

# Cisco Packet Tracer: Practice to CCNA

*Date: 10.01.2026*

*Project: Practice to CCNA*

*By Thomas Lium*

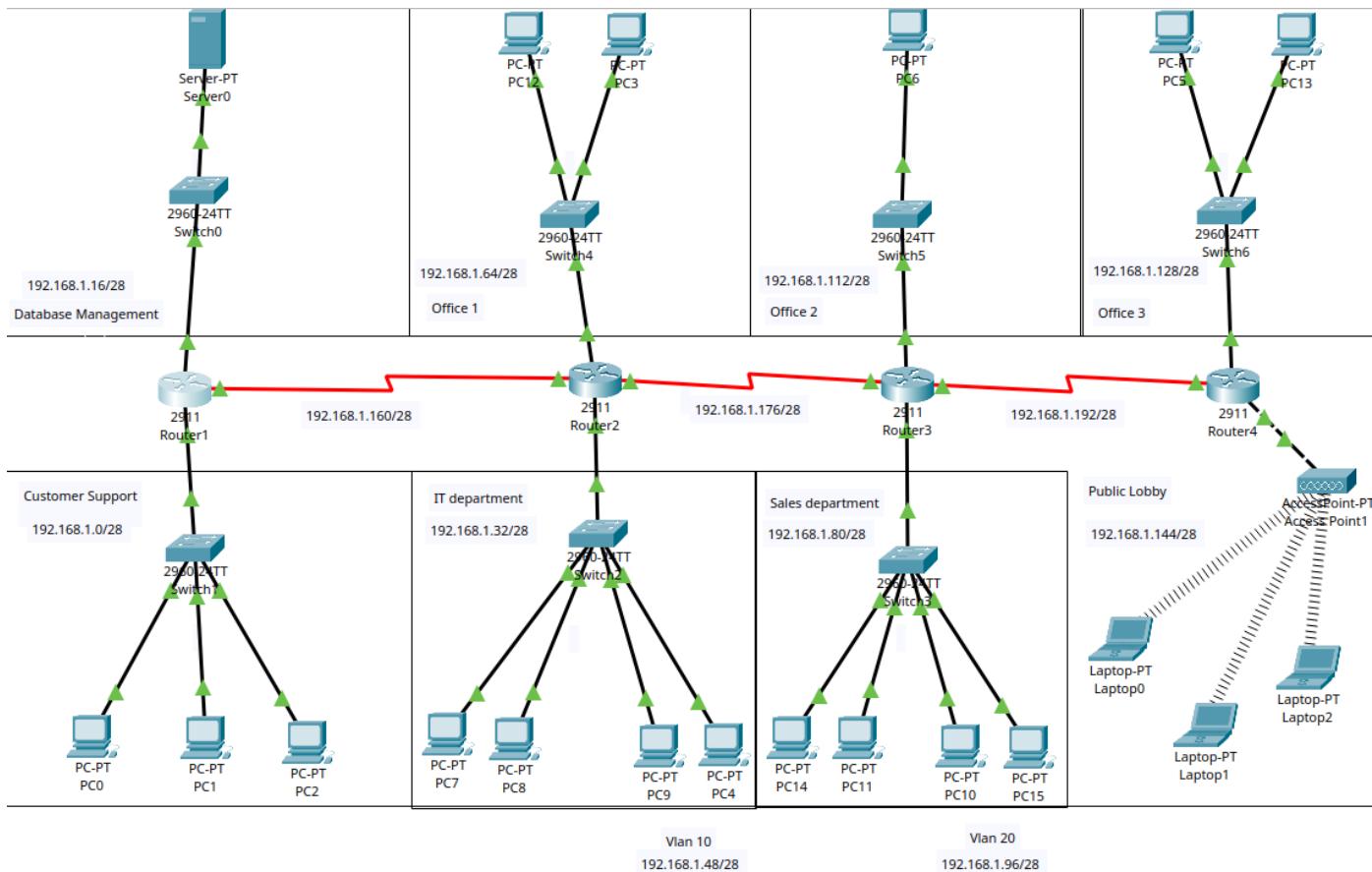


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## Introduction

This project involves documenting the preparations for an upcoming CCNA certification. It includes planning a network topology, performing subnetting, and implementing a wide range of network configurations such as IP addressing, DHCP, port security, VLANs, Wi-Fi access points, dynamic OSPF routing, access control lists (ACLs), and troubleshooting techniques. Access controls are based on least privilege to limit which networks are allowed to communicate with each other.

The purpose of this project is to document preparations for an upcoming CCNA exam and show off Cisco networking skills on Github.



Objectives to be explored in this project:

- Planning project
- Cisco configurations

### Disclaimer

This project is for educational purposes only. All scenarios and activities were conducted within the controlled virtual environment hosted on my local network. No real systems, networks, or users were involved or harmed.

### Planning project

*Planning potential topology in Packet Tracer*

This project will be simulated in the application Cisco Packet Tracer, an app where cisco routers, switches, and endpoints are simulated to practice Cisco IOS usage and configurations to build networks digitally.

For this project, I have chosen to build a network using Cisco 2911 Integrated Services Routers (ISR). Although this model is old and retired, it serves the purpose of learning about cisco networking configurations.



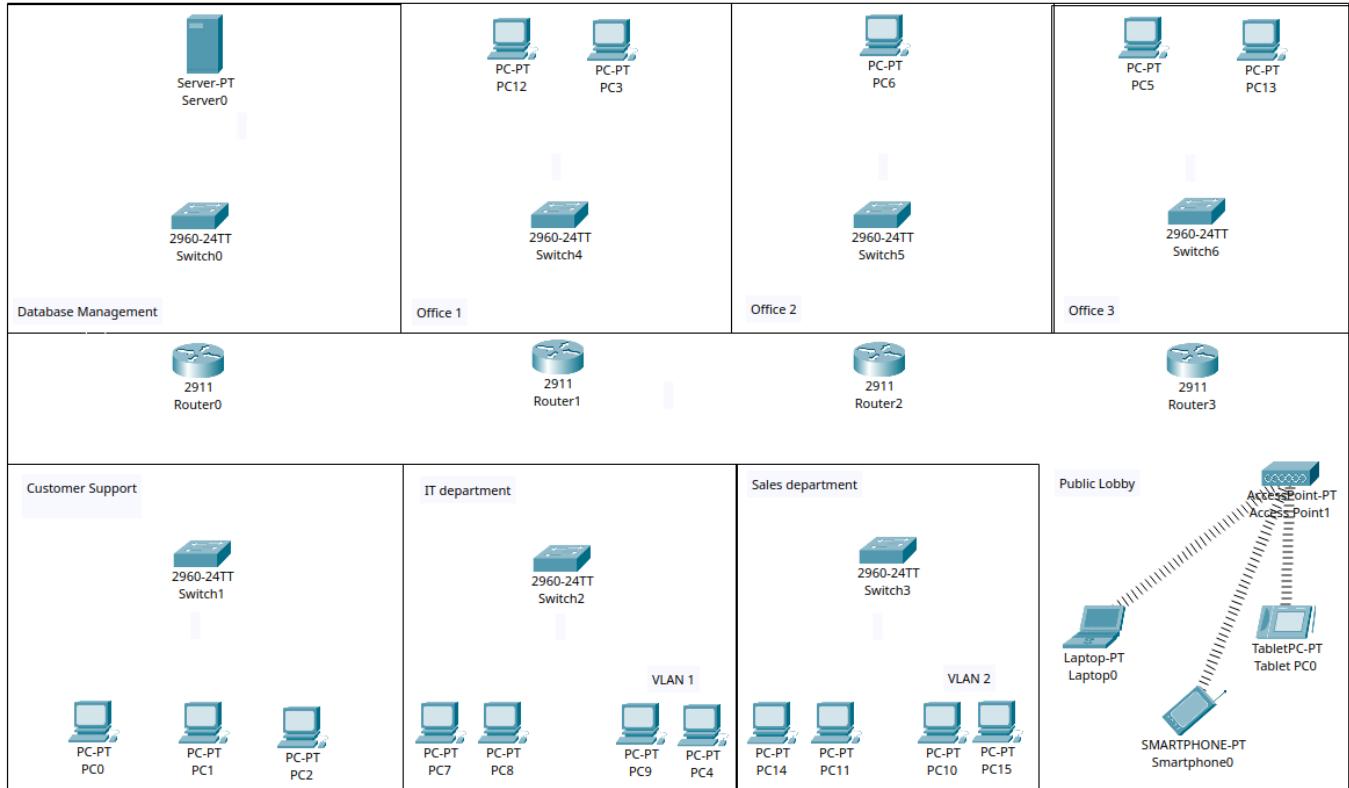
(Cisco 2911 Integrated Services Router (ISR))

For switches used in this network, I have chosen to build with Cisco Catalyst 2960 Series Switches.



(Cisco Catalyst 2960 Series)

The next step is to build a sketch topology in Cisco Packet Tracer of what I would want to build. Before connecting anything, try to visualize what I could build. Something like this image below:



I have made some type of building including rooms such as a public lobby, 3 offices, a Sales department, IT department, Customer support department and Database Management room. Each room has their own network/networks and are all divided by the 4 routers in the middle leading to their own switches to endpoints.

### *Subnetting required networks for project*

One of the first steps to building a Cisco network is to calculate how many networks are needed to subnet an IP address and segment multiple networks across the building using a single IP address.

Subnets are needed to break large networks into smaller, manageable segments, improving performance by reducing congestion, enhancing security by isolating traffic, conserving IP addresses,

Based on the network sketch topology I have made, I have counted a need for 13 network subnets needed to build this enterprise network.

3 networks needed for 4 connected routers

3 networks needed for Office 1-3

1 network needed for Server Management Room

1 network needed for Public Lobby Wifi

1 network needed for Customer Support department

2 networks needed for IT department (1 VLAN included)

2 networks needed for Sales department (1 VLAN included)

= 13

Total networks needed for subnetting: 13

Subnet 192.168.1.0/24 into at least 13 subnets:

192.168.1.0/24 = Class C = 8 bits

1	2	4	8	16	32	64	128
2	x	2	x	2	x	2	= 4 bits borrowed = 16

= 16 subnets created. 13 will be used, and the last 3 goes to waste

$$2^4 = 2 \times 8 \text{ bits} - 4 = 16$$

So 16 hosts on 16 subnets

<b>Subnet #</b>	<b>Network Address</b>	<b>Usable Range</b>	<b>Broadcast</b>
1	192.168.1.0/28	192.168.1.1 – 192.168.1.14	192.168.1.15
2	192.168.1.16/28	192.168.1.17 – 192.168.1.30	192.168.1.31
3	192.168.1.32/28	192.168.1.33 – 192.168.1.46	192.168.1.47

4	192.168.1.48/28	192.168.1.49 – 192.168.1.62	192.168.1.63
5	192.168.1.64/28	192.168.1.65 – 192.168.1.78	192.168.1.79
6	192.168.1.80/28	192.168.1.81 – 192.168.1.94	192.168.1.95
7	192.168.1.96/28	192.168.1.97 – 192.168.1.110	192.168.1.111
8	192.168.1.112/28	192.168.1.113 – 192.168.1.126	192.168.1.127
9	192.168.1.128/28	192.168.1.129 – 192.168.1.142	192.168.1.143
10	192.168.1.144/28	192.168.1.145 – 192.168.1.158	192.168.1.159
11	192.168.1.160/28	192.168.1.161 – 192.168.1.174	192.168.1.175
12	192.168.1.176/28	192.168.1.177 – 192.168.1.190	192.168.1.191
13	192.168.1.192/28	192.168.1.193 – 192.168.1.206	192.168.1.207

3 more subnets go to waste as they are not needed at this point. But stays in reserve in case the network expands.

Each subnet has:

- $2^4 = 16$  addresses
- $16 - 2 = 14$  usable hosts

/24 + 4 bits borrowed = /28

Block size = 256 – 240 = **16**

So, the new subnet mask is:

**/28 = 255.255.255.240**

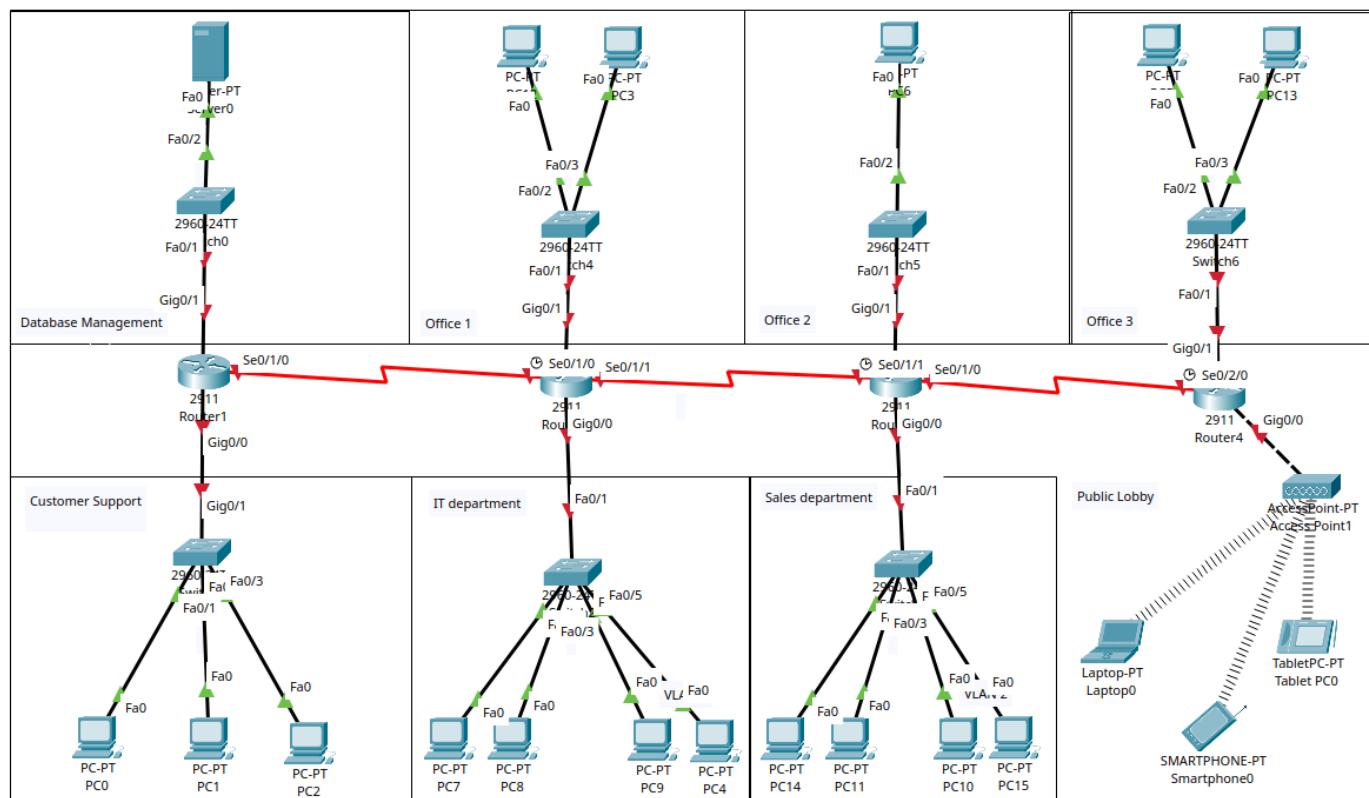
*Planning segmentation*

Segmentation is important for security and effective network management. In this project, I plan to include at least one network subnet in each room. There are eight rooms in total, and I will also include two VLAN subnets: one VLAN in the IT department alongside a regular LAN, and one VLAN in the Sales department with its own LAN.

In total, 10 subnets are segmented across 8 rooms.

The last 3 subnets will be configured to the Router interfaces for dynamic routing.

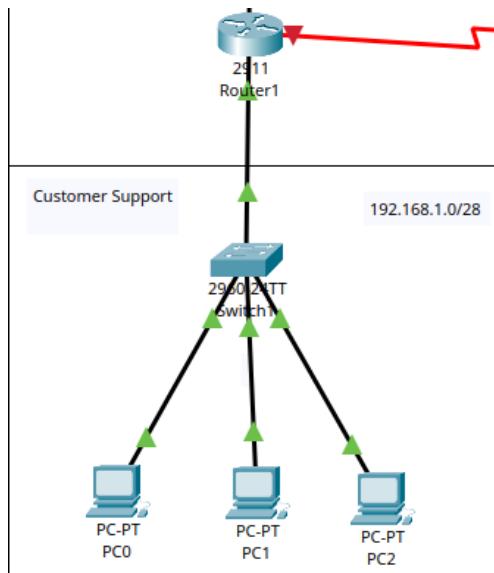
## Configurations



Connect the Cisco devices to their assigned interfaces. Once everything is set up, we are ready to configure each network.

*First network: Customer Support department*

I have set up the following network using a Cisco 2911 Router connected to switch leading to Customer support department at interface Gig0/0. Check Diagram below:



Enter Router1 CLI:

Some basic Router 1 configuration – set message of the day and passwords

```
Router(config)#banner motd #
Enter TEXT message. End with the character '#'.
Welcome to Router 1
#
Router(config)#enable password BasicPassword123
Router(config)#enable secret Advanced43admin25!gruz
Router(config)#service password-encryption
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

I have set 2 passwords, one regular and a secret admin password.

Did also set password encryption so that passwords are not leaked in the running-config.

Confirm configurations by “show running-config”

```

Router#show running-config
Building configuration...

Current configuration : 1726 bytes
!
version 15.1
no service timestamps log datetime msec
no service timestamps debug datetime msec
service password-encryption
!
hostname Router
!
!
!
enable secret 5 $1$mERr$C0Tos0TOKWWYA1g1XiVjM.
enable password 7 08034D5D001A351601181B0B382F757A60

```

## IP configuration

By starting configuration of Customer Support network, select Router 1 connected to switch leading to Customer support department at interface Gig0/0.

Using the first subnet we created, this network can use IP address range 192.168.1.1 – 192.168.1.14 using the subnet mask /28 = 255.255.255.240.

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.0/28	192.168.1.1 – 192.168.1.14

Router1 IP configuration to Gig0/0 interface:

```

Router#enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#ip address 192.168.1.1 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#end

```

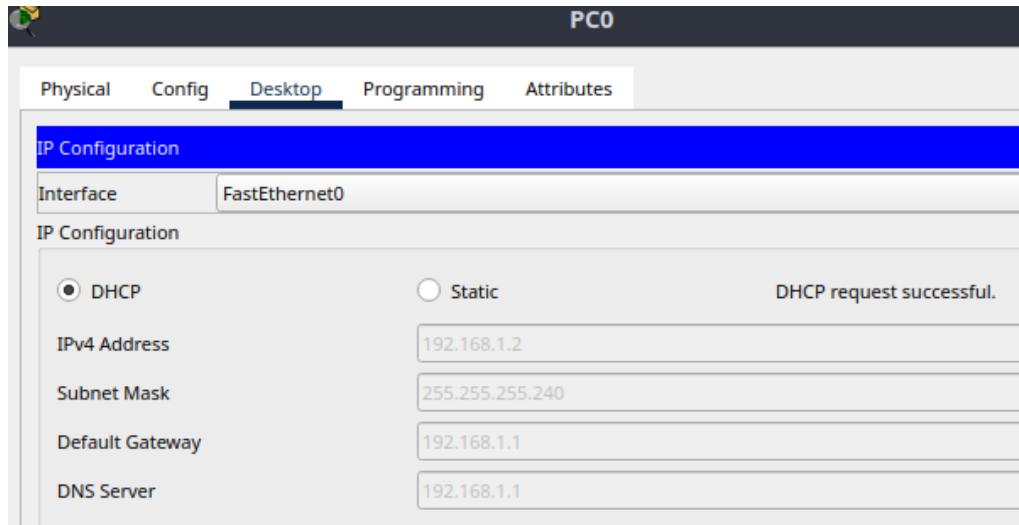
IP address 192.168.1.1 has been set on Router1.

## DHCP configuration

Configuration for easy IP address allocation to connected PCs using DHCP solution:

```
Router(config)#  
Router(config)#ip dhcp excluded-address 192.168.1.1  
Router(config)#ip dhcp pool DHCP-Router1  
Router(dhcp-config)#network 192.168.1.0 255.255.255.240  
Router(dhcp-config)#default-router 192.168.1.1  
Router(dhcp-config)#dns-server 192.168.1.1  
Router(dhcp-config)#
```

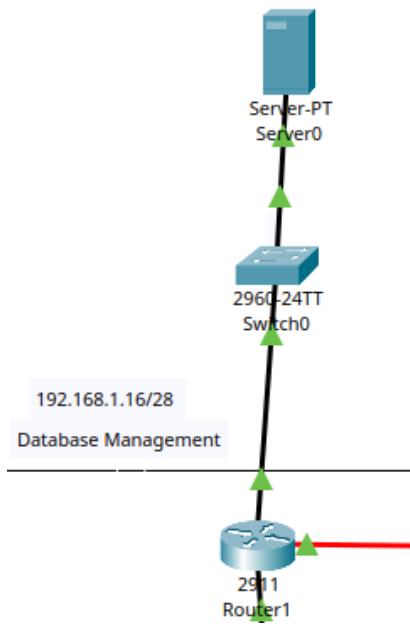
(Exclude reserved IP address of Router and default gateway.)



On PC1 under Customer support network.

DHCP configuration was successful, and IP addresses were distributed to PC endpoints.

Second network: Database Management room



## IP configuration

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.16/28	192.168.1.17 – 192.168.1.30

Set IP address to Router1 Gig0/1 interface with the subnet above:

```

Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/1
Router(config-if)#ip address 192.168.1.17 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up
Router(config-if)#

```

Database management room doesn't need DHCP as there is only 1 device in this network, so the server configuration sets manual IP address at 192.168.1.18, which is the first usable network of the second subnet.

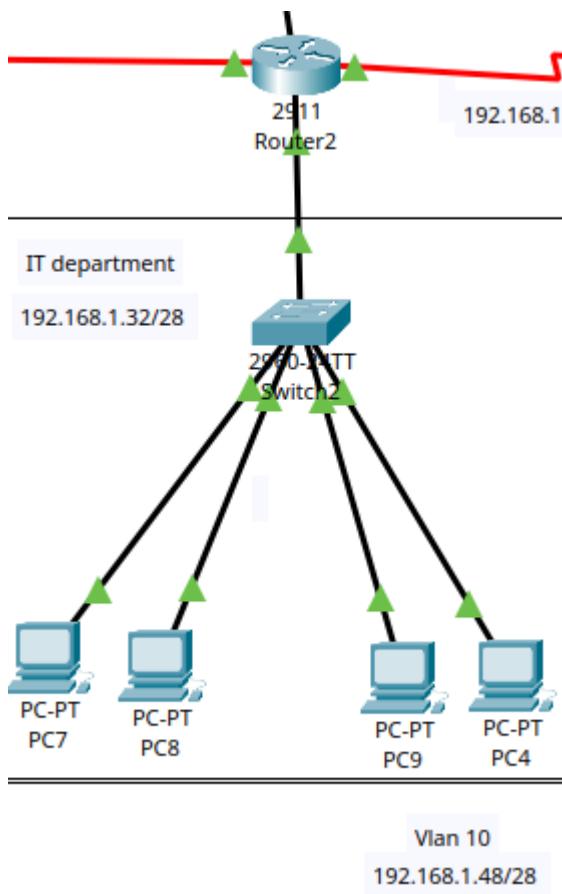
## Port security configuration

Set port security on switch to limit how many MAC addresses are allowed to connect to network:

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/1
Switch(config-if)#switch mode access
Switch(config-if)#switchport port-security
Switch(config-if)#switchport port-security maximum 1
Switch(config-if)#switchport port-security violation shutdown
Switch(config-if)#switchport port-security mac-address sticky
Switch(config-if)#exit
Switch(config)#
```

I have set maximum 1, which means no other endpoint can connect without being shutdown.

*Third network: IT department*



## IP configuration

Subnet	Address	Usable Range
1	192.168.1.32/28	192.168.1.33 – 192.168.1.46

Set IP address to Router1 Gig0/1 interface:

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#ip address 192.168.1.33 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#

```

Set IP addresses manually for the first two PCs as we are not using DHCP here.

The next two PCs will have their own VLAN network. Configuration below.

## VLAN configuration

Subnet	Address	Usable Range
1	192.168.1.48/28	192.168.1.49 – 192.168.1.62

Switch configuration of VLAN for Administrators:

Set IP address of VLAN interface using subnet 192.168.1.48/28

```
Switch>enable
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#vlan 10
Switch(config-vlan)#name Admins
Switch(config-vlan)#int vlan 10
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan10, changed state to up

Switch(config-if)#ip address 192.168.1.49 255.255.255.240
Switch(config-if)#no shutdown
```

Select interfaces where VLAN is to be used. In this case its Fa0/4 and Fa0/5:

```
Switch(config-if)#int range fa0/4-5
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 10
Switch(config-if-range)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan10, changed state to up

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

Configure trunk towards Router2 using interface fa0/1. This enables VLAN routing.

```
Switch#config term
Enter configuration commands, one per line. End with CNTL/Z.
Switch(config)#int fa0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk native vlan 1
Switch(config-if)#switchport trunk allowed vlan 1,10
Switch(config-if)#no shutdown
Switch(config-if)#end
Switch#
%SYS-5-CONFIG_I: Configured from console by console
```

(VLAN 1 is the regular LAN subnet and VLAN 10 is the Virtual LAN we made)

Configure router on a stick on Router 2:

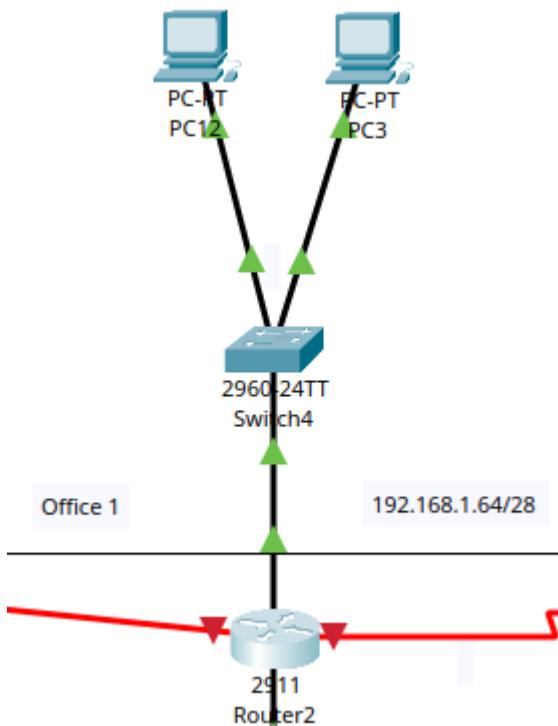
Select interface gig0/0.10 and set IP address from the VLAN subnet. This will share same physical interface with the regular LAN, but also supports a virtual LAN.

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0.10
Router(config-subif)#
%LINK-3-UPDOWN: Interface GigabitEthernet0/0.10, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10, changed state to up

Router(config-subif)#encapsulation dot1q 10
Router(config-subif)#ip address 192.168.1.52 255.255.255.240
Router(config-subif)#no shutdown
Router(config-subif)#exit
```

*Fourth network: Office 1*



For the 3 Offices, I want to keep it simple to complete the network topology quickly.  
Nothing more than an IP address and ACL access controls will be set on the Offices.

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.64/28	192.168.1.65 – 192.168.1.78

Set IP address on Gig0/1 using the subset listed above:

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/1
Router(config-if)#ip address 192.168.1.65 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

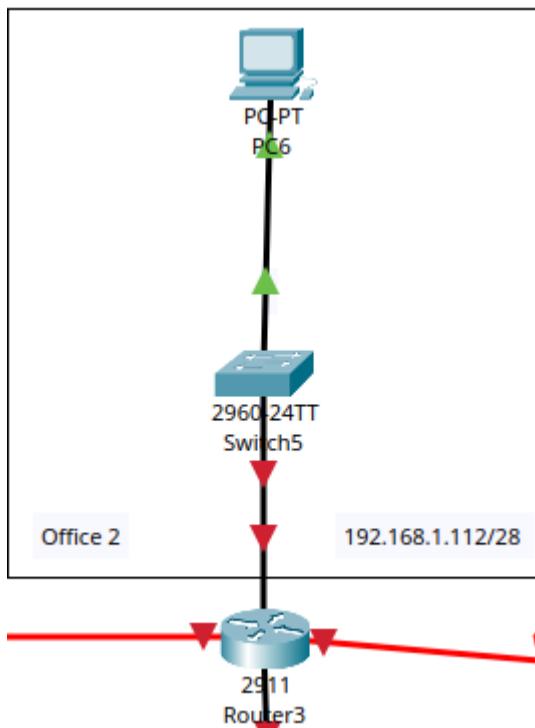
%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router(config-if)#

```

Remember to set this IP as default gateway of VLAN PCs

*Fifth network: Office 2*



<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.112/28	192.168.1.113 –
		192.168.1.128

Set IP address on Gig0/1 using the subset listed above:

```
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/1
Router(config-if)#ip address 192.168.1.113 255.255.255.240
Router(config-if)#no shutdown

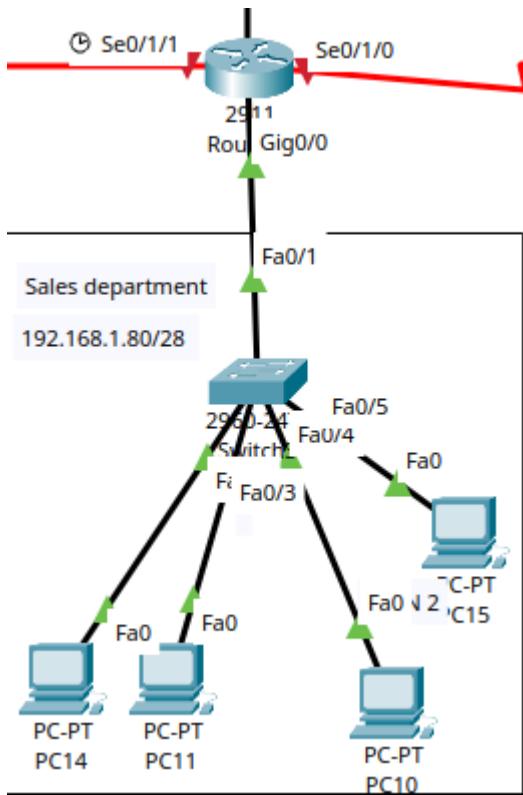
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router(config-if)#exit
Router(config)#

```

*Sixth network: Sales department*



## IP configuration

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.80/28	192.168.1.81 – 192.168.1.94

Set IP address on interface Gig0/0 from the subnet listed above:

```

Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#ip address 192.168.1.81 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#

```

Set IP addresses manually to the two PCs, create a VLAN for the other two

## VLAN configuration

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.96/28	192.168.1.97 – 192.168.1.111

Switch configuration of VLAN for Seniors:

Set IP address of VLAN interface using subnet 192.168.1.96/28

```
Switch(config)#vlan 20
Switch(config-vlan)#name Seniors
Switch(config-vlan)#int vlan 20
Switch(config-if)#
%LINK-5-CHANGED: Interface Vlan20, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface Vlan20, changed state to up

Switch(config-if)#ip address 192.168.1.97 255.255.255.240
Switch(config-if)#no shutdown
Switch(config-if)#exit
```

Select interfaces where VLAN is to be used. In this case its Fa0/4 and Fa0/5:

```
Switch(config)#int range fa0/4-5
Switch(config-if-range)#switchport mode access
Switch(config-if-range)#switchport access vlan 20
Switch(config-if-range)#exit
Switch(config)#

```

Configure trunk towards Router3 using interface fa0/1. This enables VLAN routing.

```
Switch(config)#int fa0/1
Switch(config-if)#switchport mode trunk
Switch(config-if)#switchport trunk native vlan 1
Switch(config-if)#switchport trunk allowed vlan 1,20
Switch(config-if)#no shutdown
Switch(config-if)#exit
Switch(config)#

```

Configure router on a stick on Router 3:

Select interface gig0/0.10 and set IP address from the VLAN subnet. This will share same physical interface with the regular LAN, but also supports a virtual LAN.

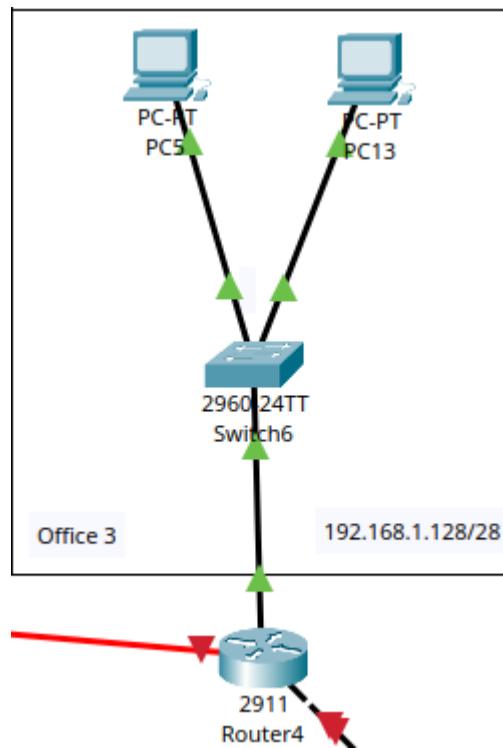
```
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0.10
Router(config-subif)#
%LINK-3-UPDOWN: Interface GigabitEthernet0/0.10, changed state to down

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0.10, changed state to up

Router(config-subif)#encapsulation dot1q 20
Router(config-subif)#ip address 192.168.1.100 255.255.255.240
Router(config-subif)#no shutdown
Router(config-subif)#[
```

Remember to set this router IP as default gateway of VLAN PCs

Seventh network: Office 3



**IP configuration**

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.128/28	192.168.1.129 – 192.168.1.142

Set IP address on Gig0/1 using the subset listed above:

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/1
Router(config-if)#ip address 192.168.1.129 255.255.255.240
Router(config-if)#no shutdown

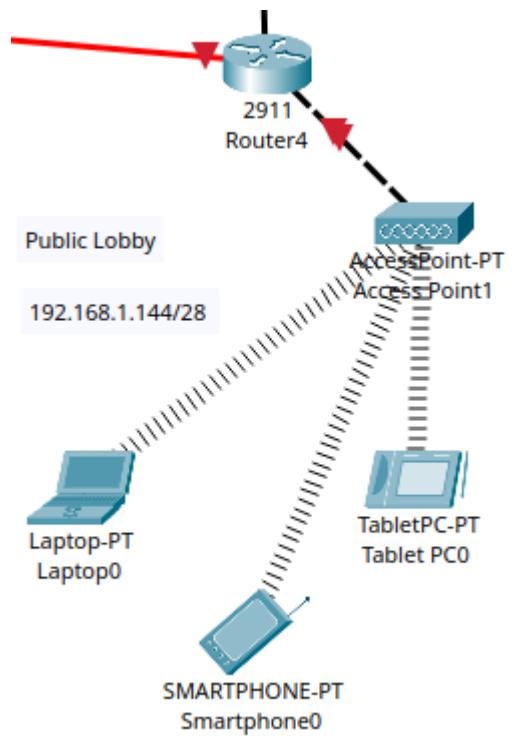
Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/1, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/1, changed state to up

Router(config-if)#

```

#### *Eight network: Public Lobby WiFi*



On the eighth network, I am going to configure a WiFi accessible network using DHCP for easy access for connected devices in the public lobby.

## IP configuration

Subnet	Address	Usable Range
1	192.168.1.144/28	192.168.1.145–158

Set IP address on Gig0/0 using the subset listed above on Router4:

```
Router>
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#ip address 192.168.1.145 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface GigabitEthernet0/0, changed state to up

%LINEPROTO-5-UPDOWN: Line protocol on Interface GigabitEthernet0/0, changed state to up

Router(config-if)#exit
Router(config)#

```

## DHCP configuration

Set DHCP pool and use the subnet 192.168.1.144/28

```
Router(config)#ip dhcp excluded-address 192.168.1.145
Router(config)#ip dhcp pool DHCP-wifi
Router(dhcp-config)#network 192.168.1.144 255.255.255.240
Router(dhcp-config)#default-router 192.168.1.145
Router(dhcp-config)#dns-server 192.168.1.145
Router(dhcp-config)#

```

*(Exclude the IP address already set on Router)*

## Wireless access point configuration

Enter the Access Point device connected to Router4:

Set WiFi SSID identifiable name, select WPA2 or above with a strong password.

WPA2 and WPA3 are currently the strongest wireless encryption options.

Access Point1

Attributes

Port 1			
Port Status	<input checked="" type="checkbox"/> On		
SSID	Lobby-Wifi		
2.4 GHz Channel	6		
Coverage Range (meters)	140.00		
<b>Authentication</b>			
<input type="radio"/> Disabled	<input type="radio"/> WEP	WEP Key	
<input type="radio"/> WPA-PSK	<input checked="" type="radio"/> WPA2-PSK	PSK Pass Phrase	OfficePassword35
		User ID	
		Password	
Encryption Type		AES	

On a laptop device in the public lobby, connect to the Wi-Fi access point we set up.

Laptop0

Physical Config Desktop Programming Attributes

**Link Information** **Connect** **Profiles**

Below is a list of available wireless networks. To search for more wireless networks, click the **Refresh** button. To view more information about a network, select the wireless network name. To connect to that network, click the **Connect** button below.

Wireless Network Name	CH	Signal
Lobby-Wifi	1	59%

**Site Information**

**Wireless Mode** Infrastructure  
**Network Type** Mixed B/G  
**Radio Band** Auto  
**Security** WPA2-PSK  
**MAC Address** 0002.16A4.1C63

**2.4GHz**



Adapter is Inactive

Wireless-N Notebook Adapter      Wireless Network Monitor v1.0      Model No. **WPC300N**

## WPA2-Personal Needed for Connection

This wireless network has WPA2-Personal enabled. To connect to this network, enter the required passphrase in the appropriate field below. Then click the **Connect** button.

Security

WPA2-Personal

Please select the wireless security method used by your existing wireless network.

Pre-shared Key

OfficePassword35

Please enter a Pre-shared Key that is 8 to 63 characters in length.

| Cancel | Connect

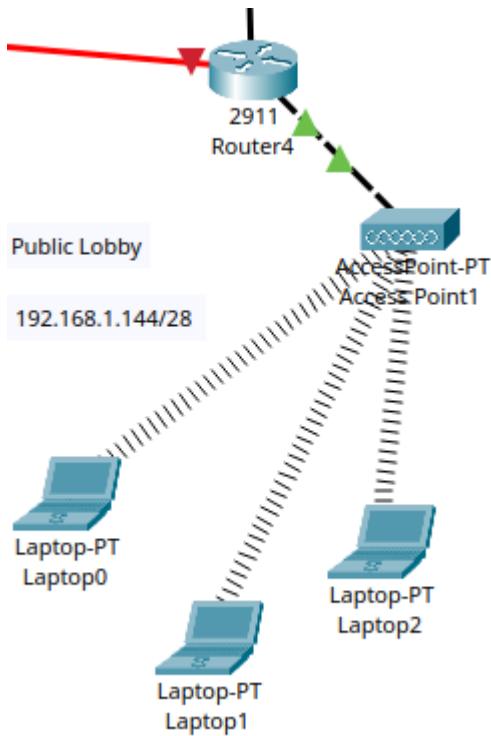
Laptop0

Physical Config Desktop Programming Attributes

IP Configuration

Interface	Wireless0
IP Configuration	
<input checked="" type="radio"/> DHCP	<input type="radio"/> Static
IPv4 Address	192.168.1.146
Subnet Mask	255.255.255.240
Default Gateway	192.168.1.145
DNS Server	192.168.1.145

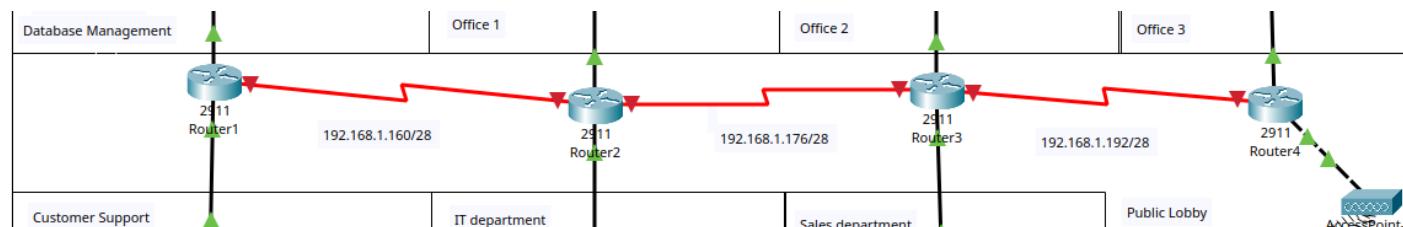
DHCP was successful when connected to wireless access point.



I switched out the tablets for laptops when I noticed they didn't have a wireless function. Apparently only the laptops in Packet Tracer have wireless functions.

#### *Set IP addresses to Router serial interfaces*

To enable dynamic routing, we first need to set IP addresses to serial interfaces using their own subnets.



Subnet	Address	Usable Range
1	192.168.1.160/28	192.168.1.161 – 192.168.1.176

Set IP on Router1 on interface s0/1/0 leading towards Router 2:

```
Router(config-if)#ip address 192.168.1.161 255.255.255.240
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Router(config-if)#no shutdown
Router(config-if)#

```

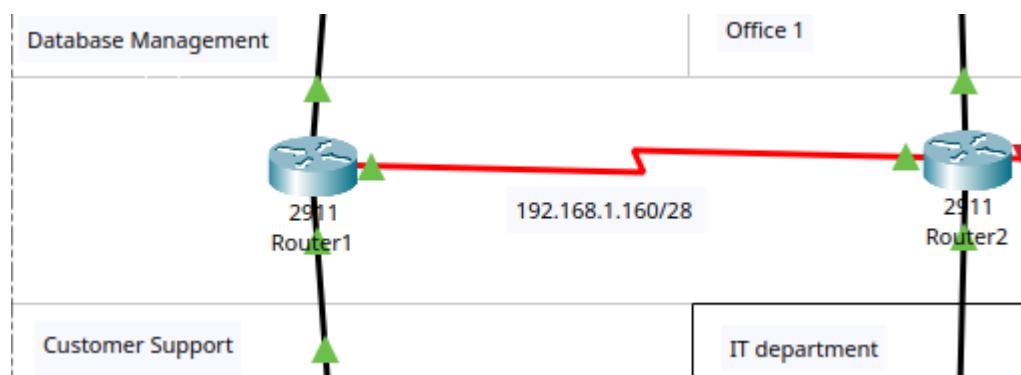
Set IP on Router2 on interface s0/1/1 leading towards Router 1:

```
Router(config)#int se0/1/0
Router(config-if)#ip address 192.168.1.162 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/1/0, changed state to up

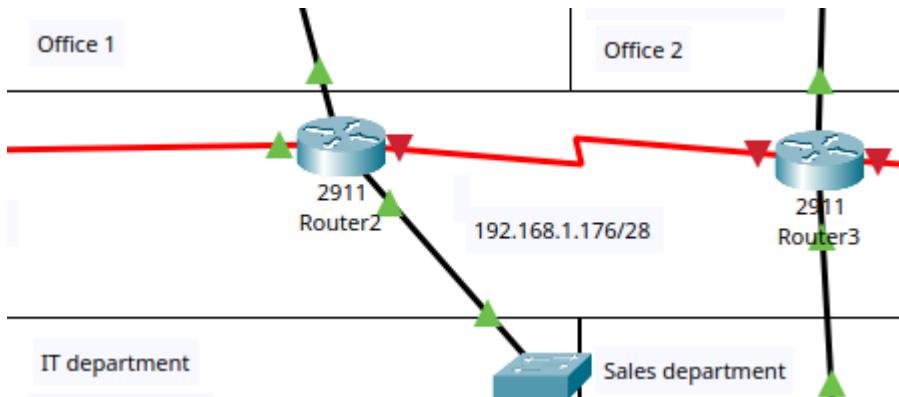
Router(config-if)#
%LINEPROTO-5-UPDOWN: Line protocol on Interface Serial0/1/0, changed state to up

```



Router 1 and Router 2 are now connected and can ping each other.

Now set IPs on Router 2 and router 3



<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.176/28	192.168.1.177 – 192.168.1.190

Set IP on Router2 on interface s0/1/1 leading towards Router 3:

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int s0/1/1
Router(config-if)#ip address 192.168.1.177 255.255.255.240
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1/1, changed state to down
Router(config-if)#

```

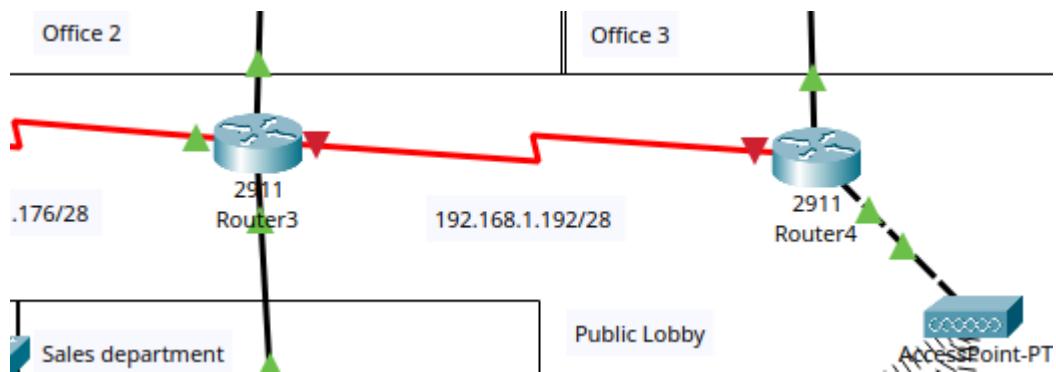
Set IP on Router3 on interface s0/1/1 leading towards Router 2:

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int s0/1/1
Router(config-if)#ip address 192.168.1.178 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/1/1, changed state to up
Router(config-if)#

```



Router 2 and 3 are now connected and can ping eachother .

Now to Router 3 and 4

<b>Subnet</b>	<b>Address</b>	<b>Usable Range</b>
1	192.168.1.192/28	192.168.1.193 – 192.168.1.106

Set IP on Router3 on interface s0/1/0 leading towards Router 4:

```

Router(config)#int s0/1/0
Router(config-if)#ip address 192.168.1.193 255.255.255.240
Router(config-if)#no shutdown

%LINK-5-CHANGED: Interface Serial0/1/0, changed state to down
Router(config-if)#

```

Set IP on Router4 on interface s0/2/0 leading towards Router 3:

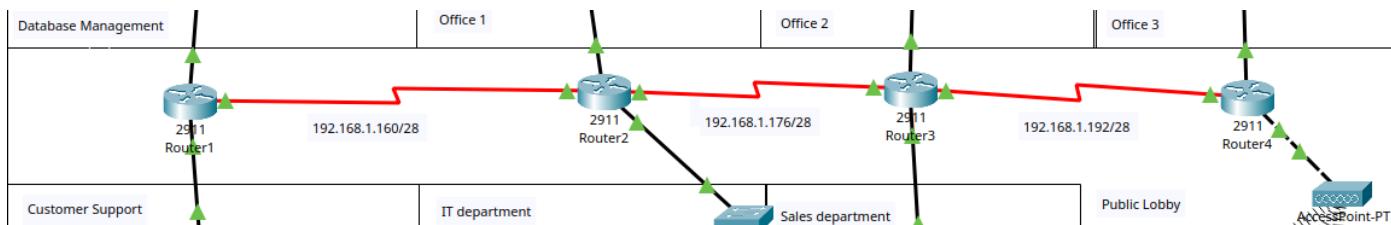
```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int s0/2/0
Router(config-if)#ip address 192.168.1.194 255.255.255.240
Router(config-if)#no shutdown

Router(config-if)#
%LINK-5-CHANGED: Interface Serial0/2/0, changed state to up

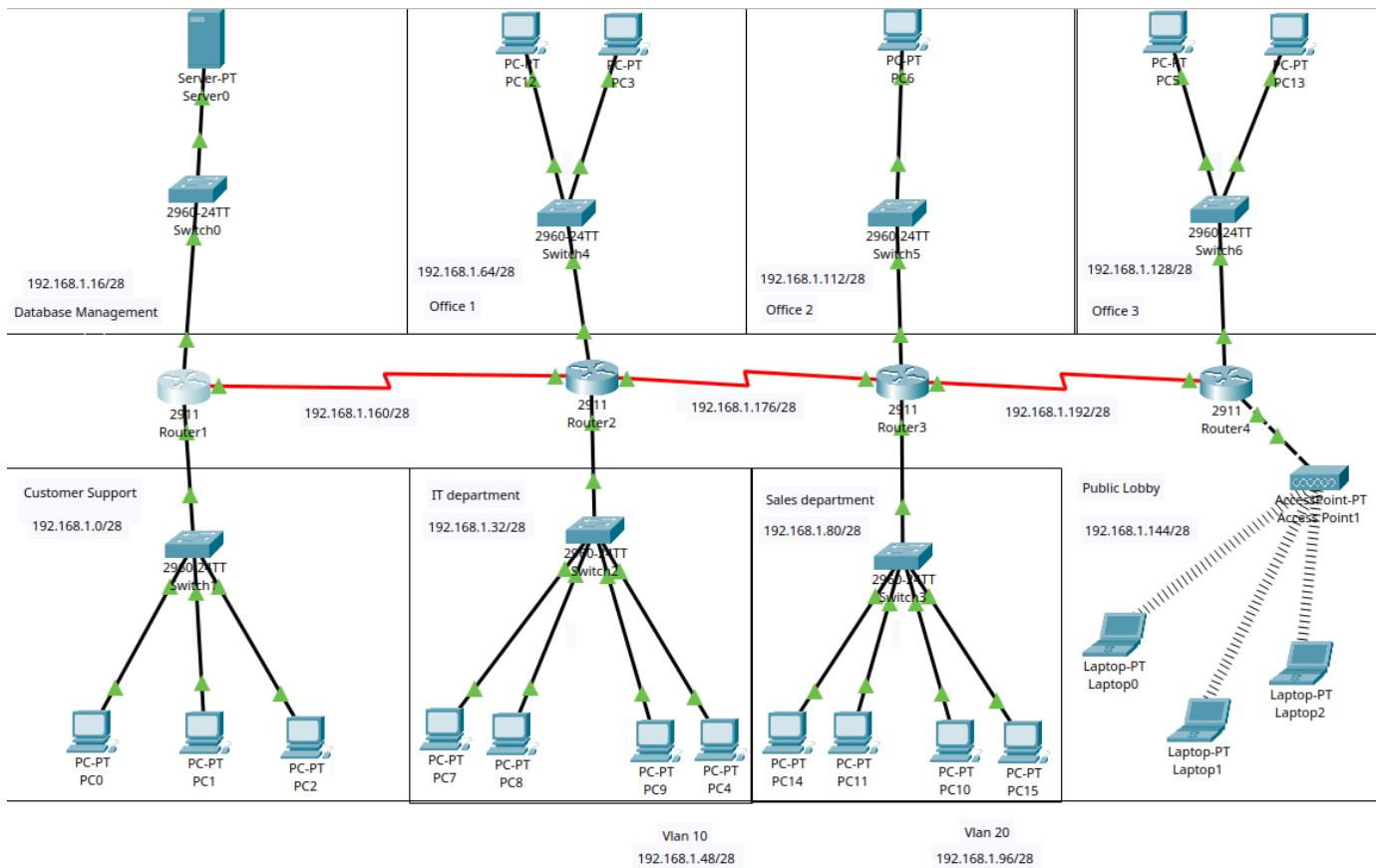
Router(config-if)#

```



IP addresses have been set for serial interfaces across 4 Routers, next step is to configure dynamic routing using OSPF.

#### *Dynamic Routing OSPF configuration*



Configure dynamic routing between 4 routers to connect all networks created:

Configure OSPF on Router1 and advertise the networks connected to Router1 which are the following:

192.168.1.0/28	192.168.1.16/28	192.168.1.160
----------------	-----------------	---------------

```

Router>enable
Router#config term
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#router-id 1.1.1.1
Router(config-router)#network 192.168.1.0 0.0.0.15 area 0
Router(config-router)#network 192.168.1.16 0.0.0.15 area 0
Router(config-router)#network 192.168.1.160 0.0.0.15 area 0
Router(config-router)#exit
Router(config)#
10:04:11: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on Serial0/1/0 from LOADING to FULL, Loading Done

```

Configure OSPF on Router2 and advertise the networks connected to Router2 which are the following:

192.168.1.160	192.168.1.32	192.168.1.48	192.168.1.64	192.168.176
---------------	--------------	--------------	--------------	-------------

```
Router#
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#network 192.168.1.160 0.0.0.15 area 0
Router(config-router)#network 192.168.1.32 0.0.0.15 area 0
Router(config-router)#network 192.168.1.48 0.0.0.15 area 0
Router(config-router)#network 192.168.1.64 0.0.0.15 area 0
Router(config-router)#network 192.168.1.176 0.0.0.15 area 0
Router(config-router)#exit
Router(config)#
```

Configure OSPF on Router3 and advertise the networks connected Router3 which are the following:

192.168.1.176	192.168.1.80	192.168.1.112	192.168.1.192
---------------	--------------	---------------	---------------

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#router-id 3.3.3.3
Router(config-router)#network 192.168.1.176 0.0.0.15 area 0
Router(config-router)#network 192.168.1.80 0.0.0.15 area 0
Router(config-router)#network 192.168.1.112 0.0.0.15 area 0
Router(config-router)#network 192.168.1.192 0.0.0.15 area 0
Router(config-router)#exit
Router(config)#
11:15:41: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on Serial0/1/0 from LOADING to FULL, Loading Done

Router(config)#router ospf 1
Router(config-router)#network 192.168.1.96 0.0.0.15 area 0
Router(config-router)#
```

Configure OSPF on Router4 and advertise the networks connected Router4 which are the following:

192.168.1.192	192.168.1.128	192.168.1.144
---------------	---------------	---------------

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#router ospf 1
Router(config-router)#router-id 4.4.4.4
Router(config-router)#network 192.168.1.192 0.0.0.15 area 0
Router(config-router)#network 192.168.1.128 0.0.0.15 area 0
Router(config-router)#network 192.168.1.128 0.0.0.15 area 0
11:15:27: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on Serial0/2/
                                         ^
% Invalid input detected at '^' marker.

Router(config-router)#network 192.168.1.144 0.0.0.15 area 0
Router(config-router)#exit
Router(config)#
```

All OSPF dynamic routing configurations has been set, let's see if it works.

For confirmation, I can use a PC for IT department network to ping 2 devices of two different networks to confirm the OSPF config was successful.

```
C:\>ping 192.168.1.146

Pinging 192.168.1.146 with 32 bytes of data:

Reply from 192.168.1.1: Destination host unreachable.
Request timed out.
Reply from 192.168.1.146: bytes=32 time=135ms TTL=124
Reply from 192.168.1.146: bytes=32 time=88ms TTL=124

Ping statistics for 192.168.1.146:
    Packets: Sent = 4, Received = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 135ms, Average = 111ms

C:\>ping 192.168.1.98

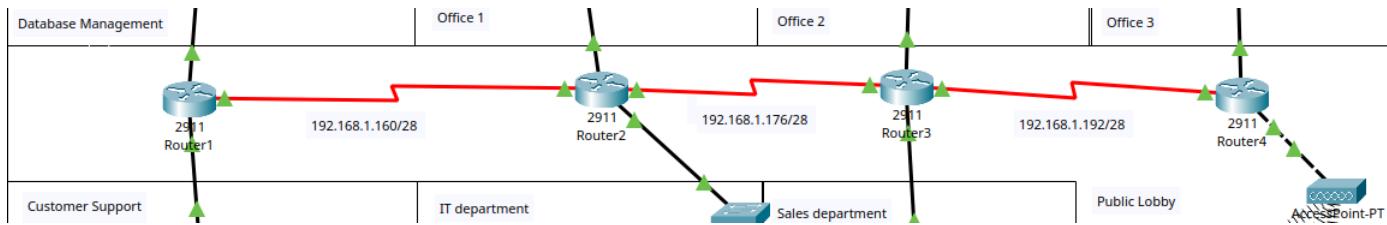
Pinging 192.168.1.98 with 32 bytes of data:

Reply from 192.168.1.98: bytes=32 time=45ms TTL=125
Reply from 192.168.1.98: bytes=32 time=63ms TTL=125
Reply from 192.168.1.98: bytes=32 time=73ms TTL=125
Reply from 192.168.1.98: bytes=32 time=2ms TTL=125

Ping statistics for 192.168.1.98:
    Packets: Sent = 4, Received = 4 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 2ms, Maximum = 73ms, Average = 45ms

C:\>
```

Ping was indeed successful, and OSPF is now working and ready to communicate between networks.



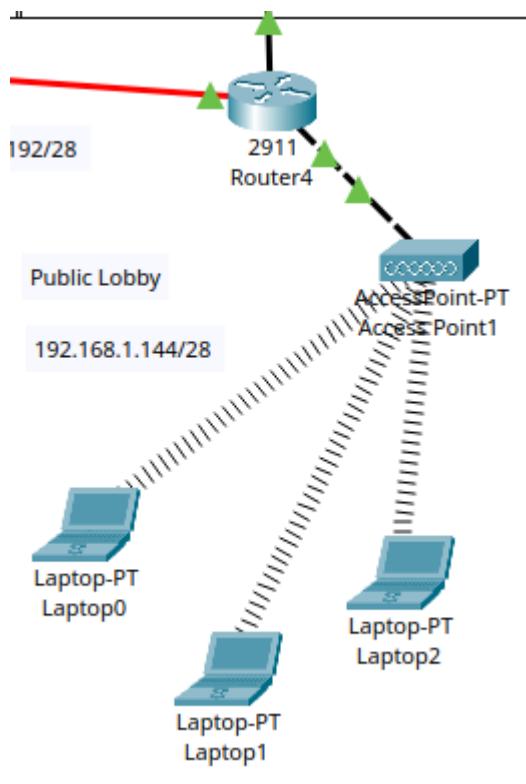
### *Access control lists configuration*

Next step is to configure access controls on which networks can communicate with each other, and which networks do not allow communications.

The following conditions need to be met:

1. Public Lobby WiFi network does not need to communicate with any other network as this network is meant only for visitors to browse their devices.
2. Restrict Customer Support and Sales Department to only communicate with each other as they handle customer contacts.
3. Restrict the Database Management network to allow access only from the IT Department VLAN network for administrators, using ports 80 and 22.
4. Restrict IT department networks to only communicate with Office 1,2 and 3

### **Limit Public Wi-Fi network to itself (Router4)**



Set standard ACL configuration on Router 4 to only allow Public Lobby endpoints to communicate with eachother, but does not allow routing out to other networks.

```

Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 1 permit 192.168.1.144 0.0.0.15
Router(config)#access-list 1 deny any
Router(config)#exit
Router#
%SYS-5-CONFIG_I: Configured from console by console

Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int gig0/0
Router(config-if)#access-group 1 out
      ^
% Invalid input detected at '^' marker.

Router(config-if)#ip access-group 1 out
Router(config-if)#exit
Router(config)#

```

*(Set the created access-group on interface gig0/0 through outbound traffic)*

From the laptop endpoint in public Wi-Fi, try to ping any other network to confirm:

```

C:\>
C:\>ping 192.168.1.130

Pinging 192.168.1.130 with 32 bytes of data:

Request timed out.
Request timed out.

Ping statistics for 192.168.1.130:
  Packets: Sent = 2, Received = 0, Lost = 2 (100% loss),
Control-C
^C
C:\>
```

Devices from Public Wifi can no longer reach other routed networks.

### **Restrict Customer Support and Sales Department to only communicate with eachother:**

Using Named ACL on Router 1 configurations, permit IP network of Customer Support leading towards Sales department network and deny any other.

Customer Support network	Sales Department networks
192.168.1.0/28	192.168.1.80/28
	192.168.1.96/28 VLAN

```

Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip access-list extended CS_TO_SALES
Router(config-ext-nacl)#permit ip 192.168.1.0 0.0.0.15 192.168.1.80 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.0 0.0.0.15 192.168.1.96 0.0.0.15
Router(config-ext-nacl)#deny   ip 192.168.1.0 0.0.0.15 any
Router(config-ext-nacl)#permit ip any any
Router(config-ext-nacl)#exit
Router(config)#int gig0/0
Router(config-if)# ip access-group CS_TO_SALES in
Router(config-if)#exit
Router(config)#

```

*(Set the created access-group on interface gig0/0 through inbound traffic leading to Customer support network)*

Vice versa on Router3 for sales department:

Using Named ACL on Router 1 configurations, permit IP networks of Sales department inbound traffic to Customer Support network and deny any other:

Customer Support network	Sales Department networks
192.168.1.0/28	192.168.1.80/28
	192.168.1.96/28 VLAN

```
Router>
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip access-list extended SALES_TO_CS
Router(config-ext-nacl)#permit ip 192.168.1.80 0.0.0.15 192.168.1.0 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.96 0.0.0.15 192.168.1.0 0.0.0.15
Router(config-ext-nacl)#deny ip 192.168.1.80 0.0.0.15 any
Router(config-ext-nacl)#deny ip 192.168.1.96 0.0.0.15 any
Router(config-ext-nacl)#permit ip any any
Router(config-ext-nacl)#exit
Router(config)#int gig0/0
Router(config-if)# ip access-group SALES_TO_CS in
Router(config-if)#exit
Router(config)#

```

*Apply on interface gig0/0*

#### **Limit Database management HTTP access only to IT department VLAN**

Using extended ACL on Router1 configurations, permit IT department VLAN network traffic inbound on port 80 to Database Management network and deny any other.

IT department VLAN	Database Management LAN
192.168.1.48/28	192.168.1.16/28

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 100 permit tcp 192.168.1.48 0.0.0.15 192.168.1.16 0.0.0.15 eq 80
Router(config)#access-list 100 deny ip any 192.168.1.16 0.0.0.15
Router(config)#access-list 100 permit ip any any
Router(config)#int gig0/1
Router(config-if)#ip access-group 100 in
Router(config-if)#exit

```

*Apply on interface gig0/1*

### **Limit Database management SSH access only to IT department VLAN**

Using extended ACL on Router1 configurations, permit IT department VLAN network traffic inbound on port 22 to Database Management network and deny any other.

IT department VLAN	Database Management LAN
192.168.1.48/28	192.168.1.16/28

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 120 permit tcp 192.168.1.48 0.0.0.15 192.168.1.16 0.0.0.15 eq 22
Router(config)#access-list 120 deny ip any 192.168.1.16 0.0.0.15
Router(config)#access-list 120 permit ip any any
Router(config)#int se0/1/0
Router(config-if)#ip access-group 120 in
Router(config-if)#
```

*Apply on interface serial0/1/0*

### **Limit SSH access only from IT department VLAN into Sales Department VLAN**

Using extended ACL on Router2 configurations, permit IT department VLAN network traffic inbound on port 22 to Sales department network and deny any other.

IT department VLAN	Sales Department VLAN
192.168.1.48/28	192.168.1.96/28

```
Router>enable
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#access-list 110 permit tcp 192.168.1.48 0.0.0.15 192.168.1.96 0.0.0.15 eq 22
Router(config)#access-list 110 deny ip any 192.168.1.96 0.0.0.15
Router(config)#access-list 110 permit ip any any
Router(config)#int se0/1/1
Router(config-if)#ip access-group 110 in
Router(config-if)#exit
Router(config)#
```

*Apply on interface serial0/1/1*

## Restrict IT department to only communicate with Office 1,2 and 3

Using named ACLs, permit inbound traffic into the two IT department networks from the networks of Office 1,2 and 3:

IT department networks	Offices networks
192.168.1.32/28	192.168.1.64
192.168.1.48/28	192.168.1.112
	192.168.1.128

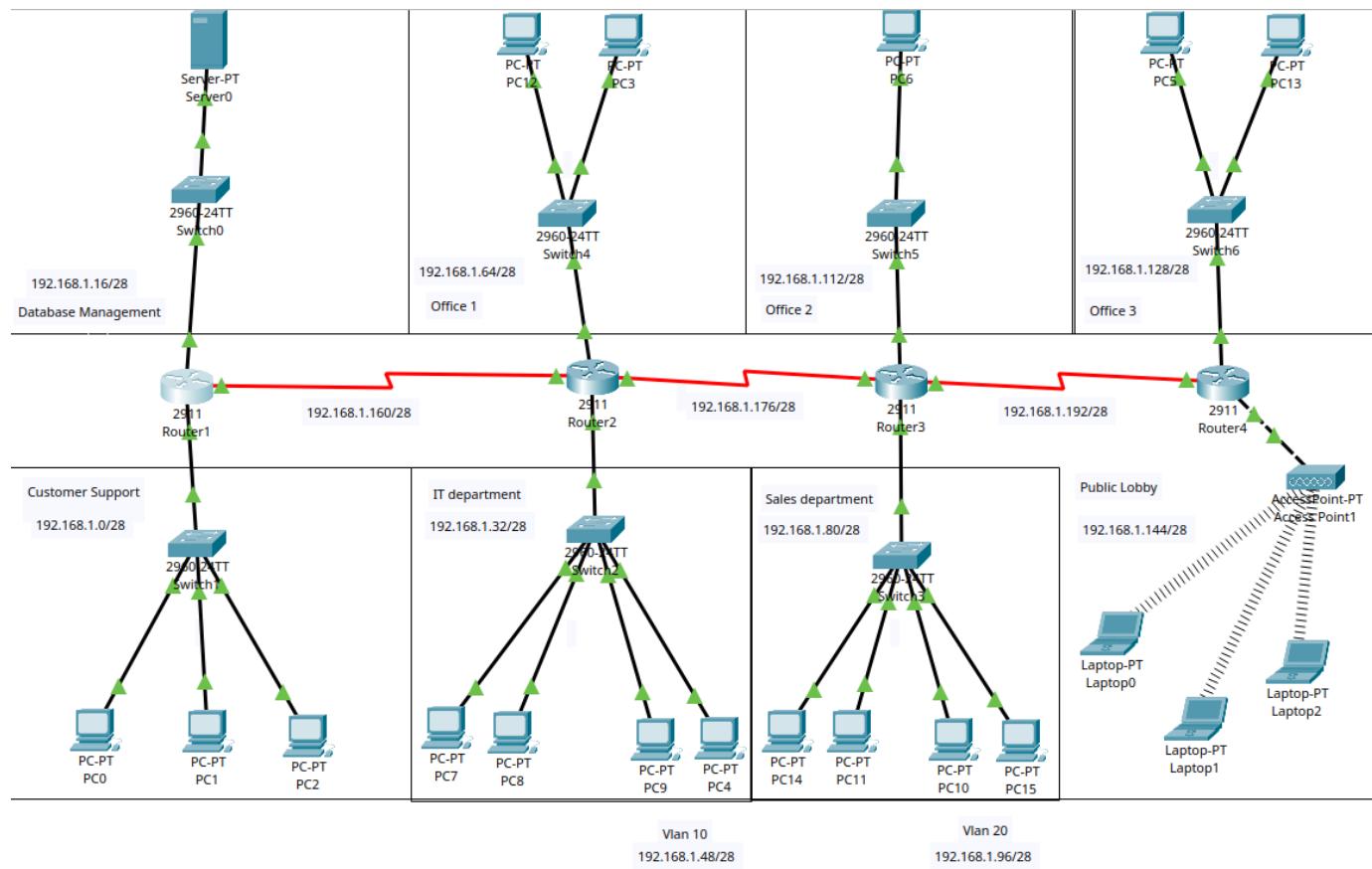
```
Router#config term
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#ip access-list extended IT_TO_OFFICES
Router(config-ext-nacl)#permit ip 192.168.1.32 0.0.0.15 192.168.1.64 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.32 0.0.0.15 192.168.1.112 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.32 0.0.0.15 192.168.1.128 0.0.0.15
Router(config-ext-nacl)#
Router(config-ext-nacl)#permit ip 192.168.1.48 0.0.0.15 192.168.1.64 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.48 0.0.0.15 192.168.1.112 0.0.0.15
Router(config-ext-nacl)#permit ip 192.168.1.48 0.0.0.15 192.168.1.128 0.0.0.15
Router(config-ext-nacl)#
Router(config-ext-nacl)#deny ip 192.168.1.32 0.0.0.15 any
Router(config-ext-nacl)#deny ip 192.168.1.48 0.0.0.15 any
Router(config-ext-nacl)#permit ip any any
Router(config-ext-nacl)#exit
Router(config)#int gig0/0
Router(config-if)# ip access-group IT_TO_OFFICES in
Router(config-if)#

```

Apply on interface gig0/0

At this point, I could configure Office 1, 2, and 3 to communicate only with the IT department as well. However, based on the access controls I have already implemented, all other networks are sufficiently restricted, making additional ACLs unnecessary.

Done



### Troubleshooting techniques used

Recheck configurations made for potential typos.

Recheck interfaces and set IP addresses are correctly configured.

Summary pages for interfaces, VLANS and ip route revealed I forgot a subnet config.

Tracert ping tool, checks which addresses connection fails.