TELE 5330 – DATA NETWORKING LABORATORY

PROJECT 2 – DESIGN OF NETWORK FOR CORPORATE ORGANIZATION USING CISCO PACKET TRACER
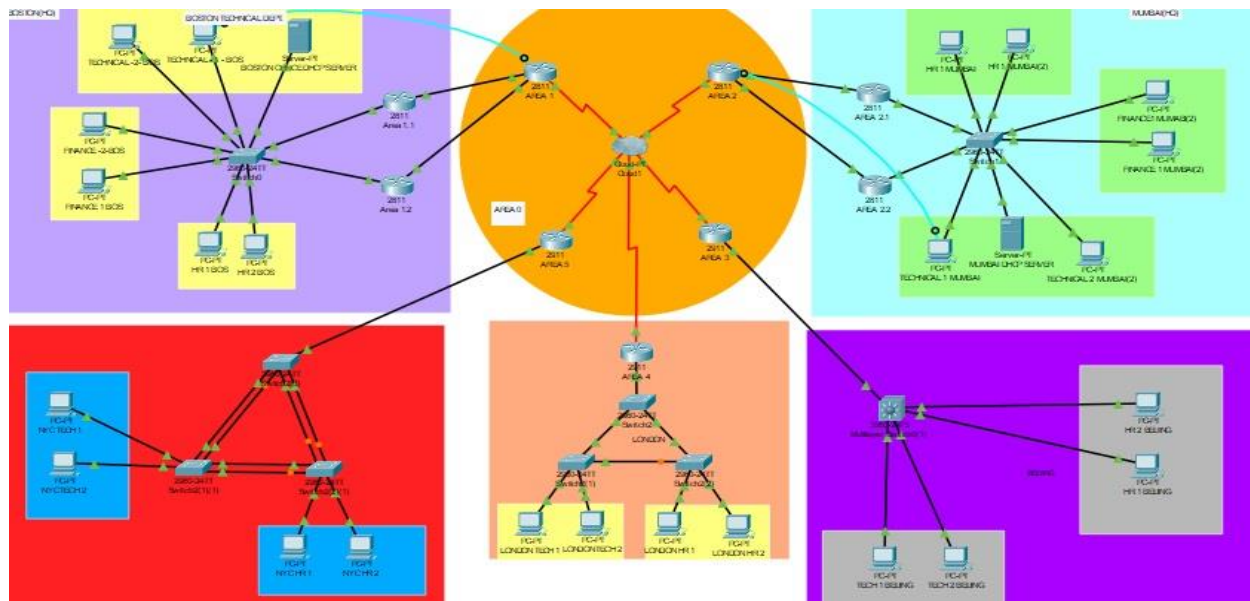
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PROJECT DESIGN:

An inter-geographical network connecting offices from five different locations (Boston, Mumbai, Beijing, London, New York). Head-quarters of organization will be based at Boston and Mumbai.

HIGH-LEVEL DIAGRAM DIAGRAM

NETWORK DETAILS:
- Boston & Mumbai office will be having technical, finance & HR department, whereas other locations will be having technical & HR departments respectively
- Each office will be having 250 hosts (85% redundancy for their addresses)
- Address for each host will be assigned dynamically by DHCP servers based at technical department of head-quarter locations (Boston & Mumbai)
- Dedicated VLAN is created for each department
- Offices at different geographical locations will be connected via internet service provider(ISP)
- Security feature is deployed for restricting the access to the finance department
- Router redundancy is implemented at head-quarter locations & switch redundancy is done at New York & Beijing location
- OSPF network protocol is implemented for communication between different locations

- MAC flooding & port security is activated for machines at HQ locations
- BPDU, Port fast enabled in all machines connected to the network
- Rapid spanning tree protocol is activated between redundant switches at New York & London location
- Multilayer switch at Beijing & LACP at New York are the additional features

Address allocation to offices

Department	Address Range	Subnet Mask	Number of hosts
BOSTON			
Technical	192.168.69.5 – 192.168.69.254	255.255.255.0	249
Finance	192.168.70.5 – 192.168.70.127	255.255.255.128	107
HR	192.168.71.5 – 192.168.71.127	255.255.255.128	107
DHCP	192.168.72.2	255.255.255.0	1
MUMBAI			
Technical	192.168.72.5 – 192.168.72.254	255.255.255.0	249
Finance	192.168.73.5 – 192.168.73.127	255.255.255.128	107
HR	192.168.74.5 – 192.168.74.127	255.255.255.128	107
DHCP	192.168.72.2	255.255.255.0	1
BEIJING			
Technical	192.168.75.2 – 192.168.75.254	255.255.255.0	253
HR	192.168.76.2 – 192.168.76.254	255.255.255.0	107
LONDON			
Technical	192.168.77.2 – 192.168.77.254	255.255.255.0	253
HR	192.168.78.2 – 192.168.78.254	255.255.255.0	253
NEWYORK			
Technical	192.168.79.2 – 192.168.79.254	255.255.255.0	253
HR	192.168.80.2 – 192.168.80.254	255.255.255.0	253

Total Cost of the project:

S.no	Name of the network component	Quantity	Price/Quantity	Total price
1	Cisco 2960 switch	8	$ 150	$1200
2	Multilayer Switch	1	$ 200	$ 200
3	DHCP Server	2	$ 2000	$ 4000
4	Cisco Router 2811	9	$ 700	$ 6300
5	Copper straight cable	In ft	$ 1.5 / feet	1.5 * distance
6	Serial DCE	In ft	$ 3 / feet	3 * distance
			Total Price	$11700

Cost optimization:

- VLAN'S for each department is configured on a single switch making the system cost efficient
- Limited utilization of DHCP servers (installed only at head quarter locations). HQ DHCP server used for assigning IP's to host at branch offices at London, Beijing & New York
- Multilayer switch erection leading to reduction in consumption of one additional router

Dynamic Host Allocation using Dynamic Host Configuration Protocol
DCHP SERVER AT BOSTON:
- Server at Boston location will assigning dynamic IP addresses to technical, finance & HR departments of Boston & Mumbai office's

Physical	Config	Services	Desktop	Programming	Attributes

DHCP

Interface	FastEthernet0 ▼	Service ● On	○ Off
Pool Name		serverPool	
Default Gateway		192.168.69.1	
DNS Server		192.168.1.1	

Start IP Address :	192	168	69	5
Subnet Mask:	255	255	255	0

Maximum Number of Users :	251
TFTP Server:	0.0.0.0
WLC Address:	0.0.0.0

Add	Save	Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
TECHNICAL BOSTON	192.168.69.1	192.168.1.1	192.168.69.5	255.255.255.0	126	0.0.0.0	0.0.0.0
serverPool	192.168.69.1	192.168.1.1	192.168.69.5	255.255.255.0	251	0.0.0.0	0.0.0.0
MUMBAI FINANCE	192.168.73.1	192.168.1.1	192.168.73.5	255.255.255.128	123	0.0.0.0	0.0.0.0
MUMBAI HR	192.168.74.1	192.168.1.1	192.168.74.5	255.255.255.128	123	0.0.0.0	0.0.0.0
HR BOSTON	192.168.71.1	192.168.1.1	192.168.71.5	255.255.255.128	123	0.0.0.0	0.0.0.0
FINANCE BOSTON	192.168.70.1	192.168.1.1	192.168.70.5	255.255.255.128	123	0.0.0.0	0.0.0.0
MUMBAI TECHNICAL	192.168.72.1	192.168.1.1	192.168.72.5	255.255.255.0	250	0.0.0.0	0.0.0.0

DCHP SERVER AT MUMBAI:
- Server at Mumbai will assign dynamic IP addresses to technical & HR departments of London, Beijing & New York office's

Physical	Config	Services	Desktop	Programming	Attributes

DHCP

Interface	FastEthernet0 ▼	Service ● On	○ Off
Pool Name		serverPool	
Default Gateway		192.168.72.1	
DNS Server		0.0.0.0	

Start IP Address :	192	168	75	2
Subnet Mask:	255	255	255	0

Maximum Number of Users :	250
TFTP Server:	0.0.0.0
WLC Address:	0.0.0.0

Add	Save	Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
serverPool	192.168.72.1	0.0.0.0	192.168.75.2	255.255.255.0	250	0.0.0.0	0.0.0.0
BEIJING TECH	192.168.75.1	0.0.0.0	192.168.75.2	255.255.255.0	250	0.0.0.0	0.0.0.0
BEIJING HR	192.168.76.1	0.0.0.0	192.168.76.2	255.255.255.0	250	0.0.0.0	0.0.0.0
NYC TECH	192.168.79.1	0.0.0.0	192.168.79.5	255.255.255.0	250	0.0.0.0	0.0.0.0
NYC HR	192.168.80.1	0.0.0.0	192.168.80.5	255.255.255.0	250	0.0.0.0	0.0.0.0
LONDON HR	192.168.78.1	0.0.0.0	192.168.78.5	255.255.255.0	250	0.0.0.0	0.0.0.0
LONDON TECH	192.168.77.1	0.0.0.0	192.168.77.5	255.255.255.0	250	0.0.0.0	0.0.0.0

WAN Configuration

- All area borders are designated in area 0 as backbone network, whereas other routers used within location premises are given the following numbers
    - Area 1 - Boston
    - Area 2 - Mumbai
    - Area 3 - Beijing
    - Area 4 - London
    - Area 5 - New York
- Frame relay helps to connect inter networks improving data quality

GLOBAL				Frame Relay				

Port | | Sublink | | <-> | Port | | Sublink | |

	From Port	Sublink	To Port	Sublink
1	Serial0	MUMBAI	Serial1	BOSTON
2	Serial0	BEIJING	Serial2	BOSTON
3	Serial0	LONDON	Serial3	BOSTON
4	Serial0	NEWYORK	Serial4	BOSTON
5	Serial1	BEIJING	Serial2	MUMBAI
6	Serial1	LONDON	Serial3	MUMBAI
7	Serial1	NEWYORK	Serial4	MUMBAI
8	Serial2	LONDON	Serial3	BEINJING
9	Serial2	NEWYORK	Serial4	BEIJING
10	Serial3	NEWYORK	Serial4	LONDON

INTERFACE panel: Serial0, Serial1, Serial2, Serial3, Serial4, Serial9
Left panel: Settings, TV Settings, CONNECTIONS, Frame Relay, DSL, Cable

- Cloud 1 acting as ISP
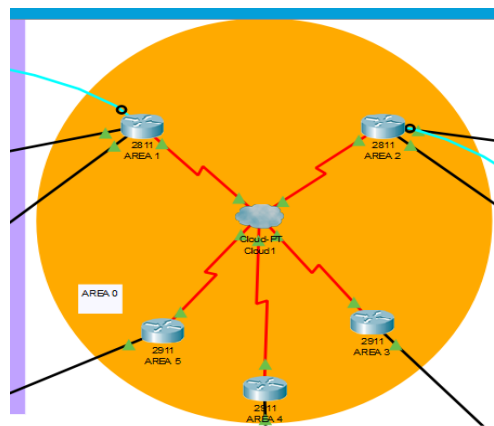
VLAN:

- Different VLAN pools are created for each departments at all locations in following manner

Boston & Mumbai:

- VLAN - 10 - Technical Department
- VLAN - 20 - Finance Department
- VLAN - 30 - HR Department

Beijing, London & New York

- VLAN - 10 - Technical Department
- VLAN - 20 - HR Department

VLAN Test plan:

```
Switch>
Switch>en
Switch#show vlan
Switch#show vlan br
Switch#show vlan brief

VLAN Name                             Status    Ports
---- -------------------------------- --------- -------------------------------
1    default                          active    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   TECH                             active    Fa0/1, Fa0/2, Fa0/3
20   fin                              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
Switch#
```
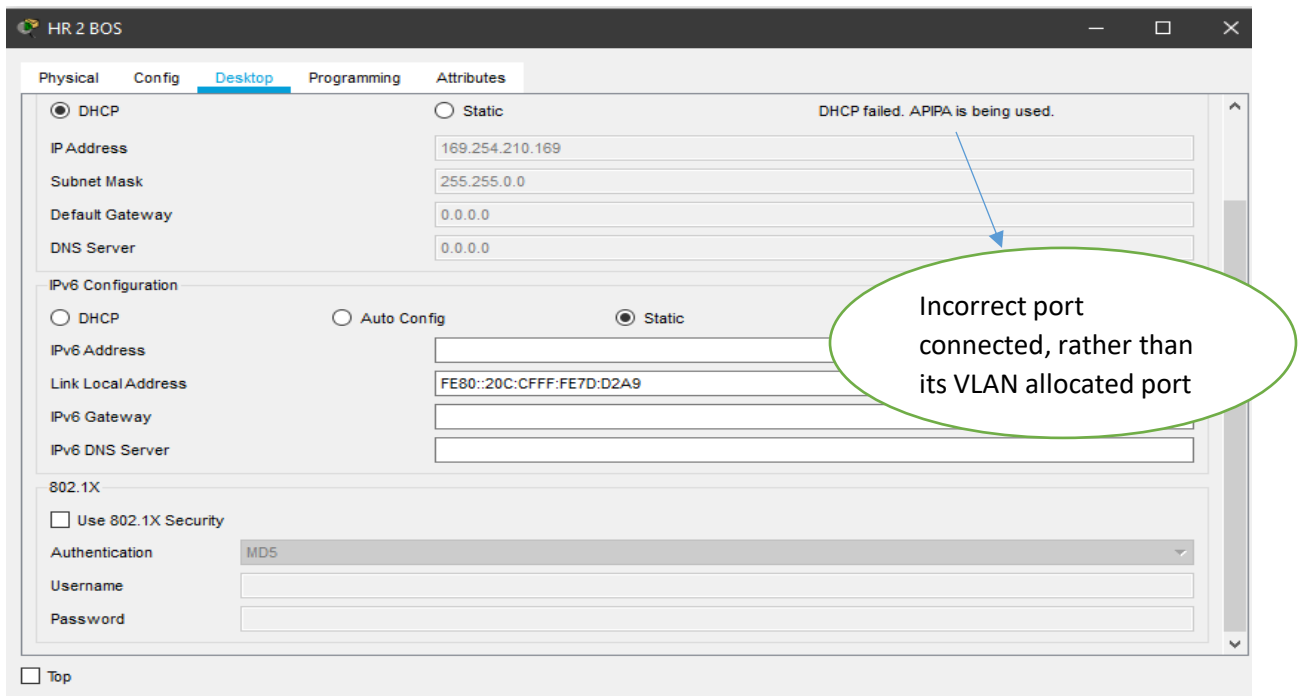
Ctrl+F6 to exit CLI focus

Dialog box shows, the VLAN's enabled in the above mentioned ports

SUCCESSFUL DHCP ALLOCATION WHEN CONNECTED TO VLAN ALLOCATED SWITCH PORT
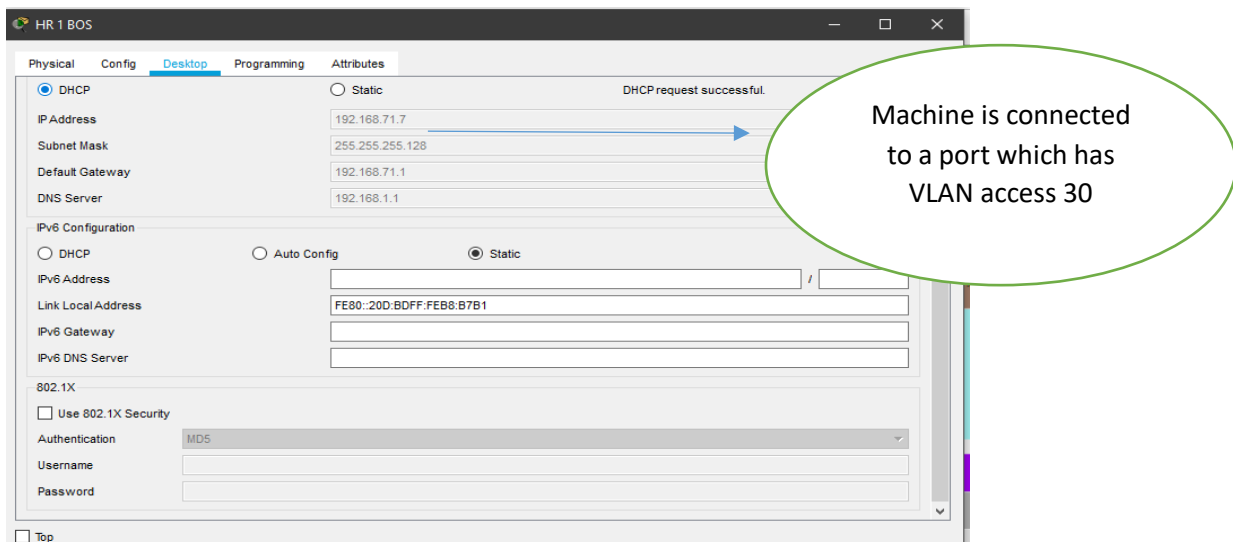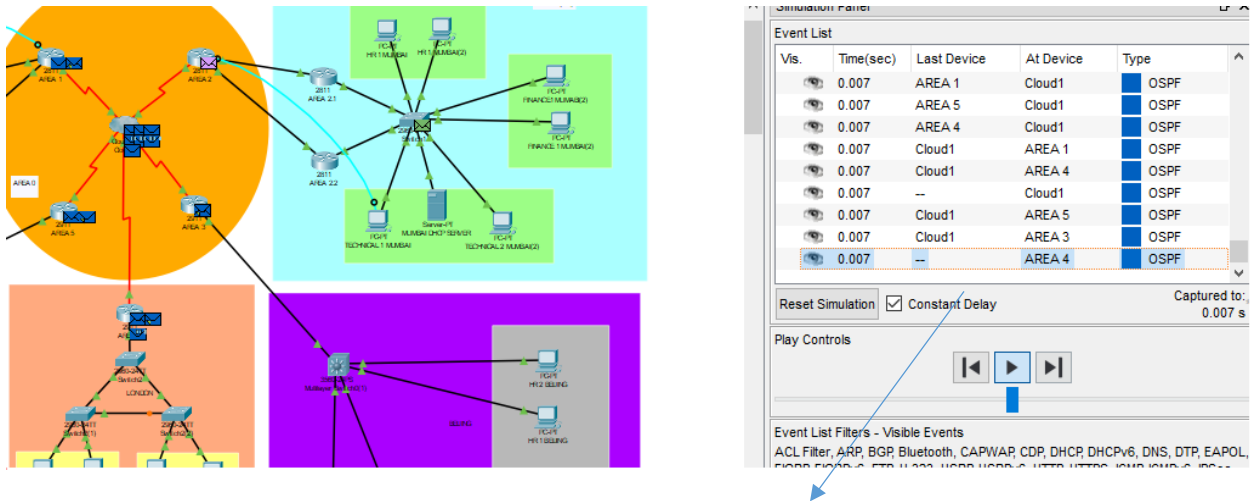

UNSUCCESSFUL DHCP ALLOCATION WHEN CONNECTED TO DIFFERENT SWITCH PORT

OSPF:

In order to communicate between PC'S on two different networks there must be a network protocol. Hence OSPF protocol is used here for this purpose. The following show the utilization of OSPF in project

"OSPF" mentioned while carrying out simulation between inter - network

Access-list (Security):

To provide access control or security for the organization, we used access control list to restrict access to finance department from HR & Technical department. Restriction to finance department is applicable to both Boston's & Mumbai's finance departments

Access list codes:

BOSTON
access-list 100 permit ip host 192.168.69.2 any
access-list 100 permit icmp any 192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any 192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 193.168.69.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 193.168.71.0 0.0.0.127 192.168.70.0 0.0.0.127
access-list 100 deny ip 193.168.69.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 193.168.71.0 0.0.0.127 192.168.73.0 0.0.0.127
access-list 100 permit ip any any

MUMBAI
access-list 100 permit ip host 192.168.72.2 any
access-list 100 permit icmp any 192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any 192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.72.0 0.0.0.255 192.168.70.0 0.0.0.127

access-list 100 deny ip 192.168.74.0 0.0.0.127 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.72.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.74.0 0.0.0.127 192.168.73.0 0.0.0.127
access-list 100 permit ip any any

BEIJING
access-list 100 permit ip host 192.168.72.2 any
access-list 100 permit icmp any 192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any 192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.75.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.76.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.75.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.76.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 permit ip any any

LONDON
access-list 100 permit ip host 192.168.72.2 any
access-list 100 permit icmp any 192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any 192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.77.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.78.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.77.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.78.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 permit ip any any

NEWYORK
access-list 100 permit ip host 192.168.72.2 any
access-list 100 permit icmp any 192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any 192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.79.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.80.0 0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.79.0 0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.80.0 0.0.0.255 192.168.73.0 0.0.0.127
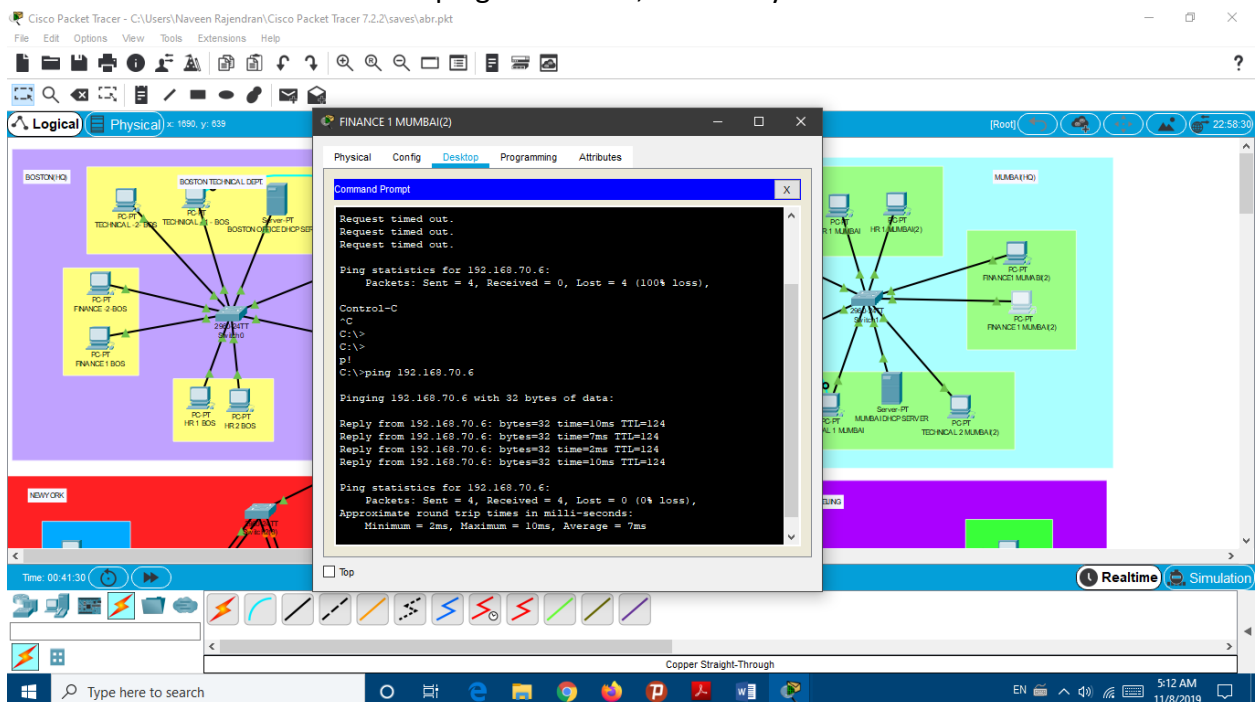access-list 100 permit ip any any

Security Test Plan:

- Unable to ping finance department of Mumbai from Boston's technical department due to ACL restriction
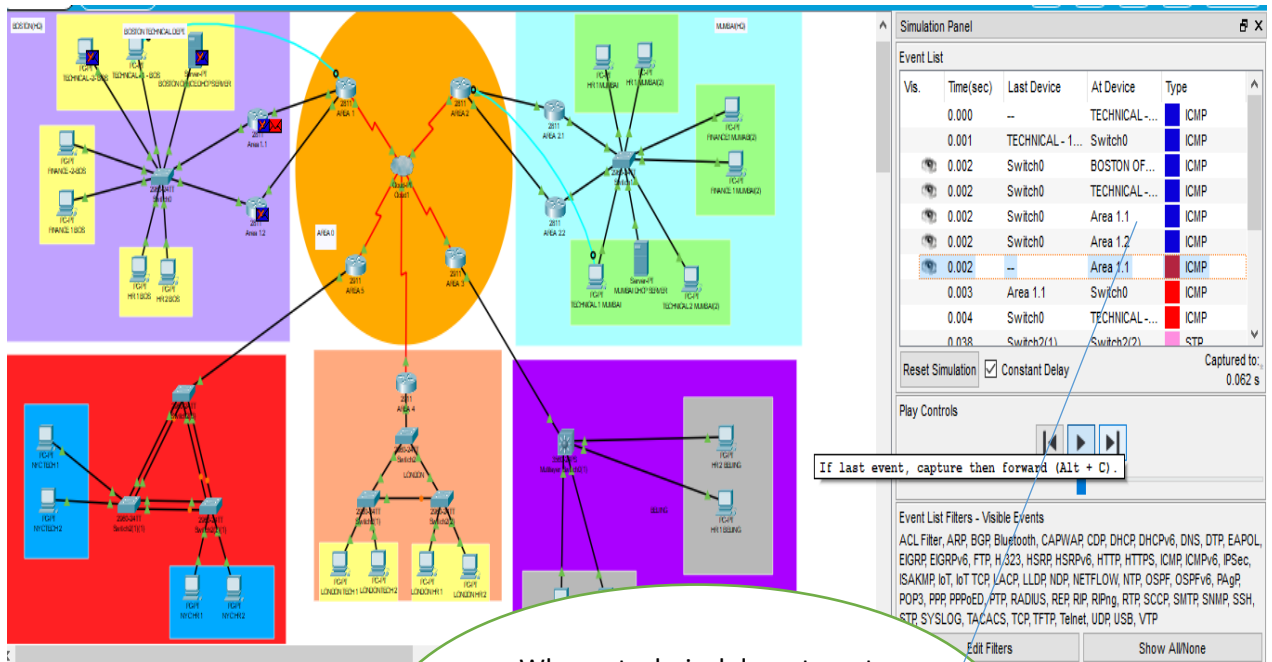
When a technical department host is trying to access finance department host, it is blocked at router using ACL's

- The finance hosts are able to ping each other, since they were not restricted in access list
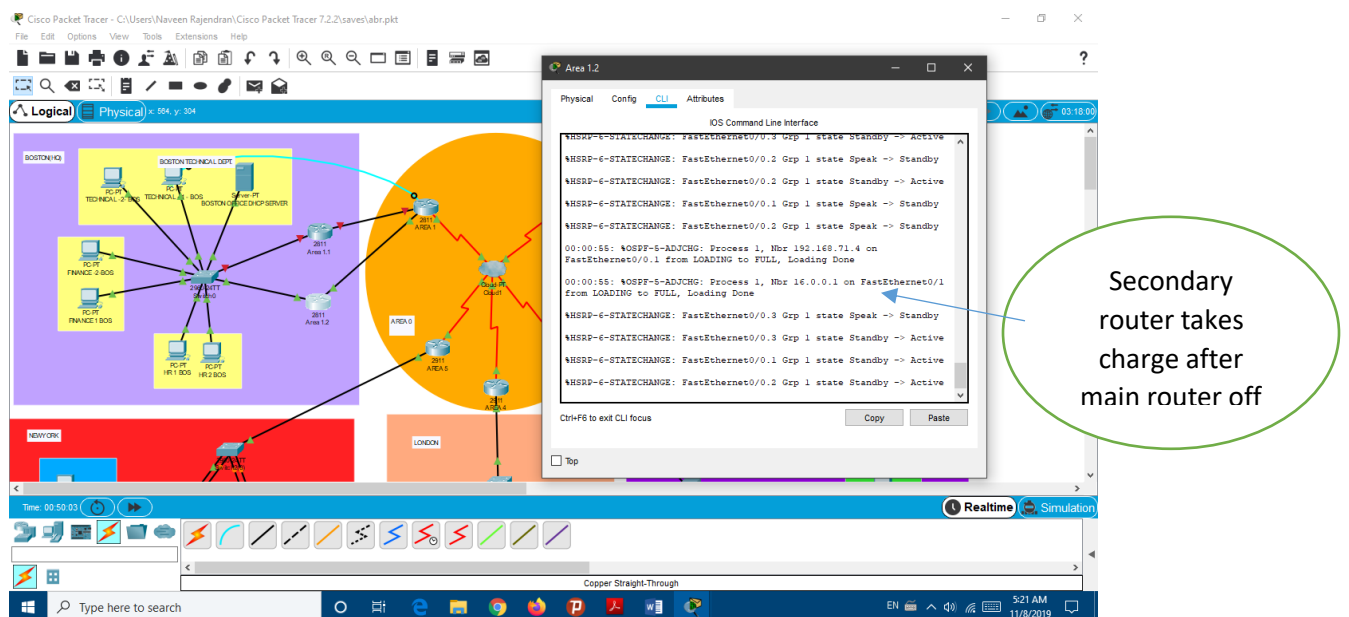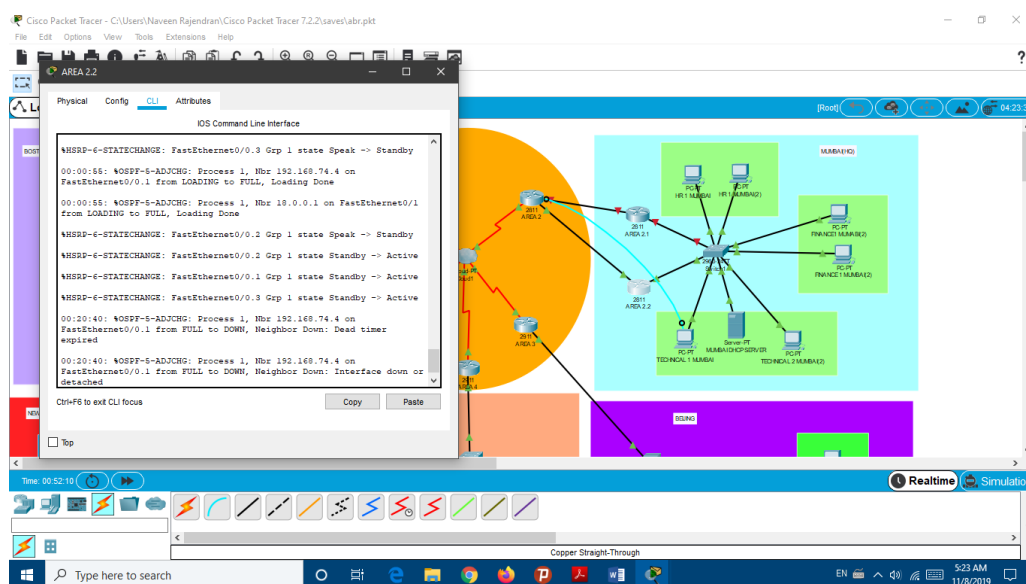
Redundancy Test plan:

For routers:

Hot standby routing protocol is executed at Boston & London location, so if the main router goes down standby gets activated. For testing, we are going to disable main routers at both the areas.

At Boston,

At Mumbai

Switch redundancy test plan:

When a trunk port is turned off, path A is blocked. Right now a redundant path which was at standby came into action instantly. Though the path is dropped, the VLAN's & network works fine due to redundant switch topology which is clearly adopted here.

BEFORE	AFTER
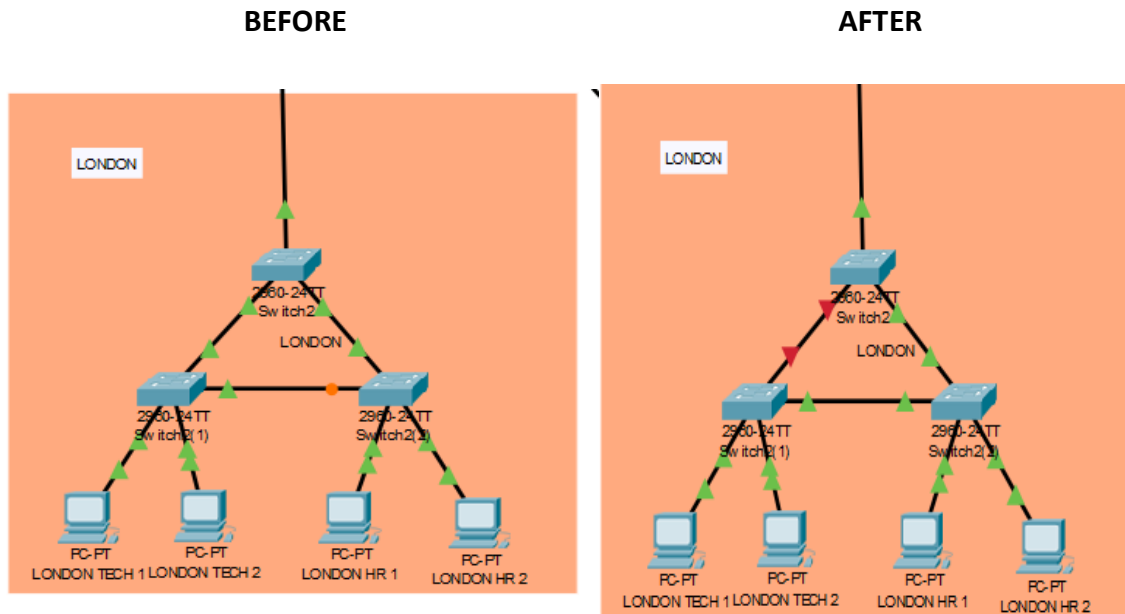
Add-on testing:
Multilayer switch

A multilayer switch is capable of doing layer 3 roles, therefore it has the capability of doing inter VLAN routing. In this project, a multilayer switch was implemented at Beijing location which performs inter vlan routing.

- When pinging HR department from technical department
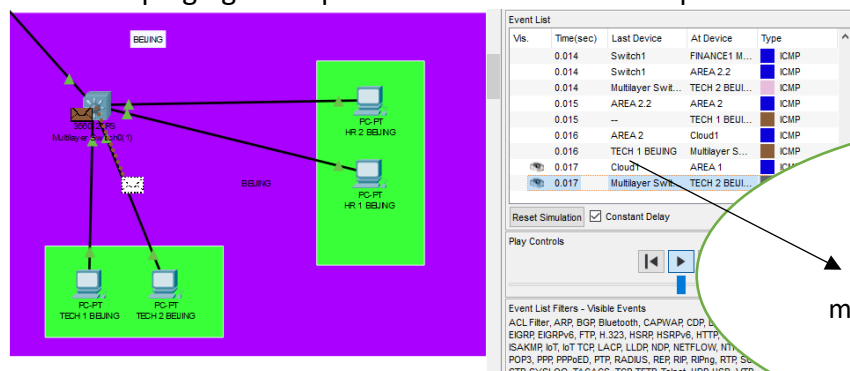
When a ping request between two vlan's technical & hr department is initiated, the routing is done by multilayer switch, which acts as layer 3 network device

LaCP

Link aggregation & control protocol was implemented at New York office for increasing the speed of communication between channels. Two separate channels were created for this purpose.

Channel - 1 through ports – fa0/1-2-3 & Channel -2 through ports – fa0/4-5-6
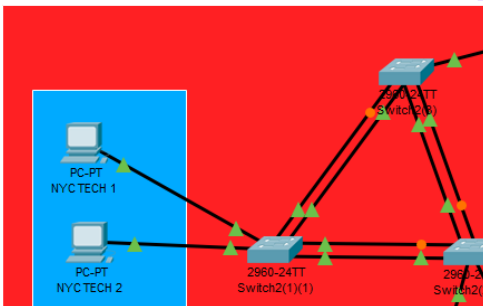

Port	Link	VLAN	IP Address	M
Port-channel1	Up	--	<not set>	0
Port-channel2	Up	--	<not set>	0
FastEthernet0/1	Down	--	--	0
FastEthernet0/2	Up	--	--	0
FastEthernet0/3	Up	--	--	0
FastEthernet0/4	Down	--	--	0
FastEthernet0/5	Up	--	--	0
FastEthernet0/6	Up	--	--	0
FastEthernet0/7	Down	1	--	0
FastEthernet0/8	Down	1	--	0
FastEthernet0/9	Down	1	--	0
FastEthernet0/10	Down	1	--	0
FastEthernet0/11	Down	10	--	0
FastEthernet0/12	Down	10	--	0
FastEthernet0/13	Up	20	--	0
FastEthernet0/14	Up	20	--	0
FastEthernet0/15	Down	1	--	0
FastEthernet0/16	Down	1	--	0
FastEthernet0/17	Down	1	--	0
FastEthernet0/18	Down	1	--	0
FastEthernet0/19	Down	1	--	0
FastEthernet0/20	Down	1	--	0
FastEthernet0/21	Down	1	--	0
FastEthernet0/22	Down	1	--	0
FastEthernet0/23	Down	1	--	0
FastEthernet0/24	Down	1	--	0
GigabitEthernet0/1	Down	1	--	0
GigabitEthernet0/2	Down	1	--	0
Vlan1	Down	1	<not set>	0
Vlan10	Up	10	<not set>	0
Vlan20	Up	20	<not set>	0

Hostname: Switch

It can be seen LaCP enable in two different channels configured in New York location

Takeaway Questions

- OSPF is always better. It is better resourceful than RIP protocol which uses lot of memory & complications. Moreover OSPF is best suitable for larger networks due to its better convergence rate than RIP

- Area concept in OSPF is used by the routers to know which location they belong to. They are utilized to segment larger networks into smaller chunks in which router is assigned a area number & connected to backbone area '0'

- If there is no common area '0', it would be difficult for routers to communicate between each other. It should use a dedicated path for ex: 1-5,2-3,4-1 etc. This causes more confusion & congestion in designing the network. Hence backbone area '0' is used here

- There are 7 types of LSA's

  1.) Router LSA

  Router LAS is used to send the packets within the same area and won't leave the area

  2.) Network LSA

  Network LSA is used to flood the neighboring routers within the same area.

  3.) Summary LSA

  Summary LSA is used to flood the packets between routers in different areas and provide OSPF with a summary

  4.) Summary ASBR LSA

  ASBR Summary LSA gets the packet from one area and injects it into the area 0

  5.) External LSA

  ASBR external LSA packets are generated by to advertise external redistributed routes

  6.) Multicast OSPF LSA

  Multicast LSA is used to multicast routing through OSPF.

  7.) Not so stubby area LSA (External)

This LSA allows limited amount of external routes to the stubby area

- Security plan is defined as the strategy for restricting the access between different hosts & redundancy plan is to place standby devices to avoid single point or device failure leading to shutdown of entire network
- If 2 switches are connected without STP, then the switches will infinitely duplicate the initial broadcast packet because nothing at the layer 2 to stop. Whereas, the STP helps in avoiding the loopback.

- STP gives a loop-free tree inconsistent topology of switches. It enables users to set the preferred location of root and determines the cost.

- PSTP is the Cisco proprietary protocol which is almost like STP, but the only difference is that PSTP allows each VLAN to run their own STP.

- RSTP provides a fast convergence rate when compared to the previous versions

Concepts learned during this project:

- Various network terminologies

- CLI Commands

- IP addressing & Sub netting

- Configuring switches & routers

- DHCP Configuration

- Network protocols (OSPF)

- Redundancy topologies

- Spanning tree & Rapid spanning tree protocols

- Frame relay implementation

- MAC flooding

BOSTON SWITCH CONFIGURATION

Switch>
Switch>
Switch>en
Switch#show run
Switch#show running-config
Building configuration...

Current configuration : 2621 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
switchport access vlan 10
switchport mode access
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/2
switchport access vlan 10
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/3
switchport access vlan 10
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable

!
interface FastEthernet0/4
switchport access vlan 20
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/5
switchport access vlan 20
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/6
switchport access vlan 30
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/7
switchport access vlan 30
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/8
switchport trunk native vlan 30
switchport trunk allowed vlan 2-1001
switchport mode trunk
!
interface FastEthernet0/9
switchport trunk native vlan 30
switchport trunk allowed vlan 2-1001
switchport mode trunk
!
interface FastEthernet0/10
!

interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
end

interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
no ip address
!
interface Vlan10
mac-address 0090.0c2b.b501
no ip address
!
interface Vlan20
mac-address 0090.0c2b.b502
no ip address
!
!
!
!
line con 0
!
line vty 0 4
login
line vty 5 15
login
!
!
!
!

MUMABI SWITCH CONFIGURATION

Switch>
Switch>
Switch>EN
Switch#SHOW RUN
Switch#SHOW RUNning-config
Building configuration...

Current configuration : 2555 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!

hostname Switch
!
!
!
!
!
spanning-tree mode pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
switchport access vlan 10
switchport mode access
spanning-tree portfast
spanning-tree bpduguard enable

```
!
interface FastEthernet0/2
switchport access vlan 10
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/3
switchport access vlan 10
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/4
switchport access vlan 20
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/5
switchport access vlan 20
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/6
switchport access vlan 30
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/7
switchport access vlan 30
switchport mode access
switchport port-security maximum 5
switchport port-security mac-address sticky

spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/8
switchport trunk native vlan 30
switchport mode trunk
!
interface FastEthernet0/9
switchport trunk native vlan 30
switchport mode trunk
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
```

```
no ip address
shutdown
!
interface Vlan10
mac-address 00d0.d31e.ec01
no ip address
!
interface Vlan20
mac-address 00d0.d31e.ec02
no ip address
!
!
!
```

BEIJING SWITCH CONFIGURATION

```
Switch>
Switch>
Switch>EN
Switch#SHOW RUN
Switch#SHOW RUNning-config
Building configuration...

Current configuration : 1702 bytes
!
version 12.2(37)SE1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
!
!
!
ip routing
!
!
!
!
!
!
!
!
```

```
!
line con 0
!
line vty 0 4
login
line vty 5 15
login
!
!
!
!
end
```

```
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/1
switchport trunk native vlan 20
switchport trunk encapsulation dot1q
switchport mode trunk
!
interface FastEthernet0/2
switchport access vlan 10
!
interface FastEthernet0/3
switchport access vlan 10
!
interface FastEthernet0/4
switchport access vlan 20
!
interface FastEthernet0/5
switchport access vlan 20
!
interface FastEthernet0/6
!
```

```
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10
!
interface FastEthernet0/11
!
interface FastEthernet0/12
!
interface FastEthernet0/13
!
interface FastEthernet0/14
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
no ip address
shutdown
!
interface Vlan10
mac-address 0001.63a1.5d01
ip address 192.168.75.1 255.255.255.0
ip helper-address 192.168.72.2
!
interface Vlan20
mac-address 0001.63a1.5d02
ip address 192.168.76.1 255.255.255.0
ip helper-address 192.168.72.2
!
router ospf 1
log-adjacency-changes
network 192.168.75.0 0.0.0.255 area 3
network 192.168.76.0 0.0.0.255 area 3
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
!
end
```

```
Switch#show running-config
Building configuration...

Current configuration : 1772 bytes
!
version 12.2
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Switch
!
!
!
!
!
spanning-tree mode rapid-pvst
spanning-tree extend system-id
!
interface FastEthernet0/1
switchport trunk native vlan 20
switchport mode trunk
!
interface FastEthernet0/2
switchport trunk native vlan 20
switchport mode trunk
spanning-tree link-type point-to-point
!
interface FastEthernet0/3
switchport trunk native vlan 20
switchport mode trunk
spanning-tree link-type point-to-point
!
interface FastEthernet0/4
!
interface FastEthernet0/5
!
interface FastEthernet0/6
!
interface FastEthernet0/7
!
interface FastEthernet0/8
!
interface FastEthernet0/9
!
interface FastEthernet0/10

!
interface FastEthernet0/11
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/12
switchport access vlan 10
switchport mode access
!
interface FastEthernet0/13
switchport access vlan 20
switchport mode access
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/14
switchport access vlan 20
switchport mode access
spanning-tree portfast
spanning-tree bpduguard enable
!
interface FastEthernet0/15
!
interface FastEthernet0/16
!
interface FastEthernet0/17
!
interface FastEthernet0/18
!
interface FastEthernet0/19
!
interface FastEthernet0/20
!
interface FastEthernet0/21
!
interface FastEthernet0/22
!
interface FastEthernet0/23
!
interface FastEthernet0/24
!
interface GigabitEthernet0/1
!
interface GigabitEthernet0/2
!
interface Vlan1
```

```
no ip address
shutdown
!
interface Vlan10
mac-address 00d0.d323.6601
no ip address
!
interface Vlan20
mac-address 00d0.d323.6602
no ip address
!
!
end
```

BOSTON ROUTER CONFIGURATION

```
Router#show run
Router#show running-config
Building configuration...

Current configuration : 2151 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
!
!
!
```

```
!
!
line con 0
!
line vty 0 4
login
line vty 5 15
login
!
!
!
!
!
```

```
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
no ip address
duplex auto
speed auto
!
interface FastEthernet0/0.1
encapsulation dot1Q 10
ip address 192.168.69.4 255.255.255.0
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.69.1
standby 1 priority 105
standby 1 preempt
standby preempt
standby 0 timers 2 6
!
interface FastEthernet0/0.2
encapsulation dot1Q 20
ip address 192.168.70.4 255.255.255.128
```

```
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.70.1
standby 1 priority 105
standby 1 preempt
standby preempt
standby 0 timers 2 6
!
interface FastEthernet0/0.3
encapsulation dot1Q 30 native
ip address 192.168.71.4 255.255.255.128
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.71.1
standby 1 priority 105
standby 1 preempt
standby preempt
standby 0 timers 2 6
!
interface FastEthernet0/1
ip address 15.0.0.2 255.255.255.0
duplex auto
speed auto
!
interface Serial0/2/0
no ip address
clock rate 2000000
shutdown
!
interface Serial0/3/0
no ip address
clock rate 2000000
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes

network 192.168.69.0 0.0.0.255 area 1
network 192.168.70.0 0.0.0.127 area 1
network 192.168.71.0 0.0.0.127 area 1
network 15.0.0.0 0.0.0.255 area 0
!
ip classless
!
ip flow-export version 9
!
!
access-list 100 permit ip host 192.168.69.2
any
access-list 100 permit icmp any
192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any
192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.69.0
0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.71.0
0.0.0.127 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.69.0
0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.71.0
0.0.0.127 192.168.73.0 0.0.0.127
access-list 100 permit ip any any

line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

BOSTON AREA BORDER ROUTER CONFIGURATION

Router>
Router>EN
Router#sho run
Router#sho running-config
Building configuration...

Current configuration : 2028 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
!

interface FastEthernet0/0
ip address 15.0.0.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 16.0.0.1 255.255.255.0
duplex auto
speed auto
!
interface Ethernet0/2/0
no ip address
duplex auto
speed auto
shutdown
!
interface Ethernet0/3/0
no ip address
duplex auto
speed auto
shutdown
!
interface Serial1/0
no ip address
encapsulation frame-relay
!
interface Serial1/0.102 point-to-point
bandwidth 64
ip address 10.0.0.1 255.255.255.0
frame-relay interface-dlci 102
clock rate 2000000
!
interface Serial1/0.103 point-to-point
bandwidth 64
ip address 10.0.1.1 255.255.255.0
frame-relay interface-dlci 103
clock rate 2000000
!
interface Serial1/0.104 point-to-point
bandwidth 64
ip address 10.0.2.1 255.255.255.0
frame-relay interface-dlci 104
clock rate 2000000

```
!
interface Serial1/0.105 point-to-point
bandwidth 64
ip address 10.0.3.1 255.255.255.0
frame-relay interface-dlci 105
clock rate 2000000
!
interface Serial1/1
no ip address
clock rate 2000000
shutdown
!
interface Serial1/2
no ip address
clock rate 2000000
shutdown
!
interface Serial1/3
no ip address
clock rate 2000000
!
interface Serial1/4
no ip address
clock rate 2000000
!
interface Serial1/5
no ip address
clock rate 2000000
!
interface Serial1/6
no ip address
clock rate 2000000
!
interface Serial1/7
no ip address
clock rate 2000000

.

!
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
network 10.0.0.0 0.0.0.255 area 0
network 10.0.1.0 0.0.0.255 area 0
network 10.0.2.0 0.0.0.255 area 0
network 10.0.3.0 0.0.0.255 area 0
network 15.0.0.0 0.0.0.255 area 0
network 16.0.0.0 0.0.0.255 area 0
!
ip classless
!
ip flow-export version 9
!
!
!
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

MUMBAI ABR CONFIGURATION

Router>
Router>en
Router#show run
Router#show running-config
Building configuration...

Current configuration : 1570 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0

ip address 17.0.0.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 18.0.0.1 255.255.255.0
duplex auto
speed auto
!
interface Serial0/0/0
bandwidth 64
no ip address
encapsulation frame-relay
clock rate 2000000
!
interface Serial0/0/0.201 point-to-point
bandwidth 64
ip address 10.0.0.2 255.255.255.0
frame-relay interface-dlci 201
clock rate 2000000
!
interface Serial0/0/0.203 point-to-point
bandwidth 64
ip address 11.0.0.1 255.255.255.0
frame-relay interface-dlci 203
clock rate 2000000
!
interface Serial0/0/0.204 point-to-point
bandwidth 64
ip address 11.0.1.1 255.255.255.0
frame-relay interface-dlci 204
clock rate 2000000
!
interface Serial0/0/0.205 point-to-point
bandwidth 64
ip address 11.0.2.1 255.255.255.0
frame-relay interface-dlci 205
clock rate 2000000
!
interface Serial0/0/1
no ip address
clock rate 2000000
shutdown
!

```
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
network 10.0.0.0 0.0.0.255 area 0
network 11.0.0.0 0.0.0.255 area 0
network 11.0.1.0 0.0.0.255 area 0
network 11.0.2.0 0.0.0.255 area 0
network 17.0.0.0 0.0.0.255 area 0
network 18.0.0.0 0.0.0.255 area 0
!
```

MUMBAI AREA ROUTER CONF

```
Router>
Router>en
Router#copy
Router#copy run
Router#copy running-config
% Incomplete command.
Router#copy running-config sta
Router#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
Router#
```

Router con0 is now available

Press RETURN to get started.

```
Router>
Router>EN
Router#sho
Router#show run
Router#show running-config
Building configuration...

Current configuration : 1975 bytes
!
version 12.4
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
ip cef
no ipv6 cef
!
!
!
!
!
!
!
!
!
!
```

```
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface FastEthernet0/0
no ip address
duplex auto
speed auto
!
interface FastEthernet0/0.1
encapsulation dot1Q 10
ip address 192.168.72.4 255.255.255.0
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.72.1
standby 1 priority 115
standby 1 preempt
standby preempt
standby 0 timers 2 6
!
interface FastEthernet0/0.2
encapsulation dot1Q 20
ip address 192.168.73.4 255.255.255.0
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.73.1
standby 1 priority 115
standby 1 preempt
standby preempt
!
interface FastEthernet0/0.3
encapsulation dot1Q 30 native
ip address 192.168.74.4 255.255.255.0
ip helper-address 192.168.69.2
ip access-group 100 in
standby 1 ip 192.168.74.1
standby 1 priority 115
standby 1 preempt
standby preempt
!

interface FastEthernet0/1
ip address 17.0.0.2 255.255.255.0
duplex auto
speed auto
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
network 192.168.72.0 0.0.0.255 area 2
network 192.168.73.0 0.0.0.127 area 2
network 192.168.74.0 0.0.0.127 area 2
network 17.0.0.0 0.0.0.255 area 0
!
ip classless
!
ip flow-export version 9
!
!
access-list 100 permit ip host 192.168.72.2
any
access-list 100 permit icmp any
192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any
192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.72.0
0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.74.0
0.0.0.127 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.72.0
0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.74.0
0.0.0.127 192.168.73.0 0.0.0.127
access-list 100 permit ip any any
!
!
!
!
!
!
line con 0
!
line aux 0
!
```

```
line vty 0 4
login
!
!
!
end


```

BEIJING ROUTER CONF

```
Current configuration : 2032 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
license udi pid CISCO2911/K9 sn
FTX15243294-
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
```

```
!
!
!
!
!
!
interface GigabitEthernet0/0
no ip address
ip helper-address 192.168.72.2
duplex auto
speed auto
!
interface GigabitEthernet0/0.1
encapsulation dot1Q 10
ip address 192.168.75.1 255.255.255.0
ip helper-address 192.168.72.2
!
interface GigabitEthernet0/0.2
encapsulation dot1Q 20 native
ip address 192.168.76.1 255.255.255.0
ip helper-address 192.168.72.2
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/0/0
no ip address
shutdown
!
interface Serial0/1/0
bandwidth 64
no ip address
encapsulation frame-relay
clock rate 2000000
!
interface Serial0/1/0.301 point-to-point
bandwidth 64
ip address 10.0.1.2 255.255.255.0
frame-relay interface-dlci 301
```

```
clock rate 2000000
!
interface Serial0/1/0.302 point-to-point
bandwidth 64
ip address 11.0.0.2 255.255.255.0
frame-relay interface-dlci 302
clock rate 2000000
!
interface Serial0/1/0.304 point-to-point
bandwidth 64
ip address 12.0.0.1 255.255.255.0
frame-relay interface-dlci 304
clock rate 2000000
!
interface Serial0/1/0.305 point-to-point
bandwidth 64
ip address 12.0.1.1 255.255.255.0
frame-relay interface-dlci 305
clock rate 2000000
!
interface Serial0/1/1
no ip address
clock rate 2000000
shutdown
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
network 10.0.1.0 0.0.0.255 area 0
network 11.0.0.0 0.0.0.255 area 0
network 12.0.0.0 0.0.0.255 area 0
network 12.0.1.0 0.0.0.255 area 0
network 192.168.75.0 0.0.0.255 area 3
network 192.168.76.0 0.0.0.255 area 3
!
ip classless
!
ip flow-export version 9
!
!
!
no cdp run
!
```

```
!
!
!
!
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
!
!
end
```

LONDON ROUTER CONFIGURATION
```
Router>
Router>
Router>EN
Router#SHOW RUN
Router#SHOW RUNning-config
Building configuration...

Current configuration : 2481 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
no service password-encryption
!
hostname Router
!
!
!
!
!
!
!
!
!
no ip cef
no ipv6 cef
!
!
!
!
```

```
license udi pid CISCO2911/K9 sn
FTX152435AI-
!
!
!
!
!
!
!
!
!
!
!
spanning-tree mode pvst
!
!
!
!
!
!
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/0.1
encapsulation dot1Q 10
ip address 192.168.77.1 255.255.255.0
ip helper-address 192.168.72.2
ip access-group 100 in
!
interface GigabitEthernet0/0.2
encapsulation dot1Q 20 native
ip address 192.168.78.1 255.255.255.0
ip helper-address 192.168.72.2
ip access-group 100 in
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto

shutdown
!
interface Serial0/0/0
bandwidth 64
no ip address
encapsulation frame-relay
clock rate 2000000
!
interface Serial0/0/0.401 point-to-point
bandwidth 64
ip address 10.0.2.2 255.255.255.0
frame-relay interface-dlci 401
clock rate 2000000
!
interface Serial0/0/0.402 point-to-point
bandwidth 64
ip address 11.0.1.2 255.255.255.0
frame-relay interface-dlci 402
clock rate 2000000
!
interface Serial0/0/0.403 point-to-point
bandwidth 64
ip address 12.0.0.2 255.255.255.0
frame-relay interface-dlci 403
clock rate 2000000
!
interface Serial0/0/0.405 point-to-point
bandwidth 64
ip address 13.0.0.1 255.255.255.0
frame-relay interface-dlci 405
clock rate 2000000
!
interface Serial0/0/1
no ip address
clock rate 2000000
shutdown
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
log-adjacency-changes
network 192.168.77.0 0.0.0.255 area 4
network 192.168.78.0 0.0.0.255 area 4
network 13.0.0.0 0.0.0.255 area 0
```

network 10.0.2.0 0.0.0.255 area 0
network 11.0.1.0 0.0.0.255 area 0
network 12.0.0.0 0.0.0.255 area 0
!
ip classless
!
ip flow-export version 9
!
!
access-list 100 permit ip host 192.168.72.2
any
access-list 100 permit icmp any
192.168.70.0 0.0.0.127 echo-reply
access-list 100 permit icmp any
192.168.73.0 0.0.0.127 echo-reply
access-list 100 deny ip 192.168.77.0
0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.78.0
0.0.0.255 192.168.70.0 0.0.0.127
access-list 100 deny ip 192.168.77.0
0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 deny ip 192.168.78.0
0.0.0.255 192.168.73.0 0.0.0.127
access-list 100 permit ip any any
!
!
!
!
!
!
line con 0
!
line aux 0
!

line vty 0 4
login
!
!
!
end

Conclusion

Thus an enterprise network was built successfully with cisco packet tracer implementing various network protocols and output was tested successfully

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