from Cisco to ANSI.
- Configure a Frame Relay subinterface.

Lab 4 Basic DHCP and NAT Configuration

Topology Diagram



Addressing Table

R1	S0/0/0	10.1.1.1	255.255.255.252
	Fa0/0	192.168.10.1	255.255.255.0
	Fa0/1	192.168.11.1	255.255.255.0

R2	S0/0/0	10.1.1.2	255.255.255.252
	S0/0/1	209.165.200.225	255.255.255.252
	Fa0/0	192.168.20.1	255.255.255.0
ISP	S0/0/1	209.165.200.226	255.255.255.252

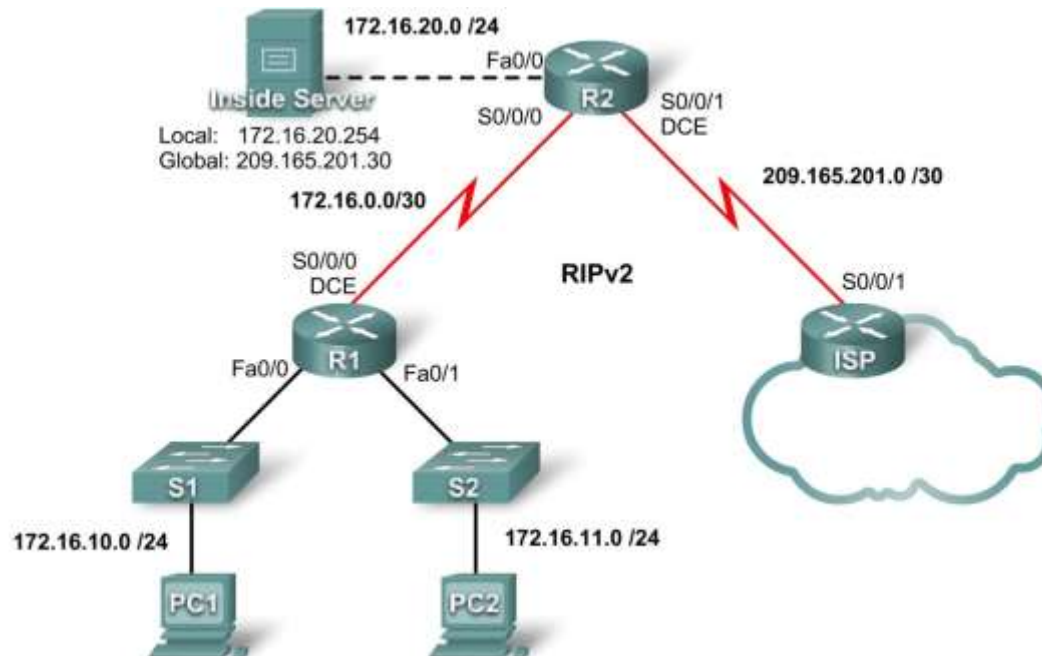
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- Prepare the network.
- Perform basic router configurations.
- Configure a Cisco IOS DHCP server.
- Configure static and default routing.
- Configure static NAT.
- Configure dynamic NAT with a pool of addresses.
- Configure NAT overload.

Scenario

In this lab, you will configure the DHCP and NAT IP services. One router is the DHCP server. The other router forwards DHCP requests to the server. You will also configure both static and dynamic NAT configurations, including NAT overload. When you have completed the configurations, verify the connectivity between the inside and outside addresses.

Lab 5 Troubleshooting DHCP and NAT

Topology Diagram



Addressing Table

R1	S0/0/0	172.16.0.1	255.255.255.252
	Fa0/0	172.16.10.1	255.255.255.0
	Fa0/1	172.16.11.1	255.255.255.0
R2	S0/0/0	172.16.0.2	255.255.255.252
	S0/0/1	209.165.201.1	255.255.255.252
	Fa0/0	172.16.20.1	255.255.255.0
ISP	S0/0/1	209.165.201.2	255.255.255.252

-
-
- Prepare the network.
- Load routers with scripts.
- Find and correct network errors.
- Document the corrected network.

Scenario

The routers, R1 and R2, at your company were configured by an inexperienced network engineer. Several errors in the configuration have resulted in connectivity issues. Your boss has asked you to troubleshoot and correct the configuration errors and document your work. Using your knowledge of DHCP, NAT, and standard testing methods, find and correct the errors. Make sure all clients have full connectivity. The ISP has been configured correctly.

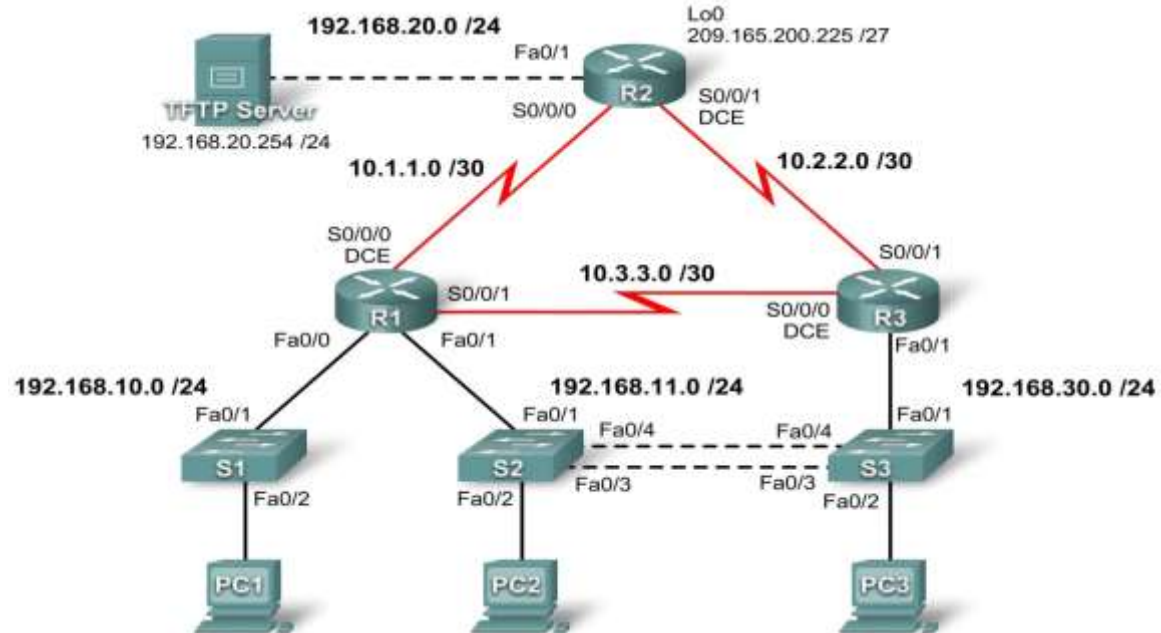
Ensure that the network supports the following:

1. The router R2 should serve as the DHCP server for the 172.16.10.0/24 and 172.16.11.0/24 networks connected to R1.
2. All PCs connected to R1 should receive an IP address in the correct network via DHCP.
3. Traffic from the R1 LANs entering the Serial 0/0/0 interface on R2 and exiting the Serial 0/0/1 interface on R2 should receive NAT translation with a pool of addresses provided by the ISP.

The Inside Server should be reachable from outside networks using IP address 209.165.201.30, and to inside networks using IP address 172.16.20.254

Lab 6: Troubleshooting Enterprise Networks 1

Topology Diagram



Addressing Table

R1	Fa0/0	192.168.10.1	255.255.255.0	N/A
	Fa0/1	192.168.11.1	255.255.255.0	N/A
	S0/0/0	10.1.1.1	255.255.255.252	N/A
	S0/0/1	10.3.3.1	255.255.255.252	N/A
R2	Fa0/1	192.168.20.1	255.255.255.0	N/A
	S0/0/0	10.1.1.2	255.255.255.252	N/A
	S0/0/1	10.2.2.1	255.255.255.252	N/A
	Lo0	209.165.200.225	255.255.255.224	209.165.200.226
R3	Fa0/1	N/A	N/A	N/A

	Fa0/1.11	192.168.11.3	255.255.255.0	N/A
	Fa0/1.30	192.168.30.1	255.255.255.0	N/A
	S0/0/0	10.3.3.2	255.255.255.252	N/A
	S0/0/1	10.2.2.2	255.255.255.252	N/A
S1	VLAN10	DHCP	255.255.255.0	N/A
S2	VLAN11	192.168.11.2	255.255.255.0	N/A
S3	VLAN30	192.168.30.2	255.255.255.0	N/A
PC1	NIC	192.168.10.10	255.255.255.0	192.168.10.1
PC2	NIC	192.168.11.10	255.255.255.0	192.168.11.1
PC3	NIC	192.168.30.10	255.255.255.0	192.168.30.1
TFTP Server	NIC	192.168.20.254	255.255.255.0	192.168.20.1

Learning Objectives

Upon completion of this lab, you will be able to:

- Cable a network according to the topology diagram
- Erase the startup configuration and reload a router to the default state
- Load the routers and switches with supplied scripts
- Find and correct all network errors
- Document the corrected network

Scenario

You have been asked to correct configuration errors in the company network. For this lab, do not use login or password protection on any console lines to prevent accidental lockout. Use **cisco** for all passwords in this scenario.

Note: Because this lab is cumulative, you will be using all the knowledge and troubleshooting techniques that you have acquired from the previous material to successfully complete this lab.

Requirements

- S2 is the spanning-tree root for VLAN 11, and S3 is the spanning-tree root for VLAN 30.
- S3 is a VTP server with S2 as a client.
- The serial link between R1 and R2 is Frame Relay. Make sure that each router can ping their own Frame Relay interface.
- The serial link between R2 and R3 uses HDLC encapsulation.

- The serial link between R1 and R3 uses PPP.
- The serial link between R1 and R3 is authenticated using CHAP.
- R2 must have secure login procedures because it is the Internet edge router.
- All vty lines, except those belonging to R2, allow connections only from the subnets shown in the topology diagram, excluding the public address.
- Hint:
- R2# **telnet 10.1.1.1 /source-interface loopback 0**
- Trying 10.1.1.1 ...
- % Connection refused by remote host
-
- Source IP address spoofing should be prevented on all links that do not connect to other routers.
- Routing protocols must be secured. All RIP routers must use MD5 authentication.
- R3 must not be able to telnet to R2 through the directly connected serial link.
- R3 has access to both VLAN 11 and 30 via its Fast Ethernet port 0/0.
- The TFTP server should not get any traffic that has a source address outside the subnet. All devices have access to the TFTP server.
- All devices on the 192.168.10.0 subnet must be able to get their IP addresses from DHCP on R1. This includes S1.
- R1 must be accessible via SDM.
- All addresses shown in the diagram must be reachable from every device.

Pedagogy for Course Delivery:

The method of the course delivery will be lecture – based, assisted by power point presentations. The hands –on practice of various configurations such as PPP, Authentication using PPP Configuration, Frame Relay Configuration, Tunneling, Security of Routers, Access Control Lists, DHCP –NAT translation and troubleshooting of each layer would be taught using Packet Tracer Activity.

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
75	25	100

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop	ATTN	CT	S/W	Viva	

down)					
Weightage (%)	05	10	10	05	70

Practical (P)

	Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	Mid-Term Exam	Lab Record	Continuous Performance	Internal Viva	Attendance	
Weightage (%)	10	10	10	5	5	60

Text & References:

Text

- Cisco Networking Academy Programme CCNA 3 & 4 Companion Guide, 3rd edition by Pearson Education
- Cisco Networking Academy Programme CCNA 3 & 4 Lab Companion, 3rd edition by Pearson Education

References:

- Cisco Networking Academy Programme CCNA 3 & 4 Engineering General, 3rd Edn by Pearson Education
- Data Communications and Networking by Behrouz Forouzan, 3e, Tata McGraw-Hill
- Computer Networks by Andrews S. Tanenbaum, 4e, Pearson Education

Web Portal:

- <https://learningnetwork.cisco.com/index.jspa>
- <https://learningspace.cisco.com/>