

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

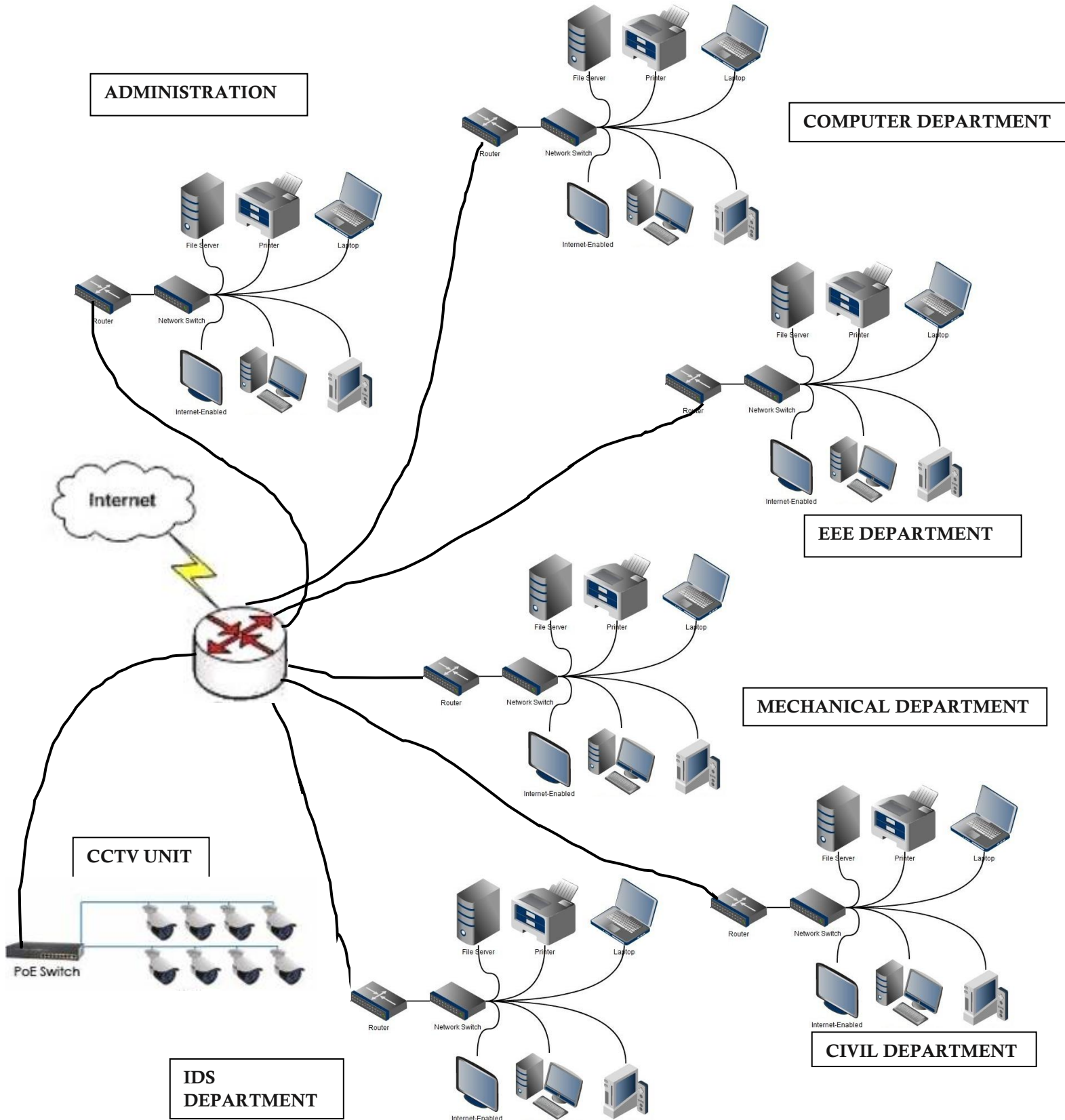
3. VLAN and Inter-VLAN Routing

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

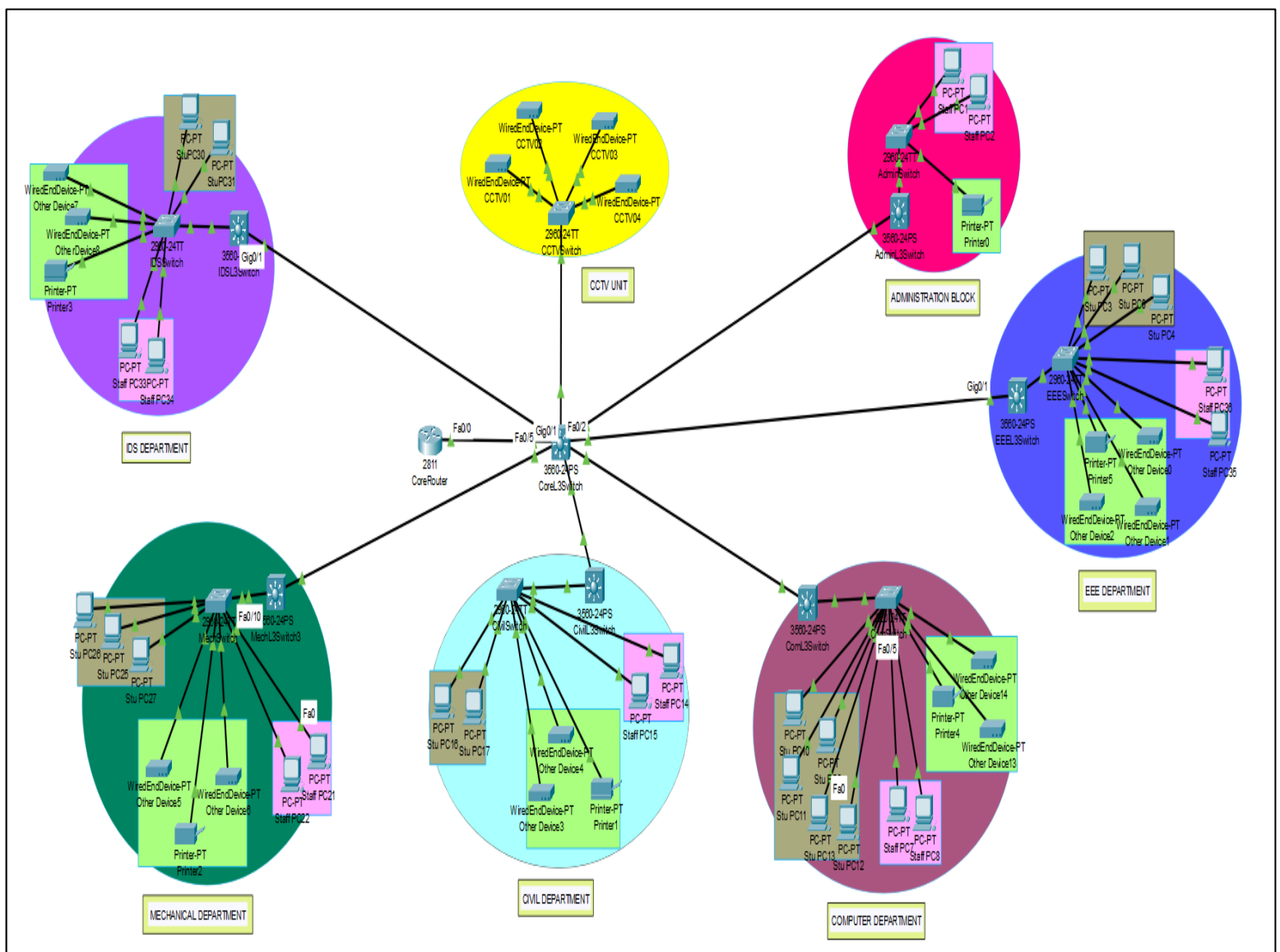
4. Network Topology



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

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

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

5.3 Inter-VLAN Routing on Department L3 Switches

Com Eng L3 Switch Configuration

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

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

EEE L3 Switch Configuration

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

Civil L3 Switch Configuration

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

Mech L3 Switch Configuration

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

```

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

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

EEE L2 Switch Configuration

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

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

Civil L2 Switch Configuration

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

<i>description Civil Eng Other Devices</i>	<i>exit</i>
<i>switchport mode access</i>	<i>exit</i>
<i>switchport access vlan 90</i>	<i>write memory</i>
<i>no shutdown</i>	

Mech L2 Switch Configuration

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

IDS L2 Switch Configuration

<i>enable</i>	<i>vlan 140</i>
<i>configure terminal</i>	<i>name IDS_Staff</i>
<i>vlan 130</i>	<i>vlan 150</i>
<i>name IDS_Students</i>	<i>name IDS_Other_Devices</i>

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

Admin L2 Switch Configuration

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

CCTV L2 Switch Configuration

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

5.5 DHCP Configuration for L3 and L2 Switches

Configure DHCP on the Core L3 Switch

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

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

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

DHCP Configuration for Com Eng L3 Switch

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

<i>ip dhcp excluded-address 192.168.2.1 192.168.2.10</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.2.129 192.168.2.138</i>	<i>write memory</i>

DHCP configuration commands for the EEE L3 Switch:

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

DHCP configuration commands for the Civil Eng L3 Switch:

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

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

DHCP configuration commands for the Mech Eng L3 Switch:

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

<i>ip helper-address 192.168.255.2</i>	<i>interface Vlan120</i>
<i>exit</i>	<i>ip helper-address 192.168.255.2</i>
<i>interface Vlan110</i>	<i>exit</i>
<i>ip helper-address 192.168.255.2</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>

DHCP configuration commands for the IDS L3 Switch:

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

DHCP configuration commands for the Admin L3 Switch:

<i>enable</i>	<i>network 192.168.8.0 255.255.255.192</i>
<i>configure terminal</i>	<i>default-router 192.168.8.1</i>
<i>service dhcp</i>	<i>dns-server 8.8.8.8</i>
<i>ip dhcp pool Admin_Staff</i>	<i>dns-server 8.8.4.4</i>

<i>exit</i>	<i>enable</i>
<i>ip dhcp pool Admin_Printers</i>	<i>configure terminal</i>
<i>network 192.168.8.64 255.255.255.240</i>	<i>interface Vlan160</i>
<i>default-router 192.168.8.65</i>	<i>ip helper-address 192.168.255.2</i>
<i>dns-server 8.8.8.8</i>	<i>exit</i>
<i>dns-server 8.8.4.4</i>	<i>interface Vlan170</i>
<i>exit</i>	<i>ip helper-address 192.168.255.2</i>
<i>ip dhcp excluded-address 192.168.8.1 192.168.8.10</i>	<i>exit</i>
<i>ip dhcp excluded-address 192.168.8.65 192.168.8.74</i>	<i>exit</i>
<i>exit</i>	<i>write memory</i>
<i>write memory</i>	

5.6 Steps to Block Students from Accessing Printers and Other Devices

Commands for Com Eng L3 Switch

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

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

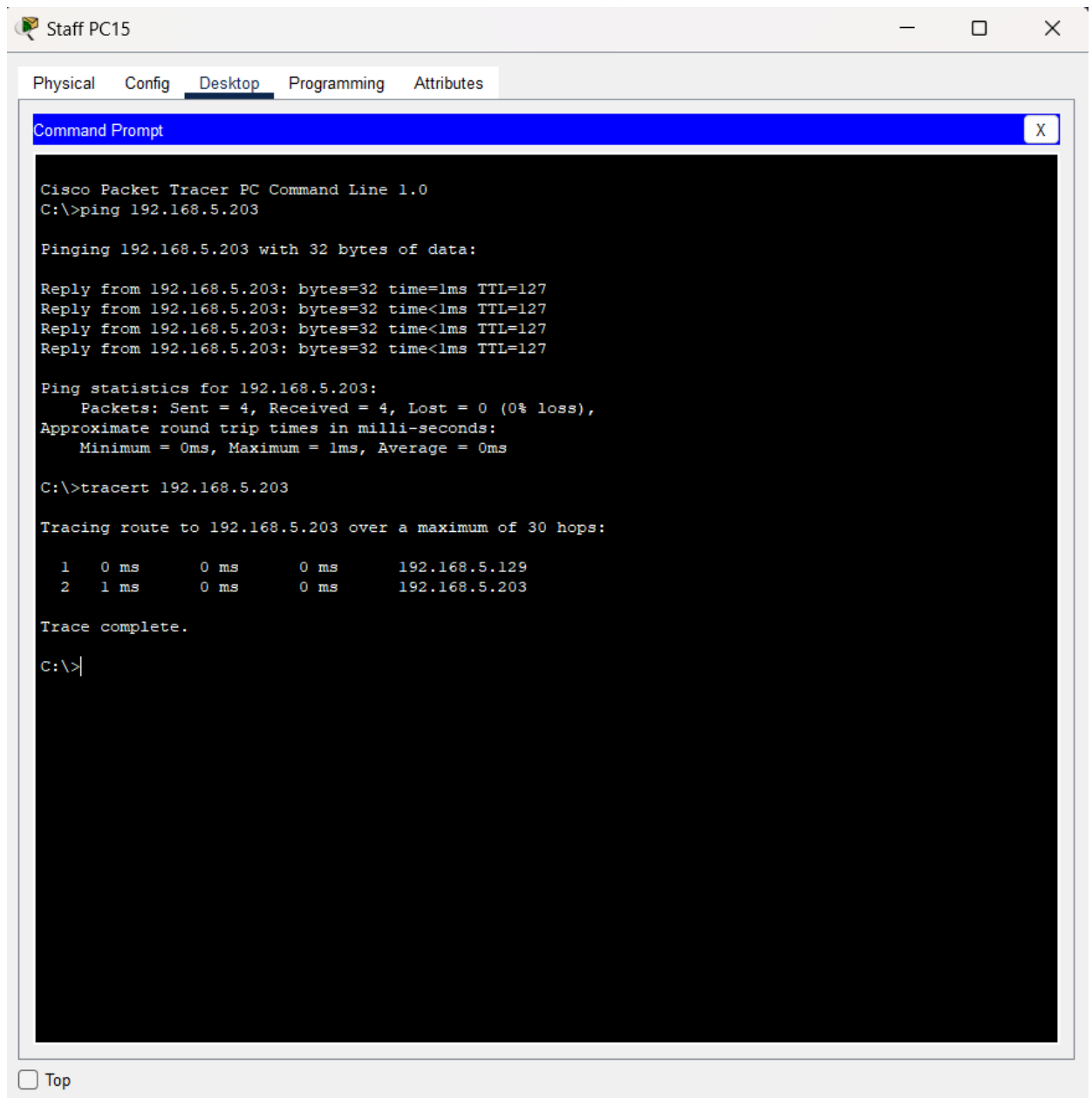


Figure 01: Between Staff Devices and Printers

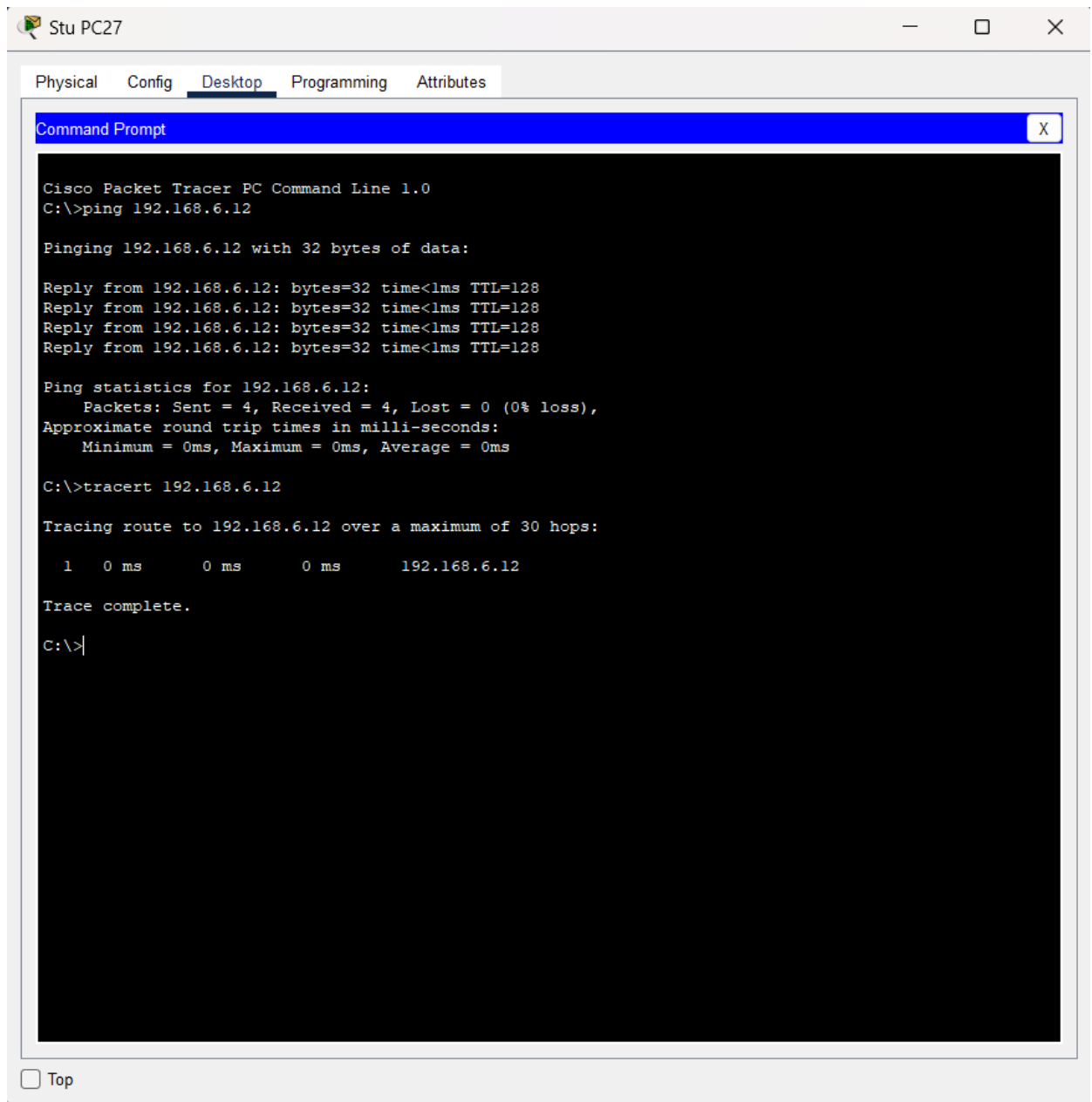


Figure 02: Between Student Devices Within the Same Subnet

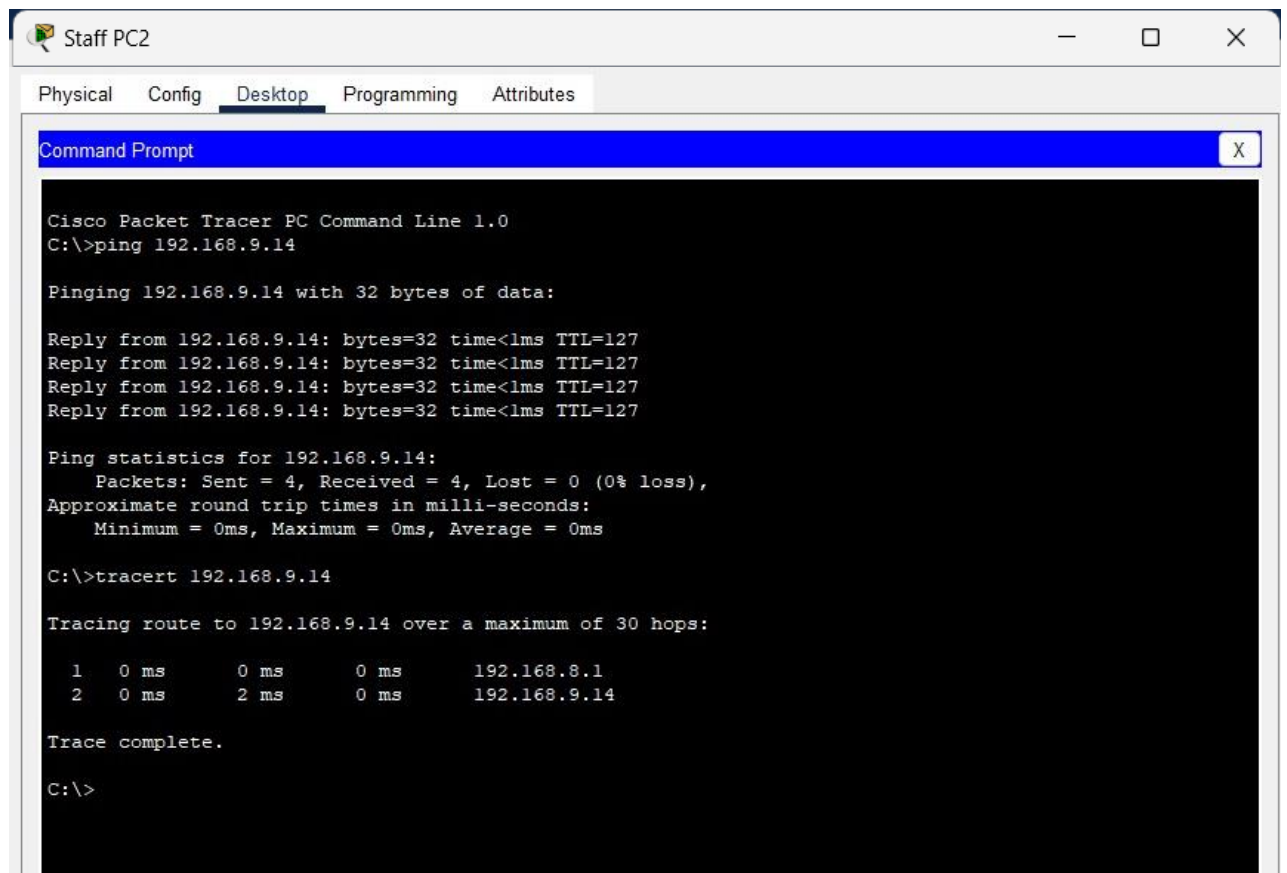


Figure 03: Between Admin Staff Devices and CCTV

7. Testing and Validation

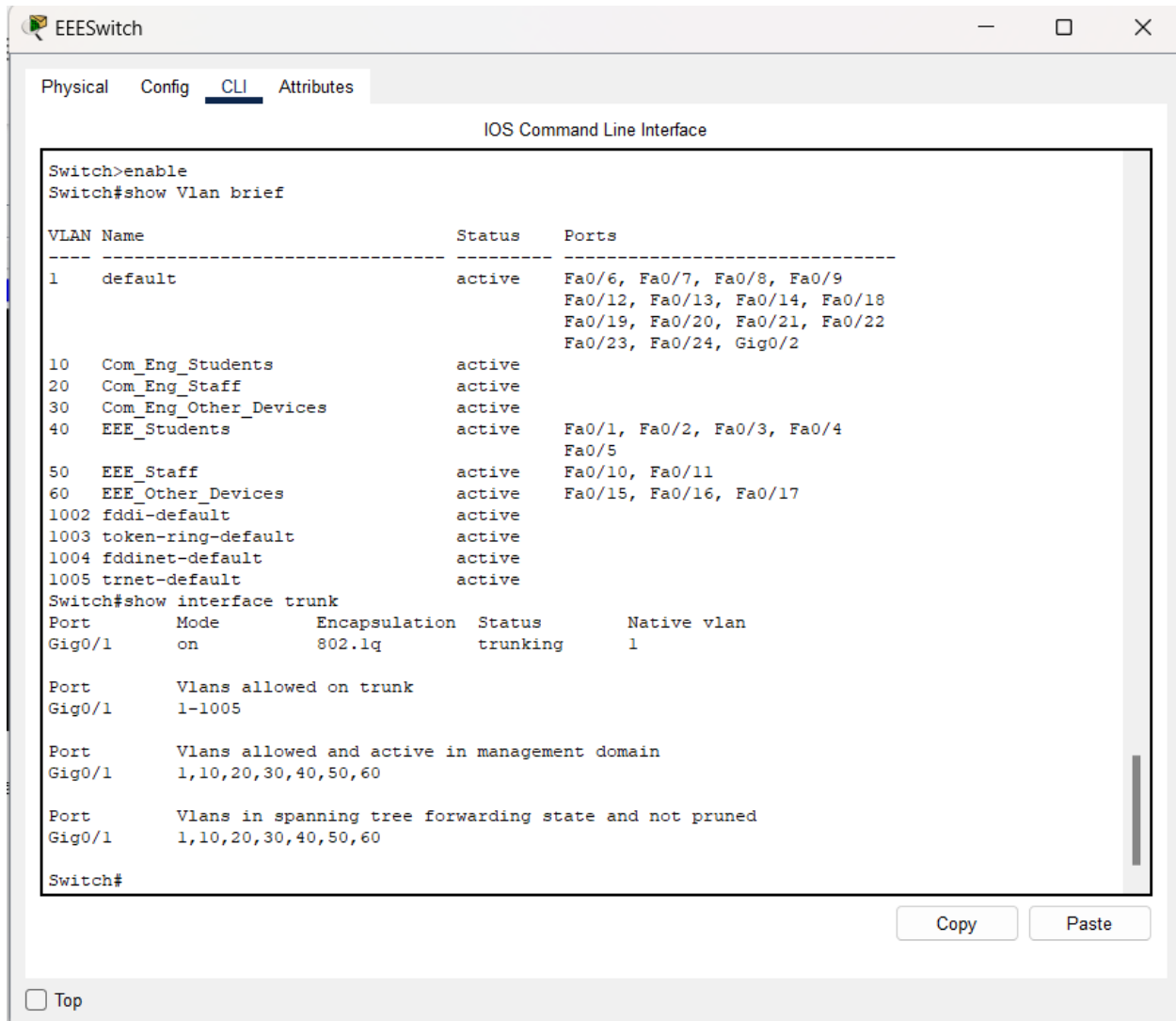


Figure 04: VLAN and routing functionality tested with show VLAN brief and show interfaces trunk commands.

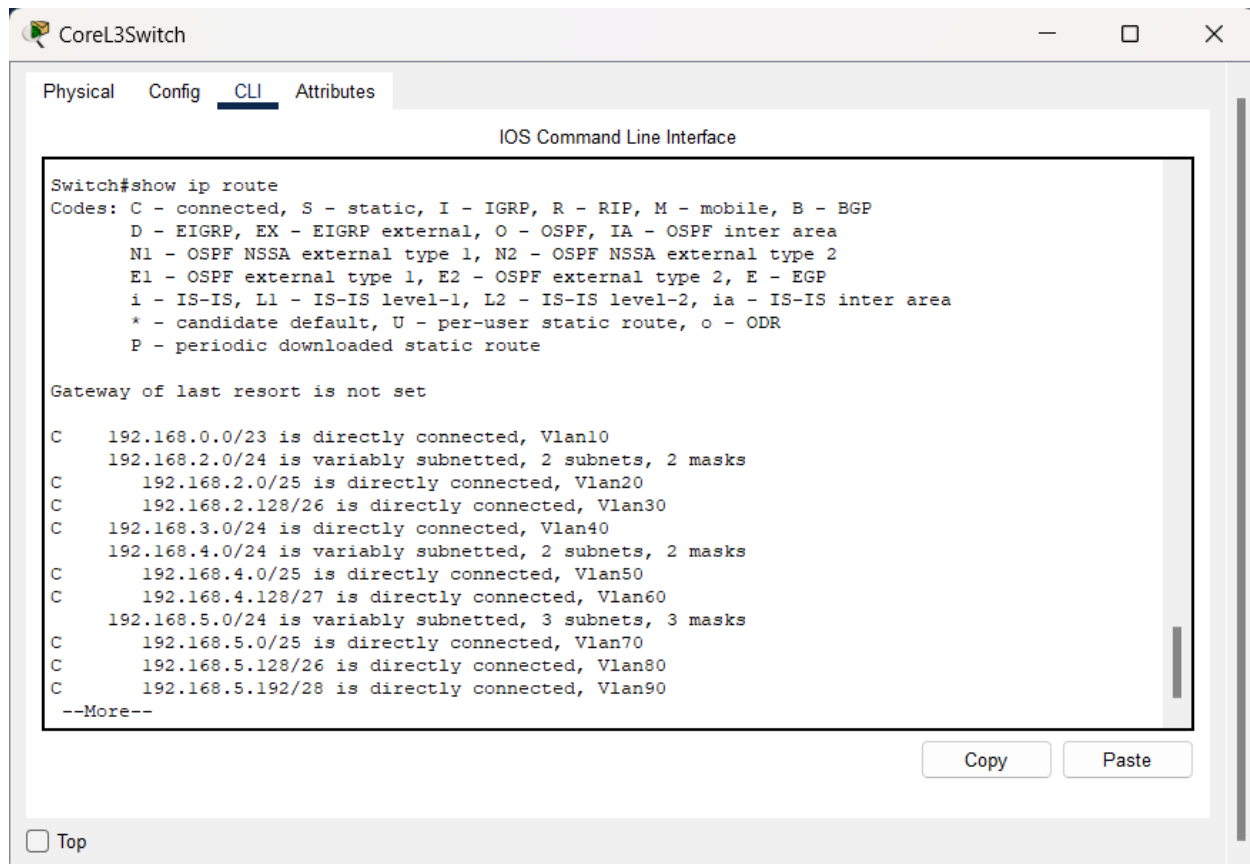


Figure 05: VLAN and routing functionality tests using show ip route command

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%): $250 \times 1.3 = 325$
- 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.