

University Lab Networking

COMPUTER NETWORKS

PROJECT REPORT

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Report: Networking Functions in University Lab Setup

OVERVIEW

This project report outlines the configuration and testing of a networking system for a university lab. The network was set up using various servers, routers, switches, and configurations to ensure seamless communication, efficient resource sharing, and network management.

Key Functions and Configurations

SERVER CONFIGURATION

DHCP Configuration

- Setup of Dynamic Host Configuration Protocol (DHCP) to assign IP addresses automatically to devices within the network.
- Ensures dynamic allocation of IP addresses to improve manageability.

DNS Configuration

- Implementation of the Domain Name System (DNS) to resolve domain names to IP addresses.
- Enhances user accessibility by translating human-friendly names into machine-friendly IP addresses.

HTTP Configuration

- Configuring an HTTP server to serve web pages within the network.
- Modifications were demonstrated by adding new HTTP files, showing changes before and after deployment.

ROUTER CONFIGURATION

Three routers were configured as follows:

Router 1: Primary routing functions and network segmentation.

Router 2 & 3: Interconnectivity and redundancy. Each router was tailored to meet specific network topology and traffic flow requirements.

LAYER 3 SWITCH CONFIGURATION

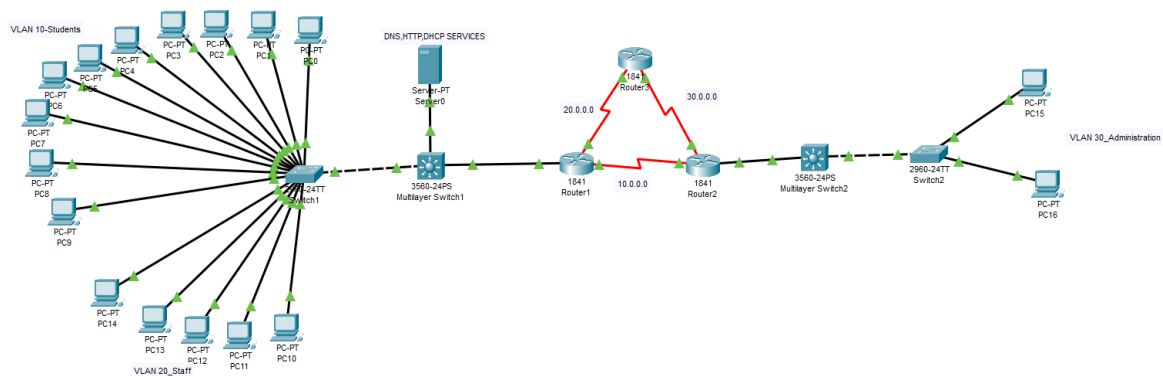
Two Layer 3 switches were set up to handle inter-VLAN routing. These configurations helped:

- Combine routing and switching functionalities.
- Improve data transfer efficiency and reduce latency in intra-network communications.

LAYER 2 SWITCH CONFIGURATION

Layer 2 switches were configured to facilitate basic switching functions like MAC address learning and forwarding.

Design



SERVER CONFIGURATION

DHCP Configuration:

Result:

Server0

Physical Config **Services** Desktop Programming Attributes

SERVICES

- HTTP
- DHCP**
- DHCPv6
- TFTP
- DNS
- SYSLOG
- AAA
- NTP
- EMAIL
- FTP
- IoT
- VM Management
- Radius EAP

DHCP

Interface: FastEthernet0 Service: ☐ On ☒ Off

Pool Name: Pool for Staff (VLAN 20)

Default Gateway: 192.168.2.2

DNS Server: 0.0.0.0

Start IP Address: 192 168 2 0

Subnet Mask: 255 255 255 0

Maximum Number of Users: 255

TFTP Server: 0.0.0.0

WLC Address: 0.0.0.0

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
Pool for Staff (VLAN 20)	192.168....	0.0.0.0	192.168....	255.255....	255	0.0.0.0	0.0.0.0
Pool for Students (VLAN 10)	192.168....	0.0.0.0	192.168....	255.255....	255	0.0.0.0	0.0.0.0
serverPool	0.0.0.0	0.0.0.0	192.168....	255.255....	255	0.0.0.0	0.0.0.0

☐ Top

DNS Configuration:

Result:

The screenshot shows the 'Services' tab in a configuration window for 'Server0'. The 'DNS' service is selected in the left sidebar. The main panel is titled 'DNS' and contains the following elements:

- DNS Service:** A toggle switch set to 'On'.
- Resource Records:** A section with a 'Name' input field, a 'Type' dropdown menu set to 'A Record', and an 'Address' input field.
- Buttons:** 'Add', 'Save', and 'Remove' buttons are located below the input fields.
- Table:** A table displaying existing resource records.
- DNS Cache:** A button at the bottom of the panel.

No.	Name	Type	Detail
0	www.staff.com	A Record	192.168.1.102
1	www.students.com	A Record	192.168.1.101
2	www.university.com	A Record	192.168.1.100

At the bottom left of the window, there is a 'Top' button.

HTTP Configuration:

Result:

Before adding new http file:

The screenshot shows the 'Services' tab in a configuration window for 'Server0'. The 'HTTP' service is selected in the left sidebar. The main panel is titled 'HTTP' and contains the following elements:

- HTTP/HTTPS Toggles:** Two toggle switches, one for 'HTTP' (set to 'On') and one for 'HTTPS' (set to 'On').
- File Manager:** A table displaying a list of files.
- Buttons:** 'New File' and 'Import' buttons are located at the bottom right of the panel.

	File Name	Edit	Delete
1	copyrights.html	(edit)	(delete)
2	cscoptlogo177x111.jpg		(delete)
3	helloworld.html	(edit)	(delete)
4	image.html	(edit)	(delete)
5	index.html	(edit)	(delete)

At the bottom left of the window, there is a 'Top' button.

After adding http file:

Server0

Physical

Config

Services

Desktop

Programming

Attributes

SERVICES

HTTP

DHCP

DHCPv6

TFTP

DNS

SYSLOG

AAA

NTP

EMAIL

FTP

IoT

VM Management

Radius EAP

HTTP

HTTPS

File Manager

	File Name	Edit	Delete
1	University Lab Network.html	(edit)	(delete)
2	copyrights.html	(edit)	(delete)
3	cscoptlogo177x111.jpg		(delete)
4	helloworld.html	(edit)	(delete)
5	image.html	(edit)	(delete)
6	index.html	(edit)	(delete)

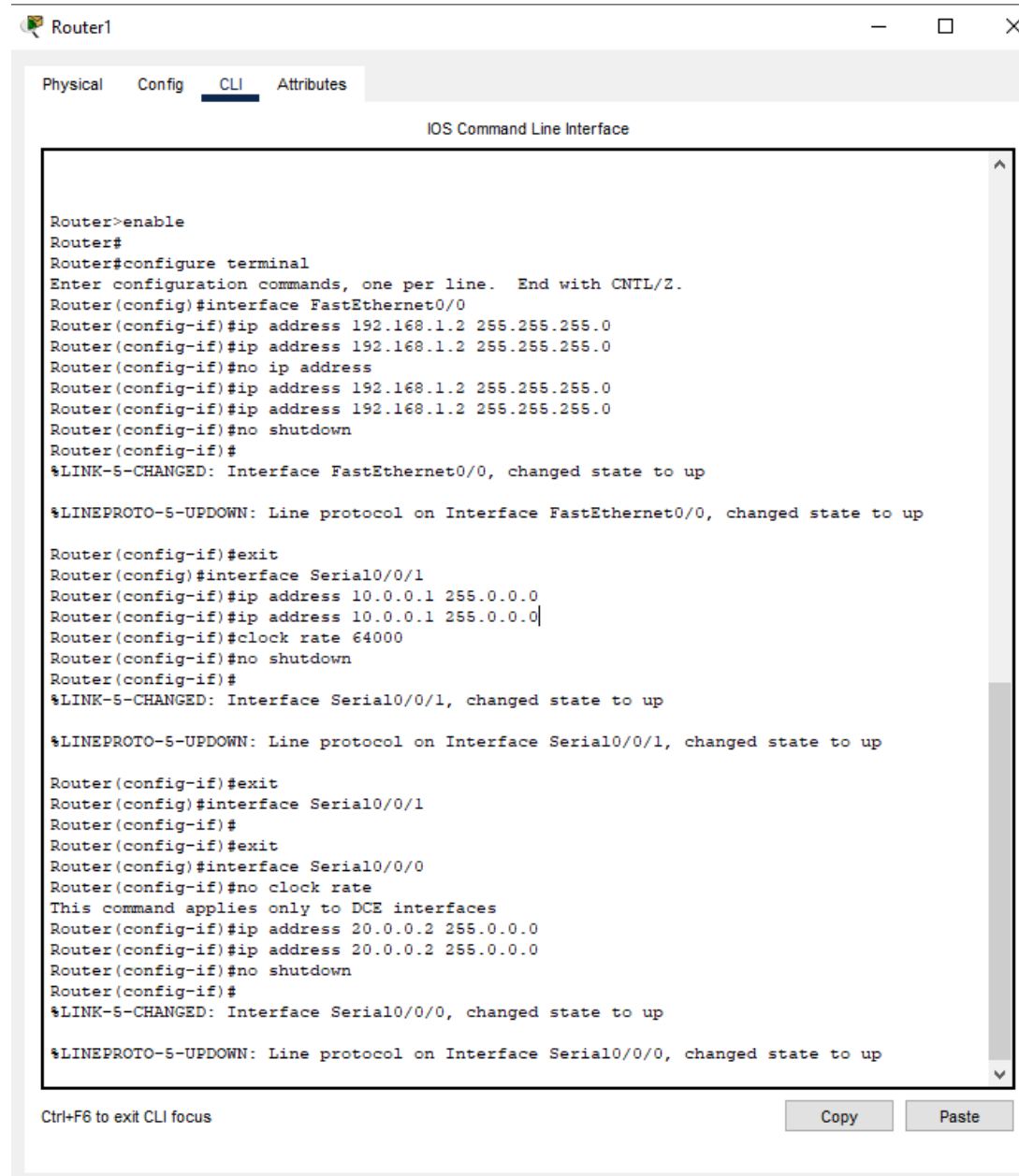
New File

Import

ROUTER CONFIGURATION

Router 1 Configuration:

Result:



Router1

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#no ip address
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#ip address 192.168.1.2 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#no clock rate
This command applies only to DCE interfaces
Router(config-if)#ip address 20.0.0.2 255.0.0.0
Router(config-if)#ip address 20.0.0.2 255.0.0.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up
```

Ctrl+F6 to exit CLI focus

Copy Paste

```
Router>router OSPF 1
      ^
% Invalid input detected at '^' marker.

Router>enable
Router#configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#interface 192.168.1.0 0.0.0.255 area 0
      ^
% Invalid input detected at '^' marker.

Router(config-router)#netwoth 192.168.1.0 0.0.0.255 area 0
      ^
% Invalid input detected at '^' marker.

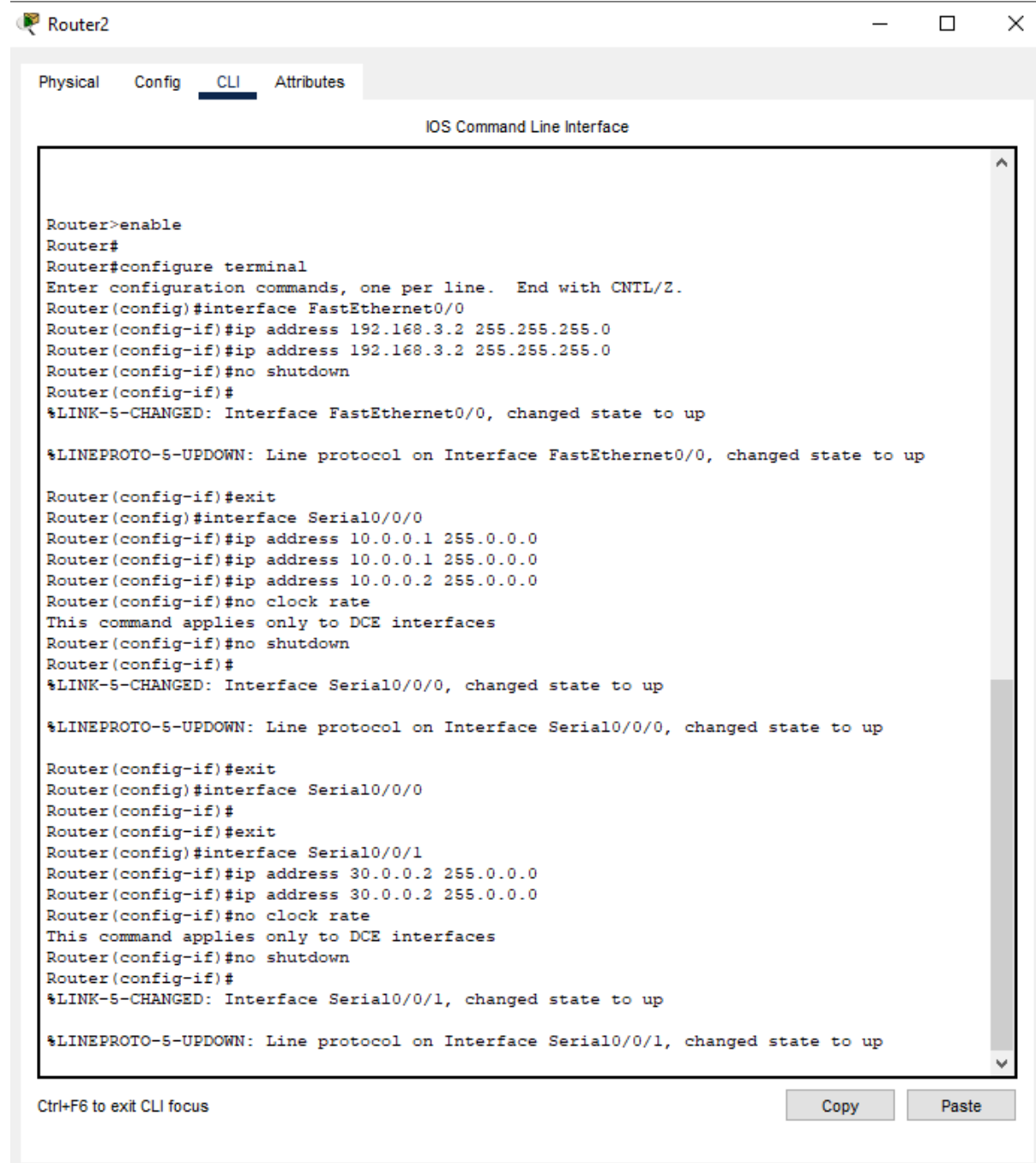
Router(config-router)#exit
Router(config)#router ospf 1
Router(config-router)#network 192.168.1.0 0.0.0.255 area 0
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#network 20.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#end
Translating "end"...domain server (255.255.255.255)
% Unknown command or computer name, or unable to find computer address

Router#write
Building configuration...
[OK]
Router#
```


Router 2 Configuration:

Result:



Router2

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface FastEthernet0/0
Router(config-if)#ip address 192.168.3.2 255.255.255.0
Router(config-if)#ip address 192.168.3.2 255.255.255.0
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface FastEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#ip address 10.0.0.1 255.0.0.0
Router(config-if)#ip address 10.0.0.2 255.0.0.0
Router(config-if)#no clock rate
This command applies only to DCE interfaces
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#ip address 30.0.0.2 255.0.0.0
Router(config-if)#ip address 30.0.0.2 255.0.0.0
Router(config-if)#no clock rate
This command applies only to DCE interfaces
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up
```

Ctrl+F6 to exit CLI focus

Copy Paste

Router2

Physical Config CLI Attributes

IOS Command Line Interface

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 10.0.0.0 0.255.255.255 area 0
Router(config-router)#netwo
00:32:06: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.2 on Serial0/0/0 from LOADING to FULL,
Loading Done

% Incomplete command.
Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#network 192.168.3.0 0.0.0.255 area 0
^
% Invalid input detected at '^' marker.

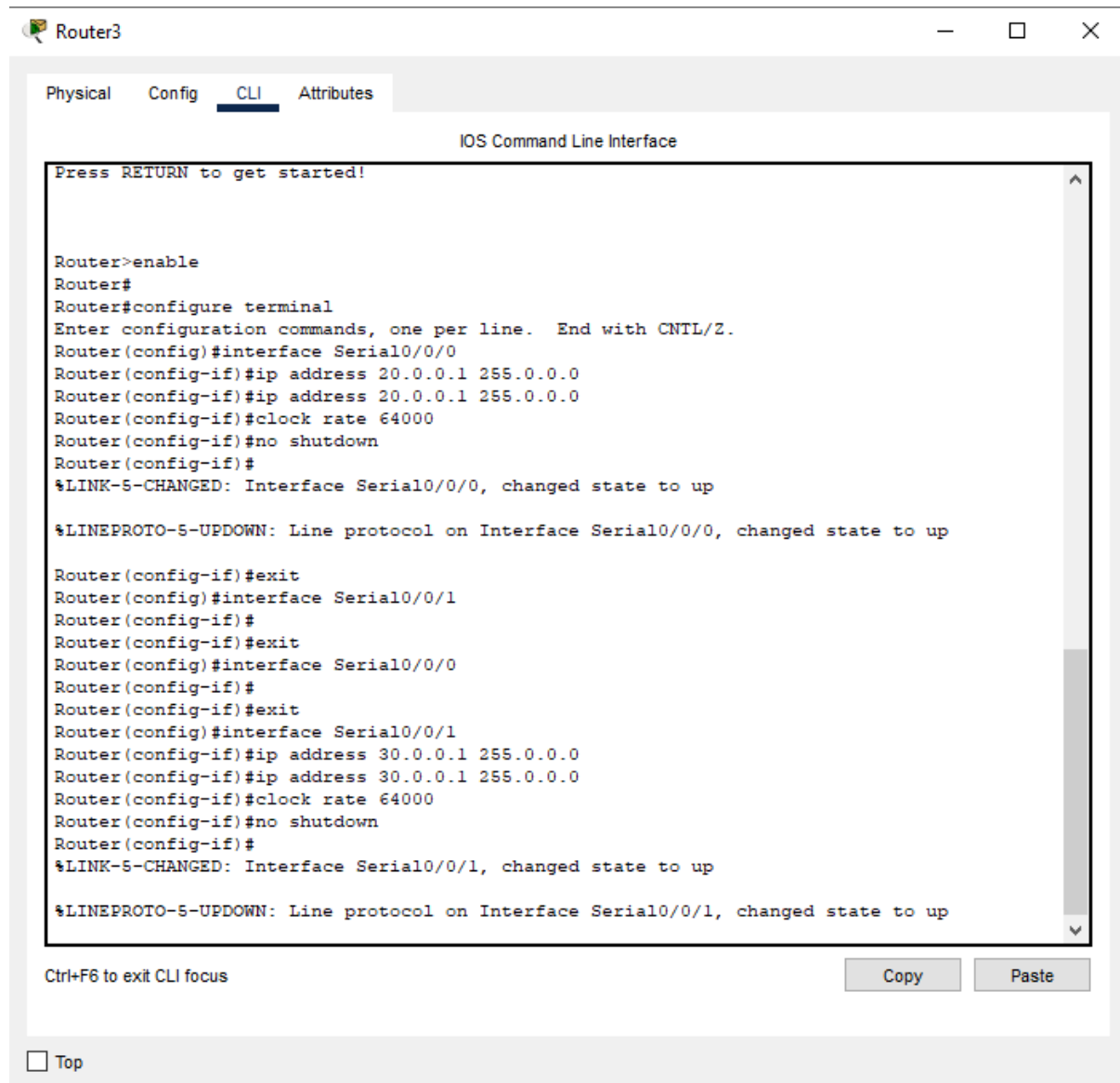
Router(config-router)#network 192.168.3.0 0.0.0.255 area 0
Router(config-router)#exit
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#end
Translating "end"...domain server (255.255.255.255)|
```

Copy Paste

Router 3 Configuration:

Result:



The screenshot shows a window titled "Router3" with a standard Windows title bar (minimize, maximize, close buttons). Inside the window, there are four tabs: "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is selected and highlighted with a blue underline. Below the tabs, the text "IOS Command Line Interface" is centered. The main area of the window is a terminal window with a black border and a scroll bar on the right. It contains the following text:

```
Press RETURN to get started!

Router>enable
Router#
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#interface Serial0/0/0
Router(config-if)#ip address 20.0.0.1 255.0.0.0
Router(config-if)#ip address 20.0.0.1 255.0.0.0
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/0, changed state to up

Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/0/0
Router(config-if)#
Router(config-if)#exit
Router(config)#interface Serial0/0/1
Router(config-if)#ip address 30.0.0.1 255.0.0.0
Router(config-if)#ip address 30.0.0.1 255.0.0.0
Router(config-if)#clock rate 64000
Router(config-if)#no shutdown
Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/0/1, changed state to up
```

Below the terminal window, there is a status bar with the text "Ctrl+F6 to exit CLI focus" on the left. On the right, there are two buttons: "Copy" and "Paste". At the bottom left of the window, there is a checkbox labeled "Top".

IOS Command Line Interface

```
Router>enable
Router#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 20.0.0.0 0.255.255.255 area 0
Router(config-router)#network 3
00:36:14: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.1.2 on Serial0/0/0 from LOADING to FULL,
Loading Done
^
% Invalid input detected at '^' marker.

Router(config-router)#network 30.0.0.0 0.255.255.255 area 0
Router(config-router)#exit
Router(config)#
00:36:44: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.3.2 on Serial0/0/1 from LOADING to FULL,
Loading Done

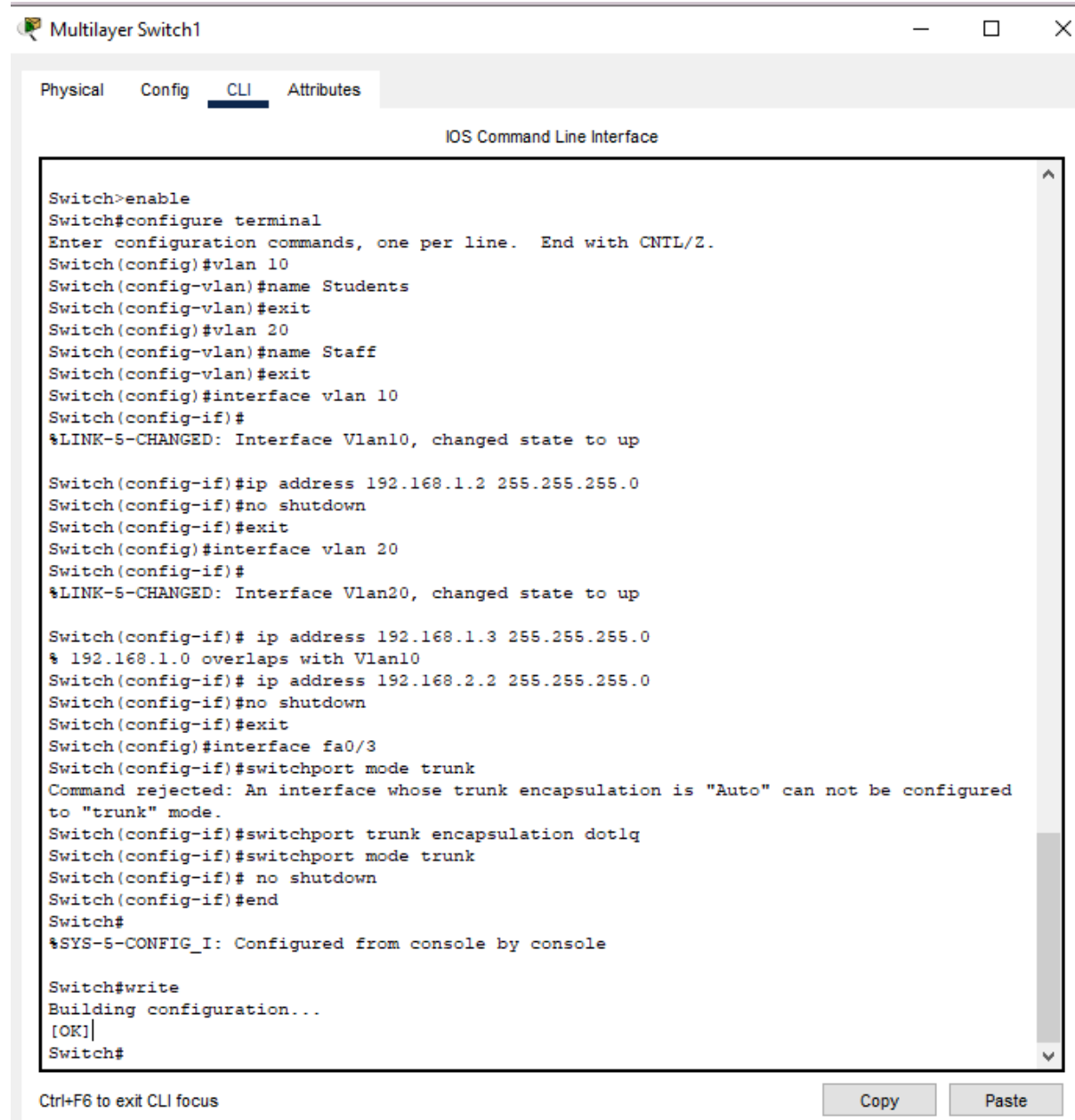
Router(config)#end
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#write
Building configuration...
[OK]
Router#
```

LAYER 3 SWITCH CONFIGURATION

Layer 3 Switch-1 Configuration:

Result:



The screenshot shows a window titled "Multilayer Switch1" with a tabbed interface. The "CLI" tab is selected, displaying the "IOS Command Line Interface". The terminal shows the following commands and output:

```
Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name Students
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name Staff
Switch(config-vlan)#exit
Switch(config)#interface vlan 10
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

Switch(config-if)#ip address 192.168.1.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up

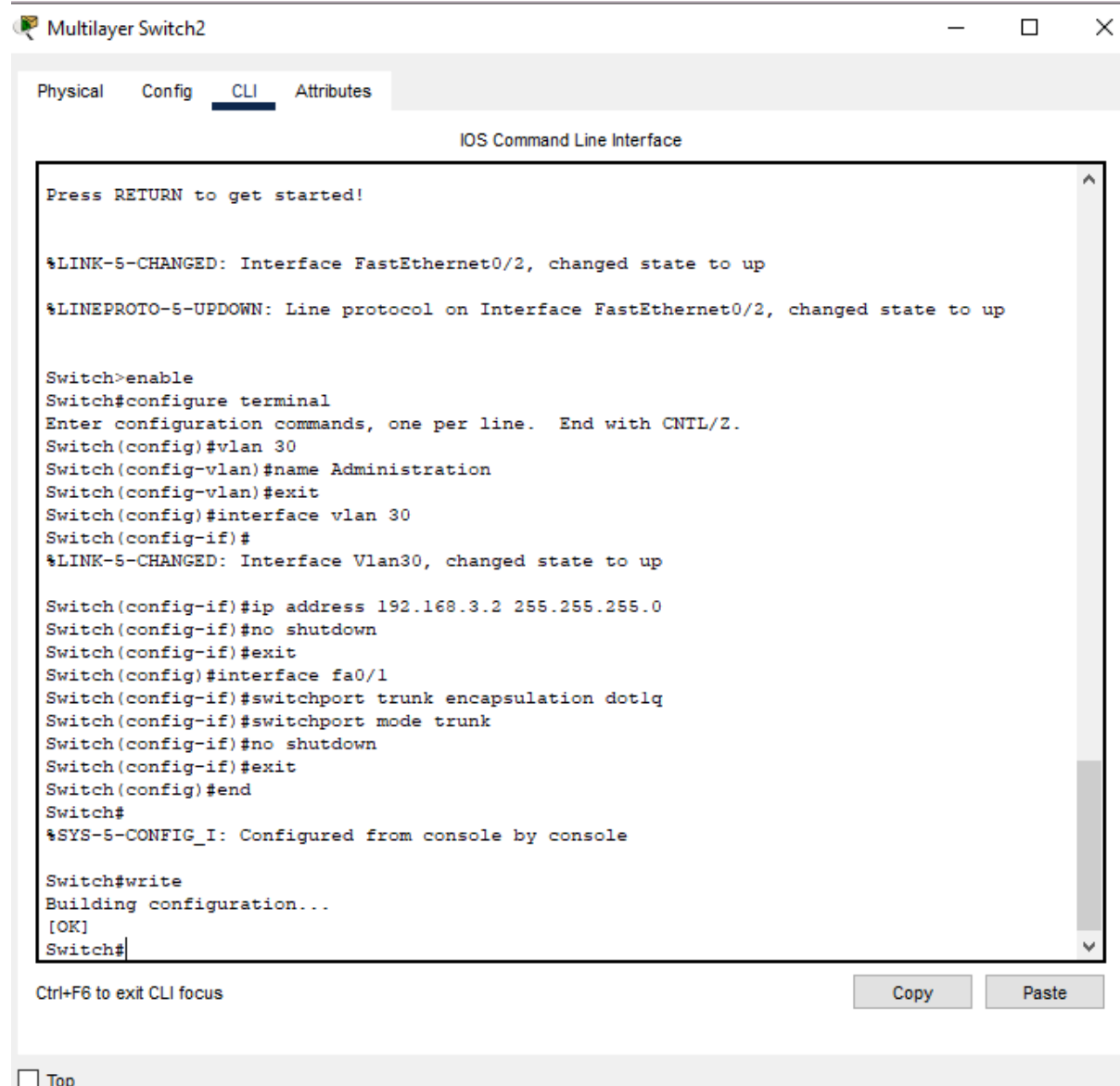
Switch(config-if)# ip address 192.168.1.3 255.255.255.0
% 192.168.1.0 overlaps with Vlan10
Switch(config-if)# ip address 192.168.2.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fa0/3
Switch(config-if)#switchport mode trunk
Command rejected: An interface whose trunk encapsulation is "Auto" can not be configured
to "trunk" mode.
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)# no shutdown
Switch(config-if)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#write
Building configuration...
[OK]
Switch#
```

At the bottom of the window, there is a status bar that says "Ctrl+F6 to exit CLI focus" and two buttons: "Copy" and "Paste".

Layer 3 Switch-2 Configuration:

Result:



The screenshot shows a window titled "Multilayer Switch2" with a tabbed interface. The "CLI" tab is selected, displaying the "IOS Command Line Interface". The interface shows a series of commands and their outputs:

```
Press RETURN to get started!

%LINK-5-CHANGED: Interface FastEthernet0/2, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/2, changed state to up

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#name Administration
Switch(config-vlan)#exit
Switch(config)#interface vlan 30
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan30, changed state to up

Switch(config-if)#ip address 192.168.3.2 255.255.255.0
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#interface fa0/1
Switch(config-if)#switchport trunk encapsulation dot1q
Switch(config-if)#switchport mode trunk
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

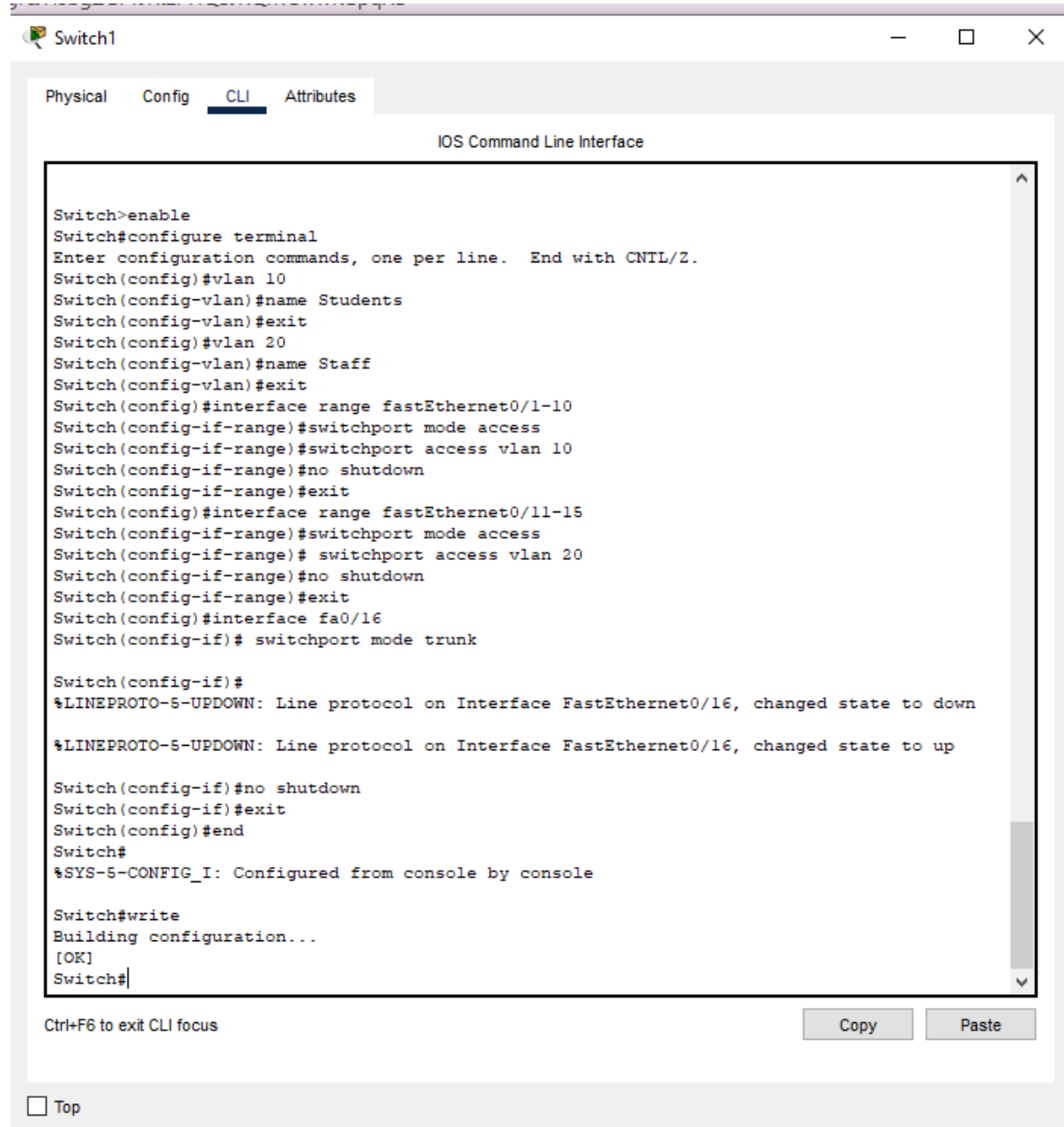
Switch#write
Building configuration...
[OK]
Switch#
```

At the bottom of the CLI window, there is a status bar with the text "Ctrl+F6 to exit CLI focus" and two buttons: "Copy" and "Paste". Below the window, there is a "Top" link with a small square icon next to it.

LAYER 2 SWITCH CONFIGURATION

Layer 2 Switch-1 Configuration:

Result:



```
Switch1
Physical Config CLI Attributes
IOS Command Line Interface

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name Students
Switch(config-vlan)#exit
Switch(config)#vlan 20
Switch(config-vlan)#name Staff
Switch(config-vlan)#exit
Switch(config)#interface range fastEthernet0/1-10
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 10
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#interface range fastEthernet0/11-15
Switch(config-if-range)#switchport mode access
Switch(config-if-range)# switchport access vlan 20
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)#interface fa0/16
Switch(config-if)# switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/16, changed state to up

Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#write
Building configuration...
[OK]
Switch#
```

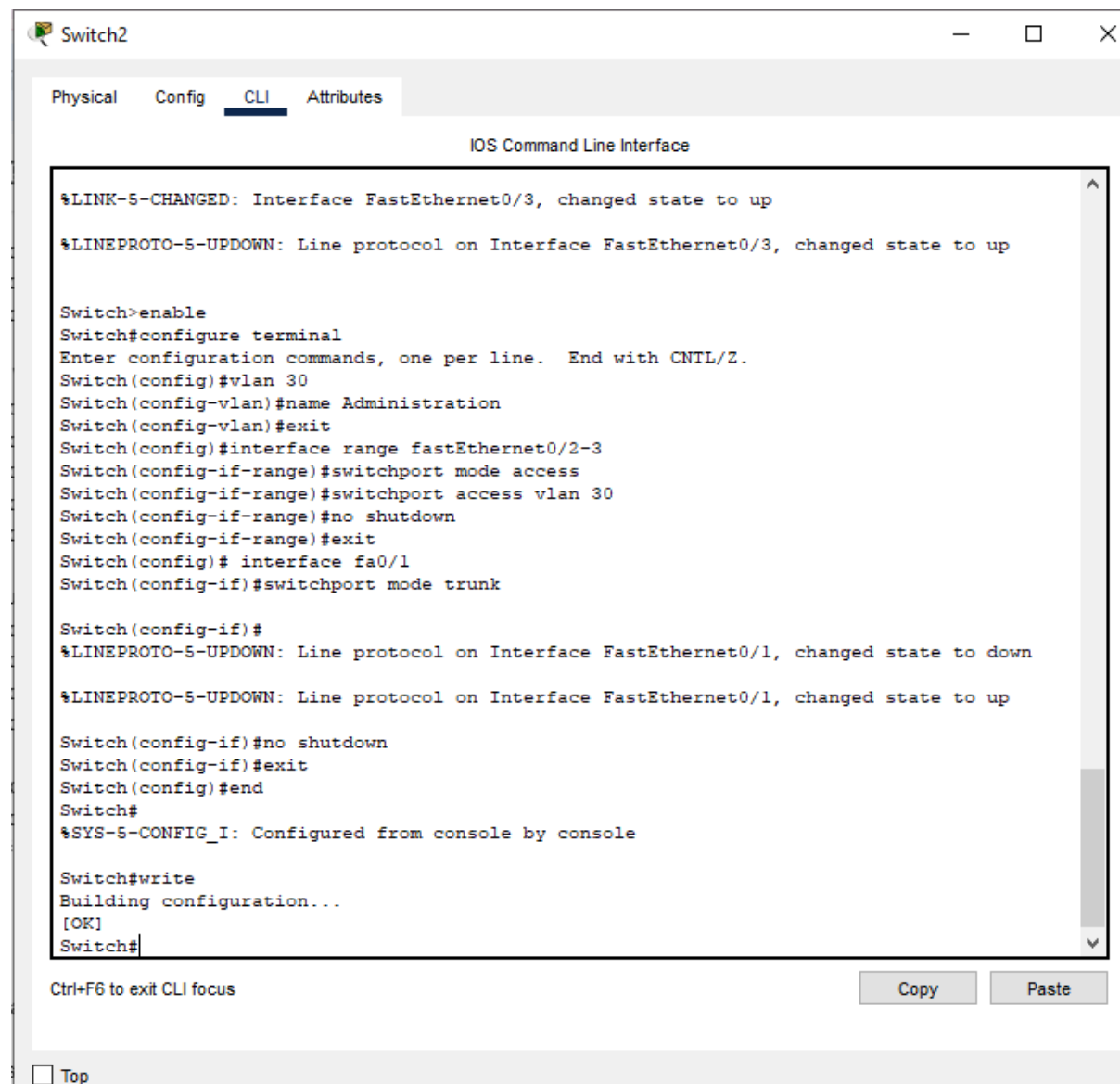
Ctrl+F6 to exit CLI focus

Copy Paste

☐ Top

Layer 3 Switch-1 Configuration:

Result:



The screenshot shows a window titled "Switch2" with tabs for "Physical", "Config", "CLI", and "Attributes". The "CLI" tab is active, displaying the "IOS Command Line Interface". The interface shows a series of commands and status messages:

```
%LINK-5-CHANGED: Interface FastEthernet0/3, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/3, changed state to up

Switch>enable
Switch#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 30
Switch(config-vlan)#name Administration
Switch(config-vlan)#exit
Switch(config)#interface range fastEthernet0/2-3
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#no shutdown
Switch(config-if-range)#exit
Switch(config)# interface fa0/1
Switch(config-if)#switchport mode trunk

Switch(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up

Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console

Switch#write
Building configuration...
[OK]
Switch#
```

At the bottom of the CLI window, there is a prompt "Ctrl+F6 to exit CLI focus" and two buttons: "Copy" and "Paste". Below the CLI window, there is a "Top" button.

Conclusion

This project showcased a structured approach to designing and configuring a robust network for a university lab. By integrating advanced networking principles like DHCP, DNS, routing, and switching, the team successfully implemented a system capable of meeting diverse academic and administrative needs.