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# **Network Design For Office Management System**

## **INTRODUCTION**

This document presents the network design for Office Management, featuring key networking technologies such as VLAN, DHCP, OSPF routing, and NAT. The setup divides the network into three main floors facilitating optimized communication and resource management between departments.

## **COMPREHENSIVE NETWORK TOPOLOGY**

The network design spans three levels, with each floor organized into distinct departmental zones for streamlined operations.

### **1. Floor 1:**

Includes Reception, store and logistics.

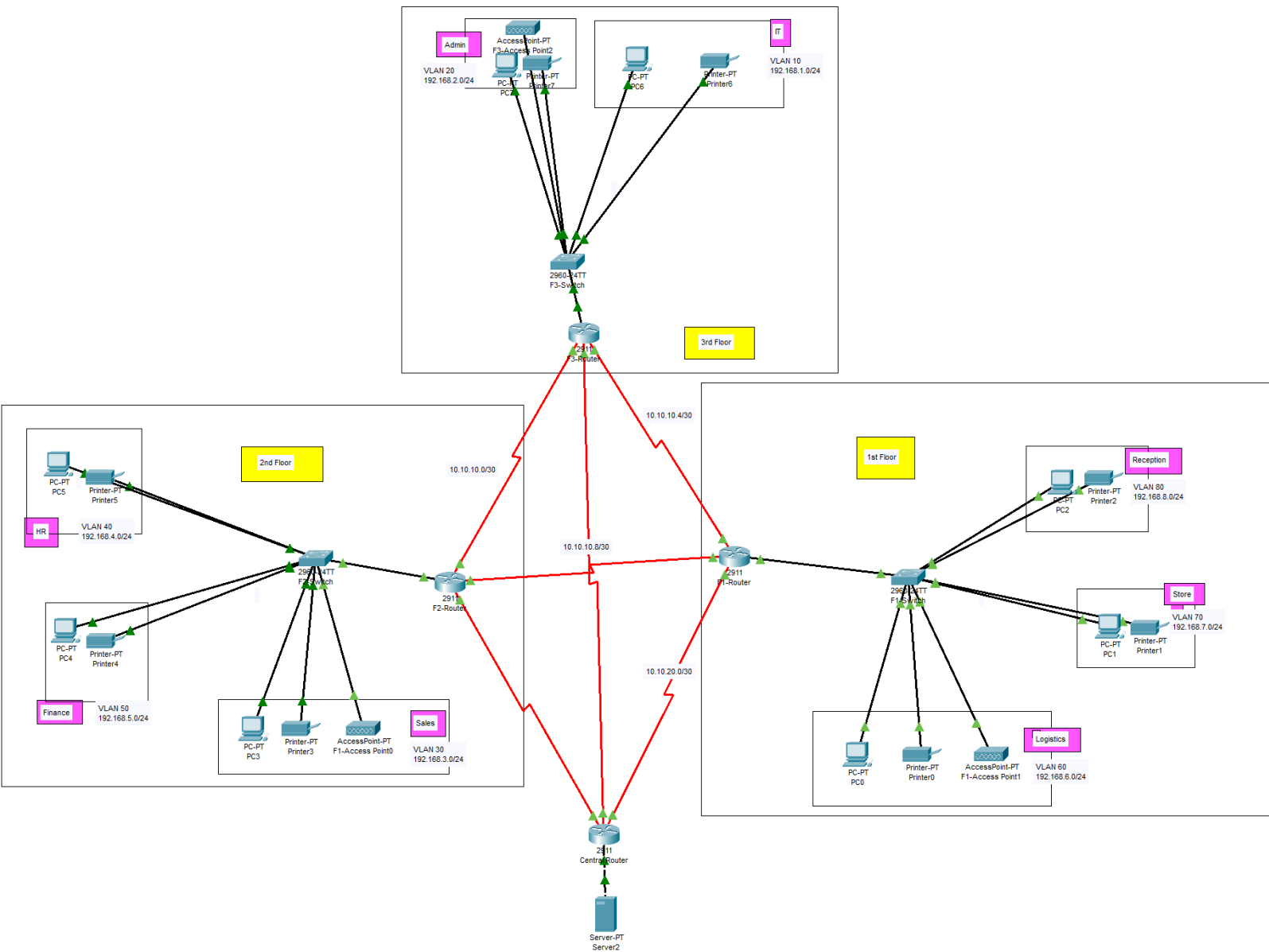
### **2. Floor 2 :**

Includes HR, finance, and sales departments.

### **3. Floor 3 :**

Includes admin and IT departments.

The central router connects the network to the internet. Each department is assigned a dedicated VLAN and utilizes subnetting for managing IP addresses. Routers configured with OSPF and NAT enable seamless communication between VLANs and provide internet connectivity.



**IP ADDRESSING SCHEME:****1. FLOOR 1:**

<b>Departments</b>	<b>Network ID</b>	<b>Subnet Mask</b>	<b>Range of Usable Hosts</b>	<b>Broadcast ID</b>
Reception	192.168.8.0	255.255.255.0/24	192.168.8.1 to 192.168.8.254	192.168.8.255
Store	192.168.7.0	255.255.255.0/24	192.168.7.1 to 192.168.7.254	192.168.7.255
Logistics	192.168.6.0	255.255.255.0/24	192.168.6.1 to 192.168.6.254	192.168.6.255

**2. FLOOR 2:**

<b>Department</b>	<b>Network ID</b>	<b>Subnet Mask</b>	<b>Range of Usable Hosts</b>	<b>Broadcast ID</b>
Finance	192.168.5.0	255.255.255.0/24	192.168.5.1 to 192.168.5.254	192.168.5.255
HR	192.168.4.0	255.255.255.0/24	192.168.4.1 to 192.168.4.254	192.168.4.255
Sales	192.168.3.0	255.255.255.0/24	192.168.3.1 to 192.168.3.254	192.168.3.255

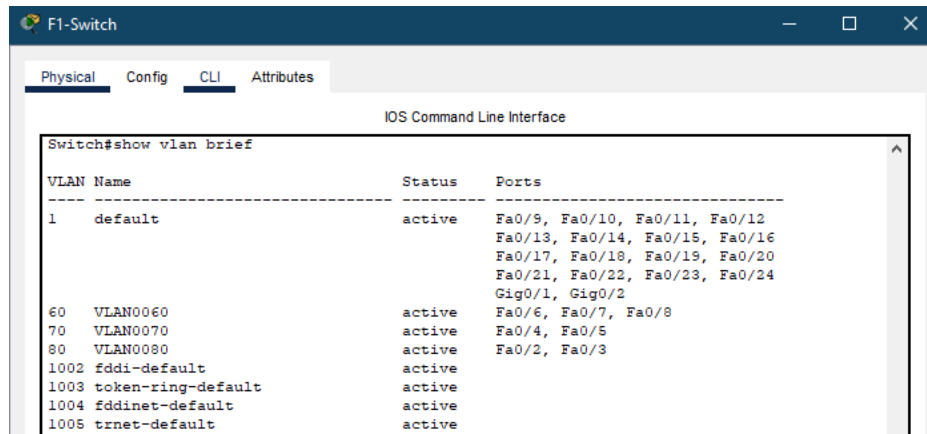
**3. FLOOR 3:**

<b>Department</b>	<b>Network ID</b>	<b>Subnet Mask</b>	<b>Range of Usable Hosts</b>	<b>Broadcast ID</b>
Admin	192.168.2.0	255.255.255.0/24	192.168.2.1 to 192.168.2.254	192.168.2.255
IT	192.168.1.0	255.255.255.0/24	192.168.1.1 to 192.168.1.254	192.168.1.255

## VLAN CONFIGURATION

VLANs were configured to create logical divisions between departments, enhancing both traffic control and network security. Each VLAN has been allocated a distinct subnet, as detailed below:

Each VLAN has been allocated a /24 subnet, allowing for up to 254 devices per VLAN, leaving room for growth.



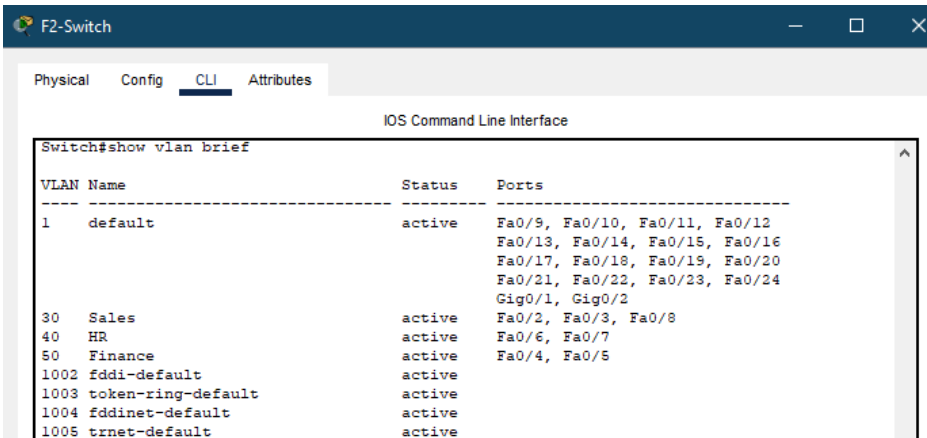
F1-Switch

Physical Config CLI Attributes

IOS Command Line Interface

```
Switch#show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gig0/1, Gig0/2
60 VLAN0060	active	Fa0/6, Fa0/7, Fa0/8
70 VLAN0070	active	Fa0/4, Fa0/5
80 VLAN0080	active	Fa0/2, Fa0/3
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	



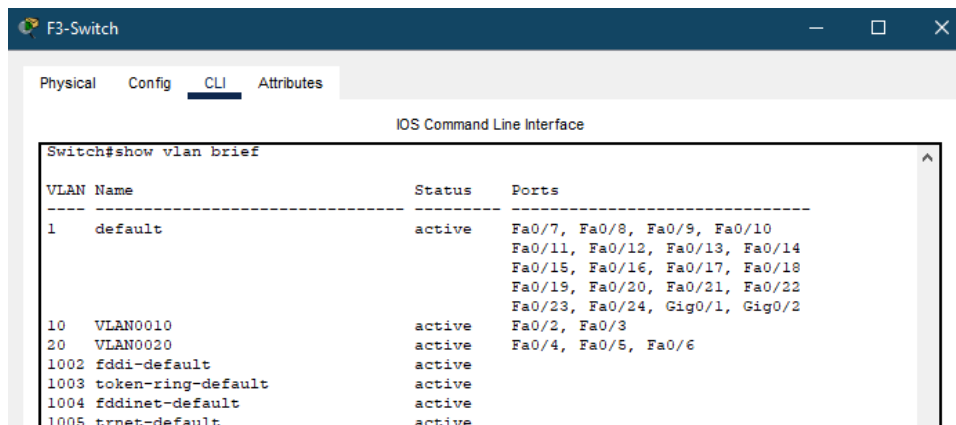
F2-Switch

Physical Config CLI Attributes

IOS Command Line Interface

```
Switch#show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/9, Fa0/10, Fa0/11, Fa0/12 Fa0/13, Fa0/14, Fa0/15, Fa0/16 Fa0/17, Fa0/18, Fa0/19, Fa0/20 Fa0/21, Fa0/22, Fa0/23, Fa0/24 Gig0/1, Gig0/2
30 Sales	active	Fa0/2, Fa0/3, Fa0/8
40 HR	active	Fa0/6, Fa0/7
50 Finance	active	Fa0/4, Fa0/5
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	



F3-Switch

Physical Config CLI Attributes

IOS Command Line Interface

```
Switch#show vlan brief
```

VLAN Name	Status	Ports
1 default	active	Fa0/7, Fa0/8, Fa0/9, Fa0/10 Fa0/11, Fa0/12, Fa0/13, Fa0/14 Fa0/15, Fa0/16, Fa0/17, Fa0/18 Fa0/19, Fa0/20, Fa0/21, Fa0/22 Fa0/23, Fa0/24, Gig0/1, Gig0/2
10 VLAN0010	active	Fa0/2, Fa0/3
20 VLAN0020	active	Fa0/4, Fa0/5, Fa0/6
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	

## DHCP CONFIGURATION

Routers have been configured as a DHCP servers to automate IP address assignment for devices within each VLAN. Individual DHCP pools were created for each VLAN to ensure accurate address allocation. This setup allows devices in the each VLAN to receive IP addresses dynamically.

```

F1-Router
Physical Config CLI Attributes
IOS Command Line Interface

Pool Reception :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 0
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.8.1 192.168.8.1 - 192.168.8.254 1 / 0 / 254

Pool Store :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 0
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.7.1 192.168.7.1 - 192.168.7.254 1 / 0 / 254

Pool Logistics :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 0
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.6.1 192.168.6.1 - 192.168.6.254 1 / 0 / 254
Router#
  
```

```

F2-Router
Physical Config CLI Attributes
IOS Command Line Interface

Pool Finance :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 0
Excluded addresses : 3
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.5.1 192.168.5.1 - 192.168.5.254 0 / 3 / 254

Pool HR :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 3
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.4.1 192.168.4.1 - 192.168.4.254 1 / 3 / 254

Pool Sales :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 3
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.3.1 192.168.3.1 - 192.168.3.254 1 / 3 / 254
Router#
  
```

```

F3-Router
Physical Config CLI Attributes
IOS Command Line Interface

Pool IT :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 1
Excluded addresses : 0
Pending event : none

1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.1.1 192.168.1.1 - 192.168.1.254 1 / 0 / 254

Pool Admin :
Utilization mark (high/low) : 100 / 0
Subnet size (first/next) : 0 / 0
Total addresses : 254
Leased addresses : 0
Excluded addresses : 0
Pending event : none

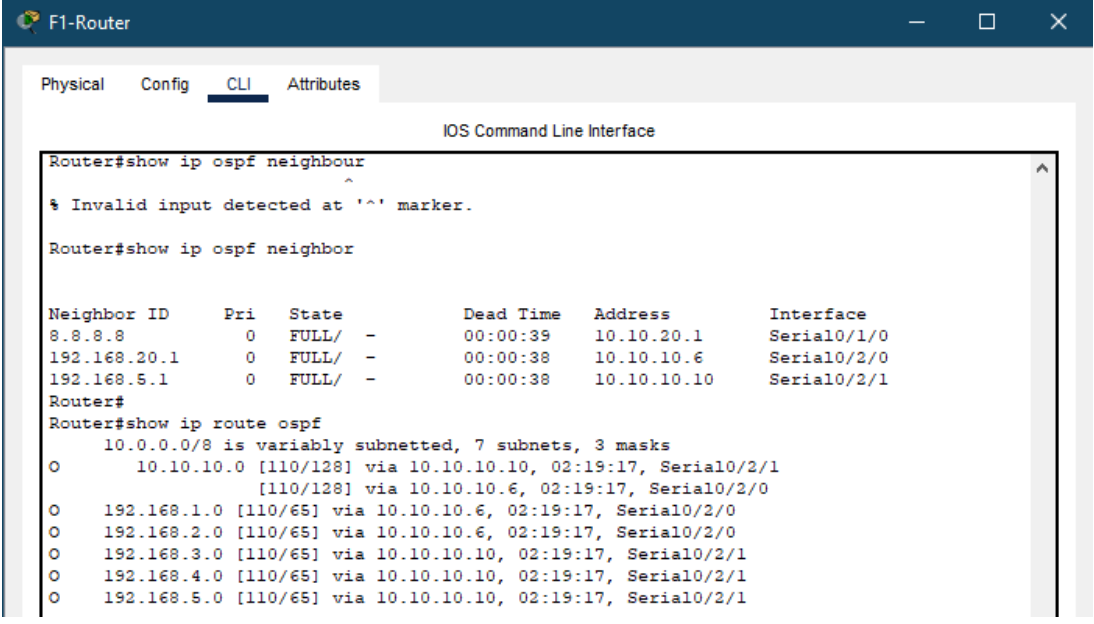
1 subnet is currently in the pool
Current index IP address range Leased/Excluded/Total
192.168.2.1 192.168.2.1 - 192.168.2.254 0 / 0 / 254
  
```

## WHY OSPF ROUTING PROTOCOL?

OSPF (Open Shortest Path First) was chosen as the routing protocol due to its ability to scale efficiently and its rapid convergence capabilities. The routers were set up to broadcast their directly connected networks, facilitating communication both between VLANs and with the ISP.

### ADVANTAGES:

1. Facilitates structured and hierarchical routing.
2. Responds swiftly to changes in the network topology.
3. Minimizes excess traffic using designated and backup routers.



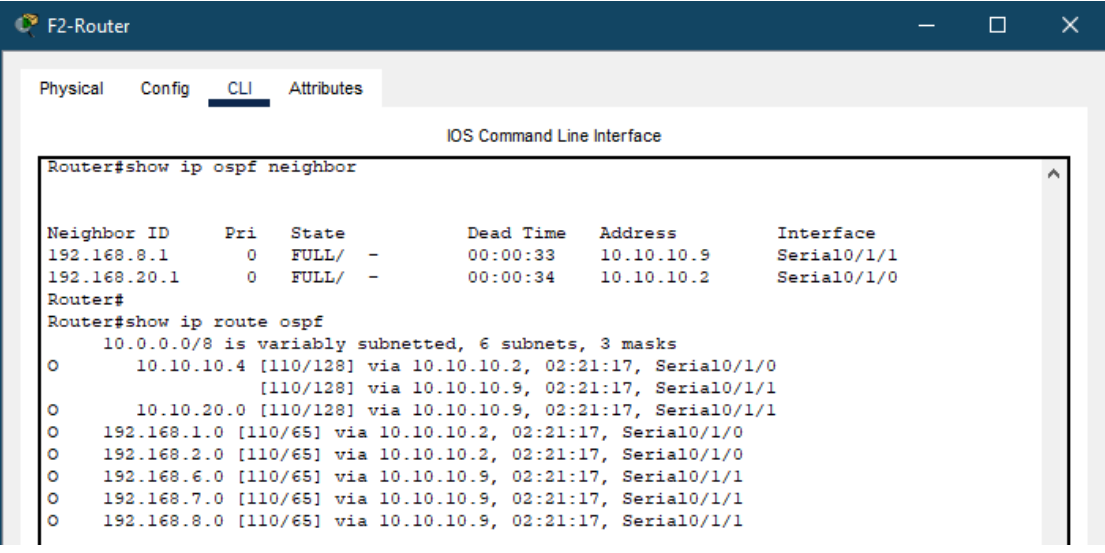
The screenshot shows the CLI of F1-Router. The user enters the command `show ip ospf neighbour`, which results in an error: `% Invalid input detected at '^' marker.`. The user then enters `show ip ospf neighbor`, which displays the following table:

Neighbor ID	Pri	State	Dead Time	Address	Interface
8.8.8.8	0	FULL/ -	00:00:39	10.10.20.1	Serial0/1/0
192.168.20.1	0	FULL/ -	00:00:38	10.10.10.6	Serial0/2/0
192.168.5.1	0	FULL/ -	00:00:38	10.10.10.10	Serial0/2/1

The user then enters `show ip route ospf`, which displays the following information:

```

10.0.0.0/8 is variably subnetted, 7 subnets, 3 masks
O       10.10.10.0 [110/128] via 10.10.10.10, 02:19:17, Serial0/2/1
         [110/128] via 10.10.10.6, 02:19:17, Serial0/2/0
O       192.168.1.0 [110/65] via 10.10.10.6, 02:19:17, Serial0/2/0
O       192.168.2.0 [110/65] via 10.10.10.6, 02:19:17, Serial0/2/0
O       192.168.3.0 [110/65] via 10.10.10.10, 02:19:17, Serial0/2/1
O       192.168.4.0 [110/65] via 10.10.10.10, 02:19:17, Serial0/2/1
O       192.168.5.0 [110/65] via 10.10.10.10, 02:19:17, Serial0/2/1
  
```



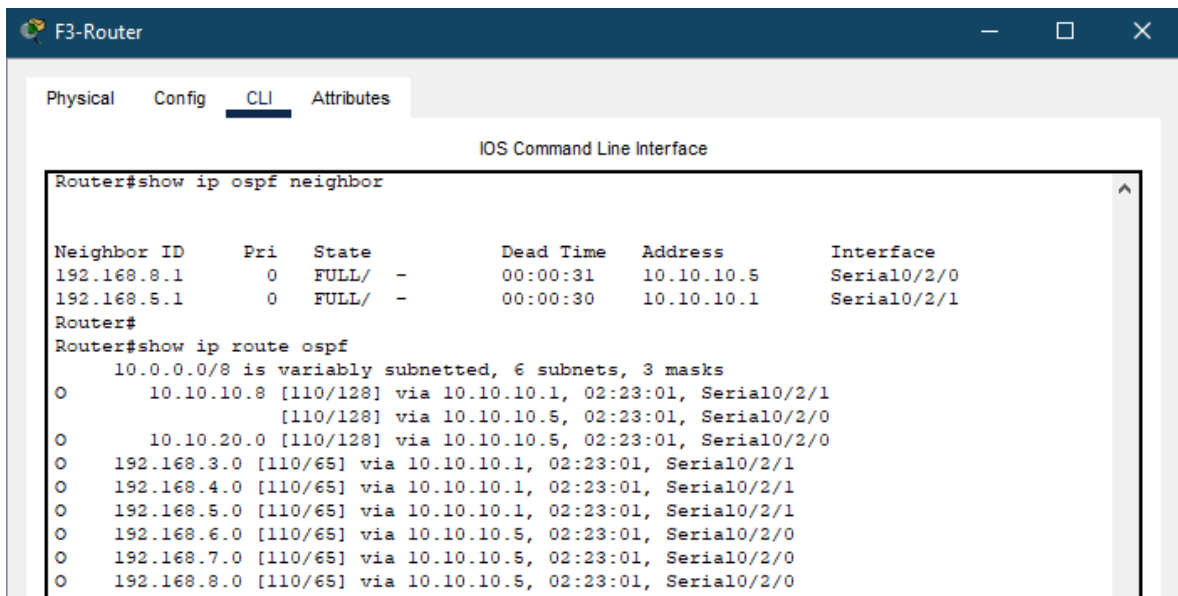
The screenshot shows the CLI of F2-Router. The user enters the command `show ip ospf neighbor`, which displays the following table:

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.8.1	0	FULL/ -	00:00:33	10.10.10.9	Serial0/1/1
192.168.20.1	0	FULL/ -	00:00:34	10.10.10.2	Serial0/1/0

The user then enters `show ip route ospf`, which displays the following information:

```

10.0.0.0/8 is variably subnetted, 6 subnets, 3 masks
O       10.10.10.4 [110/128] via 10.10.10.2, 02:21:17, Serial0/1/0
         [110/128] via 10.10.10.9, 02:21:17, Serial0/1/1
O       10.10.20.0 [110/128] via 10.10.10.9, 02:21:17, Serial0/1/1
O       192.168.1.0 [110/65] via 10.10.10.2, 02:21:17, Serial0/1/0
O       192.168.2.0 [110/65] via 10.10.10.2, 02:21:17, Serial0/1/0
O       192.168.6.0 [110/65] via 10.10.10.9, 02:21:17, Serial0/1/1
O       192.168.7.0 [110/65] via 10.10.10.9, 02:21:17, Serial0/1/1
O       192.168.8.0 [110/65] via 10.10.10.9, 02:21:17, Serial0/1/1
  
```



F3-Router

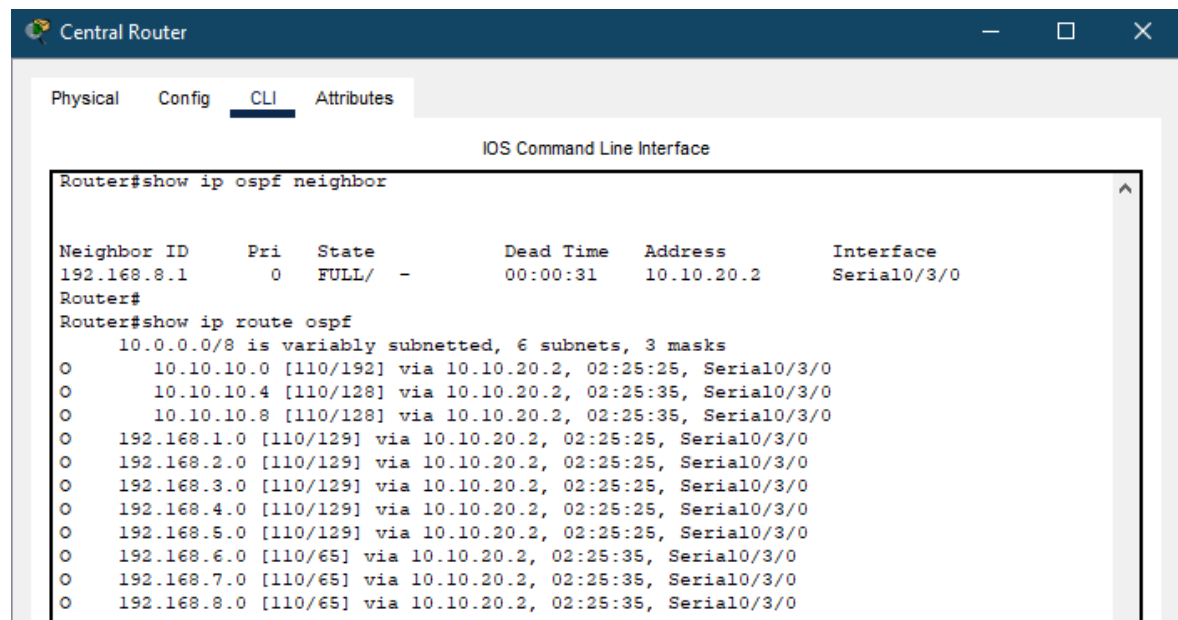
Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router#show ip ospf neighbor
```

Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.8.1	0	FULL/ -	00:00:31	10.10.10.5	Serial0/2/0
192.168.5.1	0	FULL/ -	00:00:30	10.10.10.1	Serial0/2/1

```
Router#
Router#show ip route ospf
10.0.0.0/8 is variably subnetted, 6 subnets, 3 masks
O 10.10.10.8 [110/128] via 10.10.10.1, 02:23:01, Serial0/2/1
  [110/128] via 10.10.10.5, 02:23:01, Serial0/2/0
O 10.10.20.0 [110/128] via 10.10.10.5, 02:23:01, Serial0/2/0
O 192.168.3.0 [110/65] via 10.10.10.1, 02:23:01, Serial0/2/1
O 192.168.4.0 [110/65] via 10.10.10.1, 02:23:01, Serial0/2/1
O 192.168.5.0 [110/65] via 10.10.10.1, 02:23:01, Serial0/2/1
O 192.168.6.0 [110/65] via 10.10.10.5, 02:23:01, Serial0/2/0
O 192.168.7.0 [110/65] via 10.10.10.5, 02:23:01, Serial0/2/0
O 192.168.8.0 [110/65] via 10.10.10.5, 02:23:01, Serial0/2/0
```



Central Router

Physical Config **CLI** Attributes

IOS Command Line Interface

```
Router#show ip ospf neighbor
```

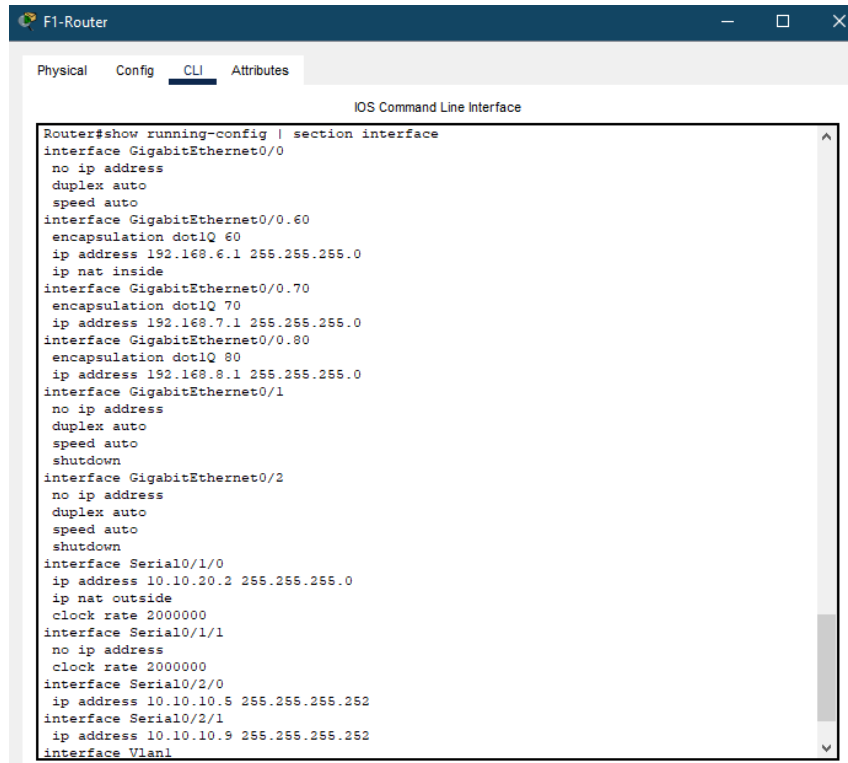
Neighbor ID	Pri	State	Dead Time	Address	Interface
192.168.8.1	0	FULL/ -	00:00:31	10.10.20.2	Serial0/3/0

```
Router#
Router#show ip route ospf
10.0.0.0/8 is variably subnetted, 6 subnets, 3 masks
O 10.10.10.0 [110/192] via 10.10.20.2, 02:25:25, Serial0/3/0
O 10.10.10.4 [110/128] via 10.10.20.2, 02:25:35, Serial0/3/0
O 10.10.10.8 [110/128] via 10.10.20.2, 02:25:35, Serial0/3/0
O 192.168.1.0 [110/129] via 10.10.20.2, 02:25:25, Serial0/3/0
O 192.168.2.0 [110/129] via 10.10.20.2, 02:25:25, Serial0/3/0
O 192.168.3.0 [110/129] via 10.10.20.2, 02:25:25, Serial0/3/0
O 192.168.4.0 [110/129] via 10.10.20.2, 02:25:25, Serial0/3/0
O 192.168.5.0 [110/129] via 10.10.20.2, 02:25:25, Serial0/3/0
O 192.168.6.0 [110/65] via 10.10.20.2, 02:25:35, Serial0/3/0
O 192.168.7.0 [110/65] via 10.10.20.2, 02:25:35, Serial0/3/0
O 192.168.8.0 [110/65] via 10.10.20.2, 02:25:35, Serial0/3/0
```



## NAT CONFIGURATION

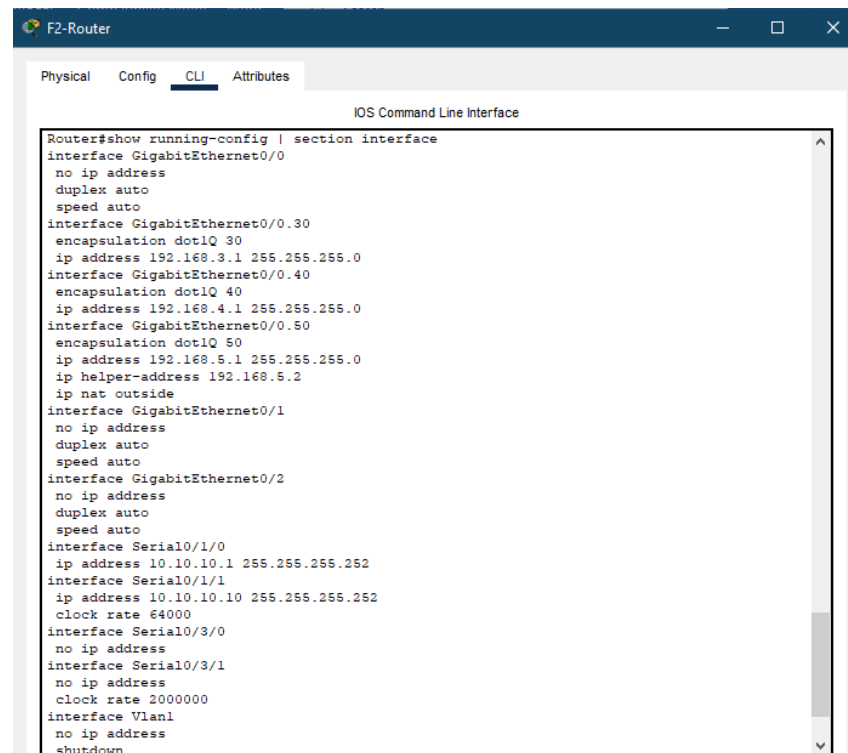
Network Address Translation (NAT) was configured to enable devices within the private VLANs to connect to the internet using a single public IP address assigned by the ISP.



```

F1-Router
Physical Config CLI Attributes
IOS Command Line Interface
Router#show running-config | section interface
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
interface GigabitEthernet0/0.60
encapsulation dot1Q 60
ip address 192.168.6.1 255.255.255.0
ip nat inside
interface GigabitEthernet0/0.70
encapsulation dot1Q 70
ip address 192.168.7.1 255.255.255.0
interface GigabitEthernet0/0.80
encapsulation dot1Q 80
ip address 192.168.8.1 255.255.255.0
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
shutdown
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto
shutdown
interface Serial0/1/0
ip address 10.10.20.2 255.255.255.0
ip nat outside
clock rate 2000000
interface Serial0/1/1
no ip address
clock rate 2000000
interface Serial0/2/0
ip address 10.10.10.5 255.255.255.252
interface Serial0/2/1
ip address 10.10.10.9 255.255.255.252
interface Vlan1

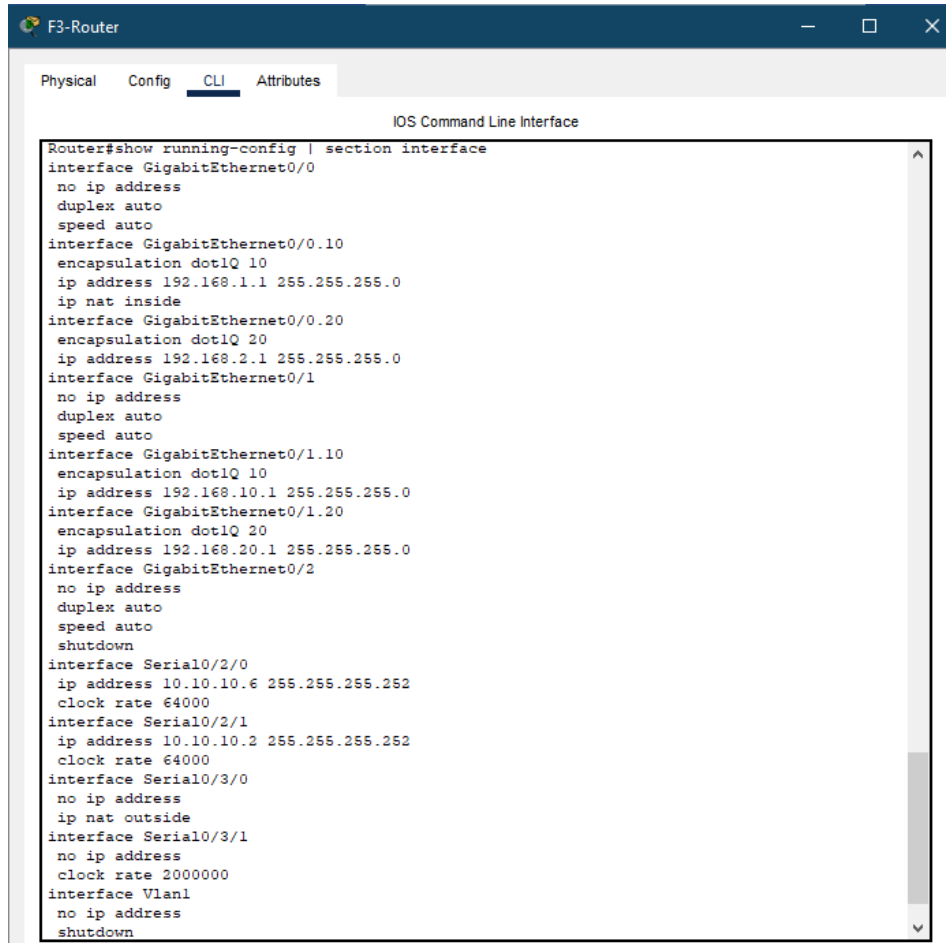
```



```

F2-Router
Physical Config CLI Attributes
IOS Command Line Interface
Router#show running-config | section interface
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
interface GigabitEthernet0/0.30
encapsulation dot1Q 30
ip address 192.168.3.1 255.255.255.0
interface GigabitEthernet0/0.40
encapsulation dot1Q 40
ip address 192.168.4.1 255.255.255.0
interface GigabitEthernet0/0.50
encapsulation dot1Q 50
ip address 192.168.5.1 255.255.255.0
ip helper-address 192.168.5.2
ip nat outside
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto
interface Serial0/1/0
ip address 10.10.10.1 255.255.255.252
interface Serial0/1/1
ip address 10.10.10.10 255.255.255.252
clock rate 64000
interface Serial0/3/0
no ip address
interface Serial0/3/1
no ip address
clock rate 2000000
interface Vlan1
no ip address
shutdown

```



```
Router#show running-config | section interface
interface GigabitEthernet0/0
no ip address
duplex auto
speed auto
interface GigabitEthernet0/0.10
encapsulation dot1Q 10
ip address 192.168.1.1 255.255.255.0
ip nat inside
interface GigabitEthernet0/0.20
encapsulation dot1Q 20
ip address 192.168.2.1 255.255.255.0
interface GigabitEthernet0/1
no ip address
duplex auto
speed auto
interface GigabitEthernet0/1.10
encapsulation dot1Q 10
ip address 192.168.10.1 255.255.255.0
interface GigabitEthernet0/1.20
encapsulation dot1Q 20
ip address 192.168.20.1 255.255.255.0
interface GigabitEthernet0/2
no ip address
duplex auto
speed auto
shutdown
interface Serial0/2/0
ip address 10.10.10.6 255.255.255.252
clock rate 64000
interface Serial0/2/1
ip address 10.10.10.2 255.255.255.252
clock rate 64000
interface Serial0/3/0
no ip address
ip nat outside
interface Serial0/3/1
no ip address
clock rate 2000000
interface Vlan1
no ip address
shutdown
```

## **INSPIRATION SOURCES**

These websites/videos were used as a source of inspiration and came in handy for completion of the project:

1. <https://www.youtube.com/watch?v=NIaP2Bkzs6k>
2. <https://www.youtube.com/watch?v=ZCz9rRhzy4>
3. <https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/13772-12.html>