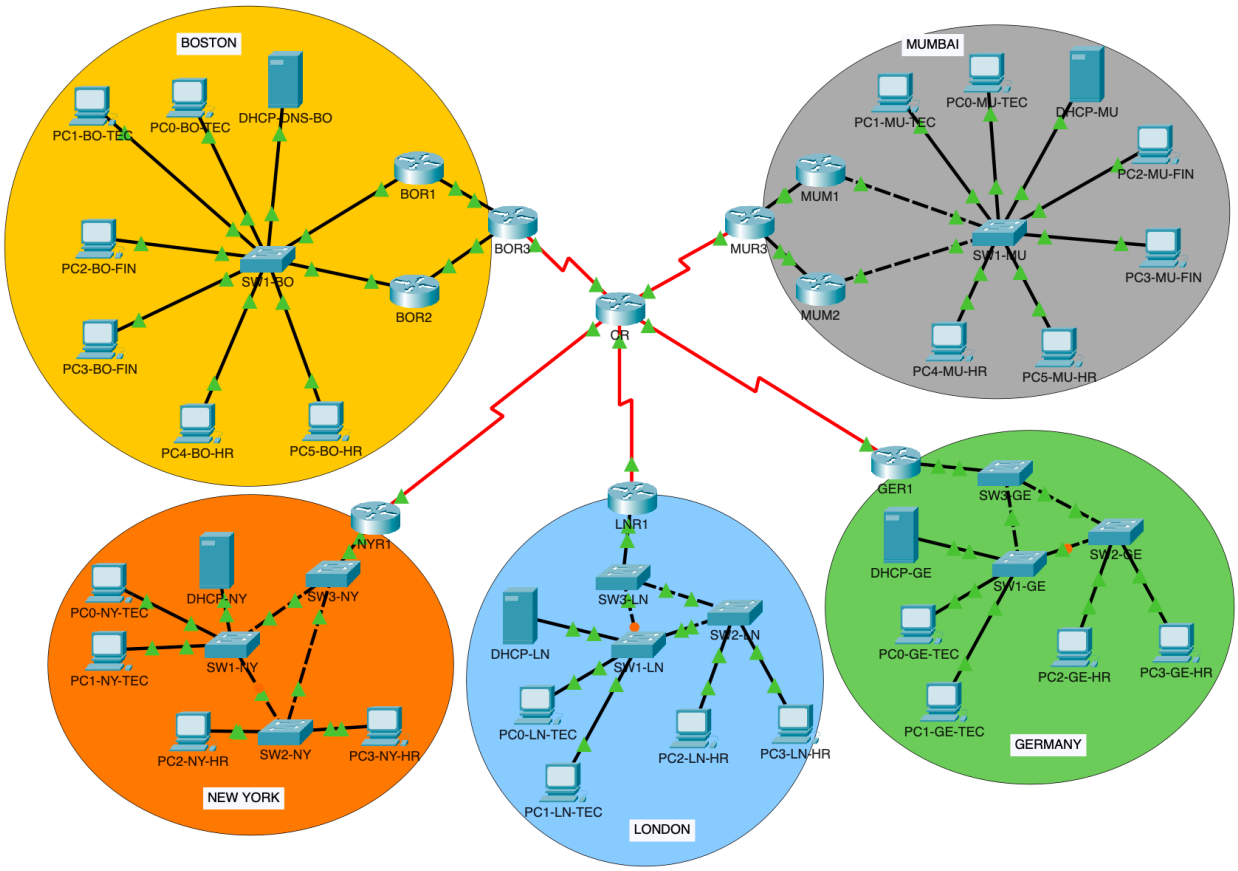
PROJECT 2

TELE5330 – DATA NETWORKING – Spring 2024

002827845 • Tirupathi Rushi Vedulapurapu • vedulapurapu.t@northeastern.edu

Network Diagram :



Network Setup :

As per the project requirement headquarters and in Boston and Mumbai are created. Both of these are containing Technical, Finance and HR departments. Remaining three branch offices London, New York and Germany are created with only Technical and HR.

In both headquarters, VLAN 10,20 and 30 are attached to Technical, Finance and HR respectively. Whereas three branch offices having VLAN 10,20 referring to Technical and HR.

Every Technical department is implemented with a DHCP server that allots IP address to all other departments in the network. In Boston, this DHCP will take up the work of DNS server as well. DNS server is configured in such a way that any host in Boston can access any router in the entire network using their code names like 'bor1', 'ger1', 'mum3'...etc.

Subnetting :

The given network is 192.168.0.0/16 for all offices. There is a limit of 50 IPs per office. So, the given subnet is further divided and the detailed networks are in the below table

Office	Subnets
Boston	
• **Technical department**	• 192.168.10.0/27
• **Finance department**	• 192.168.10.32/28
• **HR department**	• 192.168.10.48/29
• **BOR1 to BOR3(ABR)**	• 192.168.10.248/30
• **BOR2 to BOR3(ABR)**	• 192.168.10.252/30
Mumbai	
• **Technical department**	• 192.168.20.0/27
• **Finance department**	• 192.168.20.32/28
• **HR department**	• 192.168.20.48/29
• **MUR1 to MUR3(ABR)**	• 192.168.20.248/30
• **MUR2 to MUR3(ABR)**	• 192.168.20.252/30
London	
• **Technical department**	• 192.168.1.0/27
• **HR department**	• 192.168.1.32/29
New York	
• **Technical department**	• 192.168.2.0/27
• **HR department**	• 192.168.2.32/29
Germany	
• **Technical department**	• 192.168.3.0/27
• **HR department**	• 192.168.3.32/29

*ABR – Adjacent Border Router

Now, 192.168.0.0/24 is considered for the connections in the backbone area.

Connection to CR (central router)	Subnet
BOR3	192.168.0.0/30
MUR3	192.168.0.4/30
NYR1	192.168.0.8/30
LNR1	192.168.0.12/30
GER1	192.168.0.16/30

Implementation of redundancy :

We have used two main redundancy protocols in the network. One is Rapid Spanning Tree Protocol(RSTP) and HSRP(Hot Standby Routing Protocol).

RSTP is implemented in New York, London and Germany offices. There are three switches in the network and one Distribution layer switch and Two access layer switches. By default STP is implement on them, and it is modified to RSTP. In all offices, access ports of the switches are portfast and BPDU guard enabled.

HSRP is another redundancy protocol that helps in configuring a standby router using a virtual IP or virtual MAC. Here using virtual IP(VIP), HSRP is implemented in Boston and Mumbai offices.

While configuring VLANs, using port security option, maximum number of allowed MAC address for a switchport is given. If table row count hits that number, then it will stop learning and accepting new MAC address. This will help controlling MAC flooding.

Implementation of security :

Security is implemented via ACLs to restrict the access among the departments. We use port-security to defend the network against MAC flooding

Routing :

We have selected OSPF as the router protocol for this project. There is total 6 areas in this network. One central router(CR) and one router from each office. All these routers connected to the CR in backbone area or area 0. Other areas are Boston-Area1, Mumbai-Area2, London-Area3, New York-Area4, Germany-Area5.

Backbone area contains CR, BOR3, MUR3, NYR1, LNR1 and GER1 routers. All these routers are connected via serial connections. The network that is used to implement this backbone area is 192.168.0.0/24.

Area	Location	Routers
Area 1	Boston	BOR3, BOR1, BOR2
Area 2	Mumbai	MUR3, MUR1, MUR2
Area 3	London	LNR1
Area 4	New York	NYR1
Area 5	Germany	GER1
Area 0	-	CR, BOR3, MUR3, LNR1, NYR1, GER1

Router	Router ID	Router	Router ID
BOR1	1.1.1.0	MUR3	2.2.2.2
BOR2	1.1.1.1	LNR1	3.3.3.3
BOR3	1.1.1.2	NYR1	4.4.4.4
MUR1	2.2.2.0	GER1	5.5.5.5
MUR2	2.2.2.1	CR	255.255.255.254

Takeaway Questions :

1. Routing Protocol OSPF: Explain the following?

   Open Shortest Path First(OSPF) is a link-state routing protocol. It exchange the information of its neighbors by broadcasting Link State Advertisements(LSAs). After obtaining the neighbor router's information through these LSAs, it forms a map of the network and calculate the distance to every destination.

2. Which one is better Routing protocol RIP or OSPF? Why?

   RIP is a distance-vector protocol whereas OSPF is link-state routing protocol. RIP use hop count as cost metric. It can lead to selecting suboptimal routes. OSPF consider other elements like bandwidth for selecting an optimal path. So OSPF is better than RIP.

3. Explain why do we use the area concept in OSPF?

   In OSPF network, routers broadcast LSAs. If the network is large and complex, then there will be so much noise(traffic) because of these LSAs. And also, the link-state database will be large. To make this database less and for better administration, we divide the network into areas.

4. Why do we configure the backbone network as area 0?

   Because it is the core area where all other areas connect using their Adjacent Border Routers(ABR).

5. What are the different types of messages exchanged in OSPF?

   Hello Messages: To establish and maintain relationships with neighbors
   Database Description (DD) Packets: Advertise the existence of the OSPF routing database and synchronize routing information exchange.
   Link State Advertisements (LSAs): Contain information about network links, costs, and reachability. Routers use LSAs to build the network topology map.
   Link State Request (LSR) and Link State Update (LSU) Packets: Used for requesting and updating missing or changed link-state information.

6. Security and Redundancy plan?

   For security in the network, we can make use of Access Control Lists(ACL). There are two types of ACLs. Standard and Extended are the types. Using these, we can restrict the access of one or more hosts to other hosts. We can also use the port-security feature to control the MAC flooding attack.

   For redundancy we used HSRP and RSTP protocols in the project. Hot Standby Routing Protocol(HSRP) creates a standby router using virtial IP. RSTP helps to prevent loops and broadcast storms in the network.

7. How does STP avoid looping? Explain its working in detail?

   In STP network, the switch with the lowest Bridge ID is chosen as the root bridge. The Bridge ID is a unique identifier calculated based on the switch's MAC address and a configurable priority. The root bridge is responsible for calculating the loop-free path for the entire network. STP uses BPDUs to communicate with neighboring

switches, exchanging information about bridge IDs, port states, and the designated bridge.

STP defines several port states (Blocking, Learning, Forwarding) for each switch port. Only designated ports forward traffic to create a loop-free path towards the root bridge. Here's a breakdown of the states:
Blocking: A port in the blocking state does not participate in forwarding traffic. It's typically used for ports that could potentially create loops.
Learning: In the learning state, the port receives frames but does not forward them yet. The switch is learning the MAC addresses of devices connected to the port.
Forwarding: The designated port, responsible for forwarding traffic towards the root bridge. Ports in this state forward frames based on the MAC address table.

8. Difference between STP, PVSTP and MSTP?

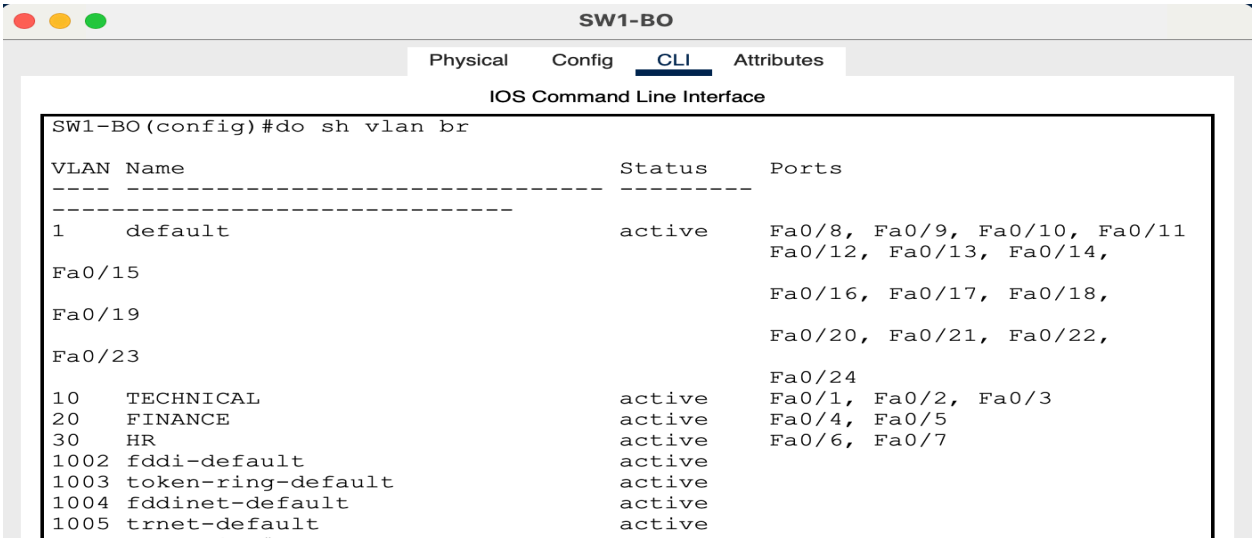
STP (Spanning Tree Protocol): A standard IEEE protocol used to prevent loops in Ethernet networks.
PVSTP (Per VLAN Spanning Tree Protocol): An extension of STP that allows for a separate spanning tree for each VLAN in a network.
MSTP (Multiple Spanning Tree Protocol): An enhancement of STP that allows for multiple spanning trees to be created, each spanning tree encompassing multiple VLANs, thus reducing the number of spanning tree instances required in the network.

Test plan for the network :

2. Testing VLANs :

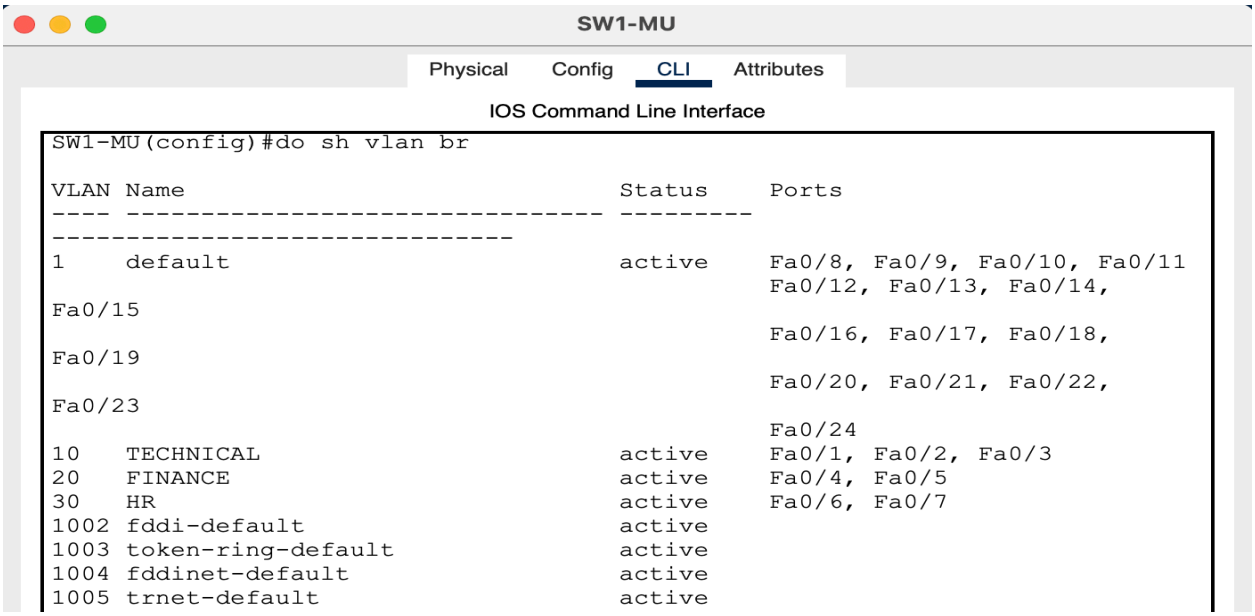
At every switch we can verify the existing VLANs with associated interfaces. We use the command ‘sh vlan br’ or ‘do sh vlan br’(in user EXEC mode).

Boston :




```
SW1-BO(config)#do sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                 Fa0/12, Fa0/13, Fa0/14,
Fa0/15
                                                 Fa0/16, Fa0/17, Fa0/18,
Fa0/19
                                                 Fa0/20, Fa0/21, Fa0/22,
Fa0/23
                                                 Fa0/24
10   TECHNICAL                         active    Fa0/1, Fa0/2, Fa0/3
20   FINANCE                           active    Fa0/4, Fa0/5
30   HR                                active    Fa0/6, Fa0/7
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

Mumbai :




```
SW1-MU(config)#do sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/8, Fa0/9, Fa0/10, Fa0/11
                                                 Fa0/12, Fa0/13, Fa0/14,
Fa0/15
                                                 Fa0/16, Fa0/17, Fa0/18,
Fa0/19
                                                 Fa0/20, Fa0/21, Fa0/22,
Fa0/23
                                                 Fa0/24
10   TECHNICAL                         active    Fa0/1, Fa0/2, Fa0/3
20   FINANCE                           active    Fa0/4, Fa0/5
30   HR                                active    Fa0/6, Fa0/7
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

London :

SW1-LN

Physical Config CLI Attributes

IOS Command Line Interface

```
SW1-LN#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                 Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                 Fa0/14, Fa0/15, Fa0/16,
Fa0/17
                                                 Fa0/18, Fa0/19, Fa0/20,
Fa0/21
                                                 Fa0/22, Fa0/23, Fa0/24,
Gig0/1
                                                 Gig0/2
10   TECHNICAL                         active    Fa0/2, Fa0/3, Fa0/4
20   HR                                active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

SW2-LN

Physical Config CLI Attributes

IOS Command Line Interface

```
SW2-LN(config)#do sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15,
Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19,
Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23,
Fa0/24
                                                 Gig0/1, Gig0/2
10   TECHNICAL                         active
20   HR                                active    Fa0/3, Fa0/4
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

New York :

SW1-NY

Physical Config CLI Attributes

IOS Command Line Interface

```
SW1-NY#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                 Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                 Fa0/14, Fa0/15, Fa0/16,
Fa0/17
                                                 Fa0/18, Fa0/19, Fa0/20,
Fa0/21
                                                 Fa0/22, Fa0/23, Fa0/24,
Gig0/1
                                                 Gig0/2
10   TECHNICAL                         active    Fa0/2, Fa0/3, Fa0/4
20   HR                                active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

SW2-NY

Physical Config CLI Attributes

IOS Command Line Interface

```
SW2-NY#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15,
Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19,
Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23,
Fa0/24
                                                 Gig0/1, Gig0/2
10   TECHNICAL                         active
20   HR                                active    Fa0/3, Fa0/4
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

Germany :

SW1-GE

Physical Config CLI Attributes

IOS Command Line Interface

```
SW1-GE#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/6, Fa0/7, Fa0/8, Fa0/9
                                                 Fa0/10, Fa0/11, Fa0/12,
Fa0/13
                                                 Fa0/14, Fa0/15, Fa0/16,
Fa0/17
                                                 Fa0/18, Fa0/19, Fa0/20,
Fa0/21
                                                 Fa0/22, Fa0/23, Fa0/24,
Gig0/1
                                                 Gig0/2
10   TECHNICAL                         active    Fa0/2, Fa0/3, Fa0/4
20   HR                                active
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

SW2-GE

Physical Config CLI Attributes

IOS Command Line Interface

```
SW2-GE#sh vlan br

VLAN Name                              Status    Ports
---- --------------------------------- --------- -------------------------------
1    default                           active    Fa0/5, Fa0/6, Fa0/7, Fa0/8
                                                 Fa0/9, Fa0/10, Fa0/11, Fa0/12
                                                 Fa0/13, Fa0/14, Fa0/15,
Fa0/16
                                                 Fa0/17, Fa0/18, Fa0/19,
Fa0/20
                                                 Fa0/21, Fa0/22, Fa0/23,
Fa0/24
                                                 Gig0/1, Gig0/2
10   TECHNICAL                         active
20   HR                                active    Fa0/3, Fa0/4
1002 fddi-default                      active
1003 token-ring-default                active
1004 fddinet-default                   active
1005 trnet-default                     active
```

3. Test routing protocol

Boston :

```
BOR1(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.0
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.10.248 0.0.0.3 area 1
    192.168.10.0 0.0.0.31 area 1
    192.168.10.32 0.0.0.15 area 1
    192.168.10.48 0.0.0.7 area 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.0              110      00:21:06
    1.1.1.1              110      00:21:06
    1.1.1.2              110      00:21:01
  Distance: (default is 110)
```

```
BOR2(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.10.252 0.0.0.3 area 1
    192.168.10.0 0.0.0.31 area 1
    192.168.10.32 0.0.0.15 area 1
    192.168.10.48 0.0.0.7 area 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.0              110      00:21:56
    1.1.1.1              110      00:21:56
    1.1.1.2              110      00:22:01
  Distance: (default is 110)
```

```
BOR3#sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 1.1.1.2
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.0 0.0.0.3 area 0
    192.168.10.248 0.0.0.3 area 1
    192.168.10.252 0.0.0.3 area 1
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.0              110      00:22:28
    1.1.1.1              110      00:22:28
    1.1.1.2              110      00:22:33
    2.2.2.2              110      00:23:04
    3.3.3.3              110      00:23:03
    4.4.4.4              110      00:23:03
    5.5.5.5              110      00:23:03
    255.255.255.254      110      00:23:04
  Distance: (default is 110)
```

Mumbai :

```
MUM1(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.0
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.20.248 0.0.0.3 area 2
    192.168.20.0 0.0.0.31 area 2
    192.168.20.32 0.0.0.15 area 2
    192.168.20.48 0.0.0.7 area 2
  Routing Information Sources:
    Gateway         Distance      Last Update
    2.2.2.0              110      00:23:07
    2.2.2.1              110      00:23:07
    2.2.2.2              110      00:23:07
  Distance: (default is 110)
```

```
MUM2(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.1
  Number of areas in this router is 1. 1 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.20.252 0.0.0.3 area 2
    192.168.20.0 0.0.0.31 area 2
    192.168.20.32 0.0.0.15 area 2
    192.168.20.48 0.0.0.7 area 2
  Routing Information Sources:
    Gateway         Distance      Last Update
    2.2.2.0              110      00:23:25
    2.2.2.1              110      00:23:30
    2.2.2.2              110      00:23:30
  Distance: (default is 110)
```

```
MUR3(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 2.2.2.2
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.4 0.0.0.3 area 0
    192.168.20.248 0.0.0.3 area 2
    192.168.20.252 0.0.0.3 area 2
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.2              110      00:24:21
    2.2.2.0              110      00:23:43
    2.2.2.1              110      00:23:48
    2.2.2.2              110      00:23:48
    3.3.3.3              110      00:24:21
    4.4.4.4              110      00:24:21
    5.5.5.5              110      00:24:20
    255.255.255.254      110      00:24:21
  Distance: (default is 110)
```

London :

```
LNR1(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 3.3.3.3
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.12 0.0.0.3 area 0
    192.168.2.0 0.0.0.31 area 3
    192.168.2.32 0.0.0.7 area 3
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.2              110      00:24:56
    2.2.2.2              110      00:24:56
    3.3.3.3              110      00:25:06
    4.4.4.4              110      00:24:55
    5.5.5.5              110      00:24:55
    255.255.255.254      110      00:24:55
  Distance: (default is 110)
```

New York :

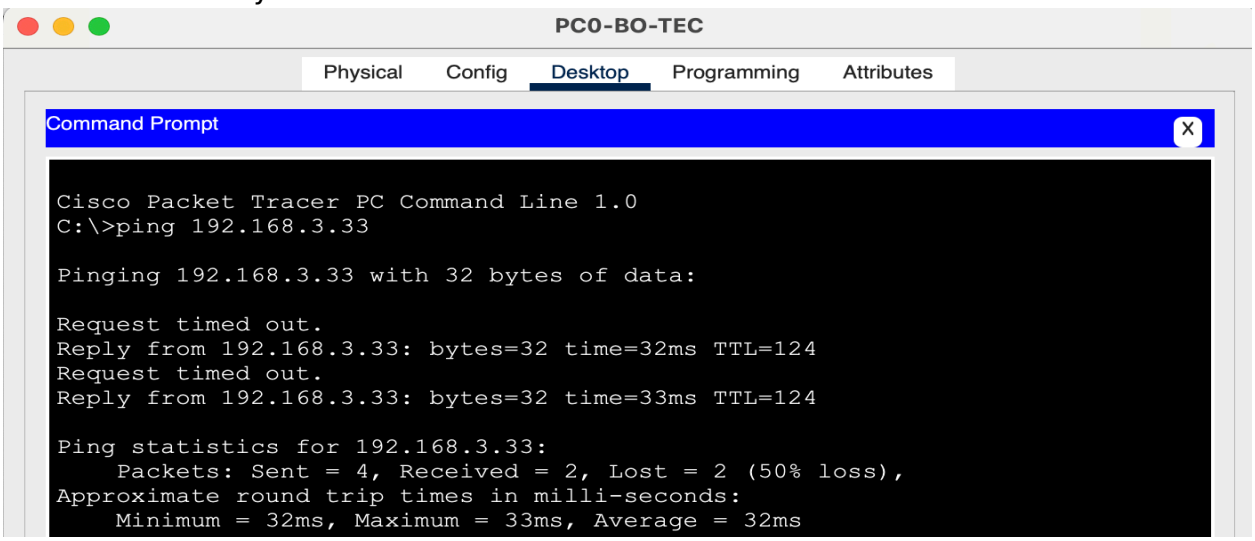
```
NYR1(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 4.4.4.4
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.8 0.0.0.3 area 0
    192.168.1.0 0.0.0.31 area 4
    192.168.1.32 0.0.0.7 area 4
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.2              110      00:24:40
    2.2.2.2              110      00:24:40
    3.3.3.3              110      00:24:39
    4.4.4.4              110      00:24:49
    5.5.5.5              110      00:24:39
    255.255.255.254      110      00:24:40
  Distance: (default is 110)
```

Germany :

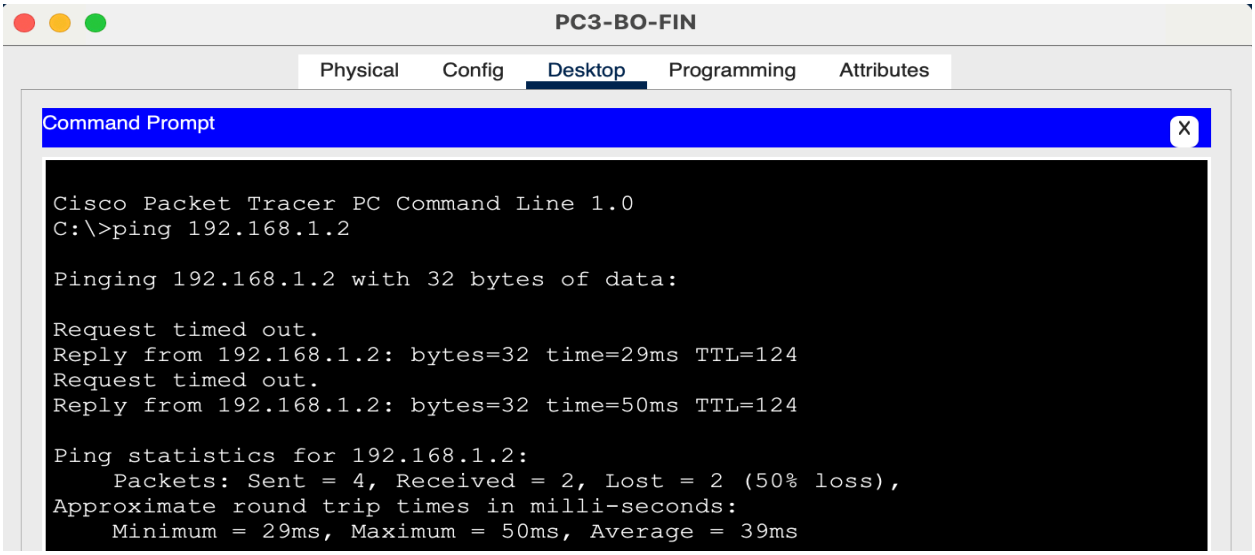
```
GER1(config)#do sh ip protocols

Routing Protocol is "ospf 1"
  Outgoing update filter list for all interfaces is not set
  Incoming update filter list for all interfaces is not set
  Router ID 5.5.5.5
  Number of areas in this router is 2. 2 normal 0 stub 0 nssa
  Maximum path: 4
  Routing for Networks:
    192.168.0.16 0.0.0.3 area 0
    192.168.3.0 0.0.0.31 area 5
    192.168.3.32 0.0.0.7 area 5
  Routing Information Sources:
    Gateway         Distance      Last Update
    1.1.1.2              110      00:25:27
    2.2.2.2              110      00:25:27
    3.3.3.3              110      00:25:28
    4.4.4.4              110      00:25:28
    5.5.5.5              110      00:25:35
    255.255.255.254      110      00:25:28
  Distance: (default is 110)
```

Ping test :

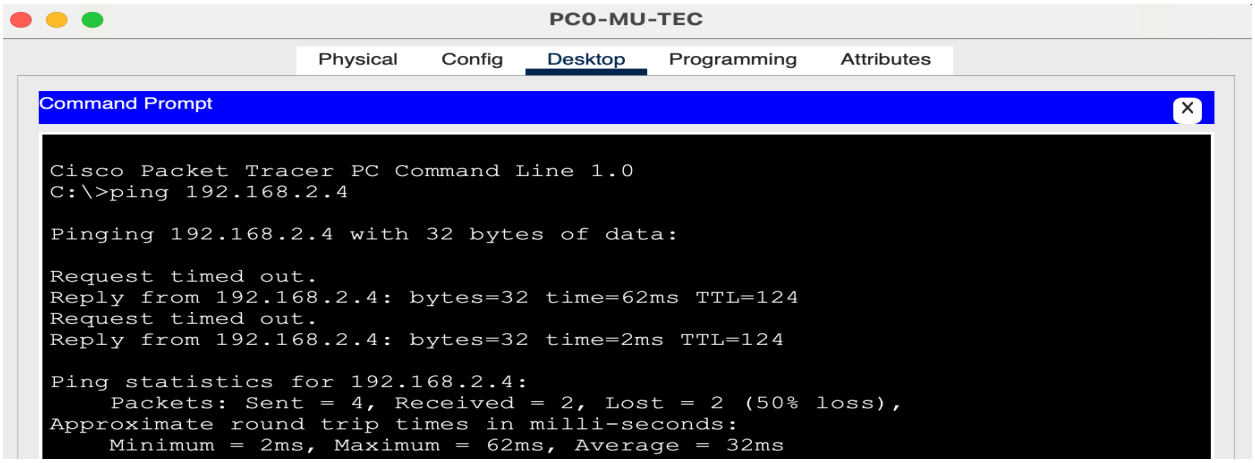
Boston to Germany



Boston to New York :



Mumbai to London :

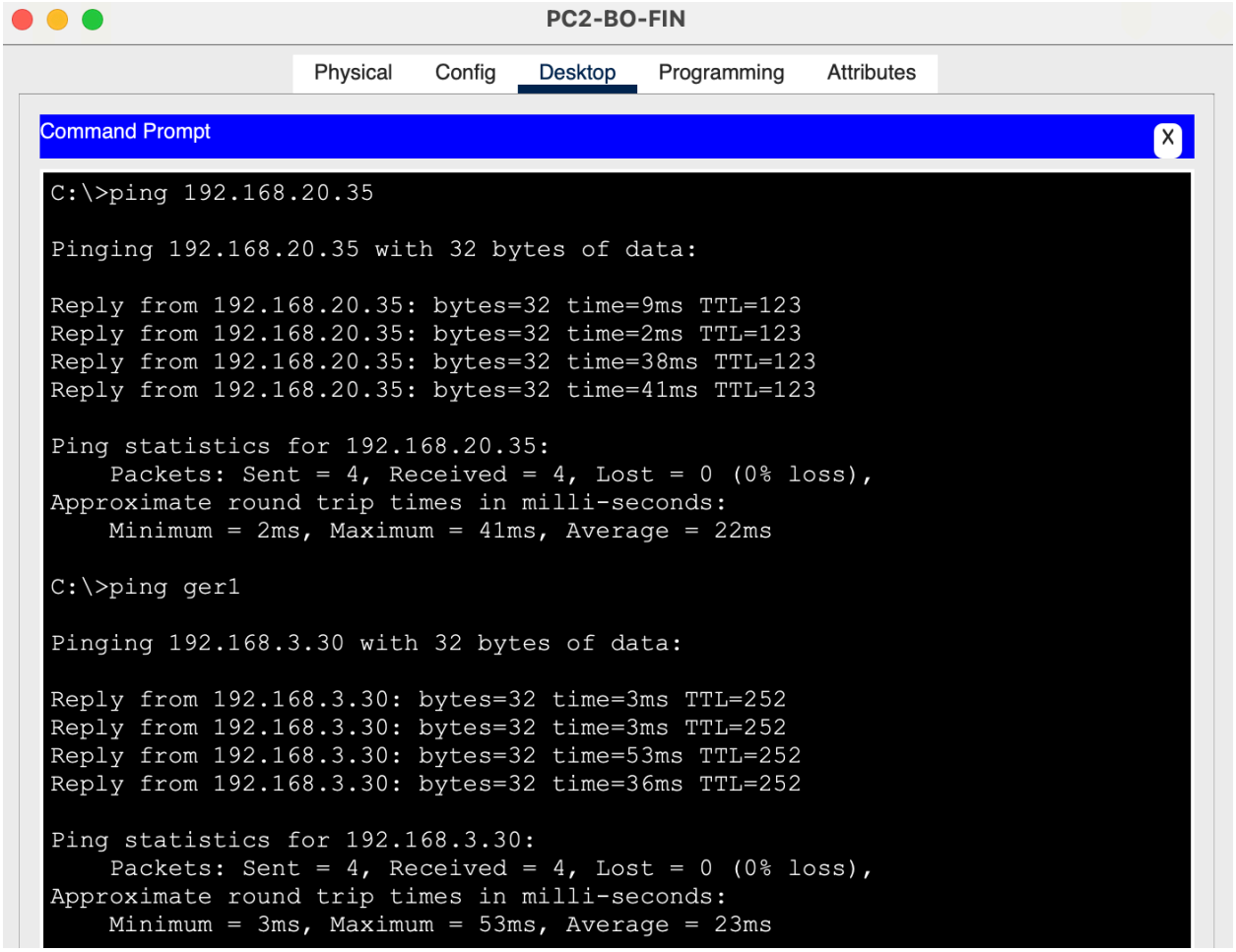


4. Test security plan :

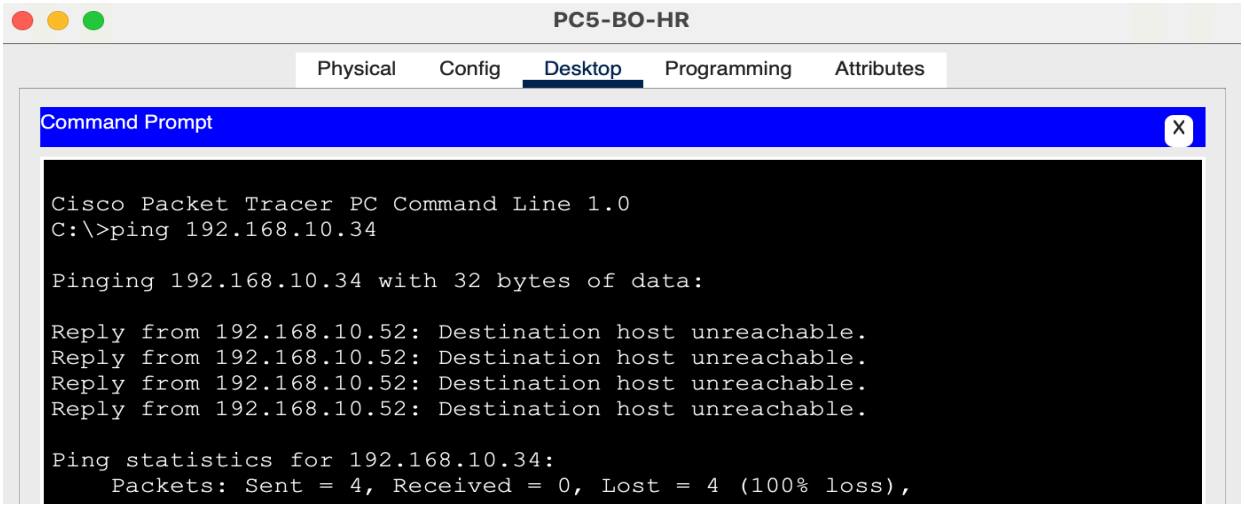
To control other departments from accessing Finance departments, extended ACLs are implemented on outbound traffic. As per the project requirement only a Finance department can access the other finance department. But Finance department can access all other departments.

Let’s try to ping these departments to test the ACL

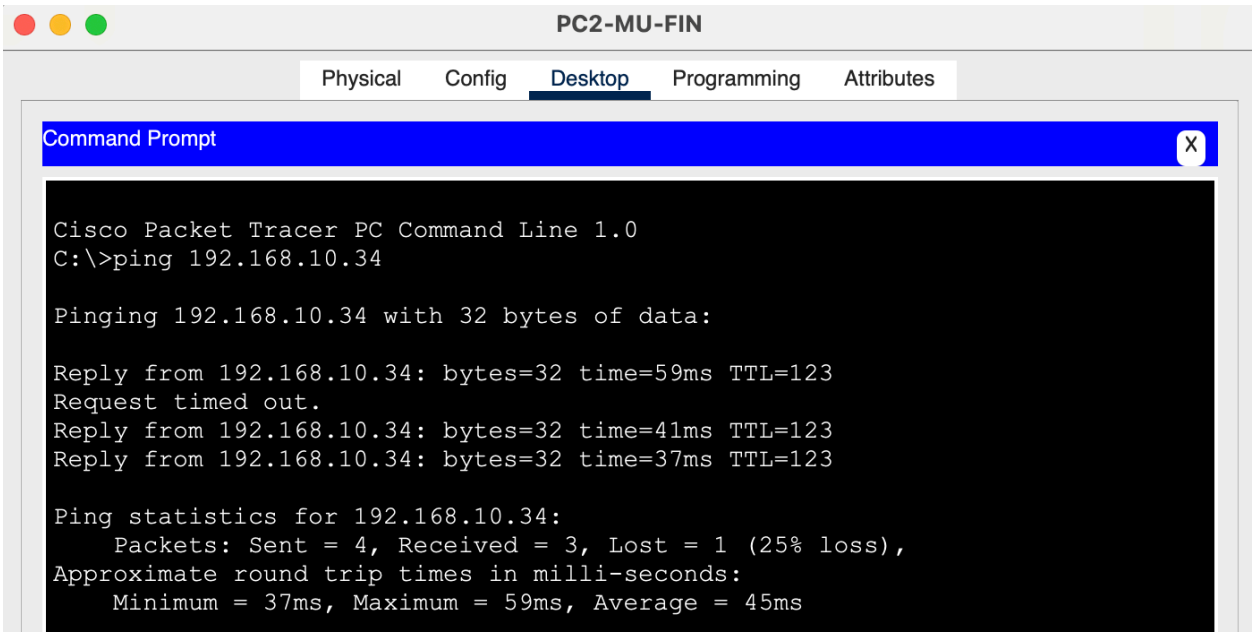
Boston Finance to Mumbai Finance and Germany office router



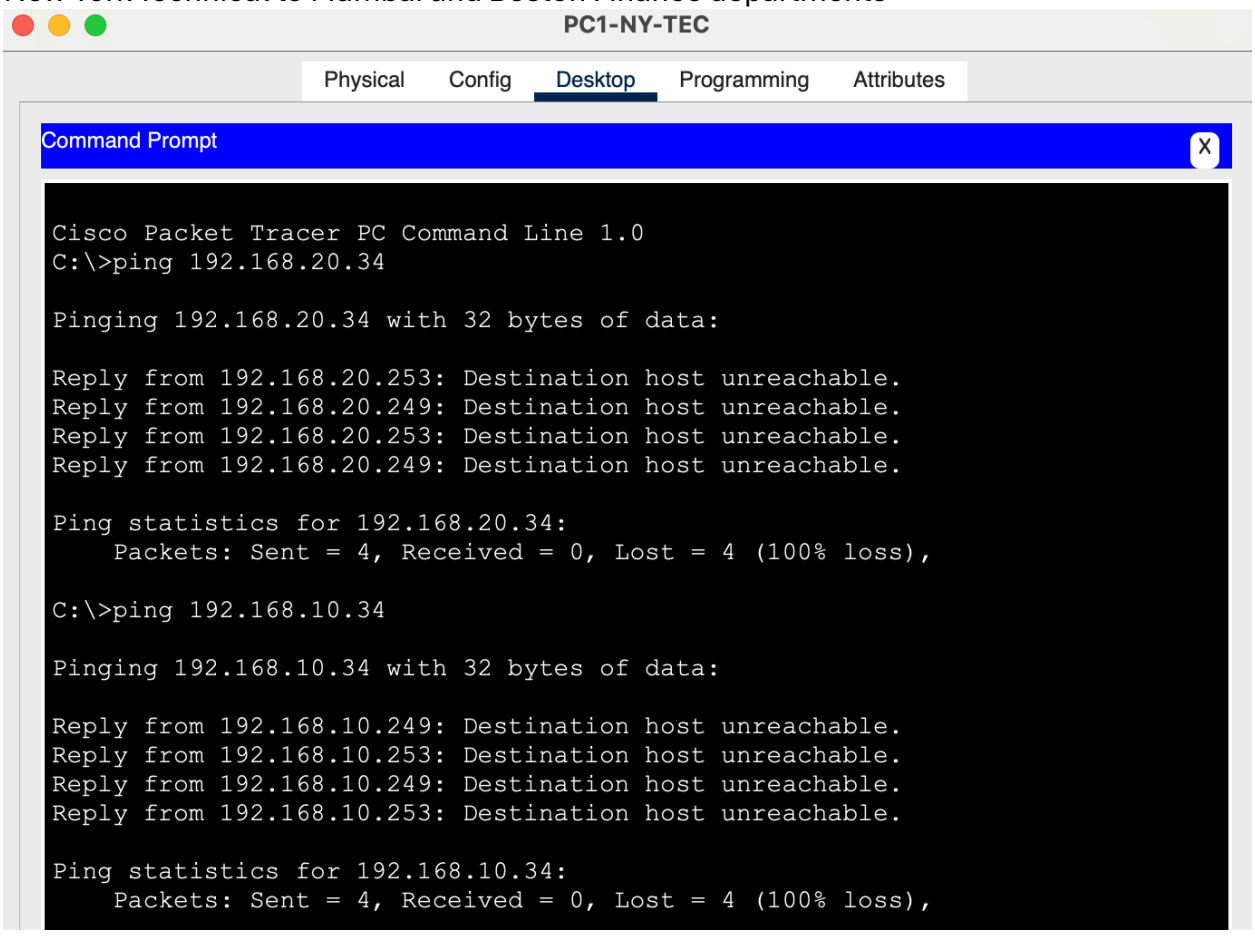
Boston HR to Boston Finance



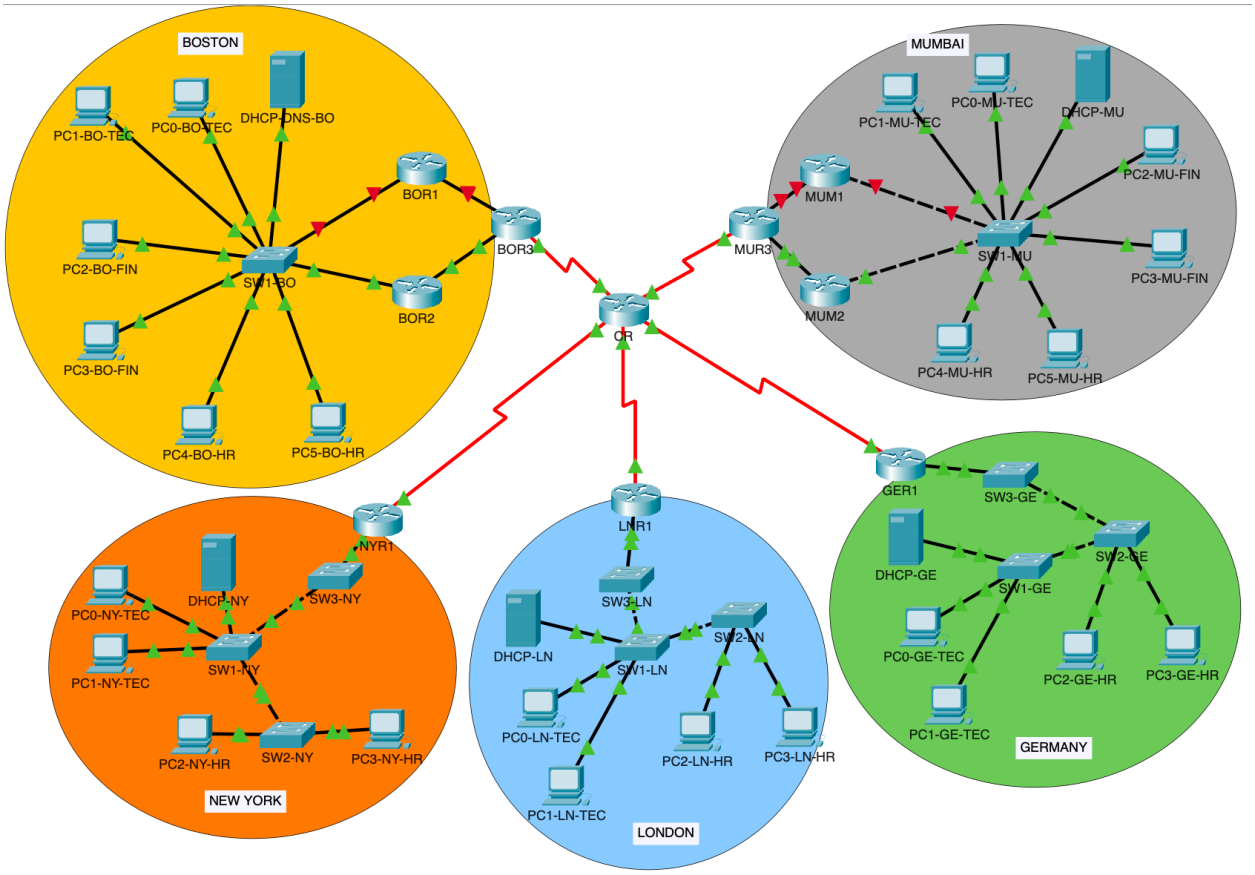
Mumbai Finance to Boston Finance



New York Technical to Mumbai and Boston Finance departments

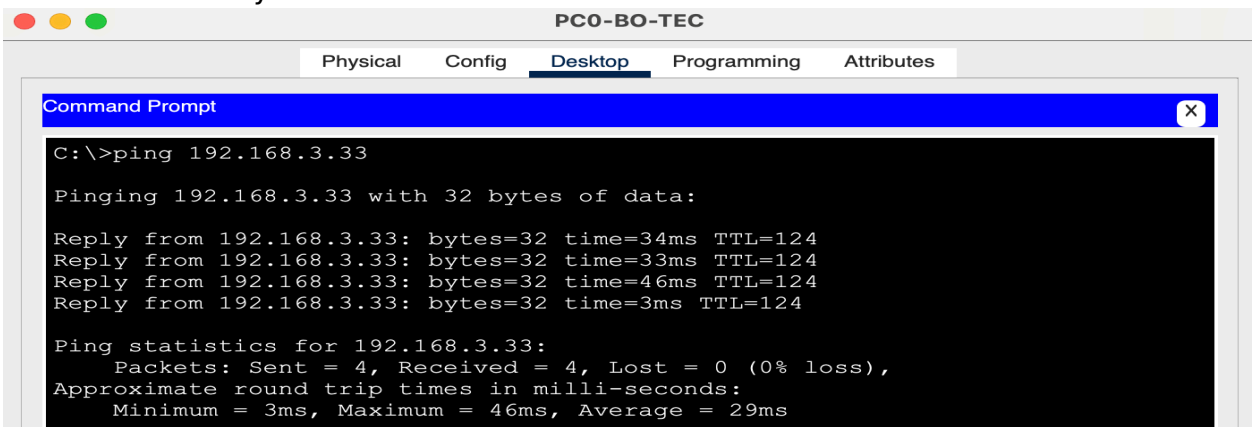


5. Test redundancy plan :

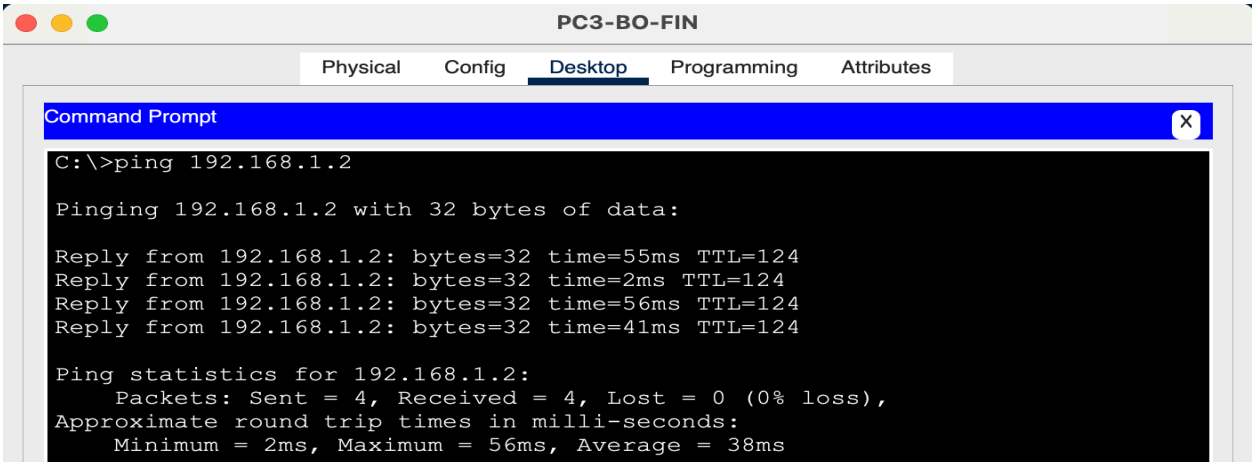


To test the redundancy in the network, few changes are made in the network. In Boston office, BOR1 is turned off. And in Mumbai office MUR1 is turned off. In New York, London offices, the link between SW2 and SW3 is removed. In Germany office, SW1 and SW3 link is removed.

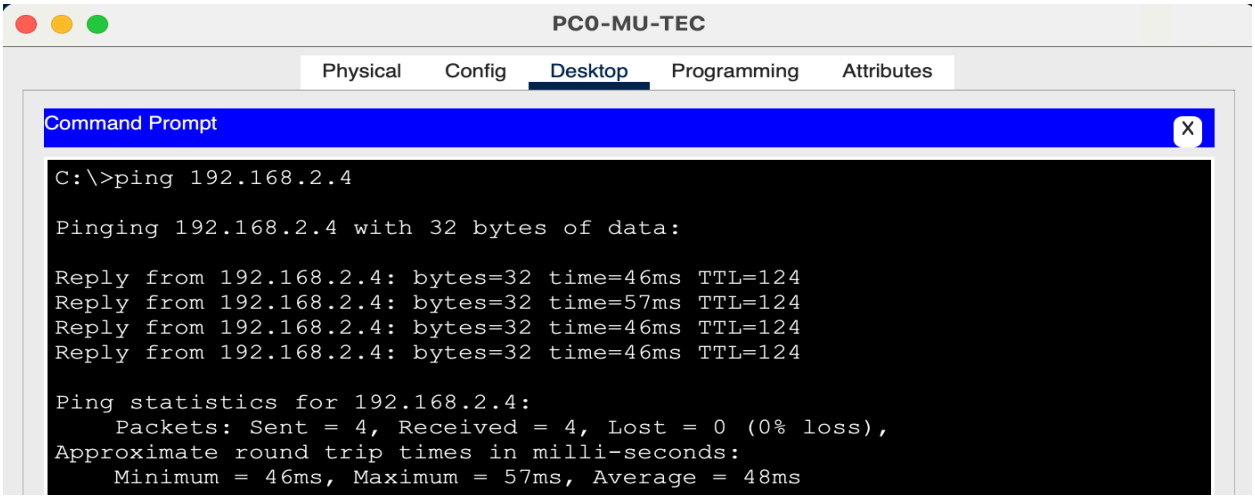
Now let's see the results if we ping the same PCs as above
Boston to Germany :



Boston to New York :



Mumbai to London :



6. Test Bonus

Defend MAC flooding attack :
To defend against a MAC flooding attack, port-security feature is implemented on all switches in the network. Here, we can see the details after setting up the maximum allowed entries in the MAC table and violation mode.

```
SW1-BO(config)#do sh port-security interface f0/6
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0002.1660.EB98:30
Security Violation Count   : 0
```

```
SW1-BO(config)#do sh port-security interface f0/1
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0007.EC0D.EE7A:10
Security Violation Count   : 0
```

```
SW1-NY(config)#do sh port-security interface f0/2
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0006.2A20.0145:10
Security Violation Count   : 0
```

```
SW1-NY(config)#do sh port-security interface f0/4
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 000D.BD42.CC16:10
Security Violation Count   : 0
```

```
SW1-GE(config)#do sh port-security interface f0/3
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 000D.BD81.0BD8:10
Security Violation Count   : 0
```

```
SW1-MU(config)#do sh port-security interface f0/3
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0001.4341.4641:10
Security Violation Count   : 0
```

```
SW1-MU(config)#do sh port-security interface f0/4
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 00D0.58AC.5D06:20
Security Violation Count   : 0
```

```
SW2-LN(config)#do sh port-security interface f0/3
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0001.4261.282A:20
Security Violation Count   : 0
```

```
SW2-LN(config)#do sh port-security interface f0/4
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 0060.3E5A.B0B1:20
Security Violation Count   : 0
```

```
SW1-GE(config)#do sh port-security interface f0/4
Port Security              : Enabled
Port Status                : Secure-up
Violation Mode             : Restrict
Aging Time                 : 0 mins
Aging Type                 : Absolute
SecureStatic Address Aging : Disabled
Maximum MAC Addresses      : 65
Total MAC Addresses        : 1
Configured MAC Addresses   : 0
Sticky MAC Addresses       : 0
Last Source Address:Vlan   : 000B.BEB5.EDE0:10
Security Violation Count   : 0
```

5. CONCEPTS LEARNED DURING THE PROJECT

Throughout the course of designing and implementing a network infrastructure project, I have delved into a plethora of new and essential topics, significantly enriching my understanding of network architecture and administration.

From mastering Spanning Tree Protocol (STP) to ensure network redundancy and prevent loops, to configuring Portfast to expedite port convergence in rapid spanning tree environments, each concept has equipped me with invaluable skills in optimizing network performance and reliability.

Additionally, I have gained proficiency in establishing serial connections to facilitate communication between distant network segments, as well as implementing Open Shortest Path First (OSPF) routing protocol to dynamically manage routing tables in multi-area networks, thereby enhancing scalability and efficiency.

Furthermore, I have acquired the knowledge and expertise to deploy Domain Name System (DNS) services for efficient name resolution across the network, and to enforce network security through the implementation of Access Control Lists (ACLs) and extended ACLs, safeguarding against unauthorized access and malicious activities. Embracing these topics throughout the project has not only broadened my technical aptitude but also reinforced the importance of meticulous planning and implementation in building robust and resilient network infrastructures.

6. CONCLUSION

In conclusion, this project has successfully delivered a robust and efficient network solution for the organization's multi-location setup. By leveraging advanced technologies such as OSPF routing, VLAN segmentation, and HSRP for high availability, we have ensured seamless connectivity and optimized network performance. The implementation of defense against MAC flooding attacks underscores our commitment to data integrity and confidentiality. Through meticulous planning, careful execution, and thorough testing, demonstrating my expertise in network design and administration. This project has enriched my understanding of networking concepts and protocols, equipping me with valuable skills for addressing real-world networking challenges.