Network Infrastructure Design Report

EC4060

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1. Introduction

A well-structured and efficient network infrastructure is important for any institution to effectively communicate and manage resources. Also, increased demands by the students, the faculty, and the staff in six different departments-Civil, Mechanical, Electrical and Electronic Engineering, Computer, Interdisciplinary Studies, and Administration-led the Faculty of Engineering at the University of Jaffna to go for an upgradation of the already available network.

This project details the design and implementation of a scalable, secure, high-performance network that addresses the needs of these departments. It provides for the integration of VLANs, inter-VLAN routing, DHCP services, and mechanisms for access control on the network for maximum connectivity, ensuring data security and efficient traffic management. The structured subnetting approach allows this design to provide for both present needs and future development. This will be achieved by making use of Layer 3 and Layer 2 switches in addition to a core routing framework that will provide device and department connectivity while logically segmenting and providing security policies.

2. Network Design Overview

2.1 Subnet Allocation

Each department and device category (students, staff, and other devices) was allocated unique subnets to optimize performance and security. Subnets were designed with scalability in mind, ensuring a 30% growth allowance

Table01: Subnet Table

Department	Device Type	Total Devices	Future Growth (30%)	Required Hosts	Subnet Mask	Network Address	Usable IP Range	Broadcast Address
Computer Eng	Students	250	325	512	255.255.254.0 (/23)	192.168.0.0	192.168.0.1 - 192.168.1.254	192.168.1.255
	Staff	50	65	128	255.255.255.128 (/25)	192.168.2.0	192.168.2.1 - 192.168.2.126	192.168.2.127
	Other Devices	27	35	64	255.255.255.192 (/26)	192.168.2.128	192.168.2.129 - 192.168.2.190	192.168.2.191
EEE Eng	Students	150	195	256	255.255.255.0 (/24)	192.168.3.0	192.168.3.1 - 192.168.3.254	192.168.3.255
	Staff	50	65	128	255.255.255.128 (/25)	192.168.4.0	192.168.4.1 - 192.168.4.126	192.168.4.127
	Other Devices	17	22	32	255.255.255.224 (/27)	192.168.4.128	192.168.4.129 - 192.168.4.158	192.168.4.159
Civil Eng	Students	75	98	128	255.255.255.128 (/25)	192.168.5.0	192.168.5.1 - 192.168.5.126	192.168.5.127
	Staff	25	33	64	255.255.255.192 (/26)	192.168.5.128	192.168.5.129 - 192.168.5.190	192.168.5.191
	Other Devices	7	10	16	255.255.255.240 (/28)	192.168.5.192	192.168.5.193 - 192.168.5.206	192.168.5.207
Mech Eng	Students	75	98	128	255.255.255.128 (/25)	192.168.6.0	192.168.6.1 - 192.168.6.126	192.168.6.127
	Staff	25	33	64	255.255.255.192 (/26)	192.168.6.128	192.168.6.129 - 192.168.6.190	192.168.6.191
	Other Devices	12	16	32	255.255.255.224 (/27)	192.168.6.192	192.168.6.193 - 192.168.6.222	192.168.6.223
IDS	Students	15	20	32	255.255.255.224 (/27)	192.168.7.0	192.168.7.1 - 192.168.7.30	192.168.7.31
	Staff	25	33	64	255.255.255.192 (/26)	192.168.7.32	192.168.7.33 - 192.168.7.94	192.168.7.95
	Other Devices	7	10	16	255.255.255.240 (/28)	192.168.7.96	192.168.7.97 - 192.168.7.110	192.168.7.111
Administration	Staff	25	33	64	255.255.255.192 (/26)	192.168.8.0	192.168.8.1 - 192.168.8.62	192.168.8.63
	Printers	5	7	16	255.255.255.240 (/28)	192.168.8.64	192.168.8.65 - 192.168.8.78	192.168.8.79
CCTV System	CCTV Cameras	50	65	128	255.255.255.128 (/25)	192.168.9.0	192.168.9.1 - 192.168.9.126	192.168.9.127

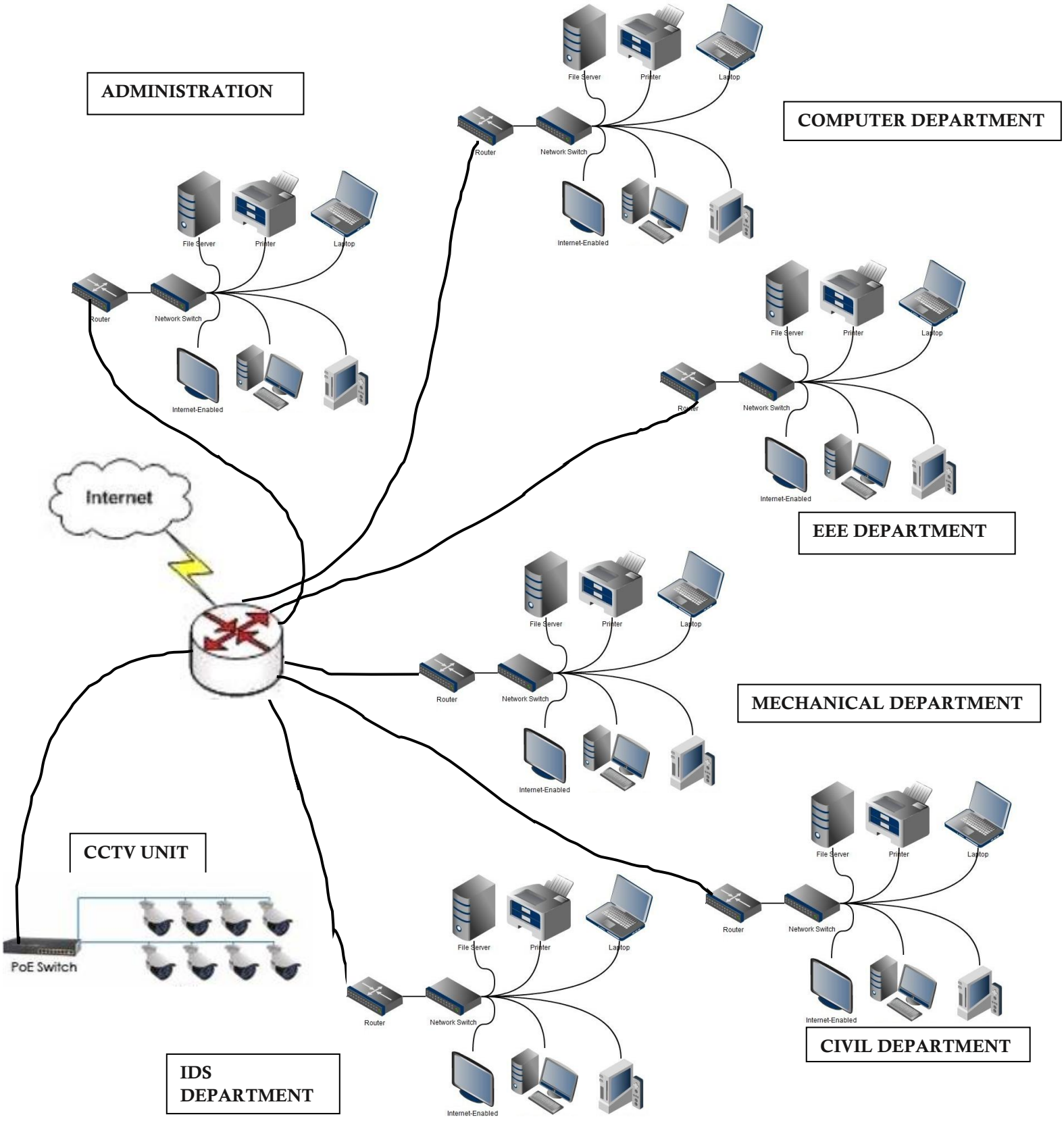
3. VLAN and Inter-VLAN Routing

VLANs were configured for logical separation of network traffic. Inter-VLAN routing was implemented on Layer 3 switches to ensure controlled communication between VLANs.

TABLE02: VLAN Plan and Mapping

Department	VLAN ID	Device Type	Subnet	Subnet Mask	Network Address
Computer Eng	**10**	**Students**	192.168.0.0/23	255.255.254.0	192.168.0.0
	20	**Staff**	192.168.2.0/25	255.255.255.128	192.168.2.0
	30	**Other Devices**	192.168.2.128/26	255.255.255.192	192.168.2.128
EEE	**40**	**Students**	192.168.3.0/24	255.255.255.0	192.168.3.0
	50	**Staff**	192.168.4.0/25	255.255.255.128	192.168.4.0
	60	**Other Devices**	192.168.4.128/27	255.255.255.224	192.168.4.128
Civil Eng	**70**	**Students**	192.168.5.0/25	255.255.255.128	192.168.5.0
	80	**Staff**	192.168.5.128/26	255.255.255.192	192.168.5.128
	90	**Other Devices**	192.168.5.192/28	255.255.255.240	192.168.5.192
Mech Eng	**100**	**Students**	192.168.6.0/25	255.255.255.128	192.168.6.0
	110	**Staff**	192.168.6.128/26	255.255.255.192	192.168.6.128
	120	**Other Devices**	192.168.6.192/27	255.255.255.224	192.168.6.192
IDS	**130**	**Students**	192.168.7.0/27	255.255.255.224	192.168.7.0
	140	**Staff**	192.168.7.32/26	255.255.255.192	192.168.7.32
	150	**Other Devices**	192.168.7.96/28	255.255.255.240	192.168.7.96
Admin	**160**	**Staff**	192.168.8.0/26	255.255.255.192	192.168.8.0
	170	**Printers**	192.168.8.64/28	255.255.255.240	192.168.8.64
CCTV	**180**	**CCTV Cameras**	192.168.9.0/25	255.255.255.128	192.168.9.0

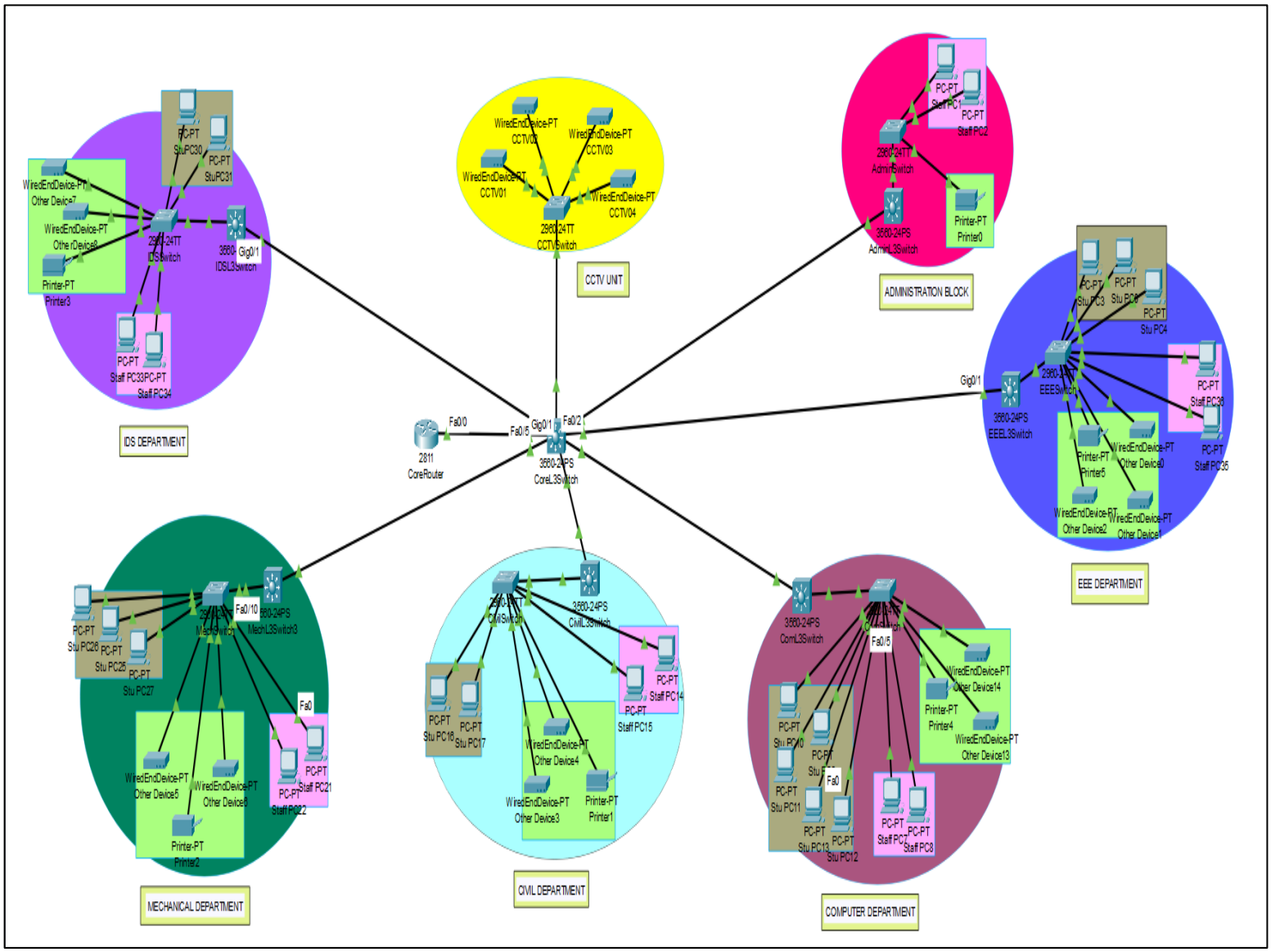
4. Network Topology



The network follows a **star topology**, ensuring a central connection point that enhances performance, scalability, and fault tolerance. This structure minimizes collision domains and optimizes data flow within departments.

The network topology consists of:

- Core Router: Connects all department L3 switches.
- Core L3 Switch: Provides VLAN routing and interconnectivity.
- Department L3 Switches: Handle inter-VLAN routing within each department.
- Department L2 Switches: Provide access-level switching for end devices



5. Implementation in Cisco Packet Tracer

5.1 Core Router Configuration

Commands for Core Router:

enable

configure terminal

interface FastEthernet0/0

ip address 192.168.255.1 255.255.255.0

no shutdown

exit

ip routing

ip route 192.168.0.0 255.255.254.0 192.168.255.2

ip route 192.168.2.0 255.255.255.0 192.168.255.2

ip route 192.168.3.0 255.255.255.0 192.168.255.2

ip route 192.168.4.0 255.255.255.0 192.168.255.2

ip route 192.168.5.0 255.255.255.0 192.168.255.2

ip route 192.168.6.0 255.255.255.0 192.168.255.2

ip route 192.168.7.0 255.255.255.0 192.168.255.2

ip route 192.168.8.0 255.255.255.0 192.168.255.2

ip route 192.168.9.0 255.255.255.128 192.168.255.2

copy running-config startup-config

exit

5.2 VLAN Configuration on Core L3 Switch

Core L3 Switch Configuration

```
enable
configure terminal
vlan 10
name Computer_Eng_Students
vlan 20
name Computer_Eng_Staff
vlan 30
name Computer_Eng_Other_Devices
vlan 40
name EEE_Students
vlan 50
name EEE_Staff
vlan 60
name EEE_Other_Devices
vlan 70
name Civil_Eng_Students
vlan 80
name Civil_Eng_Staff
vlan 90
name Civil_Eng_Other_Devices
vlan 100
name Mech_Eng_Students
vlan 110
name Mech_Eng_Staff
vlan 120
name Mech_Eng_Other_Devices
vlan 130
name IDS_Students
vlan 140
name IDS_Staff
vlan 150
name IDS_Other_Devices
vlan 160
name Admin_Staff
vlan 170
name Admin_Printers
vlan 180
name CCTV_Cameras
exit
interface GigabitEthernet0/1
description Link to Core Router
no switchport
ip address 192.168.255.2 255.255.255.0
no shutdown
exit
interface FastEthernet0/1
description Link to Computer Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/2
description Link to EE Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/3
```

```
description Link to Civil Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/4
description Link to Mech Eng L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/5
description Link to IDS L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/6
description Link to Admin L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface FastEthernet0/7
description Link to CCTV L2 Switch
switchport mode access
switchport access vlan 180
no shutdown
exit
write memory
```

5.3 Inter-VLAN Routing on Department L3 Switches

Com Eng L3 Switch Configuration

```
enable
configure terminal
vlan 10
name Com_Eng_Students
vlan 20
name Com_Eng_Staff
vlan 30
name Com_Eng_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
Switch
interface GigabitEthernet0/2
description Link to Com Eng L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
(VLAN 10)
interface Vlan10
description Com Eng Students
ip address 192.168.0.1 255.255.254.0
```

```
no shutdown
exit
interface Vlan20
description Com Eng Staff
ip address 192.168.2.1 255.255.255.128
no shutdown
exit
interface Vlan30
description Com Eng Other Devices
ip address 192.168.2.129 255.255.255.192
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

EEE L3 Switch Configuration

```
enable
configure terminal
vlan 40
name EEE_Students
vlan 50
name EEE_Staff
vlan 60
name EEE_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface GigabitEthernet0/2
description Link to EEE L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface Vlan40
description EEE Students
ip address 192.168.3.1 255.255.255.0
no shutdown
exit
interface Vlan50
description EEE Staff
ip address 192.168.4.1 255.255.255.128
no shutdown
exit
interface Vlan60
description EEE Other Devices
ip address 192.168.4.129 255.255.255.224
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

Civil L3 Switch Configuration

```
enable
configure terminal
vlan 70
name Civil_Eng_Students
vlan 80
name Civil_Eng_Staff
vlan 90
name Civil_Eng_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface GigabitEthernet0/2
description Link to Civil Eng L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface Vlan70
description Civil Eng Students
ip address 192.168.5.1 255.255.255.128
no shutdown
exit
interface Vlan80
description Civil Eng Staff
ip address 192.168.5.129 255.255.255.192
no shutdown
exit
interface Vlan90
description Civil Eng Other Devices
ip address 192.168.5.193 255.255.255.240
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

Mech L3 Switch Configuration

```
enable
configure terminal
vlan 100
name Mech_Eng_Students
vlan 110
name Mech_Eng_Staff
vlan 120
name Mech_Eng_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface GigabitEthernet0/2
```

```
description Link to Mech Eng L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface Vlan100
description Mech Eng Students
ip address 192.168.6.1 255.255.255.128
no shutdown
exit
interface Vlan110
description Mech Eng Staff
ip address 192.168.6.129 255.255.255.192
no shutdown
exit
interface Vlan120
description Mech Eng Other Devices
ip address 192.168.6.193 255.255.255.224
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

IDS L3 Switch Configuration

```
enable
configure terminal
vlan 130
name IDS_Students
vlan 140
name IDS_Staff
vlan 150
name IDS_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface GigabitEthernet0/2
description Link to IDS L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface Vlan130
description IDS Students
ip address 192.168.7.1 255.255.255.224
no shutdown
exit
interface Vlan140
description IDS Staff
ip address 192.168.7.33 255.255.255.192
no shutdown
exit
interface Vlan150
```

```
description IDS Other Devices
ip address 192.168.7.97 255.255.255.240
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

Admin L3 Switch Configuration

```
enable
configure terminal
vlan 160
name Admin_Staff
vlan 170
name Admin_Printers
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface GigabitEthernet0/2
description Link to Admin L2 Switch
switchport trunk encapsulation dot1q
switchport mode trunk
no shutdown
exit
interface Vlan160
description Admin Staff
ip address 192.168.8.1 255.255.255.192
no shutdown
exit
interface Vlan170
description Admin Printers
ip address 192.168.8.65 255.255.255.240
no shutdown
exit
ip routing
ip default-gateway 192.168.255.2
exit
write memory
```

5.4 Inter-VLAN Routing on Department L2 Switches

Com Eng L2 Switch Configuration

```
enable
configure terminal
vlan 10
name Com_Eng_Students
vlan 20
name Com_Eng_Staff
vlan 30
name Com_Eng_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Com Eng L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 5
description Com Eng Student PCs
switchport mode access
switchport access vlan 10
no shutdown
exit
interface range FastEthernet0/10 - 11
description Com Eng Staff PCs
switchport mode access
switchport access vlan 20
no shutdown
exit
interface FastEthernet0/15
description Com Eng Printer
switchport mode access
switchport access vlan 30
no shutdown
exit
interface range FastEthernet0/16 - 17
description Com Eng Other Devices
switchport mode access
switchport access vlan 30
no shutdown
exit
exit
write memory
```

EEE L2 Switch Configuration

```
enable
configure terminal
vlan 40
name EEE_Students
vlan 50
name EEE_Staff
vlan 60
name EEE_Other_Devices
exit
interface GigabitEthernet0/1
description Link to EEE L3 Switch
switchport mode trunk
no shutdown
exit
```

```
interface range FastEthernet0/1 - 5
description EEE Student PCs
switchport mode access
switchport access vlan 40
no shutdown
exit
interface range FastEthernet0/10 - 11
description EEE Staff PCs
switchport mode access
switchport access vlan 50
no shutdown
exit
interface FastEthernet0/15
description EEE Printer
switchport mode access
switchport access vlan 60
no shutdown
exit
interface range FastEthernet0/16 - 17
description EEE Other Devices
switchport mode access
switchport access vlan 60
no shutdown
exit
exit
write memory
```

Civil L2 Switch Configuration

```
enable
configure terminal
vlan 70
name Civil_Eng_Students
vlan 80
name Civil_Eng_Staff
vlan 90
name Civil_Eng_Other_Devices
interface GigabitEthernet0/1
description Link to Civil Eng L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 5
description Civil Eng Student PCs
switchport mode access
switchport access vlan 70
no shutdown
exit
interface range FastEthernet0/10 - 11
description Civil Eng Staff PCs
switchport mode access
switchport access vlan 80
no shutdown
exit
interface FastEthernet0/15
description Civil Eng Printer
switchport mode access
switchport access vlan 90
no shutdown
exit
interface range FastEthernet0/16 - 17
```

```
description Civil Eng Other Devices
switchport mode access
switchport access vlan 90
no shutdown
exit
exit
write memory
```

Mech L2 Switch Configuration

```
enable
configure terminal
vlan 100
name Mech_Eng_Students
vlan 110
name Mech_Eng_Staff
vlan 120
name Mech_Eng_Other_Devices
exit
interface GigabitEthernet0/1
description Link to Mech Eng L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 5
description Mech Eng Student PCs
switchport mode access
switchport access vlan 100
no shutdown
exit
interface range FastEthernet0/10 - 11
description Mech Eng Staff PCs
switchport mode access
switchport access vlan 110
no shutdown
exit
interface FastEthernet0/15
description Mech Eng Printer
switchport mode access
switchport access vlan 120
no shutdown
exit
interface range FastEthernet0/16 - 17
description Mech Eng Other Devices
switchport mode access
switchport access vlan 120
no shutdown
exit
exit
write memory
```

IDS L2 Switch Configuration

```
enable
configure terminal
vlan 130
name IDS_Students
vlan 140
name IDS_Staff
vlan 150
name IDS_Other_Devices
```

```
exit
interface GigabitEthernet0/1
description Link to IDS L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 3
description IDS Student PCs
switchport mode access
switchport access vlan 130
no shutdown
exit
interface range FastEthernet0/10 - 11
description IDS Staff PCs
switchport mode access
switchport access vlan 140
no shutdown
exit
interface FastEthernet0/15
description IDS Printer
switchport mode access
switchport access vlan 150
no shutdown
exit
interface range FastEthernet0/16 - 17
description IDS Other Devices
switchport mode access
switchport access vlan 150
no shutdown
exit
exit
write memory
```

Admin L2 Switch Configuration

```
enable
configure terminal
vlan 160
name Admin_Staff
vlan 170
name Admin_Printers
exit
interface GigabitEthernet0/1
description Link to Admin L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 2
description Admin Staff PCs
switchport mode access
switchport access vlan 160
no shutdown
exit
interface FastEthernet0/10
description Admin Printer
switchport mode access
switchport access vlan 170
no shutdown
exit
exit
write memory
```

CCTV L2 Switch Configuration

```
Step 1: Create VLAN for CCTV Cameras
enable
configure terminal
vlan 180
name CCTV_Cameras
exit
interface GigabitEthernet0/1
description Link to Core L3 Switch
switchport mode trunk
no shutdown
exit
interface range FastEthernet0/1 - 4
description CCTV Cameras
switchport mode access
switchport access vlan 180
no shutdown
exit
exit
write memory
```

5.5 DHCP Configuration for L3 and L2 Switches

Configure DHCP on the Core L3 Switch

```
enable
configure terminal
service dhcp
ip dhcp pool Com_Eng_Students
network 192.168.0.0 255.255.254.0
default-router 192.168.0.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Com_Eng_Staff
network 192.168.2.0 255.255.255.128
default-router 192.168.2.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Com_Eng_Other_Devices
network 192.168.2.128 255.255.255.192
default-router 192.168.2.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool EEE_Students
network 192.168.3.0 255.255.255.0
default-router 192.168.3.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool EEE_Staff
network 192.168.4.0 255.255.255.128
default-router 192.168.4.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool EEE_Other_Devices
```

```
network 192.168.4.128 255.255.255.224
default-router 192.168.4.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Students
network 192.168.5.0 255.255.255.128
default-router 192.168.5.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Staff
network 192.168.5.128 255.255.255.192
default-router 192.168.5.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Other_Devices
network 192.168.5.192 255.255.255.240
default-router 192.168.5.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Students
network 192.168.6.0 255.255.255.128
default-router 192.168.6.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Staff
network 192.168.6.128 255.255.255.192
default-router 192.168.6.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Other_Devices
network 192.168.6.192 255.255.255.224
default-router 192.168.6.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Students
network 192.168.7.0 255.255.255.224
default-router 192.168.7.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Staff
network 192.168.7.32 255.255.255.192
default-router 192.168.7.33
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Other_Devices
network 192.168.7.96 255.255.255.240
default-router 192.168.7.97
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Admin_Staff
network 192.168.8.0 255.255.255.192
default-router 192.168.8.1
dns-server 8.8.8.8
dns-server 8.8.4.4
```

```
exit
ip dhcp pool Admin_Printers
network 192.168.8.64 255.255.255.240
default-router 192.168.8.65
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool CCTV_Cameras
network 192.168.9.0 255.255.255.128
default-router 192.168.9.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.0.1 192.168.0.10
ip dhcp excluded-address 192.168.2.1 192.168.2.10
ip dhcp excluded-address 192.168.2.129 192.168.2.138
ip dhcp excluded-address 192.168.3.1 192.168.3.10
ip dhcp excluded-address 192.168.4.1 192.168.4.10
ip dhcp excluded-address 192.168.4.129 192.168.4.138
ip dhcp excluded-address 192.168.5.1 192.168.5.10
ip dhcp excluded-address 192.168.5.129 192.168.5.138
ip dhcp excluded-address 192.168.5.193 192.168.5.202
ip dhcp excluded-address 192.168.6.1 192.168.6.10
ip dhcp excluded-address 192.168.6.129 192.168.6.138
ip dhcp excluded-address 192.168.6.193 192.168.6.202
ip dhcp excluded-address 192.168.7.1 192.168.7.10
ip dhcp excluded-address 192.168.7.33 192.168.7.42
ip dhcp excluded-address 192.168.7.97 192.168.7.106
ip dhcp excluded-address 192.168.8.1 192.168.8.10
ip dhcp excluded-address 192.168.8.65 192.168.8.74
ip dhcp excluded-address 192.168.9.1 192.168.9.10
exit
write memory
```

DHCP Configuration for Com Eng L3 Switch

```
enable
configure terminal
service dhcp
ip dhcp pool Com_Eng_Students
network 192.168.0.0 255.255.254.0
default-router 192.168.0.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Com_Eng_Staff
network 192.168.2.0 255.255.255.128
default-router 192.168.2.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Com_Eng_Other_Devices
network 192.168.2.128 255.255.255.192
default-router 192.168.2.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.0.1 192.168.0.10
```

```
ip dhcp excluded-address 192.168.2.1 192.168.2.10
ip dhcp excluded-address 192.168.2.129 192.168.2.138
exit
write memory
```

DHCP configuration commands for the EEE L3 Switch:

```
enable
configure terminal
service dhcp
ip dhcp pool EEE_Students
network 192.168.3.0 255.255.255.0
default-router 192.168.3.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool EEE_Staff
network 192.168.4.0 255.255.255.128
default-router 192.168.4.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool EEE_Other_Devices
network 192.168.4.128 255.255.255.224
default-router 192.168.4.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.3.1 192.168.3.10
ip dhcp excluded-address 192.168.4.1 192.168.4.10
ip dhcp excluded-address 192.168.4.129 192.168.4.138
exit
write memory
enable
configure terminal
interface Vlan40
ip helper-address 192.168.255.2
exit
interface Vlan50
ip helper-address 192.168.255.2
exit
interface Vlan60
ip helper-address 192.168.255.2
exit
write memory
```

DHCP configuration commands for the Civil Eng L3 Switch:

```
enable
configure terminal
service dhcp
ip dhcp pool Civil_Eng_Students
network 192.168.5.0 255.255.255.128
default-router 192.168.5.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Staff
```

```
network 192.168.5.128 255.255.255.192
default-router 192.168.5.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Civil_Eng_Other_Devices
network 192.168.5.192 255.255.255.240
default-router 192.168.5.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.5.1 192.168.5.10
ip dhcp excluded-address 192.168.5.129 192.168.5.138
ip dhcp excluded-address 192.168.5.193 192.168.5.202
exit
write memory
enable
configure terminal
interface Vlan70
ip helper-address 192.168.255.2
exit
interface Vlan80
ip helper-address 192.168.255.2
exit
interface Vlan90
ip helper-address 192.168.255.2
exit
exit
write memory
```

DHCP configuration commands for the Mech Eng L3 Switch:

```
enable
configure terminal
service dhcp
ip dhcp pool Mech_Eng_Students
network 192.168.6.0 255.255.255.128
default-router 192.168.6.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Staff
network 192.168.6.128 255.255.255.192
default-router 192.168.6.129
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool Mech_Eng_Other_Devices
network 192.168.6.192 255.255.255.224
default-router 192.168.6.193
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.6.1 192.168.6.10
ip dhcp excluded-address 192.168.6.129 192.168.6.138
ip dhcp excluded-address 192.168.6.193 192.168.6.202
exit
write memory
enable
configure terminal
interface Vlan100
```

```
ip helper-address 192.168.255.2
exit
interface Vlan110
ip helper-address 192.168.255.2
exit
interface Vlan120
ip helper-address 192.168.255.2
exit
exit
write memory
```

DHCP configuration commands for the IDS L3 Switch:

```
enable
configure terminal
service dhcp
ip dhcp pool IDS_Students
network 192.168.7.0 255.255.255.224
default-router 192.168.7.1
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Staff
network 192.168.7.32 255.255.255.192
default-router 192.168.7.33
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp pool IDS_Other_Devices
network 192.168.7.96 255.255.255.240
default-router 192.168.7.97
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.7.1 192.168.7.10
ip dhcp excluded-address 192.168.7.33 192.168.7.42
ip dhcp excluded-address 192.168.7.97 192.168.7.106
exit
write memory
enable
configure terminal
interface Vlan130
ip helper-address 192.168.255.2
exit
interface Vlan140
ip helper-address 192.168.255.2
exit
interface Vlan150
ip helper-address 192.168.255.2
exit
exit
write memory
```

DHCP configuration commands for the Admin L3 Switch:

```
enable
configure terminal
service dhcp
ip dhcp pool Admin_Staff
network 192.168.8.0 255.255.255.192
default-router 192.168.8.1
dns-server 8.8.8.8
dns-server 8.8.4.4
```

```
exit
ip dhcp pool Admin_Printers
network 192.168.8.64 255.255.255.240
default-router 192.168.8.65
dns-server 8.8.8.8
dns-server 8.8.4.4
exit
ip dhcp excluded-address 192.168.8.1 192.168.8.10
ip dhcp excluded-address 192.168.8.65 192.168.8.74
exit
write memory
```

```
enable
configure terminal
interface Vlan160
ip helper-address 192.168.255.2
exit
interface Vlan170
ip helper-address 192.168.255.2
exit
exit
write memory
```

5.6 Steps to Block Students from Accessing Printers and Other Devices

Commands for Com Eng L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.0.0 0.0.1.255 192.168.2.128 0.0.0.63
permit ip any any
exit
interface Vlan10
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for EEE L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.3.0 0.0.0.255 192.168.4.128 0.0.0.31
permit ip any any
exit
interface Vlan40
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for Civil Eng L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.5.0 0.0.0.127 192.168.5.192 0.0.0.15
permit ip any any
exit
interface Vlan70
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for Mech Eng L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.6.0 0.0.0.127 192.168.6.192 0.0.0.31
permit ip any any
exit
interface Vlan100
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

Commands for IDS L3 Switch

```
enable
configure terminal
ip access-list extended BLOCK_STUDENTS
deny ip 192.168.7.0 0.0.0.31 192.168.7.96 0.0.0.15
permit ip any any
exit
interface Vlan130
ip access-group BLOCK_STUDENTS in
exit
exit
write memory
```

6. Testing and Validation

 Ping Tests were conducted between:

1. Staff devices and printers.
2. Student devices within the same VLAN.
3. CCTV cameras and administration compute

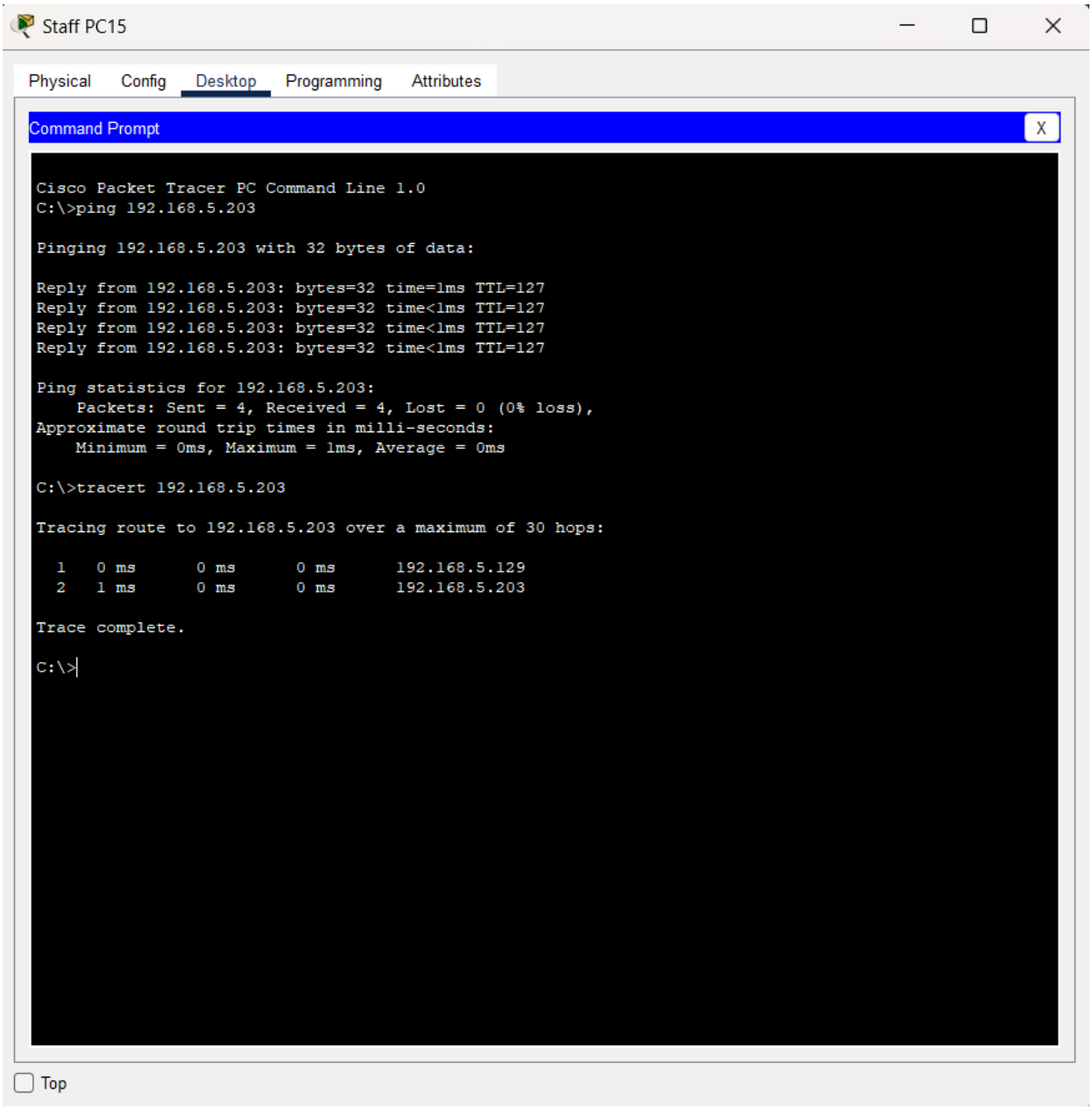


Figure 01: Between Staff Devices and Printers

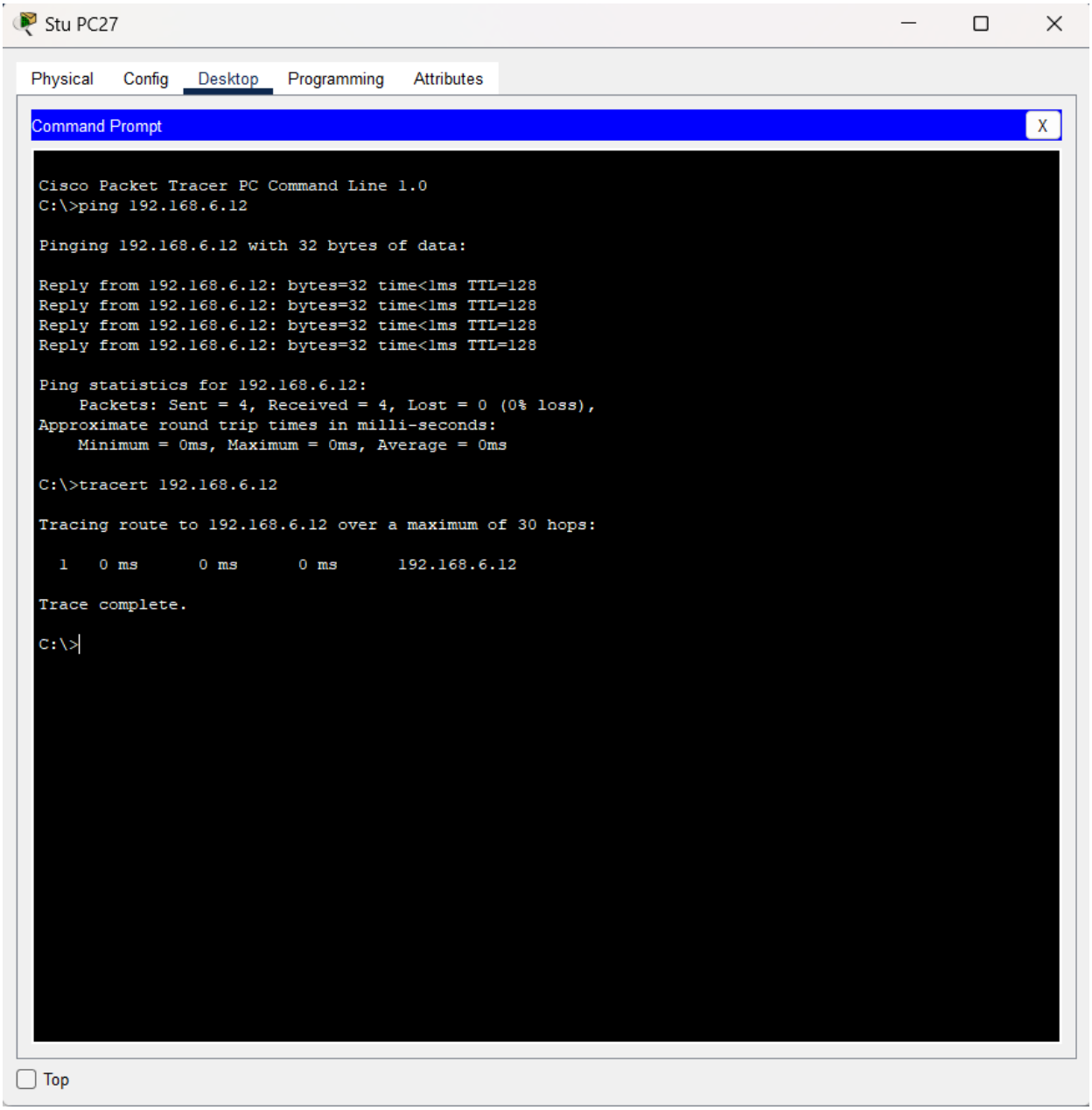


Figure 02: Between Student Devices Within the Same Subnet

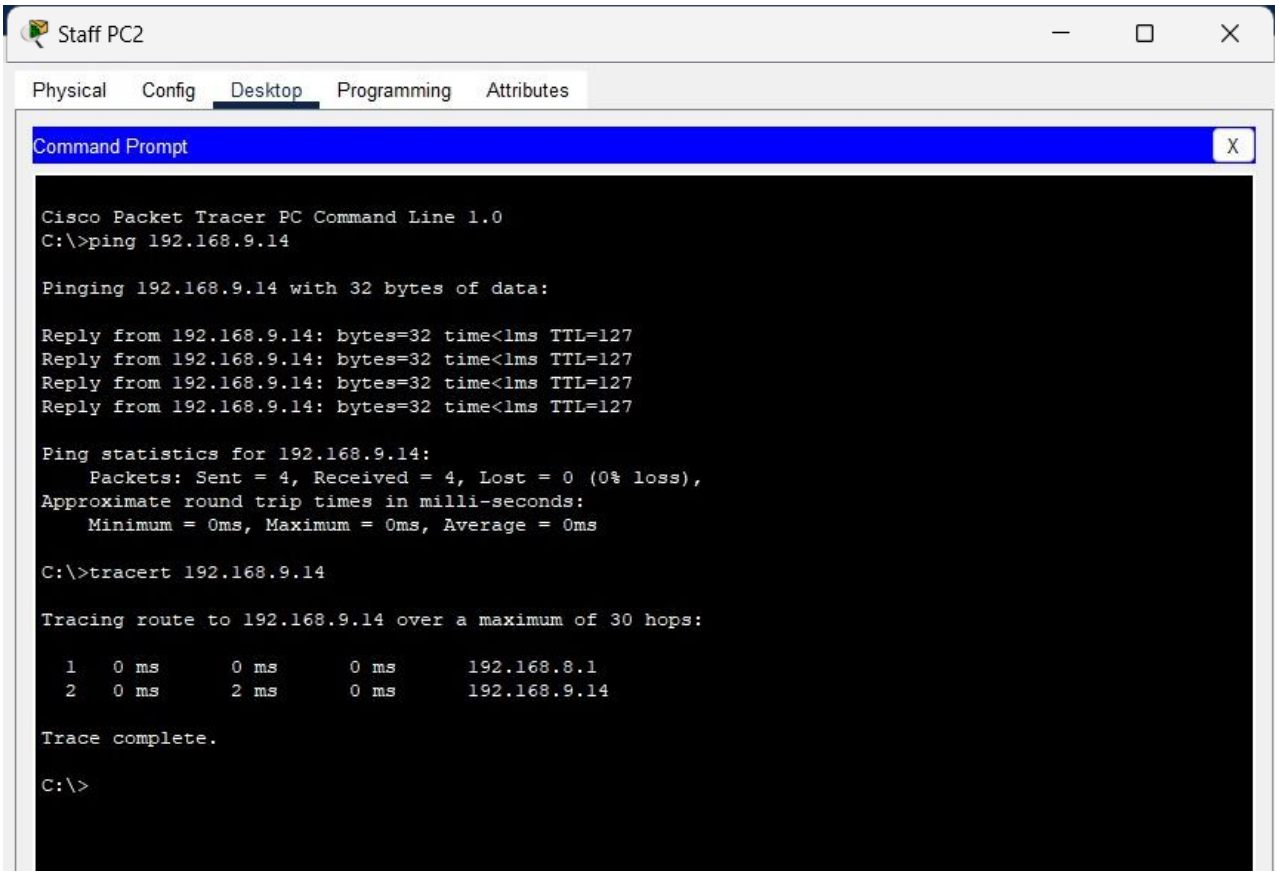


Figure 03: Between Admin Staff Devices and CCTV

7. Testing and Validation

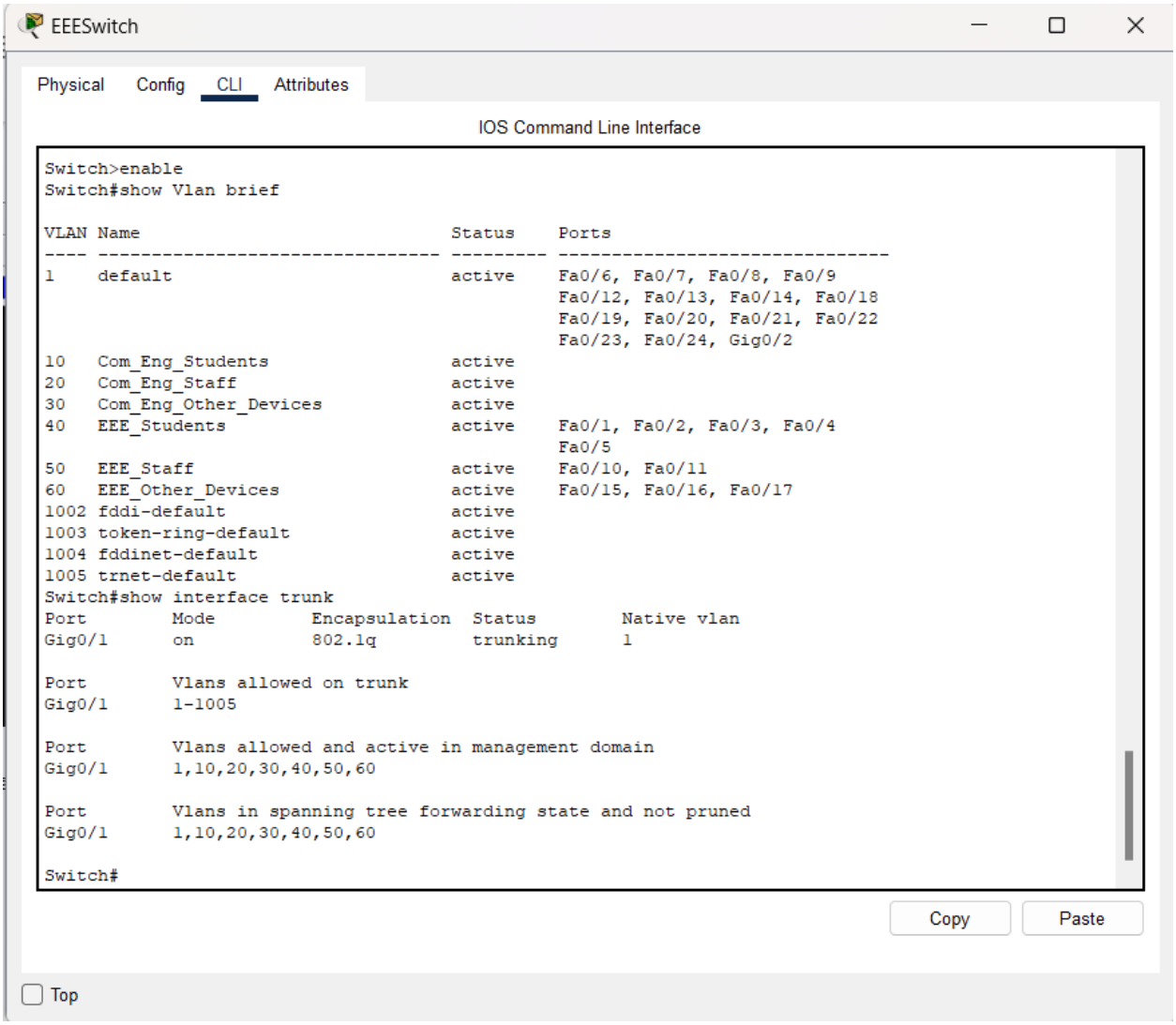


Figure 04: VLAN and routing functionality tested with show VLAN brief and show interfaces trunk commands.

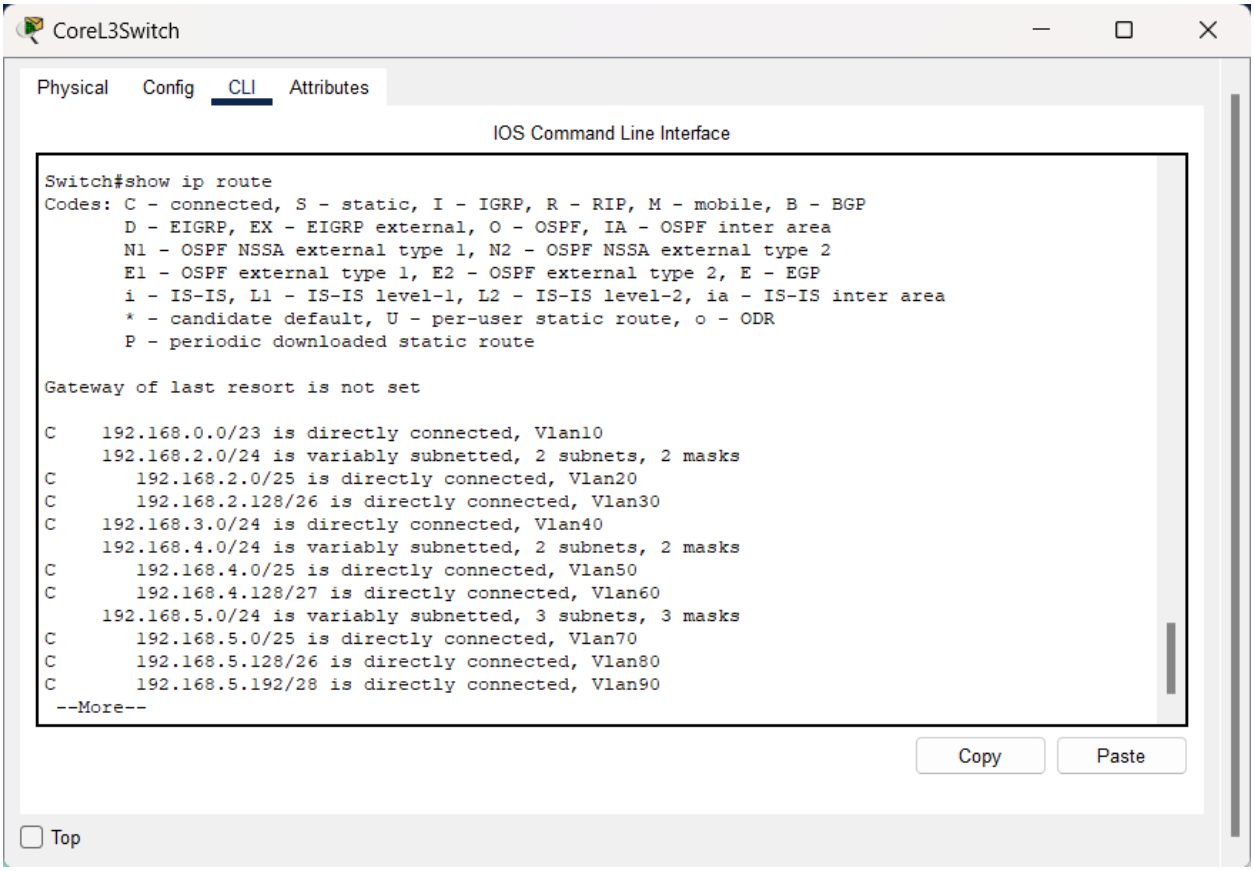


Figure 05: VLAN and routing functionality tests using show Ip route command

8. Scalability Considerations

Subnet Expansion for Future Growth

To ensure that the network can support future expansion without the need for frequent restructuring, each subnet has been allocated an additional 30% capacity. This foresight ensures that when new devices are added to the network, the subnets will be able to handle the increased load without immediate reconfiguration.

Example Calculation for the Computer Engineering Department:

- Current Devices: 250
- Growth Factor (30%): 250×1.3=325250 \times 1.3 = 325
- Subnet Selection:
  - A /24 subnet (with 256 hosts) would not provide sufficient room for both current and future devices.

- As a result, a /23 subnet (which supports 512 hosts) has been chosen to ensure enough capacity for future growth.

This approach allows for a flexible and scalable network design that can grow in parallel with the institution's needs.

9. Conclusion

The network infrastructure design meets the objectives of security, scalability, and efficiency. The simulation results validate the configuration, ensuring optimal performance for the institution's multi-branch facility.