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Princess Sumaya University for Technology

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Computer Networks Lab Report

22449

Final Project

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Abstract

This project involves the design, configuration, and implementation of a network topology using Cisco Packet Tracer. The topology consists of three ISR4331 routers, three 2960 switches, 11 PCs, and a server. The network is logically segmented using VLANs to ensure efficient traffic management and security. Routing protocols such as OSPF were configured for dynamic inter-VLAN routing, while NAT and ACLs were implemented to provide secure external access. The project demonstrates practical knowledge of network design, addressing, and security configurations.

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Introduction

In modern networking, efficient design and secure implementation are crucial for ensuring reliable communication. This project simulates a real-world network scenario using Cisco Packet Tracer, focusing on VLAN segmentation, interconnectivity through routing protocols, and the application of access control for enhanced security. The configuration addresses multiple aspects of networking, including DHCP, NAT, and ACLs, to meet organizational requirements and support scalable communication.

Objectives

- Design a network topology with three routers, three switches, 11 PCs, and a server.
- Configure VLANs for logical segmentation of the network.
- Implement inter-VLAN routing using OSPF for dynamic connectivity.
- Configure DHCP to automate IP address assignment for specific VLANs.
- Set up NAT and PAT to enable secure communication between private and public networks.
- Apply ACLs to restrict unauthorized access and manage traffic effectively.
- Validate connectivity and ensure compliance with project requirements.

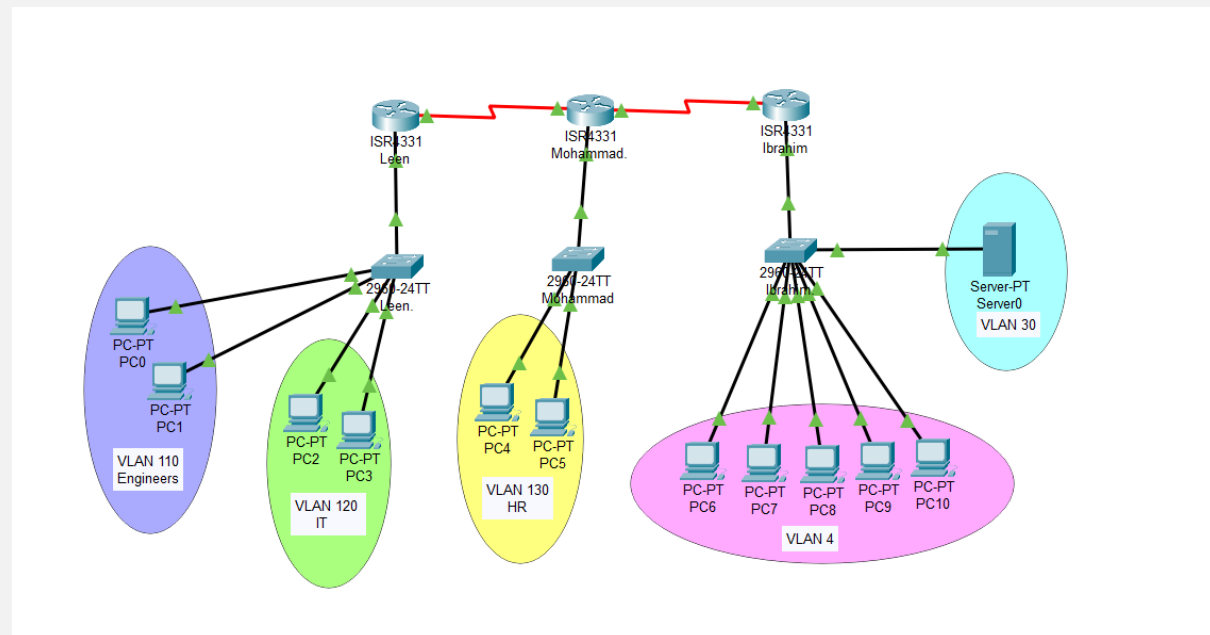
Theory

This project applies key networking principles:

1. **VLANs (Virtual LANs):** Used to logically segment the network, enhancing security and reducing broadcast domains.
2. **OSPF (Open Shortest Path First):** A link-state routing protocol that enables dynamic routing across the network.
3. **DHCP (Dynamic Host Configuration Protocol):** Simplifies IP address management by dynamically allocating IP addresses to devices.
4. **NAT (Network Address Translation):** Enables communication between private and public IP addresses by translating them.
5. **ACLs (Access Control Lists):** Provide traffic filtering to enforce security policies.

Procedure and Discussions

Topology



Configurations

- VLANs

Switch0:

PC0 and PC1 should be in the same VLAN with ID 110 and name of Engineers.

PC2 and PC3 should be in the same VLAN with ID 120 and name of IT.

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 110
Switch(config-vlan)#name Engineers
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#vlan 120
Switch(config-vlan)#name IT
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#interface range FastEthernet0/1-2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 110
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#interface range FastEthernet0/3-4
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 120
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

Using **show vlan brief** command to make sure our vlans are set correctly.

```
Switch#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	Fa0/5, Fa0/6, 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
110	Engineers	active	Fa0/1, Fa0/2
120	IT	active	Fa0/3, Fa0/4
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

```
Switch#
```

Switch1:

PC4 and PC5 should be in the same VLAN with ID 130 and name of HR.

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 130
Switch(config-vlan)#name HR
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#interface range FastEthernet0/1-2
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 130
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Switch#show vlan brief
```

VLAN	Name	Status	Ports
1	default	active	Fa0/3, Fa0/4, Fa0/5, Fa0/6 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
130	HR	active	Fa0/1, Fa0/2
1002	fddi-default	active	
1003	token-ring-default	active	
1004	fddinet-default	active	
1005	trnet-default	active	

```
Switch#
```

Switch2:

PCs 6-10 in VLAN 4 and Server SRV0 in VLAN 30

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 4
Switch(config-vlan)#name VLAN4
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#vlan 30
Switch(config-vlan)#name VLAN30
Switch(config-vlan)#exit
Switch(config)#
Switch(config)#interface range FastEthernet0/1-5
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 4
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#interface range FastEthernet0/6
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 30
Switch(config-if-range)#exit
Switch(config)#
Switch(config)#interface GigabitEthernet0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#exit
Switch(config)#exit
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

```
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
4 VLAN4	active	Fa0/1, Fa0/2, Fa0/3, Fa0/4 Fa0/5
30 VLAN30	active	Fa0/6
1002 fddi-default	active	
1003 token-ring-default	active	
1004 fddinet-default	active	
1005 trnet-default	active	

```
Switch#
```

- IP Addresses

Router0:

```
Router0>enable
Router0#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#interface GigabitEthernet0/0/0.110
Router0(config-subif)#encapsulation dot1Q 110
Router0(config-subif)#ip address 110.0.0.1 255.255.255.0
Router0(config-subif)#no shutdown
Router0(config-subif)#exit
Router0(config)#
Router0(config)#interface GigabitEthernet0/0/0.120
Router0(config-subif)#encapsulation dot1Q 120
Router0(config-subif)#ip address 120.0.0.1 255.255.255.0
Router0(config-subif)#no shutdown
Router0(config-subif)#exit
Router0(config)#
Router0(config)#interface Serial0/1/0
Router0(config-if)#ip address 200.0.0.1 255.255.255.0
Router0(config-if)#no shutdown
Router0(config-if)#exit
Router0(config)#exit
Router0#
%SYS-5-CONFIG_I: Configured from console by console
```

Router1:

```
Router1>enable
Router1#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router1(config)#interface GigabitEthernet0/0/0
Router1(config-if)#ip address 30.0.0.1 255.255.255.0
Router1(config-if)#no shutdown
Router1(config-if)#exit
Router1(config)#
Router1(config)#interface GigabitEthernet0/0/0.130
Router1(config-subif)#ip address 130.0.0.1 255.255.255.0
Router1(config-subif)#no shutdown
Router1(config-subif)#exit
Router1(config)#
Router1(config)#interface Serial0/1/0
Router1(config-if)#ip address 200.0.0.2 255.255.255.0
Router1(config-if)#no shutdown
Router1(config-if)#exit
Router1(config)#
Router1(config)#interface Serial0/1/1
Router1(config-if)#ip address 201.0.0.1 255.255.255.0
Router1(config-if)#no shutdown
Router1(config-if)#exit
Router1(config)#exit
Router1#
%SYS-5-CONFIG_I: Configured from console by console
```

Router2:

```
Router2>enable
Router2#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router2(config)#interface GigabitEthernet0/0/0.30
Router2(config-subif)#encapsulation dot1Q 30
Router2(config-subif)#ip address 192.168.30.1 255.255.255.0
Router2(config-subif)#no shutdown
Router2(config-subif)#exit
Router2(config)#
Router2(config)#interface GigabitEthernet0/0/0.4
Router2(config-subif)#encapsulation dot1Q 4
Router2(config-subif)#ip address 192.168.4.1 255.255.255.0
Router2(config-subif)#no shutdown
Router2(config-subif)#exit
Router2(config)#exit
Router2#
%SYS-5-CONFIG_I: Configured from console by console

Router2#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router2(config)#interface Serial0/1/1
Router2(config-if)#ip address 201.0.0.2 255.255.255.0
Router2(config-if)#no shutdown
Router2(config-if)#exit
Router2(config)#exit
Router2#
%SYS-5-CONFIG_I: Configured from console by console
```

Switch1:

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#interface vlan 1
Switch(config-if)#ip address 30.0.0.5 255.255.255.0
Switch(config-if)#no shutdown

Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan1, changed state to up

Switch(config-if)#exit
Switch(config)#
```

PC0:

PC0

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 110.0.0.17

Subnet Mask 255.255.255.0

Default Gateway 110.0.0.1

DNS Server 0.0.0.0

PC1:

PC1

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 110.0.0.16

Subnet Mask 255.255.255.0

Default Gateway 110.0.0.1

DNS Server 0.0.0.0

PC2:

PC2

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 120.0.0.16

Subnet Mask 255.255.255.0

Default Gateway 120.0.0.1

DNS Server 0.0.0.0

PC3:

PC3

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☒ DHCP ☐ Static

IPv4 Address 120.0.0.17

Subnet Mask 255.255.255.0

Default Gateway 120.0.0.1

DNS Server 0.0.0.0

PC4:

PC4

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 130.0.0.10

Subnet Mask 255.255.0.0

Default Gateway 130.0.0.1

DNS Server 0.0.0.0

PC5:

PC5

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 130.0.0.11

Subnet Mask 255.255.0.0

Default Gateway 130.0.0.1

DNS Server 0.0.0.0

PC6:

PC6

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

IPv4 Address 192.168.4.2

Subnet Mask 255.255.255.0

Default Gateway 192.168.4.1

DNS Server 0.0.0.0

PC7:

PC7

Physical Config **Desktop** Programming Attributes

IP Configuration

Interface FastEthernet0

IP Configuration

☐ DHCP ☒ Static

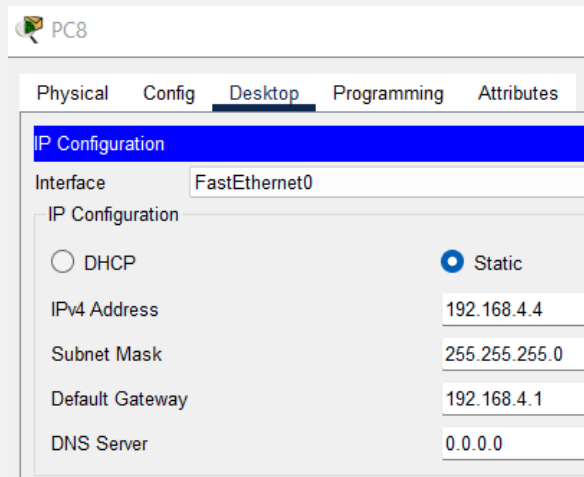
IPv4 Address 192.168.4.3

Subnet Mask 255.255.255.0

Default Gateway 192.168.4.1

DNS Server 0.0.0.0

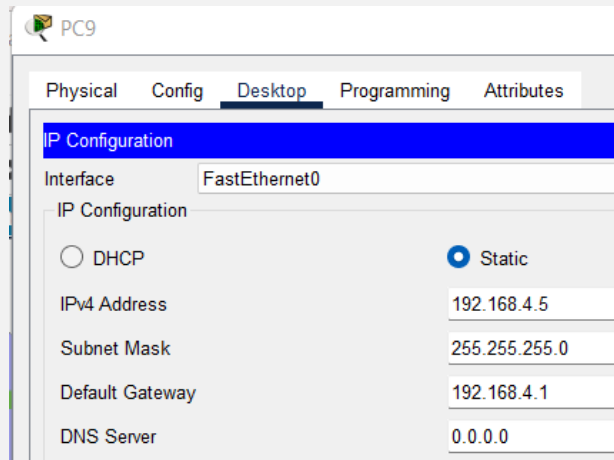
PC8:



PC8 configuration window showing the Desktop tab. The IP Configuration section for FastEthernet0 is set to Static. The IPv4 Address is 192.168.4.4, Subnet Mask is 255.255.255.0, Default Gateway is 192.168.4.1, and DNS Server is 0.0.0.0.

Interface	FastEthernet0
IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IPv4 Address	192.168.4.4
Subnet Mask	255.255.255.0
Default Gateway	192.168.4.1
DNS Server	0.0.0.0

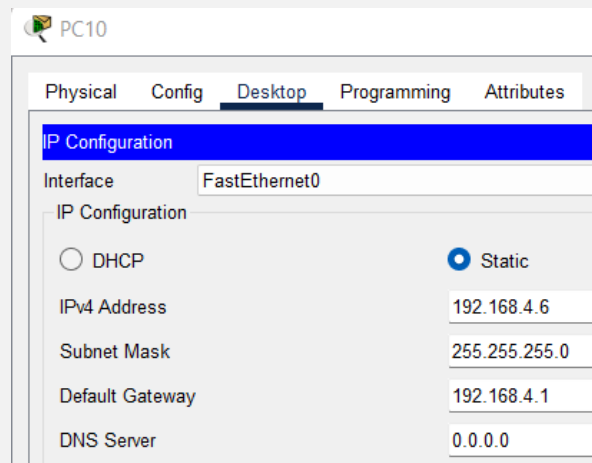
PC9:



PC9 configuration window showing the Desktop tab. The IP Configuration section for FastEthernet0 is set to Static. The IPv4 Address is 192.168.4.5, Subnet Mask is 255.255.255.0, Default Gateway is 192.168.4.1, and DNS Server is 0.0.0.0.

Interface	FastEthernet0
IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IPv4 Address	192.168.4.5
Subnet Mask	255.255.255.0
Default Gateway	192.168.4.1
DNS Server	0.0.0.0

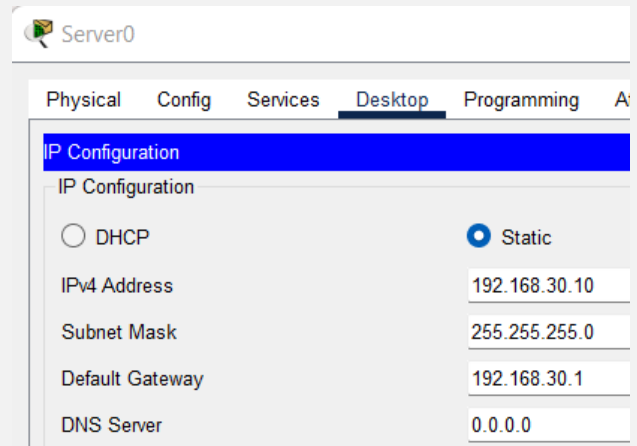
PC10:



PC10 configuration window showing the Desktop tab. The IP Configuration section for FastEthernet0 is set to Static. The IPv4 Address is 192.168.4.6, Subnet Mask is 255.255.255.0, Default Gateway is 192.168.4.1, and DNS Server is 0.0.0.0.

Interface	FastEthernet0
IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IPv4 Address	192.168.4.6
Subnet Mask	255.255.255.0
Default Gateway	192.168.4.1
DNS Server	0.0.0.0

SRV0:



SRV0 configuration window showing the Desktop tab. The IP Configuration section for FastEthernet0 is set to Static. The IPv4 Address is 192.168.30.10, Subnet Mask is 255.255.255.0, Default Gateway is 192.168.30.1, and DNS Server is 0.0.0.0.

Interface	FastEthernet0
IP Configuration	
<input type="radio"/> DHCP	<input checked="" type="radio"/> Static
IPv4 Address	192.168.30.10
Subnet Mask	255.255.255.0
Default Gateway	192.168.30.1
DNS Server	0.0.0.0

- **VLANs Ping**
 - Ping devices in the same VLAN

PC0 ping PC1

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 110.0.0.16

Pinging 110.0.0.16 with 32 bytes of data:

Reply from 110.0.0.16: bytes=32 time<1ms TTL=128
Reply from 110.0.0.16: bytes=32 time<1ms TTL=128
Reply from 110.0.0.16: bytes=32 time<1ms TTL=128
Reply from 110.0.0.16: bytes=32 time=1ms TTL=128

Ping statistics for 110.0.0.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

PC2 ping PC3

```
C:\>ping 120.0.0.16

Pinging 120.0.0.16 with 32 bytes of data:

Reply from 120.0.0.16: bytes=32 time<1ms TTL=128
Reply from 120.0.0.16: bytes=32 time<1ms TTL=128
Reply from 120.0.0.16: bytes=32 time<1ms TTL=128
Reply from 120.0.0.16: bytes=32 time=1ms TTL=128

Ping statistics for 120.0.0.16:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

PC4 ping PC5

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 130.0.0.11

Pinging 130.0.0.11 with 32 bytes of data:

Reply from 130.0.0.11: bytes=32 time<1ms TTL=128
Reply from 130.0.0.11: bytes=32 time<1ms TTL=128
Reply from 130.0.0.11: bytes=32 time<1ms TTL=128
Reply from 130.0.0.11: bytes=32 time<1ms TTL=128

Ping statistics for 130.0.0.11:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC6 ping PC7, PC8, PC9, and PC10

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.4.3

Pinging 192.168.4.3 with 32 bytes of data:

Reply from 192.168.4.3: bytes=32 time<1ms TTL=128
Reply from 192.168.4.3: bytes=32 time<1ms TTL=128
Reply from 192.168.4.3: bytes=32 time<1ms TTL=128
Reply from 192.168.4.3: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.4.3:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.4.4

Pinging 192.168.4.4 with 32 bytes of data:

Reply from 192.168.4.4: bytes=32 time<1ms TTL=128
Reply from 192.168.4.4: bytes=32 time<1ms TTL=128
Reply from 192.168.4.4: bytes=32 time=1ms TTL=128
Reply from 192.168.4.4: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.4.4:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>ping 192.168.4.5

Pinging 192.168.4.5 with 32 bytes of data:

Reply from 192.168.4.5: bytes=32 time<1ms TTL=128
Reply from 192.168.4.5: bytes=32 time<1ms TTL=128
Reply from 192.168.4.5: bytes=32 time=1ms TTL=128
Reply from 192.168.4.5: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.4.5:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms
```

```
C:\>ping 192.168.4.6

Pinging 192.168.4.6 with 32 bytes of data:

Reply from 192.168.4.6: bytes=32 time=1ms TTL=128
Reply from 192.168.4.6: bytes=32 time<1ms TTL=128
Reply from 192.168.4.6: bytes=32 time<1ms TTL=128
Reply from 192.168.4.6: bytes=32 time=1ms TTL=128

Ping statistics for 192.168.4.6:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

All VLANs are correctly configured for our topology.

- **Router Interfaces Ping**

PC0 ping Router0

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 110.0.0.1

Pinging 110.0.0.1 with 32 bytes of data:

Reply from 110.0.0.1: bytes=32 time<1ms TTL=255
Reply from 110.0.0.1: bytes=32 time<1ms TTL=255
Reply from 110.0.0.1: bytes=32 time<1ms TTL=255
Reply from 110.0.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 110.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC2 ping Router0

```
C:\>ping 120.0.0.1

Pinging 120.0.0.1 with 32 bytes of data:

Reply from 120.0.0.1: bytes=32 time<1ms TTL=255
Reply from 120.0.0.1: bytes=32 time<1ms TTL=255
Reply from 120.0.0.1: bytes=32 time<1ms TTL=255
Reply from 120.0.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 120.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC4 ping Router1

```
C:\>ping 130.0.0.1

Pinging 130.0.0.1 with 32 bytes of data:

Reply from 130.0.0.1: bytes=32 time<1ms TTL=255
Reply from 130.0.0.1: bytes=32 time<1ms TTL=255
Reply from 130.0.0.1: bytes=32 time<1ms TTL=255
Reply from 130.0.0.1: bytes=32 time<1ms TTL=255

Ping statistics for 130.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC6 ping Router2

```
C:\>ping 192.168.4.1

Pinging 192.168.4.1 with 32 bytes of data:

Reply from 192.168.4.1: bytes=32 time<1ms TTL=255
Reply from 192.168.4.1: bytes=32 time<1ms TTL=255
Reply from 192.168.4.1: bytes=32 time<1ms TTL=255
Reply from 192.168.4.1: bytes=32 time=1ms TTL=255

Ping statistics for 192.168.4.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

SRV0 ping Router2

```
Cisco Packet Tracer SERVER Command Line 1.0
C:\>ping 192.168.30.1

Pinging 192.168.30.1 with 32 bytes of data:

Reply from 192.168.30.1: bytes=32 time<1ms TTL=255
Reply from 192.168.30.1: bytes=32 time<1ms TTL=255
Reply from 192.168.30.1: bytes=32 time<1ms TTL=255
Reply from 192.168.30.1: bytes=32 time<1ms TTL=255

Ping statistics for 192.168.30.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

- **Inter-VLAN Routing**
 - Ping devices in different VLANs

PC0 ping PC2

```
C:\>ping 120.0.0.17

Pinging 120.0.0.17 with 32 bytes of data:

Reply from 120.0.0.17: bytes=32 time<1ms TTL=127
Reply from 120.0.0.17: bytes=32 time=1ms TTL=127
Reply from 120.0.0.17: bytes=32 time<1ms TTL=127
Reply from 120.0.0.17: bytes=32 time<1ms TTL=127

Ping statistics for 120.0.0.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 1ms, Average = 0ms

C:\>
```

PC4 ping PC6

```
C:\>ping 192.168.4.2

Pinging 192.168.4.2 with 32 bytes of data:

Reply from 201.0.0.2: bytes=32 time=7ms TTL=126
Reply from 201.0.0.2: bytes=32 time=1ms TTL=126
Reply from 201.0.0.2: bytes=32 time=1ms TTL=126
Reply from 201.0.0.2: bytes=32 time=13ms TTL=126

Ping statistics for 192.168.4.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 13ms, Average = 5ms

C:\>
```

PC10 ping SRV0

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.30.10

Pinging 192.168.30.10 with 32 bytes of data:

Reply from 192.168.30.10: bytes=32 time<1ms TTL=127
Reply from 192.168.30.10: bytes=32 time<1ms TTL=127
Reply from 192.168.30.10: bytes=32 time<1ms TTL=127
Reply from 192.168.30.10: bytes=32 time<1ms TTL=127

Ping statistics for 192.168.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

- **DHCP Pools**

Configuring Router0 as DHCP server for VLAN 110 and 120.

```
Router0>enable
Router0#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#ip dhcp excluded-address 110.0.0.1
Router0(config)#ip dhcp excluded-address 120.0.0.1
Router0(config)#
Router0(config)#ip dhcp pool Engineers
Router0(dhcp-config)#network 110.0.0.0 255.255.255.0
Router0(dhcp-config)#default-router 110.0.0.1
Router0(dhcp-config)#dns-server 8.8.8.8
Router0(dhcp-config)#exit
Router0(config)#
Router0(config)#ip dhcp pool IT
Router0(dhcp-config)#network 120.0.0.0 255.255.255.0
Router0(dhcp-config)#default-router 120.0.0.1
Router0(dhcp-config)#dns-server 8.8.8.8
Router0(dhcp-config)#exit
Router0(config)#
Router0(config)#service dhcp
Router0(config)#exit
Router0#
%SYS-5-CONFIG_I: Configured from console by console
```

Using **show ip dhcp pool** command to make sure our dhcp pools are set correctly.

```
Router0#show ip dhcp pool

Pool Engineers :
Utilization mark (high/low)      : 100 / 0
Subnet size (first/next)         : 0 / 0
Total addresses                   : 254
Leased addresses                  : 0
Excluded addresses                : 2
Pending event                     : none

1 subnet is currently in the pool
Current index      IP address range      Leased/Excluded/Total
110.0.0.1          110.0.0.1 - 110.0.0.254    0 / 2 / 254

Pool IT :
Utilization mark (high/low)      : 100 / 0
Subnet size (first/next)         : 0 / 0
Total addresses                   : 254
Leased addresses                  : 0
Excluded addresses                : 2
Pending event                     : none

1 subnet is currently in the pool
Current index      IP address range      Leased/Excluded/Total
120.0.0.1          120.0.0.1 - 120.0.0.254    0 / 2 / 254
Router0#
```

DHCP verifications on PC0 & PC2

```
C:\>ipconfig

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix...:
    Link-local IPv6 Address.....: FE80::20C:85FF:FE49:4D65
    IPv6 Address.....: ::
    IPv4 Address.....: 110.0.0.16
    Subnet Mask.....: 255.255.255.0
    Default Gateway.....: ::
                        110.0.0.1

C:\>ipconfig

FastEthernet0 Connection:(default port)

    Connection-specific DNS Suffix...:
    Link-local IPv6 Address.....: FE80::209:7CFF:FE87:DAB8
    IPv6 Address.....: ::
    IPv4 Address.....: 120.0.0.17
    Subnet Mask.....: 255.255.255.0
    Default Gateway.....: ::
                        120.0.0.1
```

- OSPF

Router0:

```
Router0>enable
Router0#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router0(config)#router ospf 1
Router0(config-router)#network 110.0.0.0 0.0.0.255 area 0
Router0(config-router)#network 120.0.0.0 0.0.0.255 area 0
Router0(config-router)#network 200.0.0.0 0.0.0.255 area 0
Router0(config-router)#exit
Router0(config)#exit
Router0#
%SYS-5-CONFIG_I: Configured from console by console
```

```
Router0#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

 30.0.0.0/24 is subnetted, 1 subnets
O   30.0.0.0/24 [110/65] via 200.0.0.2, 00:02:04, Serial0/1/0
 110.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C   110.0.0.0/24 is directly connected, GigabitEthernet0/0/0.110
L   110.0.0.1/32 is directly connected, GigabitEthernet0/0/0.110
 120.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C   120.0.0.0/24 is directly connected, GigabitEthernet0/0/0.120
L   120.0.0.1/32 is directly connected, GigabitEthernet0/0/0.120
 130.0.0.0/24 is subnetted, 1 subnets
O   130.0.0.0/24 [110/65] via 200.0.0.2, 00:02:04, Serial0/1/0
 200.0.0.0/24 is variably subnetted, 2 subnets, 2 masks
C   200.0.0.0/24 is directly connected, Serial0/1/0
--More--
```


Router1:

```
Router1>enable
Router1#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router1(config)#router ospf 1
Router1(config-router)#network 130.0.0.0 0.0.0.255 area 0
Router1(config-router)#network 30.0.0.0 0.0.0.255 area 0
Router1(config-router)#network 200.0.0.0 0.0.0.255 area 0
Router1(config-router)#\
01:15:08: %OSPF-5-ADJCHG: Process 1, Nbr 200.0.0.1 on Serial0/1/0 from LOADING to FULL, Loading
Done
Router1(config-router)#network 201.0.0.0 0.0.0.255 area 0
Router1(config-router)#exit
Router1(config)#
```

```
Router1#show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       I - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set

 30.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
C    30.0.0.0/24 is directly connected, GigabitEthernet0/0/0
L    30.0.0.1/32 is directly connected, GigabitEthernet0/0/0
    110.0.0.0/24 is subnetted, 1 subnets
O    110.0.0.0/24 [110/65] via 200.0.0.1, 00:03:15, Serial0/1/0
    120.0.0.0/24 is subnetted, 1 subnets
O    120.0.0.0/24 [110/65] via 200.0.0.1, 00:03:15, Serial0/1/0
    130.0.0.0/16 is variably subnetted, 2 subnets, 2 masks
C    130.0.0.0/24 is directly connected, GigabitEthernet0/0/0.130
L    130.0.0.1/32 is directly connected, GigabitEthernet0/0/0.130
    200.0.0.0/24 is variably subnetted, 2 subnets, 2 masks
C    200.0.0.0/24 is directly connected, Serial0/1/0
--More--
```

Router2:

```
Router2>enable
Router2#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router2(config)#router ospf 1
Router2(config-router)#network 201.0.0.0 0.0.0.255 area 0
Router2(config-router)#
01:16:34: %OSPF-5-ADJCHG: Process 1, Nbr 201.0.0.1 on Serial0/1/1 from LOADING to FULL, Loading
Done
Router2(config-router)#exit
```

```

Gateway of last resort is not set

  30.0.0.0/24 is subnetted, 1 subnets
O   30.0.0.0/24 [110/65] via 201.0.0.1, 00:02:27, Serial0/1/1
  110.0.0.0/24 is subnetted, 1 subnets
O   110.0.0.0/24 [110/129] via 201.0.0.1, 00:02:27, Serial0/1/1
  120.0.0.0/24 is subnetted, 1 subnets
O   120.0.0.0/24 [110/129] via 201.0.0.1, 00:02:27, Serial0/1/1
  130.0.0.0/24 is subnetted, 1 subnets
O   130.0.0.0/24 [110/65] via 201.0.0.1, 00:02:27, Serial0/1/1
  192.168.4.0/24 is variably subnetted, 2 subnets, 2 masks
C   192.168.4.0/24 is directly connected, GigabitEthernet0/0/0.4
L   192.168.4.1/32 is directly connected, GigabitEthernet0/0/0.4
  192.168.30.0/24 is variably subnetted, 2 subnets, 2 masks
--More--

```

• OSPF Verification

PC0 ping PC4

```

C:\>ping 130.0.0.10

Pinging 130.0.0.10 with 32 bytes of data:

Reply from 130.0.0.10: bytes=32 time=13ms TTL=126
Reply from 130.0.0.10: bytes=32 time=1ms TTL=126
Reply from 130.0.0.10: bytes=32 time=7ms TTL=126
Reply from 130.0.0.10: bytes=32 time=1ms TTL=126

Ping statistics for 130.0.0.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 13ms, Average = 5ms

C:\>

```

PC6 ping PC2

```

C:\>ping 120.0.0.17

Pinging 120.0.0.17 with 32 bytes of data:

Reply from 120.0.0.17: bytes=32 time=2ms TTL=125
Reply from 120.0.0.17: bytes=32 time=2ms TTL=125
Reply from 120.0.0.17: bytes=32 time=2ms TTL=125
Reply from 120.0.0.17: bytes=32 time=10ms TTL=125

Ping statistics for 120.0.0.17:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 10ms, Average = 4ms

C:\>

```

- **Routers and Switches Hostnames**

```
Router0(config)#hostname Leen
Leen(config)#
```

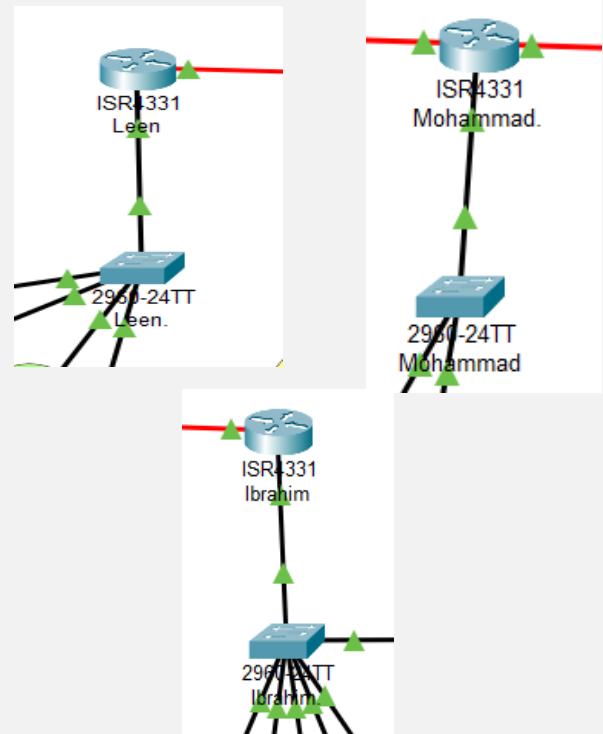
```
Switch0(config)#hostname Leen
Leen(config)#
```

```
Router1(config)#hostname Mohammad
Mohammad(config)#
```

```
Switch0(config)#hostname Mohammad
Mohammad(config)#
```

```
Router2(config)#hostname Ibrahim
Ibrahim(config)#
```

```
Switch2(config)#hostname Ibrahim
Ibrahim(config)#
```



- **Password**

Enable:

- Routers:

```
Leen>enable
Leen#config term
Enter configuration commands, one per line. End with CNTL/Z.
Leen(config)#enable secret PSUT
Leen(config)#exit
Leen#
```

```
Mohammad>enable
Mohammad#config term
Enter configuration commands, one per line. End with CNTL/Z.
Mohammad(config)#enable secret PSUT
Mohammad(config)#exit
Mohammad#
```

```
Ibrahim>enable
Ibrahim#config term
Enter configuration commands, one per line. End with CNTL/Z.
Ibrahim(config)#enable secret PSUT
Ibrahim(config)#exit
```

- Switches:

```
Leen>enable
Leen#config term
Enter configuration commands, one per line. End with CNTL/Z.
Leen(config)#enable secret PSUT
Leen(config)#exit
Leen#
```

```
Mohammad>enable
Mohammad#config term
Enter configuration commands, one per line. End with CNTL/Z.
Mohammad(config)#enable secret PSUT
Mohammad(config)#exit
Mohammad#
```

```
Ibrahim>enable
Ibrahim#config term
Enter configuration commands, one per line. End with CNTL/Z.
Ibrahim(config)#enable secret PSUT
Ibrahim(config)#exit
```

Console:

- Routers:

```
Leen(config)#line console 0
Leen(config-line)#password PSUT
Leen(config-line)#login
Leen(config-line)#exit
Leen(config)#
```

```
Mohammad(config)#line console 0
Mohammad(config-line)#password PSUT
Mohammad(config-line)#login
Mohammad(config-line)#exit
Mohammad(config)#
```

```
Enter configuration commands, one per line.
Ibrahim(config)#line console 0
Ibrahim(config-line)#password PSUT
Ibrahim(config-line)#login
Ibrahim(config-line)#exit
Ibrahim(config)#
```

- Switches:

```
Leen(config)#line console 0
Leen(config-line)#password PSUT
Leen(config-line)#login
Leen(config-line)#exit
Leen(config)#
```

```
Mohammad(config)#line console 0
Mohammad(config-line)#password PSUT
Mohammad(config-line)#login
Mohammad(config-line)#exit
Mohammad(config)#
```

```
Ibrahim(config)#line console 0
Ibrahim(config-line)#password PSUT
Ibrahim(config-line)#login
Ibrahim(config-line)#exit
Ibrahim(config)#
```

VTY:

- Routers:

```
User Access Verification
```

```
Password:
```

```
Leen>enable
```

```
Password:
```

```
Leen#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Leen(config)#line vty 0 4
```

```
Leen(config-line)#password PSUT
```

```
Leen(config-line)#login
```

```
Leen(config-line)#exit
```

```
Leen(config)#
```

```
User Access Verification
```

```
Password:
```

```
Mohammad>enable
```

```
Password:
```

```
Mohammad#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Mohammad(config)#line vty 0 4
```

```
Mohammad(config-line)#password PSUT
```

```
Mohammad(config-line)#login
```

```
Mohammad(config-line)#exit
```

```
Mohammad(config)#
```

```
User Access Verification
```

```
Password:
```

```
Ibrahim>enable
```

```
Password:
```

```
Ibrahim#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Ibrahim(config)#line vty 0 4
```

```
Ibrahim(config-line)#password PSUT
```

```
Ibrahim(config-line)#login
```

```
Ibrahim(config-line)#exit
```

```
Ibrahim(config)#
```

- Switches:

```
User Access Verification
```

```
Password:
```

```
Leen>enable
```

```
Password:
```

```
Leen#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Leen(config)#line vty 0 4
```

```
Leen(config-line)#password PSUT
```

```
Leen(config-line)#login
```

```
Leen(config-line)#exit
```

```
User Access Verification
```

```
Password:
```

```
Mohammad>enable
```

```
Password:
```

```
Mohammad#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Mohammad(config)#line vty 0 4
```

```
Mohammad(config-line)#password PSUT
```

```
Mohammad(config-line)#login
```

```
Mohammad(config-line)#exit
```

```
User Access Verification
```

```
Password:
```

```
Ibrahim>enable
```

```
Password:
```

```
Ibrahim#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Ibrahim(config)#line vty 0 4
```

```
Ibrahim(config-line)#password PSUT
```

```
Ibrahim(config-line)#login
```

```
Ibrahim(config-line)#exit
```

- **Telnet**

Used Telnet to make Mohammad Switch accessible for remote configuration from any other VLAN in the topology.

```
User Access Verification
```

```
Password:
```

```
Mohammad>enable
```

```
Password:
```

```
Mohammad#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Mohammad(config)#line vty 0 4
```

```
Mohammad(config-line)#transport input telnet
```

```
Mohammad(config-line)#password PSUT
```

```
Mohammad(config-line)#login
```

```
Mohammad(config-line)#exit
```

```
Mohammad(config)#
```

- **NAT**

Static NAT is used to reach the server since its network is private, using the public IP of Serial0/1/1 of Ibrahim Router.

passive-interface is used to prevent the ospf.

```
Ibrahim(config)#router ospf 1
Ibrahim(config-router)#passive-interface GigabitEthernet0/0/0.30
Ibrahim(config-router)#exit
Ibrahim(config)#
Ibrahim(config)#interface GigabitEthernet0/0/0.30
Ibrahim(config-subif)#ip nat inside
Ibrahim(config-subif)#exit
Ibrahim(config)#
Ibrahim(config)#interface Serial0/1/1
Ibrahim(config-if)#ip nat outside
Ibrahim(config-if)#exit
Ibrahim(config)#
Ibrahim(config)#ip nat inside source static 192.168.30.10 201.0.0.2
Ibrahim(config)#
```

Ping 201.0.0.2 (Public IP mapped to SRV0) from PC0

```
C:\>ping 201.0.0.2

Pinging 201.0.0.2 with 32 bytes of data:

Reply from 201.0.0.2: bytes=32 time=14ms TTL=125
Reply from 201.0.0.2: bytes=32 time=10ms TTL=125
Reply from 201.0.0.2: bytes=32 time=3ms TTL=125
Reply from 201.0.0.2: bytes=32 time=2ms TTL=125

Ping statistics for 201.0.0.2:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 14ms, Average = 7ms

C:\>
```

- **PAT**

All PCs in VLAN4 are using PAT for communication with other networks with the public IP 172.40.0.5

On Ibrahim Router we configure the following:

```
-----
Password:

Ibrahim>enable
Password:
Ibrahim#config term
Enter configuration commands, one per line.  End with CNTL/Z.
Ibrahim(config)#interface GigabitEthernet0/0/0.4
Ibrahim(config-subif)#ip nat inside
Ibrahim(config-subif)#exit
Ibrahim(config)#
Ibrahim(config)#interface Serial0/1/1
Ibrahim(config-if)#ip nat outside
Ibrahim(config-if)#exit
Ibrahim(config)#
Ibrahim(config)#access-list 1 permit 192.168.4.0 0.0.0.255
Ibrahim(config)#ip nat inside source list 1 interface Serial0/1/1 overload
Ibrahim(config)#exit
Ibrahim#
%SYS-5-CONFIG_I: Configured from console by console
```

Ping network 200.0.0.1 from PC6

```
C:\>ping 200.0.0.1

Pinging 200.0.0.1 with 32 bytes of data:

Reply from 200.0.0.1: bytes=32 time=22ms TTL=253
Reply from 200.0.0.1: bytes=32 time=19ms TTL=253
Reply from 200.0.0.1: bytes=32 time=23ms TTL=253
Reply from 200.0.0.1: bytes=32 time=2ms TTL=253

Ping statistics for 200.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 23ms, Average = 16ms

C:\>
```


- **ACL**

- Configure a numbered ACL to deny PC5 from accessing Engineers VLAN110.

On Mohammad Router we configure the following:

```
Enter configuration commands, one per line. End with CNTL/Z.
Mohammad(config)#access-list 100 deny ip host 130.0.0.11 110.0.0.0 0.0.0.255
Mohammad(config)#access-list permit ip any any
^
% Invalid input detected at '^' marker.

Mohammad(config)#access-list 100 permit ip any any
Mohammad(config)#exit
Mohammad#
%SYS-5-CONFIG_I: Configured from console by console

Mohammad#config term
Enter configuration commands, one per line. End with CNTL/Z.
Mohammad(config)#interface GigabitEthernet0/0/0.130
Mohammad(config-subif)#ip access-group 100 in
Mohammad(config-subif)#exit
Mohammad(config)#exit
Mohammad#
%SYS-5-CONFIG_I: Configured from console by console

Mohammad#show access-list 100
Extended IP access list 100
    deny ip host 130.0.0.11 110.0.0.0 0.0.0.255
    permit ip any any

Mohammad#
```

Pinging PC0 from PC5 must fail now

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 110.0.0.16

Pinging 110.0.0.16 with 32 bytes of data:

Reply from 130.0.0.1: Destination host unreachable.
Reply from 130.0.0.1: Destination host unreachable.
Reply from 130.0.0.1: Destination host unreachable.
Reply from 130.0.0.1: Destination host unreachable.

Ping statistics for 110.0.0.16:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),

C:\>
```

- Configure a named ACL (ALHTTP) on Ibrahim Router to deny PC4 from accessing HTTP/HTTPS service from the server while PC4 can ping the server.

On Ibrahim Router we configure the following:

```
User Access Verification
```

```
Password:
```

```
Ibrahim>enable
```

```
Password:
```

```
Ibrahim#config term
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
Ibrahim(config)#ip access-list extended ALHTTP
```

```
Ibrahim(config-ext-nacl)#deny tcp host 130.0.0.10 host 192.168.30.10 eq 80
```

```
Ibrahim(config-ext-nacl)#deny tcp host 130.0.0.10 host 192.168.30.10 eq 443
```

```
Ibrahim(config-ext-nacl)#permit ip any any
```

```
Ibrahim(config-ext-nacl)#exit
```

```
Ibrahim(config)#
```

```
Ibrahim(config)#
```

```
Ibrahim(config)#
```

```
Ibrahim(config)#interface GigabitEthernet0/0/0.30
```

```
Ibrahim(config-subif)#ip access-group ALHTTP in
```

```
Ibrahim(config-subif)#exit
```

```
Ibrahim(config)#
```

```
Ibrahim#show access-list ALHTTP
```

```
Extended IP access list ALHTTP
```

```
deny tcp host 130.0.0.10 host 192.168.30.10 eq www
```

```
deny tcp host 130.0.0.10 host 192.168.30.10 eq 443
```

```
permit ip any any
```

```
Ibrahim#
```

 PC4

Physical Config Desktop Programming Attributes

Web Browser

< > URL http://201.0.0.2

Request Timeout

http blocked

```
Cisco Packet Tracer PC Command Line 1.0
C:\>ping 192.168.30.10

Pinging 192.168.30.10 with 32 bytes of data:

Reply from 192.168.30.10: bytes=32 time<lms TTL=127
Reply from 192.168.30.10: bytes=32 time<lms TTL=127
Reply from 192.168.30.10: bytes=32 time<lms TTL=127
Reply from 192.168.30.10: bytes=32 time<lms TTL=127

Ping statistics for 192.168.30.10:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms

C:\>
```

PC4 pings the server.

Conclusion

This project successfully implemented a network topology that met all specified requirements. The network was logically segmented using VLANs, dynamically routed using OSPF, and secured with ACLs and NAT configurations. The use of DHCP simplified IP address management, and the application of ACLs enforced access restrictions. The project demonstrates a comprehensive understanding of network design, addressing, routing, and security protocols.

References

- Cisco Networking Academy. (n.d.). *Packet Tracer Tutorials and Documentation*. Retrieved from <https://www.netacad.com>
- Slides and Material on E-learning.