Cégep de la Gaspésie et des Îles

Cisco Networking

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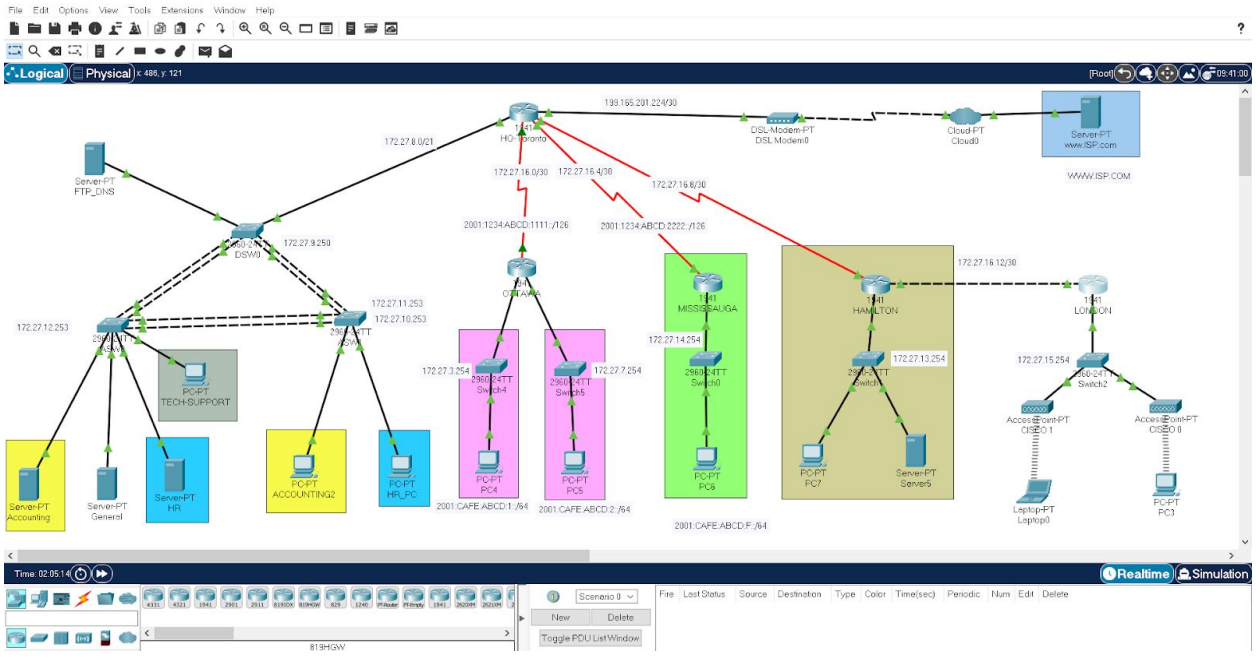
Case Study

A company wants to design and implement a network. It has several sites in five cities in canada. Three of these sites (OTTAWA, MISSISSAUGA and HAMILTON) will be connected using serial leased line connections. LONDON will be connected to the HAMILTON optical fiber line. All sites use the OSPF or EIGRP routing protocol and default-route to the Internet, newly acquired by the company. The TORONTO which is the headquarters (HQ) site is distinguished by the breadth and complexity of the LAN. Therefore, the company wants to create VLANs to control broadcasts, improve security and group users logically.

The company wants to use private addresses throughout for security reasons and DHCP for the LANs. In order to share Internet connection, you should use network address translation (NAT) and port address translation (PAT). The company also wishes to limit Internet access to Web traffic while allowing multiple protocols within its own WAN. A set of servers are provided at the company's headquarters that simulate DMZ although HR and ACCOUNTING departments have their own servers connected to their network. Due to the size and complexity, the company wants to create VLANs to control broadcasts, enhance security, and logically group users.

Although private addresses (RFC 1918) will be used, the company appreciates efficiency and address conservation in design. To minimize wasted address space, they have requested VLSM to be used when appropriate.

❑ Topological Diagram



❑ Table layout for recording the VLSM design

Network Name	VLAN	Number of host addresses required	Network Address	Subnet Mask	Max Number of Hosts Possible	Gateway Address
HQ-TORONTO	-	870	172.27.8.0/21	255.255.252.0	1022	-
HR	2	164	172.27.11.0/24	255.255.255.0	254	172.27.11.1
ACCOUNTING	3	240	172.27.10.0/24	255.255.255.0	254	172.27.10.1
GENERAL	4	400	172.27.8.0/23	255.255.254.0	510	172.27.8.1
Tech-Support	11	70	172.27.12.0/25	255.255.255.128	126	172.27.12.1
OTTAWA	-	1500	172.27.0.0/21	255.255.248.0	2046	-
OTTAWA BR1	-	700	172.27.0.0/22	255.255.252.0	1022	172.27.0.1
OTTAWA BR2	-	800	172.27.4.0/22	255.255.252.0	1022	172.27.4.1
MISSISSAUGA	-	200	172.27.14.0/24	255.255.255.0	254	172.27.14.1
HAMILTON	-	200	172.27.13.0/24	255.255.255.0	254	172.27.13.1
LONDON	-	140	172.27.15.0/24	255.255.255.0	254	172.27.15.1

❑ IPv6 addressing table

Network Name	Global Network IPv6	LINK-LOCAL network	Default GW
OTTAWA– LAN1	2001:CAFE:ABCD: 1::/64	FE80::/64	FE80::1/64
OTTAWA– LAN2	2001:CAFE:ABCD: 2::/64	FE80::/64	FE80::1/64
MISSISSAUGA - LAN	2001:CAFE:ABCD: F::/64	FE80::/64	FE80::1/64
Serial Link			
TORONTO- OTTAWA	2001:1234:ABCD: 1111::/126	N/A	N/A
TORONTO-MISSISSAUGA	2001:1234:ABCD: 2222::/126	N/A	N/A

❑ **Router Name:** TORONTO-HQ_ROUTER

Network Name	Description and Purpose	Interface / Sub Interface	VLAN	Encapsulation	Network Number	Interface IP Address	Subnet Mask/Default Gateway
Internet	Connect with internet	Gig0/1	N/A	N/A	199.165.201.224/30	199.165.201.225	255.255.255.252
Inter-VLANS	Connect with inter-vlans	Gig0/0	N/A	Dot1Q	172.27.8.0/21		
OTTAWA	Connect with toronto	S 0/0/0	N/A	PPP-PAP	172.27.16.0/30	172.27.16.1	255.255.255.252
OTTAWA	Connect with toronto	S 0/0/0	N/A	PPP-PAP	2001:1234:ABCD:1111::/126	2001:1234:ABCD:1111:20::/126	N/A
MISSISSAUGA	Connect with toronto	S 0/0/1	N/A	PPP-CHAP	172.27.16.4/30	172.27.16.5	255.255.255.252
MISSISSAUGA	Connect with toronto	S 0/0/1	N/A	PPP-CHAP	2001:1234:ABCD:2222::/126	2001:1234:ABCD:2222::20/126	N/A
HAMILTON	Connect with toronto	S 0/1/0	N/A	PPP-HDLC	172.27.16.8/30	172.27.16.9	255.255.255.252
Not In Use		S 0/1/1	Not in Use				

❑ **Router Name:** OTTAWA_ROUTER

Network Name	Description and Purpose	Interface / Sub Interface	VLAN	Encapsulation	Network Number	Interface IP Address	Subnet Mask/Default Gateway
OTTAWA BR1	Connects to Local LAN'S within the branch.	Gig0/0	N/A	N/A	2001:CAFE:ABCD:1::/64	2001:CAFE:ABCD:1::10/64	FE80::1/64
OTTAWA BR1	Connects to Local LAN'S within the branch.	Gig0/0	N/A	N/A	172.27.0.0/22	172.27.0.1	255.255.252.0
OTTAWA BR2	Connects to Local LAN'S within the branch.	Gig0/1	N/A	N/A	2001:CAFE:ABCD:2::/64	2001:CAFE:ABCD:2::10/64	FE80::1/64
OTTAWA BR2	Connects to Local LAN'S within the branch.	Gig0/1	N/A	N/A	172.27.4.0/22	172.27.4.1	255.255.252.0
TORONTO-HQ	To connect with toronto router with ospf in the same area.	S 0/0/0	N/A	PPP-PAP	2001:1234:ABCD:1111::/126	2001:1234:ABCD:1111::10/126	N/A
TORONTO-HQ	To connect with toronto router with ospf in the same area.	S 0/0/0	N/A	PPP-PAP	172.27.16.0/30	172.27.16.2	255.255.255.252
Not in Use		S 0/0/1	Not in Use				

❑ **Router Name:** MISSISSAUGA_ROUTER

Network Name	Description and Purpose	Interface / Sub Interface	VLAN	Encapsulation	Network Number	Interface IP Address	Subnet Mask/Default Gateway
MISSISSAUGA Local Network	Connects to Local LAN'S within the branch.	Gig0/0	N/A	N/A	172.27.14.0/24	172.27.14.1	255.255.255.0
MISSISSAUGA Local Network	Connects to Local LAN'S within the branch.	Gig0/0	N/A	N/A	2001:CAFE:ABCD:F::/64	2001:CAFE:ABCD:F::10/64	FE80::1/64
Not in Use		Gig0/1	Not in Use				
Not in Use		S 0/0/0	Not in Use				
TORONTO-HQ	To connect with toronto router with ospf in the same area.	S 0/0/1	N/A	PPP-CHAP	172.27.16.4/30	172.27.16.6	255.255.255.252
TORONTO-HQ	To connect with toronto router with ospf in the same area.	S 0/0/1	N/A	PPP-CHAP	2001:1234:ABCD:2222::/126	2001:1234:ABCD:2222:10:/126	N/A

❑ **Router Name:** HAMILTON_ROUTER

Network Name	Description and Purpose	Interface/ Sub Interface	VLAN	Encapsulation	Network Number	Interface IP Address	Subnet Mask
HAMILTON Local Network	Connects to Local LAN'S within the branch.	Gig0/1	N/A	N/A	172.27.13.0/24	172.27.13.1	255.255.255.0
LONDON	To connect with the London router with ospf in the same area.	Gig0/0	N/A	N/A	172.27.16.12/30	172.27.16.13	255.255.255.252
TORONTO-HQ	To connect with toronto router with ospf in the same	S 0/0/0	N/A	PPP-HDLC	172.27.16.8/30	172.27.16.10	255.255.255.252

	area.						
Not in Use		S 0/0/1	Not in Use				

❑ **Router Name:** LONDON_ROUTER

Network Name	Description and Purpose	Interface/ Sub Interface	VLAN	Encapsulation	Network Number	Interface IP Address	Subnet Mask
HAMILTON_ROUTER	Connects to the HAMILTON_Router	Gig0/0	N/A	N/A	172.27.16.12/30	172.27.16.14	255.255.255.252
LONDON	Connects to Local LAN'S within the branch.	Gig0/1	N/A	N/A	172.27.16.12/30	172.27.15.1	255.255.255.0

❑ WIRELESS ACCESS POINT NAME

Interface Type/Port	Description and Purpose	Network Name	Network Number	SSID	Security – wpa2key	Interface IP Address or IP range	Subnet Mask
Port 0 (Wired)	To connect with switch						
Port 1 (Wireless)	To provide wireless access points.			LONDON	cisco123456	172.27.15.0 - 172.27.15.255	255.255.255.0

Distribution Switch Name: DSW0

Switch IP address:172.27.9.250/23 VLAN: 4(General)

Port/Number	Description and Purpose	Speed	Duplex	VLANs allowed	Switch port Type	Encapsulation (if needed)
Fa 0/3	GENERAL	Auto	Auto	4	Access	N/A
Fa 0/18	Ether-Channel	Auto	Auto	N/A	Trunk	Dot1Q
Fa 0/19	Ether-Channel	Auto	Auto	N/A	Trunk	Dot1Q
Fa 0/20	Ether-Channel	Auto	Auto	N/A	Trunk	Dot1Q
Fa 0/21	Ether-Channel	Auto	Auto	N/A	Trunk	Dot1Q
Fa 0/3	General VLAN	Auto	Auto	4	Access	N/A

Access Switch Name: ASW0

Switch IP address: 172.27.12.253/25 VLAN: 11(Tech-Support)

Interface/Sub-interface Type/Port Number	Description and Purpose	Speed	Duplex	Network Name	Network Number	Subnet Mask	VLAN	Switchport Type	Encapsulation (if needed)
Fa 0/10	Connected to Accounting server	Auto	Auto	ACCOUNTING	172.27.10.0	255.255.255.0	3	Access	N/A
Fa 0/11	Connected to General server	Auto	Auto	GENERAL	172.27.8.0	255.255.254.0	4	Access	N/A
Fa 0/12	Connected to HRserver	Auto	Auto	HR	172.27.11.0	255.255.255.0	2	Access	N/A
Fa 0/13	Connected to Tech-Support PC	Auto	Auto	Tech-Support	172.27.12.0	255.255.255.128	11	Access	N/A
Fa 0/18		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q
Fa 0/19		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q
Fa 0/20		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q
Fa 0/21		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q

Access Switch Name: ASW1

Switch IP address: 172.27.11.253/24 and 172.27.10.253/24

VLAN: 2(HR) and 3 (ACCOUNTING)

Interface/Sub-interface Type/Port Number	Description and Purpose	Speed	Duplex	Network Name	Network Number	Subnet Mask	VLAN	Switchport Type	Encapsulation (if needed)
Fa 0/2	Connected to HR_PC	Auto	Auto	HR	172.27.11.0	255.255.255.0	2	Access	N/A
Fa 0/1	Connected to Accounting PC	Auto	Auto	ACCOUNTING	172.27.10.0	255.255.255.0	3	Access	N/A
Fa 0/18		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q
Fa 0/19		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q

Fa 0/22		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q
Fa 0/23		Auto	Auto	Ether-Channel	N/A	N/A	N/A	Trunk	Dot1Q

❏ Service:

Services Provided	VLAN	Network Number	Server / PCs	IP address	Subnet Mask	Gateway
DNS	4	172.27.8.0	Server	172.27.9.254	255.255.254.0	172.27.8.1
FTP	4	172.27.8.0	Server	172.27.9.254	255.255.254.0	172.27.8.1
Accounting	3	172.27.10.0	Server	172.27.11.254	255.255.255.0	172.27.11.1
General	4	172.27.8.0	Server	172.27.9.254	255.255.254.0	172.27.8.1
HR	2	172.27.11.0	Server	172.27.10.254	255.255.255.0	172.27.10.1
Internet	N/A	199.165.201.224	Server	199.165.201.226	255.255.255.252	199.165.201.225
Hamilton Server	N/A	172.27.13.0	Server	172.27.13.253	255.255.255.0	172.27.13.1

❏ DHCP-POOL INFO:

Services Provided	Router	POOL Name	Network Id	Subnet Mask	Default Router	DNS Server
DHCP	OTTAWA	BRANCH-1	172.27.0.0	255.255.252.0	172.27.0.1	172.27.9.254
DHCP	OTTAWA	BRANCH-2	172.27.4.0	255.255.252.0	172.27.4.1	172.27.9.254
DHCP	MISSISSAUGA	MISSISSAUGA-Pool	172.27.14.0	255.255.255.0	172.27.14.1	172.27.9.254
DHCP	HAMILTON	Hamilton-Pool	172.27.13.0	255.255.255.0	172.27.13.1	172.27.9.254
DHCP	HQ-Toronto	VLAN2	172.27.11.0	255.255.255.0	172.27.11.1	172.27.9.254
DHCP	HQ-Toronto	VLAN3	172.27.10.0	255.255.255.0	172.27.10.1	172.27.9.254
DHCP	HQ-Toronto	VLAN4	172.27.8.0	255.255.254.0	172.27.8.1	172.27.9.254

DHCP	HQ-Toronto	VLAN11	172.27.12.0	255.255.255.128	172.27.12.1	172.27.9.254
DHCP	LONDON	London-Pool	172.27.15.1	255.255.255.0	172.27.15.1	172.27.9.254

Protocol	Process-I.D	Router Name	Router I.D	Network	Wild Card	Area
OSPF	1	HQ-Toronto	1.1.1.1	172.27.16.0	0.0.0.3	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.16.4	0.0.0.3	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.16.8	0.0.0.3	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.11.0	0.0.0.255	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.10.0	0.0.0.255	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.8.0	0.0.1.255	Area 0
OSPF	1	HQ-Toronto	1.1.1.1	172.27.12.0	0.0.0.127	Area 0
OSPF IPV6	10	HQ-Toronto	1.1.1.1	2001:1234:ABCD:1111::/126	N/A	Area 0
OSPF IPV6	10	HQ-Toronto	1.1.1.1	2001:1234:ABCD:2222::/126	N/A	Area 0
OSPF	1	OTTAWA	2.2.2.2	172.27.16.0	0.0.0.3	Area 0
OSPF	1	OTTAWA	2.2.2.2	172.27.4.0	0.0.3.255	Area 0
OSPF	1	OTTAWA	2.2.2.2	172.27.0.0	0.0.3.255	Area 0
OSPF IPV6	10	OTTAWA	2.2.2.2	2001:CAFE:ABCD:1::/64	N/A	Area 0
OSPF IPV6	10	OTTAWA BR 2	2.2.2.2	2001:CAFE:ABCD:2::/64	N/A	Area 0
OSPF IPV6	10	OTTAWA BR 1	2.2.2.2	2001:CAFE:ABCD:1::/64	N/A	Area 0
OSPF	1	MISSISSAUGA	3.3.3.3	172.27.14.0	0.0.0.255	Area 0
OSPF	1	MISSISSAUGA	3.3.3.3	172.27.16.4	0.0.0.3	Area 0

OSPF IPV6	10	MISSISSAUGA	3.3.3.3	2001:1234:ABCD:2222::/126	N/A	Area 0
OSPF IPV6	10	MISSISSAUGA	3.3.3.3	2001:CAFE:ABCD:F::/64	N/A	Area 0
OSPF	1	HAMILTON	4.4.4.4	172.27.13.0	0.0.0.255	Area 0
OSPF	1	HAMILTON	4.4.4.4	172.27.16.8	0.0.0.3	Area 0
OSPF	1	HAMILTON	4.4.4.4	172.27.16.12	0.0.0.3	Area 0
OSPF	1	LONDON	5.5.5.5	172.27.15.0	0.0.0.255	Area 0
OSPF	1	LONDON	5.5.5.5	172.27.16.12	0.0.0.3	Area 0

1. DHCP

DHCP stands for dynamic host configuration protocol and is a network protocol used on IP networks where a DHCP server automatically assigns an IP address and other information to each host on the network so they can communicate efficiently with other endpoints.

We have implemented a DHCP pool in our project with,

TORONTO-HQ

OTTAWA

HAMILTON

MISSISSAUGA

LONDON

DHCP POOL command

```
ip dhcp pool VLAN2
network 172.27.11.0 255.255.255.0
default-router 172.27.11.1
dns-server 172.27.9.254
ip dhcp pool VLAN3
network 172.27.10.0 255.255.255.0
default-router 172.27.10.1
dns-server 172.27.9.254
ip dhcp pool VLAN4
network 172.27.8.0 255.255.254.0
default-router 172.27.8.1
dns-server 172.27.9.254
ip dhcp pool VLAN11
network 172.27.12.0 255.255.255.128
default-router 172.27.12.1
dns-server 172.27.9.254
```

DHCP Exclude command

```
ip dhcp excluded-address 172.27.12.1
ip dhcp excluded-address 172.27.8.1
ip dhcp excluded-address 172.27.10.1
ip dhcp excluded-address 172.27.11.1
ip dhcp excluded-address
172.27.10.254
ip dhcp excluded-address
172.27.11.254
ip dhcp excluded-address
172.27.9.254
ip dhcp excluded-address
172.27.9.253
ip dhcp excluded-address
172.27.9.250
ip dhcp excluded-address
172.27.12.253
ip dhcp excluded-address
172.27.11.253
ip dhcp excluded-address
172.27.10.253
```

2. OSPF

Open Shortest Path First (OSPF) is a routing protocol for Internet Protocol networks. It uses a link state routing algorithm and falls into the group of interior gateway protocols, operating within a single autonomous system. OSPF supports the Classless Inter-Domain Routing (CIDR) addressing model.

We have implemented OSPFin our project with

TORONTO-HQ

OTTAWA

HAMILTON

MISSISSAUGA

LONDON

OSPF command

```
router ospf 1
router-id 1.1.1.1
log-adjacency-changes
network 172.27.16.0 0.0.0.3 area 0
network 172.27.16.4 0.0.0.3 area 0
network 172.27.16.8 0.0.0.3 area 0
network 172.27.11.0 0.0.0.255 area 0
network 172.27.10.0 0.0.0.255 area 0
network 172.27.8.0 0.0.1.255 area 0
network 172.27.12.0 0.0.0.127 area 0
default-information originate
```

OSPF IPV6 command

```
interface Serial0/0/0
ipv6 address 2001:1234:ABCD:1111::20/126
ipv6 ospf 10 area 0
clock rate 2000000
interface Serial0/0/1
ipv6 address 2001:1234:ABCD:2222::20/126
ipv6 ospf 10 area 0
clock rate 2000000

ipv6 router ospf 10
router-id 1.1.1.1
log-adjacency-changes
auto-cost reference-bandwidth 1000
```

3. ETHERCHANNEL

EtherChannel is a port link aggregation technology in which multiple physical port links are grouped into one logical link. It is used to provide high speed links and redundancy. Maximum of 8 links can be aggregated to form a single logical link.

We have implemented ETHERCHANNELin our project within the switches,

DSW0

ASW0

ASW1

4. PAT

Port Address Translation (PAT) is a feature of a network device that translates TCP or UDP communications made between hosts on a private network and hosts on a public network. It allows a single public IP address to be used by many hosts on the private network, which is usually called a Local Area Network or LAN.

We have implemented NAT-Outside on gig 0/1 in our project of TORONTO_HQ-Router and every local address will be attached to one public address 199.165.201.225/30.

```
interface GigabitEthernet0/1
ip address 199.165.201.225
255.255.255.252
ip nat outside
duplex auto
speed auto
interface GigabitEthernet0/0.2
ip nat inside
interface GigabitEthernet0/0.3
ip nat inside
interface GigabitEthernet0/0.4
ip nat inside
interface GigabitEthernet0/0.11
ip nat inside
interface Serial0/0/0
ip nat inside
interface Serial0/0/1
```

```
Toronto-HQ# sh ip nat translations
Pro Inside global Inside local Outside
local Outside global
icmp 199.165.201.225:1 172.27.15.2:1
199.165.201.226:1 199.165.201.226:1
icmp 199.165.201.225:2 172.27.15.2:2
199.165.201.226:2 199.165.201.226:2
icmp 199.165.201.225:5 172.27.0.2:5
199.165.201.226:5 199.165.201.226:5
tcp
199.165.201.225:1025172.27.15.2:102
5 199.165.201.226:80
199.165.201.226:80
```

ip nat inside
interface Serial0/1/0
ip nat inside
ip nat inside source list 1 interface
GigabitEthernet0/1 overload
access-list 1 permit 172.27.0.0
0.0.255.255

5. STP-Root Bridge

A Root Bridge is a reference point for all switches in a spanning-tree topology. Across all connected switches a process of election occurs and the Bridge with the Lowest Bridge ID is elected as the Root Bridge.

In our project, and .

Root Bridge for the VLAN-4(GENERAL) is DSW0

spanning-tree vlan 4 root primary

Root Bridge for the VLAN-11(Tech-Support) IS ASW0

spanning-tree vlan 11 root primary

Root Bridge for the VLAN-2 and 3(i.e. HR and ACCOUNTING) respectively is ASW1

spanning-tree vlan 2 root primary

spanning-tree vlan 3 root primary

6. Access-Control List

In computer security, an access-control list is a list of permissions associated with a system resource. An ACL specifies which users or system processes are granted access to objects, as well as what operations are allowed on given objects. Each entry in a typical ACL specifies a subject and an operation.

We have implemented Access-Control Lists in our project with

access-list 1 permit 172.27.0.0 0.0.255.255

7. Encapsulation (PAP)

Password Authentication Protocol (PAP) is a password-based authentication protocol used by Point to Point Protocol (PPP) to validate users. ... PAP is therefore used only as a last resort when the remote server does not support a stronger scheme such as CHAP or EAP.

8. Encapsulation (CHAP)

CHAP is an authentication scheme used by Point-to-Point Protocol (PPP) servers to validate the identity of remote clients. CHAP periodically verifies the identity of the client by using a three-way handshake.

9. DNS

The Domain Name System (DNS) is the phonebook of the Internet. Humans access information online through domain names, like nytimes.com or espn.com. Web browsers interact through Internet Protocol (IP) addresses. DNS translates domain names to IP addresses so browsers can load Internet resources.

We have implemented DNS in our project in General VLAN(VLAN 4) having Ip Address (172.27.9.254/23)

10. RUNNING-Configuration

HQ-Toronto	Ottawa Router	MISSISSAUGA
Toronto-HQ#sh running-config Building configuration... Current configuration : 3296 bytes ! version 15.1 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname Toronto-HQ ! ip dhcp excluded-address 172.27.12.1 ip dhcp excluded-address 172.27.8.1 ip dhcp excluded-address 172.27.10.1 ip dhcp excluded-address 172.27.11.1 ip dhcp excluded-address 172.27.10.254 ip dhcp excluded-address 172.27.11.254 ip dhcp excluded-address 172.27.9.254 ip dhcp excluded-address 172.27.9.253 ip dhcp excluded-address 172.27.9.250 ip dhcp excluded-address 172.27.12.253 ip dhcp excluded-address 172.27.11.253 ip dhcp excluded-address 172.27.10.253 !	OTTAWA_Router# sh running-config Building configuration... Current configuration : 1815 bytes ! version 15.1 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname OTTAWA_Router ! ip dhcp excluded-address 172.27.4.1 ip dhcp excluded-address 172.27.0.1 ip dhcp excluded-address 172.27.7.254 ip dhcp excluded-address 172.27.3.254 ! ip dhcp pool BRANCH-1 network 172.27.0.0 255.255.252.0 default-router 172.27.0.1 dns-server 172.27.9.254 ip dhcp pool BRANCH-2 network 172.27.4.0 255.255.252.0 default-router 172.27.4.1 dns-server 172.27.9.254 ! no ip cef ipv6 unicast-routing ! no ipv6 cef !	MISSISSAUGA_Router#sh running-config MISSISSAUGA_Router#sh running-config Building configuration... Current configuration : 1458 bytes ! version 15.1 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname MISSISSAUGA_Router ! ip dhcp excluded-address 172.27.14.1 ip dhcp excluded-address 172.27.14.254 ! ip dhcp pool MISSISSAUGA-Pool network 172.27.14.0 255.255.255.0 default-router 172.27.14.1 dns-server 172.27.9.254 ! no ip cef ipv6 unicast-routing ! no ipv6 cef !

```
ip dhcp pool VLAN2
network 172.27.11.0
255.255.255.0
default-router 172.27.11.1
dns-server 172.27.9.254
ip dhcp pool VLAN3
network 172.27.10.0
255.255.255.0
default-router 172.27.10.1
dns-server 172.27.9.254
ip dhcp pool VLAN4
network 172.27.8.0
255.255.254.0
default-router 172.27.8.1
dns-server 172.27.9.254
ip dhcp pool VLAN11
network 172.27.12.0
255.255.255.128
default-router 172.27.12.1
dns-server 172.27.9.254
!
ip cef
ipv6 unicast-routing
!
no ipv6 cef
!
username
MISSISSAUGA_Router
password 0 cisco
username OTTAWA_Router
password 0 cisco
!
license udi pid
CISCO1941/K9 sn
FTX1524ZEM1-
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
!
interface GigabitEthernet0/0.2
encapsulation dot1Q 2
ip address 172.27.11.1
```

```
username Toronto-HQ
password 0 cisco
!
license udi pid CISCO1941/K9
sn FTX1524S94Q-
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 172.27.0.1
255.255.252.0
duplex auto
speed auto
ipv6 address FE80::1 link-local
ipv6 address
2001:CAFE:ABCD:1::10/64
ipv6 ospf 10 area 0
!
interface GigabitEthernet0/1
ip address 172.27.4.1
255.255.252.0
duplex auto
speed auto
ipv6 address FE80::1 link-local
ipv6 address
2001:CAFE:ABCD:2::10/64
ipv6 ospf 10 area 0
!
interface Serial0/0/0
ip address 172.27.16.2
255.255.255.252
encapsulation ppp
ppp authentication pap
ppp pap sent-username
OTTAWA_Router password 0
cisco
ipv6 address
2001:1234:ABCD:1111::10/12
6
ipv6 ospf 10 area 0
!
interface Serial0/0/1
no ip address
clock rate 2000000
shutdown
!
```

```
username Toronto-HQ password
0 cisco
!
license udi pid CISCO1941/K9
sn FTX1524164B-
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 172.27.14.1
255.255.255.0
duplex auto
speed auto
ipv6 address FE80::2 link-local
ipv6 address
2001:CAFE:ABCD:F::10/64
ipv6 ospf 10 area 0
!
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
shutdown
!
interface Serial0/0/0
no ip address
clock rate 2000000
shutdown
!
interface Serial0/0/1
ip address 172.27.16.6
255.255.255.252
encapsulation ppp
ppp authentication chap
ipv6 address
2001:1234:ABCD:2222::10/126
ipv6 ospf 10 area 0
!
interface Vlan1
no ip address
```

```
255.255.255.0
ip nat inside
!
interface GigabitEthernet0/0.3
encapsulation dot1Q 3
ip address 172.27.10.1
255.255.255.0
ip nat inside
!
interface GigabitEthernet0/0.4
encapsulation dot1Q 4
ip address 172.27.8.1
255.255.254.0
ip nat inside
!
interface
GigabitEthernet0/0.11
encapsulation dot1Q 11
ip address 172.27.12.1
255.255.255.128
ip nat inside
!
interface GigabitEthernet0/1
ip address 199.165.201.225
255.255.255.252
ip nat outside
duplex auto
speed auto
!
interface Serial0/0/0
ip address 172.27.16.1
255.255.255.252
encapsulation ppp
ppp authentication pap
ppp pap sent-username
Toronto-HQ password 0 cisco
ip nat inside
ipv6 address
2001:1234:ABCD:1111::20/1
26
ipv6 ospf 10 area 0
clock rate 2000000
!
interface Serial0/0/1
ip address 172.27.16.5
255.255.255.252
```

```
interface Vlan1
no ip address
shutdown
!
router ospf 1
router-id 2.2.2.2
log-adjacency-changes
network 172.27.16.0 0.0.0.3
area 0
network 172.27.4.0 0.0.3.255
area 0
network 172.27.0.0 0.0.3.255
area 0
!
ipv6 router ospf 10
router-id 1.1.1.1
log-adjacency-changes
auto-cost reference-bandwidth
1000
!
ip classless
!
ip flow-export version 9
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
end
```

```
shutdown
!
router ospf 1
router-id 3.3.3.3
log-adjacency-changes
network 172.27.14.0 0.0.0.255
area 0
network 172.27.16.4 0.0.0.3 area
0
!
ipv6 router ospf 10
router-id 3.3.3.3
log-adjacency-changes
auto-cost reference-bandwidth
1000
!
ip classless
!
ip flow-export version 9
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
end
```

encapsulation ppp ppp authentication chap ip nat inside ipv6 address 2001:1234:ABCD:2222::20/1 26 ipv6 ospf 10 area 0 clock rate 2000000 ! interface Serial0/1/0 ip address 172.27.16.9 255.255.255.252 ip nat inside clock rate 2000000 ! interface Serial0/1/1 no ip address clock rate 2000000 ! interface Vlan1 no ip address shutdown ! router ospf 1 router-id 1.1.1.1 log-adjacency-changes network 172.27.16.0 0.0.0.3 area 0 network 172.27.16.4 0.0.0.3 area 0 network 172.27.16.8 0.0.0.3 area 0 network 172.27.11.0 0.0.0.255 area 0 network 172.27.10.0 0.0.0.255 area 0 network 172.27.8.0 0.0.1.255 area 0 network 172.27.12.0 0.0.0.127 area 0 default-information originate ! ipv6 router ospf 10 router-id 2.2.2.2 log-adjacency-changes auto-cost reference-bandwidth		

1000 ! ip nat inside source list 1 interface GigabitEthernet0/1 overload ip classless ip route 0.0.0.0 0.0.0.0 GigabitEthernet0/1 ! ip flow-export version 9 ! access-list 1 permit 172.27.0.0 0.0.255.255 ! line con 0 ! line aux 0 ! line vty 0 4 login ! end		

London	HAMILTON
LONDON_Router#sh running-config Building configuration... Current configuration : 968 bytes ! version 15.1 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname LONDON_Router ! ip dhcp excluded-address 172.27.15.1 ip dhcp excluded-address 172.27.15.254 ! ip dhcp pool London-Pool network 172.27.15.0 255.255.255.0 default-router 172.27.15.1 dns-server 172.27.9.254	HAMILTON_Router#sh running-config Building configuration... Current configuration : 1145 bytes ! version 15.1 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname HAMILTON_Router ! ip dhcp excluded-address 172.27.13.1 ip dhcp excluded-address 172.27.13.254 ! ip dhcp pool Hamilton-Pool network 172.27.13.0 255.255.255.0

```
!
ip cef
no ipv6 cef
!
license udi pid CISCO1941/K9 sn
FTX1524DJ56-
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 172.27.16.14 255.255.255.252
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 172.27.15.1 255.255.255.0
duplex auto
speed auto
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
router-id 5.5.5.5
log-adjacency-changes
network 172.27.15.0 0.0.0.255 area 0
network 172.27.16.12 0.0.0.3 area 0
!
ip classless
!
ip flow-export version 9
!
line con 0
!
line aux 0
!
line vty 0 4
login
!
end
```

```
default-router 172.27.13.1
dns-server 172.27.9.254
!
no ip cef
no ipv6 cef
!
license udi pid CISCO1941/K9 sn
FTX15243F2Z-
!
spanning-tree mode pvst
!
interface GigabitEthernet0/0
ip address 172.27.16.13 255.255.255.252
duplex auto
speed auto
!
interface GigabitEthernet0/1
ip address 172.27.13.1 255.255.255.0
duplex auto
speed auto
!
interface Serial0/0/0
ip address 172.27.16.10 255.255.255.252
!
interface Serial0/0/1
no ip address
clock rate 2000000
shutdown
!
interface Vlan1
no ip address
shutdown
!
router ospf 1
router-id 4.4.4.4
log-adjacency-changes
network 172.27.13.0 0.0.0.255 area 0
network 172.27.16.8 0.0.0.3 area 0
network 172.27.16.12 0.0.0.3 area 0
!
```

	ip classless ! ip flow-export version 9 ! line con 0 ! line aux 0 ! line vty 0 4 login ! end

DSW0	ASW0	ASW1
DSW0#sh running-config Building configuration... Current configuration : 1657 bytes ! version 15.0 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname DSW0 ! enable secret 5 1mERr$9cTjUIEqNGurQiFU.ZeCi1 ! spanning-tree mode pvst spanning-tree extend system-id spanning-tree vlan 4,11 priority 24576 !	ASW0#sh running-config Building configuration... Current configuration : 1832 bytes ! version 15.0 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname ASW0 ! enable secret 5 1mERr$9cTjUIEqNGurQiFU.ZeCi1 ! spanning-tree mode pvst spanning-tree extend system-id spanning-tree vlan 2 priority 24576 !	ASW1#sh running-config Building configuration... Current configuration : 1776 bytes ! version 15.0 no service timestamps log datetime msec no service timestamps debug datetime msec no service password-encryption ! hostname ASW1 ! enable secret 5 1mERr$9cTjUIEqNGurQiFU.ZeCi1 ! spanning-tree mode pvst spanning-tree extend system-id spanning-tree vlan 2 priority 20480 spanning-tree vlan 3 priority

interface Port-channel1 switchport mode trunk ! interface Port-channel3 switchport mode trunk ! interface FastEthernet0/1 switchport mode trunk channel-group 1 mode active ! interface FastEthernet0/2 switchport mode trunk channel-group 1 mode active ! interface FastEthernet0/3 switchport access vlan 4 switchport mode access ! interface FastEthernet0/4 ! interface FastEthernet0/5 switchport mode trunk channel-group 3 mode active ! interface FastEthernet0/6 switchport mode trunk channel-group 3 mode active ! 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 Port-channel1 switchport mode trunk ! interface Port-channel2 switchport mode trunk ! interface FastEthernet0/1 switchport mode trunk channel-group 1 mode active ! interface FastEthernet0/2 switchport mode trunk channel-group 1 mode active ! interface FastEthernet0/3 switchport mode trunk channel-group 2 mode active ! interface FastEthernet0/4 switchport mode trunk channel-group 2 mode active ! interface FastEthernet0/5 ! interface FastEthernet0/6 ! interface FastEthernet0/7 ! interface FastEthernet0/8 ! interface FastEthernet0/9 ! interface FastEthernet0/10 switchport access vlan 3 switchport mode access ! interface FastEthernet0/11 switchport access vlan 4 switchport mode access ! interface FastEthernet0/12 switchport access vlan 2 switchport mode access ! interface FastEthernet0/13 switchport access vlan 11	24576 ! interface Port-channel2 switchport mode trunk ! interface Port-channel3 switchport mode trunk ! interface FastEthernet0/1 switchport access vlan 3 switchport mode access ! interface FastEthernet0/2 switchport access vlan 2 switchport mode access ! interface FastEthernet0/3 switchport mode trunk channel-group 2 mode active ! interface FastEthernet0/4 switchport mode trunk channel-group 2 mode active ! interface FastEthernet0/5 switchport mode trunk channel-group 3 mode active ! interface FastEthernet0/6 switchport mode trunk channel-group 3 mode active ! interface FastEthernet0/7 ! interface FastEthernet0/8 ! interface FastEthernet0/9 ! interface FastEthernet0/10 ! interface FastEthernet0/11 ! interface FastEthernet0/12 ! interface FastEthernet0/13 !

```
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
switchport mode trunk
!
interface GigabitEthernet0/2
!
interface Vlan1
no ip address
shutdown
!
interface Vlan4
ip address 172.27.9.250
255.255.254.0
!
line con 0
password cisco
login
!
line vty 0 4
password cisco
login
line vty 5 15
password cisco
login
!
end
```

```
switchport mode access
switchport port-security
mac-address sticky
!
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 Vlan11
ip address 172.27.12.125
255.255.255.128
!
line con 0
password cisco
login
!
line vty 0 4
password cisco
login
line vty 5 15
```

```
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 Vlan2
ip address 172.27.11.253
255.255.255.0
!
interface Vlan3
ip address 172.27.10.253
255.255.255.0
!
line con 0
password cisco
login
!
line vty 0 4
password cisco
login
line vty 5 15
```

	password cisco login ! end	password cisco login ! end

Problems Encountered

In this whole project, throughout the whole period of making the topology. We have come across quite a lot of problems or milestones. And all the way through we had our lecturers helping us on regular suggestions and debugging at each and every step of the project. That way, we had got through most of our errors. But The ones that we were stuck with for quite a long time are the wrong prefix between Wide Area Networks and PAT.

The first important problem with our project was with the mismatch of prefixes between the WAN'S. We were actually using a prefix of 24 in the WAN'S whereas we were actually supposed to be using a prefix of 32 . The only reason this didn't affect our project much was this was in the very early stages of the project being made. So, we were able to rectify it right then.

The main reason with our error in the PAT part was that we were actually applying **extended standard access lists** whereas we were actually **supposed** to be **using** just the **standard access list**. Because, we didn't recognise the error in the early stage we had to ditch our topology and start back from our most recent backups and this went on for a while. Until the lecturer actually helped us realise our mistake and we came through it.