



# Northeastern University

*Telecommunication Systems Management*

## TELE5330 Data Networking

Assignment # CPT

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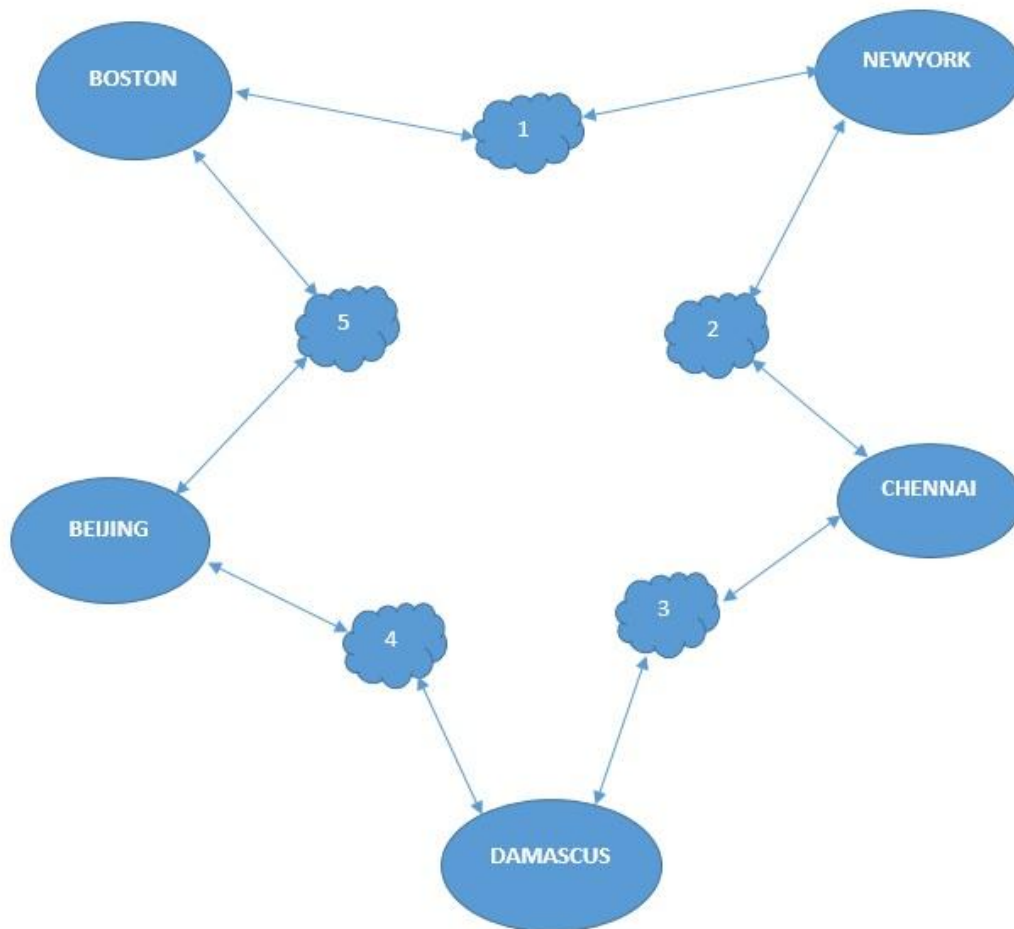
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Grade

**Project Design:**

High Level Diagram:

The below diagram shows high level diagram of the network showing how the each office in each city is connected to each other via internet.

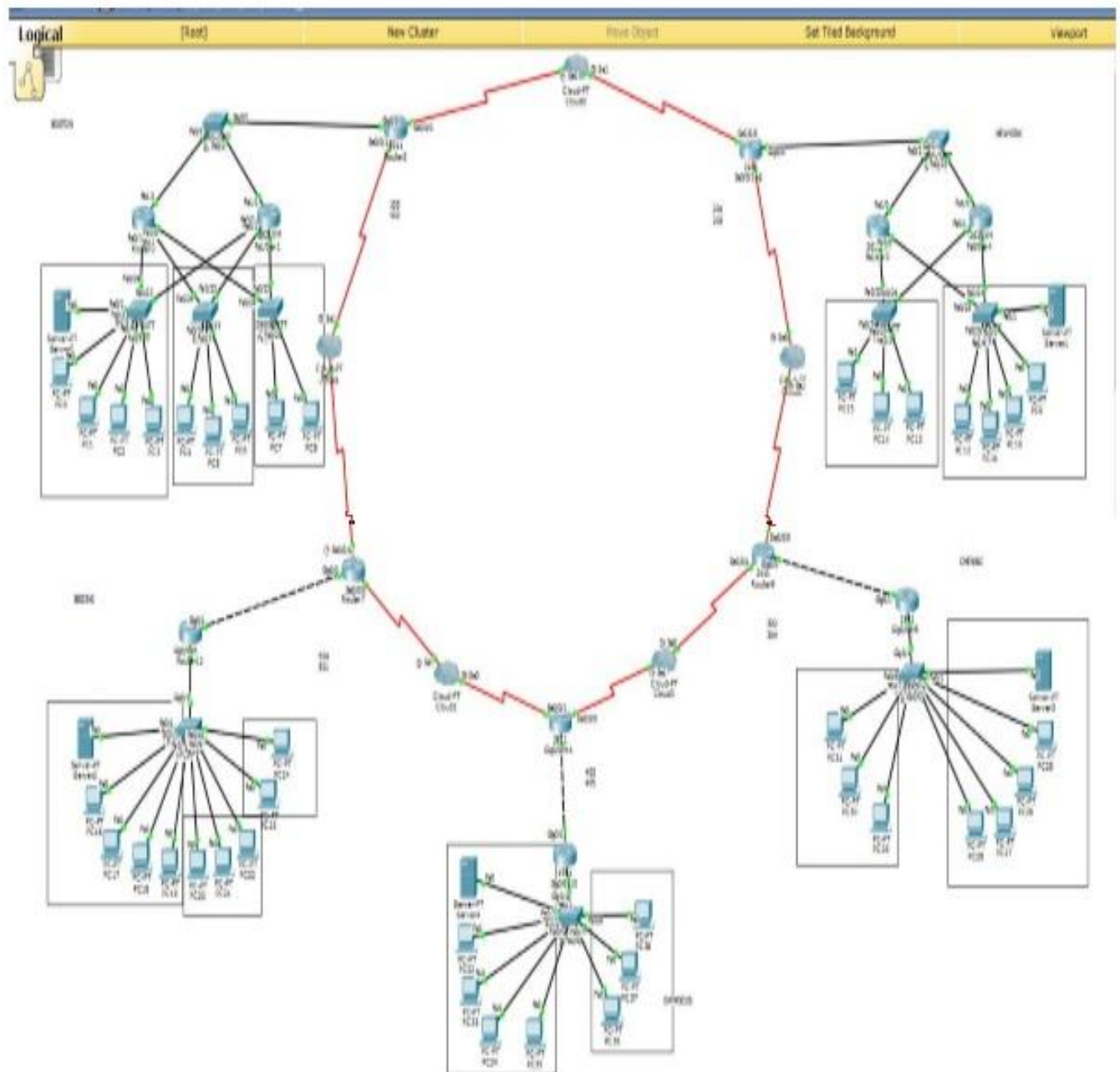


**Cost of the Network:**

The below mention table indicates the approximate cost to build entire network.

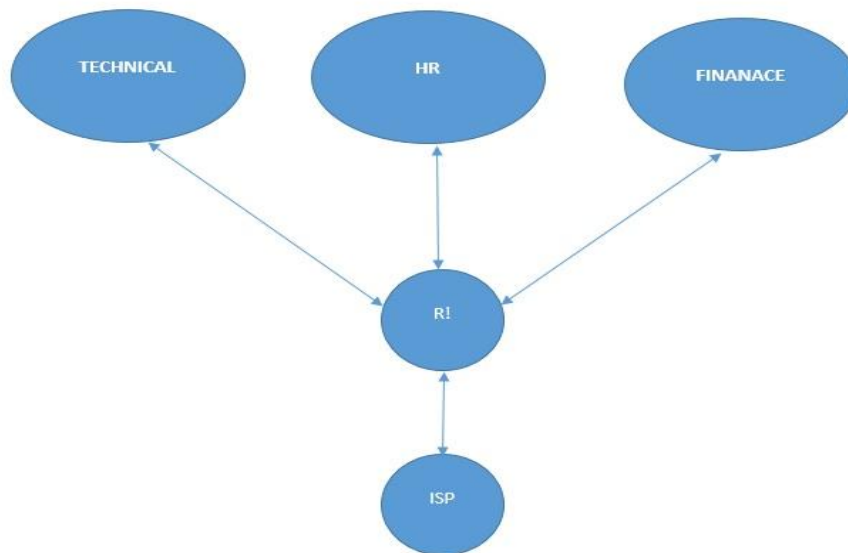
Network components	Type of model	Cost of each unit	Quantity	Total cost
<b>Switch</b>	Cisco catalyst 2950 24	\$202	10	\$2020
<b>Router</b>	Cisco 2911	\$1330	5	\$6650
<b>Router</b>	Cisco 2621XM	\$550-\$600	4	\$2200-2400
<b>server</b>	HP ProLiant g7 server	\$2000	5	\$10000
<b>Ethernet</b>	Cat5 Cables	\$15	100	\$1500
<b>Total Cost (approximately)</b>				\$22370-22570

**Network Optimization:**

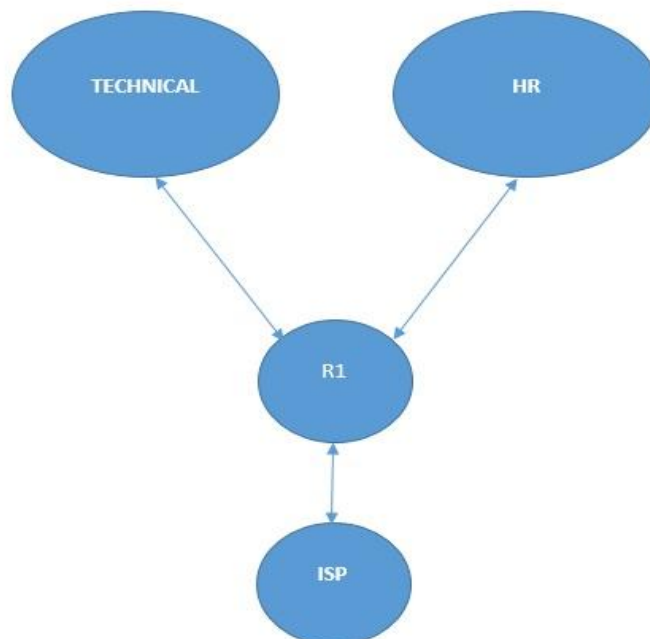


**City wise Network Diagram:**

**Boston/Beijing:**



**Chennai/New York/Damascus:**



**Cost Optimization of the Network:**

- Using VLAN we can reduce the usage of more switches. Using one switch we can serve entire network.
- IP addressing is optimized to avoid wastage of IP's.

**IP Addresses:**

IP address	Technical	HR	Finance
Boston	172.168.10.0/25	172.168.11.0/25	172.168.12.0/25
Beijing	172.170.10.0/25	172.170.10.0/25	172.170.10.0/25
New York	172.169.10.0/24	172.169.10.0/24	
Damascus	172.172.10.0/24	172.172.14.0/24	
Chennai	172.171.10.0/24	172.171.11.0/24	

**Routing Protocols used:**

**OSPF:**

- This protocol is used in the routers placed in each office.
- This is also used in ISP routers towards the office network.
- OSPF is based on Link-State Routing protocol which is good for smaller networks.
- RIP is not used as it has limited number of hops (15) and has less convergence time.

**BGP:**

- This protocol is used in all ISP routers to connect all other offices.
- Point-Point frame relay is used for implementing BGP over frame relay.
- BGP was used as it is commonly used inter AS Routing Protocol.

**Security and Redundancy:**

The following security and redundancy schemes are used in the project.

- **HSRP:**  
This is used for providing redundancy.  
Interface tracking is configured to track the routing path changes.
- **Extended ACL:**  
This is used for blocking access to finance departments from other network.  
Finance department has given access to ping other networks.  
Extended ACL is used to minimize the network utilization when the intended is packet is to be blocked.
- **IP Redundancy:**  
80% extra IP addresses are kept in DHCP pool to provide IP redundancy.
- **Security for Router:**  
All routers are Password protected.  
So, only the network administrator can access all the networks.

**Add-ons:**

- **DHCP in Technical Department:**  
DHCP in all the local networks is placed in the technical department. Routers are configured accordingly so that DHCP can provide IP addresses to all the PC's in the particular Local network.
- **BGP:**  
BGP is used in all ISP routers for inter AS routing  
Routers running BGP are also running OSPF. OSPF is used to redistribute the routing table in ISP router to local network router so they can access other networks.
- **Ring Topology:**  
Instead of Star Topology Ring Topology was used to increase the redundancy of the network.  
Using Ring topology even if one path fails it will access the network using alternative path.

**Test Plan for the Network:**

**Test Plan of VLAN:**

- Verify whether each PC is able to ping other PC within VLAN.
- Verify whether each PC is able to ping all other PC's within VLAN except Finance Department.
- Verify Finance departments is able to access each other.
- Verify each VLAN is able to obtain IP dynamically using DHCP.

```
Packet Tracer PC Command Line 1.0
PC>ping 172.172.10.14

Pinging 172.172.10.14 with 32 bytes of data:

Request timed out.
Reply from 172.172.10.14: bytes=32 time=0ms TTL=127
Reply from 172.172.10.14: bytes=32 time=0ms TTL=127
Reply from 172.172.10.14: bytes=32 time=0ms TTL=127

Ping statistics for 172.172.10.14:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

PC>|
```



### Test Plan for Routing:

- Verify Technical Department and HR Department can access all other Departments except Finance department in other Local networks.
- Verify Finance department is able to access finance department in other city.
- Verify Finance department is able to access all other departments in other cities.

```
Packet Tracer PC Command Line 1.0
PC>ping 172.169.10.13

Pinging 172.169.10.13 with 32 bytes of data:

Request timed out.
Reply from 172.169.10.13: bytes=32 time=14ms TTL=124
Reply from 172.169.10.13: bytes=32 time=3ms TTL=124
Reply from 172.169.10.13: bytes=32 time=4ms TTL=124

Ping statistics for 172.169.10.13:
    Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 3ms, Maximum = 14ms, Average = 7ms

PC>|
```

### Test Plan for Security

- Verify Technical department cannot access all Finance departments.
- Verify HR department cannot access all Finance department.

```
Packet Tracer PC Command Line 1.0
PC>ping 172.168.12.13

Pinging 172.168.12.13 with 32 bytes of data:

Reply from 172.168.12.13: bytes=32 time=0ms TTL=127
Reply from 172.168.12.13: bytes=32 time=1ms TTL=127
Reply from 172.168.12.13: bytes=32 time=0ms TTL=127
Reply from 172.168.12.13: bytes=32 time=0ms TTL=127

Ping statistics for 172.168.12.13:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

PC>|
```

### Test Plan for Redundancy:

- Verify whether HSRP is working correctly by changing active and standby routers.
- Verify Ring topology by removing the paths.



**Test Plan for Add-ons:**

- Verify whether BGP is configured and running.
- Verify Ring topology by removing paths and changing the route.
- Verify HSRP by changing active and standby routers priority.

**Concepts Learned during Project:**

**DHCP Configuration:**

- Learned how to configure DHCP inside router.
- Learned how to configure DHCP server so that it can assign IP addresses to other departments.

**VLANs and Trunking:**

- Learned how to configure VLAN, Trunk mode ports and how to configure range of interfaces in switches.
- Learned how to assign VLAN numbers and name to particular group.
- Learned how to configure router for VLAN Dot1Q encapsulation for inter VLAN Routing.

**Routing Protocols:**

- Learned how to configure BGP in routers for inter AS-routing.
- Learned how to configure OSPF in routers.
- Learned how to redistribute routing tables through inter-AS routing protocol.

**HSRP:**

- Learned how to configure HSRP in routers and give priorities so that active and passive routers are configured.
- Learned how to track the interfaces so that if the path fails it will go through alternative path.

**Frame Relay:**

- Learned how to configure frame relay in cloud and in individual ISP routers for enabling inter-AS communication.
- Learned about DLCI, serial interfaces, point-point frame relay configuration.

**Access-List Configuration:**

- Learned how to create access-list, modify and apply access-list to particular interface or sub interface.
- Learned how access-list works and also difference between standard and extended access-list

**Conclusion:**

So, the network is designed in 5 different locations using different routing protocols, redundancy schemes and frame relays. Each department in the network is able to ping other department but exceptions are given to finance department so that finance department is designed with more security protocols. This network was further optimized by giving Telnet access to all routers from Headquarter DHCP and also by adding more redundancy plans.