



## CIS 326: IT Infrastructure Management – Project

Term 2 – 2023/2024

### Final Project

Group #: 3

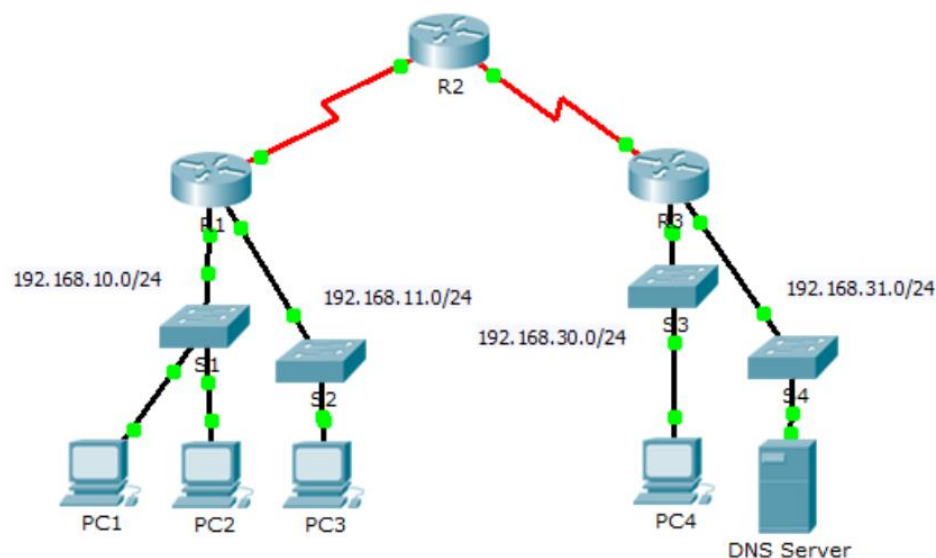
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#### Title and Topology of the Project:

Title : Office network

Topology number: 14



## Abstract:

The report shows the designing and implementation of a network (topology 14). The main goal of this project is to establish connection of an office network which consists of LANs and their ability to share files between devices. The topology that we used is consisting of different configuration such as Routers Configuration, OSPF protocol configuration, VLANs configuration, Wireless LAN Controller (WLC) and Establishing a Telnet and SSH connection configuration.

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## 1.0 Introduction:

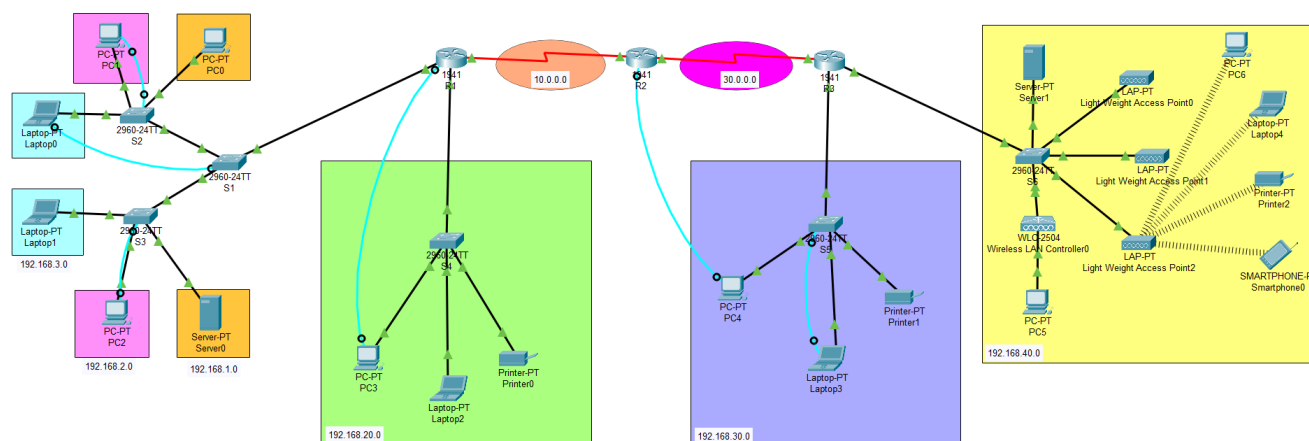
In this project, we built a network for an office that contains multiple LANs. The office needs to share and exchange information and files, so our topology enables communication and information exchange between different departments.

## 2.0 Network scenario:

Our topology contains a central router called R2 that connects two other routers containing their networks. In this scenario let's say you are in the yellow building, and you are using PC6 and you want to send an important file to someone that is in the green building using Laptop2, the message will go through Light wight access point to Switch6 to Router3 to Router2 then to Router1 to the Switch4 and then to Access Point0 then to the Laptop2 where the destination is. Thus, there are lots of other scenarios to happen.



### 3.0 Network design:



#### 3.1 Devices used in the topology:

Assist	Quantity
PC	7
Laptop	5
Printer	3
Smartphone	1
Server	2
Router	3
Switch	6
Wireless LAN Controller	1
Light Weight Access Point	3
Straight-through cables	24
Serial DCE cables	2
Console cable	6



### 3.2 Addressing Table:

Device	Interface	IP Address	Subnet Mask	Default Gateway
Router 1 (R1)	Gig0/0.10	192.168.1.1	255.255.255.0	-
Router 1 (R1)	Gig0/0.20	192.168.2.1	255.255.255.0	-
Router 1 (R1)	Gig0/0.30	192.168.3.1	255.255.255.0	-
Router 1 (R1)	Gig0/0.99	192.168.10.11	255.255.255.0	-
Router 1 (R1)	Gig0/1	192.168.20.1	255.255.255.0	-
Router 1 (R1)	Se0/0/0	10.0.0.1	255.255.255.252	-
Router 2 (R2)	Se0/0/0	10.0.0.2	255.255.255.252	-
Router 2 (R2)	Se0/0/1	30.0.0.1	255.255.255.252	-
Router 3 (R3)	Se0/0/1	30.0.0.2	255.255.255.252	-
Router 3 (R3)	Gig0/0	192.168.30.1	255.255.255.0	-
Router 3 (R3)	Gig0/1	192.168.40.1	255.255.255.0	-
PC0	NIC	192.168.1.2	255.255.255.0	192.168.1.1
PC1	NIC	192.168.2.2	255.255.255.0	192.168.2.1
PC2	NIC	192.168.2.3	255.255.255.0	192.168.2.1
PC3	Wireless	192.168.20.2	255.255.255.0	192.168.20.1
PC4	NIC	192.168.30.2	255.255.255.0	192.168.30.1
PC5	NIC	192.168.40.2	255.255.255.0	192.168.40.1
PC6	Wireless	DHCP	255.255.255.0	192.168.40.1
Laptop0	NIC	192.168.3.2	255.255.255.0	192.168.3.1
Laptop1	NIC	192.168.3.3	255.255.255.0	192.168.3.1
Laptop2	Wireless	192.168.20.3	255.255.255.0	192.168.20.1
Laptop3	NIC	192.168.30.3	255.255.255.0	192.168.30.1
Laptop4	Wireless	DHCP	255.255.255.0	192.168.40.1
Printer0	Wireless	192.168.20.4	255.255.255.0	192.168.20.1
Printer1	NIC	192.168.30.4	255.255.255.0	192.168.30.1
Printer2	Wireless	DHCP	255.255.255.0	192.168.40.1
Smartphone0	Wireless	DHCP	255.255.255.0	192.168.40.1
Server0	Fa0/3	192.168.1.3	255.255.255.0	192.168.1.1
Server1	Gig0/2	192.168.40.11	255.255.255.0	192.168.40.1





## 4.0 Configuration of the network devices:

### 4.1 hostname and password on R1, R2, and R3:

```
Router>enable
Router#configure terminal
Router(config)#hostname R1
R1(config)#enable secret Admin
R1(config)# service password-encryption
R1(config)#no ip domain-lookup
R1(config)#line console 0
R1(config-line)#logging synchronous
R1(config-line)#password Router1
R1(config-line)#login
R1(config-line)#line vty 0 4
R1(config-line)#password Router1
R1(config-line)#login
R1(config-line)#exit
R1(config)#banner MOTD #Router 1#
```

```
Router>enable
Router#configure terminal
Router(config)#hostname R2
R2(config)#enable secret Admin
R2(config)# service password-encryption
R2(config)#no ip domain-lookup
R2(config)#line console 0
R2(config-line)#logging synchronous
R2(config-line)#password Router2
R2(config-line)#login
R2(config-line)#line vty 0 4
R2(config-line)#password Router2
R2(config-line)#login
R2(config-line)#exit
R2(config)#banner MOTD #Router 2#
```



```
Router>enable
Router#configure terminal
Router(config)#hostname R3
R3(config)#enable secret Admin
R3(config)# service password-encryption
R1(config)#no ip domain-lookup
R3(config)#line console 0
R3(config-line)#logging synchronous
R3(config-line)#password Router3
R3(config-line)#login
R3(config-line)#line vty 0 4
R3(config-line)#password Router3
R3(config-line)#login
R3(config-line)#exit
R3(config)#banner MOTD #Router 3#
```

#### 4.2 Configure static routing on R1, R2, and R3:

```
R1(config)#interface GigabitEthernet0/0
R1(config-if)#no shutdown
R1(config)#interface GigabitEthernet0/1
R1(config-if)#ip address 192.168.20.1 255.255.255.0
R1(config-if)#no shutdown
R1(config)#interface serial0/0/0
R1(config-if)#ip address 10.0.0.1 255.255.255.252
R1(config-if)#clock rate 128000
R1(config-if)#no shutdown
```

For adding VLANs sub-interfaces

```
R2(config)#interface serial0/0/0
R2(config-if)#ip address 10.0.0.2 255.255.255.252
R2(config-if)#no shutdown
R2(config)#interface serial0/0/1
R2(config-if)#ip address 30.0.0.1 255.255.255.252
R2(config-if)#clock rate 128000
R2(config-if)#no shutdown
```



```
R3(config)#interface GigabitEthernet0/0
R3(config-if)#ip address 192.168.30.1 255.255.255.0
R3(config-if)#no shutdown
R3(config)#interface GigabitEthernet0/1
R3(config-if)#ip address 192.168.40.1 255.255.255.0
R3(config-if)#no shutdown
R3(config)#interface serial0/0/1
R3(config-if)#ip address 30.0.0.2 255.255.255.252
R3(config-if)#no shutdown
```

#### 4.3 Configure OSPF on R1, R2, and R3:

```
R1(config)#router ospf 1
R1(config-router)#network 192.168.1.0 0.0.0.255 area 0
R1(config-router)#network 192.168.2.0 0.0.0.255 area 0
R1(config-router)#network 192.168.3.0 0.0.0.255 area 0
R1(config-router)#network 192.168.10.0 0.0.0.255 area 0
R1(config-router)#network 192.168.20.0 0.0.0.255 area 0
R1(config-router)#network 10.0.0.0 0.0.0.3 area 0
R1(config-router)#passive-interface GigabitEthernet0/0
R1(config-router)#passive-interface GigabitEthernet0/1
R1(config-router)#end
```

```
R2(config)#router ospf 1
R2(config-router)#network 10.0.0.0 0.0.0.3 area 0
R2(config-router)#network 30.0.0.0 0.0.0.3 area 0
R2(config-router)#end
```

```
R3(config)#router ospf 1
R3(config-router)#network 192.168.30.0 0.0.0.255 area 0
R3(config-router)#network 192.168.40.0 0.0.0.255 area 0
R3(config-router)#network 30.0.0.0 0.0.0.3 area 0
R3(config-router)#passive-interface GigabitEthernet0/0
R3(config-router)#passive-interface GigabitEthernet0/1
R3(config-router)#end
```



## 4.4 WLC Configuration:

### 4.4.1 Addressing Wireless Lan Controller (WLC):

Wireless LAN Controller0

Physical **Config** Attributes

**GLOBAL**

Settings

**INTERFACE**

GigabitEthernet1

GigabitEthernet2

GigabitEthernet3

GigabitEthernet4

Management

**Management**

IP Configuration

IPv4 Address: 192.168.40.254

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.40.1

DNS Server: 192.168.40.10

### 4.4.2 Server Configuration:

#### 4.4.2.1 Interface fast-Ethernet IP address Configuration:

Server1

Physical Config **Services** **Desktop** Programming Attributes

**IP Configuration**

IP Configuration

☐ DHCP ☒ Static

IPv4 Address: 192.168.40.11

Subnet Mask: 255.255.255.0

Default Gateway: 192.168.40.1

DNS Server: 192.168.40.10

#### 4.4.2.2 DHCP Configuration:

Server1

Physical Config **Services** Desktop Programming Attributes

**SERVICES**

HTTP

DHCP

DHCPv6

TFTP

DNS

SYSLOG

AAA

NTP

EMAIL

FTP

IoT

VM Management

Radius EAP

**DHCP**

Interface: FastEthernet0 Service: ☒ On ☐ Off

Pool Name: serverPool

Default Gateway: 192.168.40.1

DNS Server: 192.168.40.10

Start IP Address: 192.168.40.0

Subnet Mask: 255.255.255.0

Maximum Number of Users: 100

TFTP Server: 0.0.0.0

WLC Address: 192.168.40.254

Add Save Remove

Pool Name	Default Gateway	DNS Server	Start IP Address	Subnet Mask	Max User	TFTP Server	WLC Address
serverPool	192.16...	192.16...	192.16...	255.25...	100	0.0.0.0	192.16...



#### 4.4.3 Accessing to WLC by PC5 web browser and set the controller from <http://192.168.40.254>:

The left screenshot shows the Cisco 2500 Series Wireless LAN Controller web interface. The URL is <http://192.168.40.254>. The page displays the Cisco logo and the text 'Cisco 2500 Series Wireless LAN Controller'. Below this, it says 'Welcome! Please start by creating an admin account.' and provides fields for 'Admin', 'Password', and 'Confirm Password'. A 'Start' button is at the bottom.

The right screenshot shows the configuration page for the Cisco 2500 Series Wireless LAN Controller. The URL is <http://192.168.40.254>. The page displays the Cisco logo and the text 'Cisco 2500 Series Wireless LAN Controller'. Below this, it says 'Please confirm settings and apply'. The configuration is divided into three sections: 1. Controller Settings, 2. Wireless Network Settings, and 3. Advanced Settings. The 'Controller Settings' section includes fields for Username (Admin), System Name (Office4-WLAN), Country (Kenya (KN)), Date & Time (01/20/2023 16:37:52), Timezone (Baghdad), and NTP Server (-). The 'Wireless Network Settings' section includes fields for Employee Network (checked), Network Name (Office4-Admin), Security (WPA2 Personal), Passphrase (\*\*\*\*\*), Employee VLAN (Management VLAN), and DHCP Server Address (-). The 'Advanced Settings' section includes fields for RF Parameter Optimization (checked), Virtual IP Address (192.0.2.1), and Local Mobility Group (Default).

#### 4.4.4 Re-access to the WLC using secure connection <https://192.168.40.254>:

The screenshot shows the Cisco 2500 Series Wireless LAN Controller web interface accessed via a secure connection. The URL is <https://192.168.40.254>. The page displays the Cisco logo and the text 'Cisco 2500 Series Wireless LAN Controller'. Below this, it says 'Welcome! Please click the login button to enter your user name and password'. A green 'Login' button is at the bottom. An 'Authentication Required' dialog box is overlaid on the page, showing 'User Name: Admin' and 'Password: \*\*\*\*\*' with 'Login' and 'Cancel' buttons.



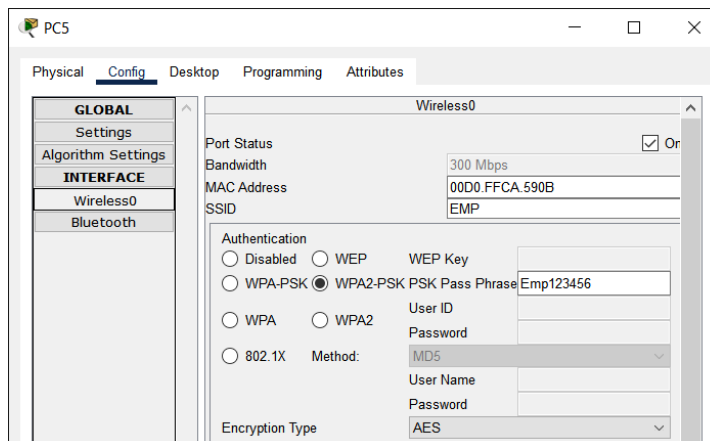
#### 4.4.4.1 WLANs:

<input type="checkbox"/>	WLAN ID	Type	Profile Name	WLAN SSID	Admin Status	Security Policies
<input type="checkbox"/>	1	WLAN	Office4-Admin	Office4-Admin	Enabled	[WPA2][Auth(PSK)]
<input type="checkbox"/>	2	WLAN	Office4-Employee	EMP	Enabled	[WPA2][Auth(PSK)]
<input type="checkbox"/>	3	WLAN	Office4-Guest	GUE	Enabled	[WPA2][Auth(PSK)]

#### 4.4.4.2 Wirelesses:

Number of APs 3			
AP Name	IP Address(Ipv4/Ipv6)	AP Model	AP MAC
<a href="#">Light Weight Access Point1</a>	192.168.40.100	PT-AIR-CAP1000I-A-K9	00:07:EC:85:00:00
<a href="#">Light Weight Access Point2</a>	192.168.40.101	PT-AIR-CAP1000I-A-K9	00:0C:85:00:00:00
<a href="#">Light Weight Access Point0</a>	192.168.40.102	PT-AIR-CAP1000I-A-K9	00:0C:85:00:00:00

#### 4.4.5 connect End wireless devices to WLANs:



#### 4.4.6 WLANs information:

Profile Name	SSID	Password
Office4-Admin	Office4-Admin	Adm123456
Office4-Employee	EMP	Emp123456
Office4-Guest	GUE	Gue123456



#### 4.5 hostname and password on S1, S2, and S3:

```
Switch>enable
Switch#configure terminal
Switch(config)#hostname S1
S1(config)#enable secret Admin
S1(config)# service password-encryption
S1(config)#no ip domain-lookup
S1(config)#line console 0
S1(config-line)#logging synchronous
S1(config-line)#password Switch1
S1(config-line)#login
S1(config-line)#line vty 0 4
S1(config-line)#password Switch1
S1(config-line)#login
S1(config-line)#exit
S1(config)#banner MOTD #Switch 1#
```

```
Switch>enable
Switch#configure terminal
Switch(config)#hostname S2
S2(config)#enable secret Admin
S2(config)# service password-encryption
S2(config)#no ip domain-lookup
S2(config)#line console 0
S2(config-line)#logging synchronous
S2(config-line)#password Switch2
S2(config-line)#login
S2(config-line)#line vty 0 4
S2(config-line)#password Switch2
S2(config-line)#login
S2(config-line)#exit
S2(config)#banner MOTD #Switch 2#
```



```
Switch>enable
Switch#configure terminal
Switch(config)#hostname S3
S3(config)#enable secret Admin
S3(config)# service password-encryption
S3(config)#no ip domain-lookup
S3(config)#line console 0
S3(config-line)#logging synchronous
S3(config-line)#password Switch3
S3(config-line)#login
S3(config-line)#line vty 0 4
S3(config-line)#password Switch3
S3(config-line)#login
S3(config-line)#exit
S3(config)#banner MOTD #Switch 3#
```

#### 4.6 Configure VLANs on S1, S2, and S3:

```
S1(config)#vlan 99
S1(config-vlan)#name Management
S1(config-vlan)#exit
S1(config)#vlan 10
S1(config-vlan)#name Admin
S1(config-vlan)#exit
S1(config)#vlan 20
S1(config-vlan)#name Employee
S1(config-vlan)#exit
S1(config)#vlan 30
S1(config-vlan)#name Guest
S1(config-vlan)#exit
```





```
S2(config)#vlan 99
S2(config-vlan)#name Management
S2(config-vlan)#exit
S2(config)#vlan 10
S2(config-lan)#name Admin
S2(config-vlan)#exit
S2(config)#vlan 20
S2(config-vlan)#name Employee
S2(config-vlan)#exit
S2(config)#vlan 30
S2(config-vlan)#name Guest
S2(config-vlan)#exit
```

```
S3(config)#vlan 99
S3(config-vlan)#name Management
S3(config-vlan)#exit
S3(config)#vlan 10
S3(config-lan)#name Admin
S3(config-vlan)#exit
S3(config)#vlan 20
S3(config-vlan)#name Employee
S3(config-vlan)#exit
S3(config)#vlan 30
S3(config-vlan)#name Guest
S3(config-vlan)#exit
```

#### 4.7 Assign switch ports to VLANs on S2 and S3:

```
S2(config)#interface fastEthernet0/11
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 10
S2(config-if)#interface fastEthernet0/18
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 20
S2(config-if)#interface fastEthernet0/6
S2(config-if)#switchport mode access
S2(config-if)#switchport access vlan 30
S2(config-if)#exit
```



```
S3(config)#interface fastEthernet0/11
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 10
S3(config-if)#interface fastEthernet0/18
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 20
S3(config-if)#interface fastEthernet0/6
S3(config-if)#switchport mode access
S3(config-if)#switchport access vlan 30
S3(config-if)#exit
```

#### 4.8 Assign the management VLAN:

```
S1(config)#interface vlan 99
S1(config-if)#ip address 192.168.10.11 255.255.255.0
S1(config-if)#no shutdown
```

```
S2(config)#interface vlan 99
S2(config-if)#ip address 192.168.10.12 255.255.255.0
S2(config-if)#no shutdown
```

```
S3(config)#interface vlan 99
S3(config-if)#ip address 192.168.10.13 255.255.255.0
S3(config-if)#no shutdown
```

#### 4.9 Configure trunking and the native VLAN on S1, S2, and S3:

```
S1(config)#interface fa0/1
S1(config-if)#switchport mode trunk
S1(config-if)#switchport trunk native vlan 99
S1(config)#interface fa0/2
S1(config-if)#switchport mode trunk
S1(config-if)#switchport trunk native vlan 99
S1(config-if)#interface fa0/3
S1(config-if)#switchport mode trunk
S1(config-if)#switchport trunk native vlan 99
S1(config-if)#end
```



```
S2(config)#interface fa0/2
S2(config-if)#switchport mode trunk
S2(config-if)#switchport trunk native vlan99
S2(config-if)#end
```

```
S3(config)#interface fa0/3
S3(config-if)#switchport mode trunk
S3(config-if)#switchport trunk native vlan 99
S3(config-if)#end
```

#### 4.10 Configure VLANs sub-interfaces on R1:

```
R1(config)#interface gigabitEthernet 0/0.10
R1(config-subif)#encapsulation dot1Q 10
R1(config-subif)#ip address 192.168.1.1 255.255.255.0
R1(config-subif)#no shutdown
R1(config-subif)#exit
R1(config)#interface gigabitEthernet 0/0.20
R1(config-subif)#encapsulation dot1Q 20
R1(config-subif)#ip address 192.168.2.1 255.255.255.0
R1(config-subif)#no shutdown
R1(config-subif)#exit
R1(config)#interface gigabitEthernet 0/0.30
R1(config-subif)#encapsulation dot1Q 30
R1(config-subif)#ip address 192.168.3.1 255.255.255.0
R1(config-subif)#no shutdown
R1(config-subif)#exit
R1(config)#interface gigabitEthernet 0/0.99
R1(config-subif)#encapsulation dot1Q 99
R1(config-subif)#ip address 192.168.10.11 255.255.255.0
R1(config-subif)#no shutdown
R1(config-subif)#end
```



#### 4.11 Create Loopback 0 interface for R3:

```
R3(config)#interface loopback 0  
R3(config-if)#ip address 209.165.200.225 255.255.255.224  
R3(config-if)#end
```

#### 4.12 hostname and password on S5:

```
Switch>enable  
Switch#configure terminal  
Switch(config)#hostname S5  
S5(config)#enable secret Admin  
S5(config)#service password-encryption  
S5(config)#no ip domain-lookup  
S5(config)#line console 0  
S5(config-line)#logging synchronous  
S5(config-line)#password Switch5  
S5(config-line)#login  
S5(config-line)#line vty 0 15  
S5(config-line)#password Switch5  
S5(config-line)#login  
S5(config-line)#exit  
S5(config)#banner MOTD #Switch 5#
```

#### 4.13 IP address and default gateway for S5:

```
S5(config)#interface vlan 1  
S5(config-if)#ip address 192.168.30.11 255.255.255.0  
S5(config-if)#no shutdown  
S5(config-if)#exit  
S5(config)#ip default-gateway 192.168.30.1  
S5(config)#end
```

#### 4.14 Configure R3 for SSH connectivity:

```
R3(config)#ip domain-name CCSIT.com.sa  
R3(config)#crypto key generate rsa  
How many bits in the modulus [512]: 1024  
R3(config)#username Admin privilege 15 secret #Admin123  
R3(config)#line vty 0 4  
R3(config-line)#transport input ssh  
R3(config-line)#login local  
R3(config-line)#end
```



#### 4.15 Configure S5 for SSH connectivity:

```
S5(config)#ip domain-name CCSIT.com.sa
S5(config)#crypto key generate rsa
How many bits in the modulus [512]: 1024
S5(config)#username Admin privilege 15 secret #Admin123
S5(config)#line vty 0 4
S5(config-line)#transport input ssh
S5(config-line)#login local
S5(config-line)#end
```

#### 4.16 Saving running configurations for all configured devices:

```
R1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

```
R2#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

```
R3#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```





```
S1#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

```
S2#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

```
S3#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```





```
S5#copy running-config startup-config
Destination filename [startup-config]?
Building configuration...
[OK]
```

## 5.0 Connections Verification:

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	R1	R2	ICMP		0.000	N	0	(edit)
	Successful	R2	R3	ICMP		0.000	N	1	(edit)





Sending message from R1 to R2 (Successful)

Sending message from R2 to R3 (Successful)

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	PC3	PC6	ICMP		0.000	N	0	(edit)
	Successful	Laptop3	Printer2	ICMP		0.000	N	1	(edit)

Sending message from PC3 to PC6 (Successful)

Sending message from Laptop3 to Printer2 (Successful)

Fire	Last Status	Source	Destination	Type	Color	Time(sec)	Periodic	Num	Edit
	Successful	Server0	PC0	ICMP		0.000	N	0	(edit)
	Successful	PC2	PC1	ICMP		0.000	N	1	(edit)

Sending message from Server0 to PC0 VLAN 10 (Successful)

Sending message from PC2 to PC1 VLAN 20 (Successful)

```
C:\>ssh -l Admin 192.168.30.1
Password:
Router 3
R3#
```

SSH Establishing with R3

```
C:\>ssh -l Admin 192.168.30.11
Password:
Switch 5
S5#
```

SSH Establishing with S5

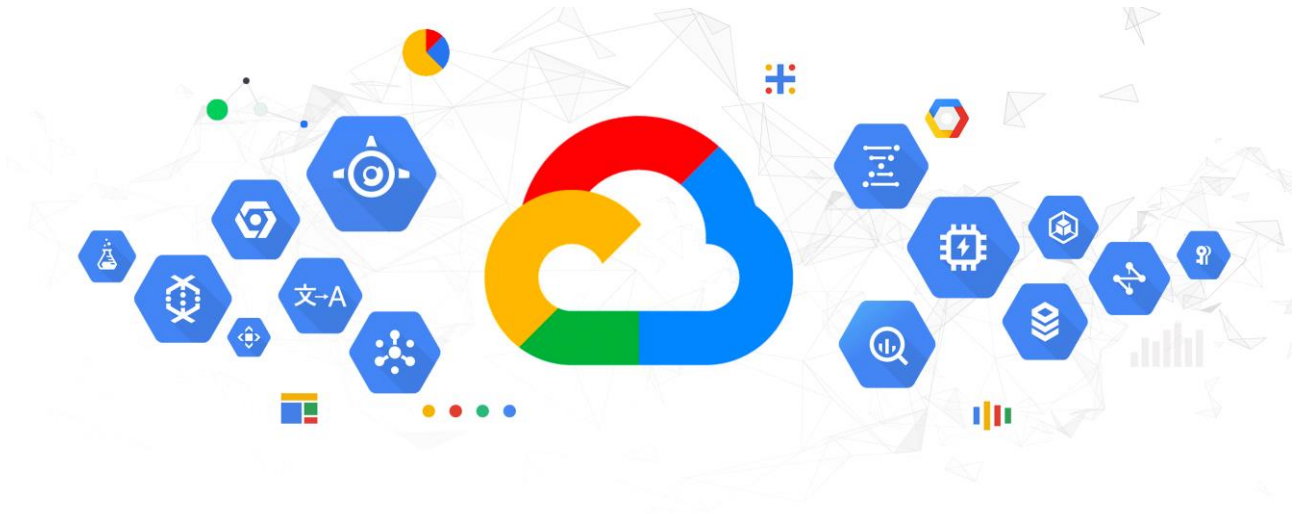
## 6.0 Conclusion:

In our organization, we have created four offices each with a LAN-LAN network, and made the configuration in each of them, including Routers Configuration ,OSPF protocol configuration, VLANs configuration, Wireless LAN Controller (WLC) and Establishing a Telnet and SSH connection configuration. And the network is working effectively. Each connection can be configured so that it will work efficiently between every two points.



# Cases study

## Cloud Service Provider: Google cloud





## Introduction

Google Cloud is a suite of cloud computing services provided by Google. It offers products to end-users such as Google Search Engine and YouTube, and the same infrastructure is used internally by Google as well. Business applications can be developed, deployed, and managed on the same infrastructure that Google utilizes their own products by the use of Google Cloud.

Regardless of the size of a business, Google Cloud can meet its needs. Services of Google include Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), and more. It also provides tools for data storage, analytics, machine learning, artificial intelligence, networking, security, and more.

What makes Google Cloud stand out from other cloud providers is its ability to provide customers with access to the same technology used by Google itself. This means customers can benefit from the same scalability, reliability, and security that power some of the world's most popular products. Additionally, customers can take advantage of the global network of data centers provided by Google to ensure their applications are always available and running optimally. Finally, with its pay-as-you-go pricing model and generous free tier offering, customers can get started quickly without breaking the bank.

### i. Concept of Cloud Computing:

Cloud computing is a technology that provides users with access to computing resources such as servers, storage, and software over the Internet. The cost of hardware and infrastructure is eliminated, allowing businesses and individuals to take advantage of provided resources. Multiple virtual machines can share the same physical resources with cloud computing, which is based on the idea of virtualization. This leads to cost savings, increased scalability, and improved reliability. Public, private, and hybrid clouds are the three main types of cloud computing. Public cloud services are operated by third-party providers and are available to the general public. Private cloud services are operated by enterprises for their own use. Hybrid cloud services combine elements of public and private clouds.

### ii. Models and scopes of use:

Cloud computing has several models, including Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). IaaS provides raw computing resources such as servers, storage, and networks that users can configure and manage. PaaS provides a platform on which the user can develop, run and manage their applications. SaaS provides a software application that the user can access and use over the Internet. Cloud computing has a wide range of application areas, including data storage, Big Data analytics, artificial intelligence, machine learning, and software development. It is also widely used in web-based applications and services, and in providing software and services to customers.

### iii. How does cloud computing work?

Over the internet, computing resources are made available to users through cloud computing. These resources are managed by a cloud provider, who is responsible for maintaining and updating the hardware and software. Users can access these resources through a web browser or API and increase or decrease their usage as needed. Cloud providers use virtualization technology to create multiple virtual machines that share the same physical resources. This allows users to access more resources than would be possible with physical hardware, resulting in cost savings, higher scalability, and greater reliability.

### iv. What cloud computing services are available?

Google Cloud Platform (GCP) is one of the leading cloud computing providers, offering a wide range of services to its customers. GCP services include storage, data processing, networking, and machine learning. GCP's specialized services include Google Compute Engine, Google Kubernetes Engine, Google Cloud Storage, Google Cloud SQL, Google Cloud Spanner, Google BigQuery, and many more. GCP also offers a range of application management and deployment tools and services, including Cloud Deployment Manager, Cloud SDK, and Cloud Console.

### v. What cloud services are different from other providers?

One of the key services that differentiates GCP from other vendors is the Google Kubernetes Engine (GKE). GKE is a powerful and flexible platform for managing containerized applications that allows customers to easily deploy, scale and manage their applications. In addition, GCP provides advanced machine learning services such as Google Cloud Machine Learning Engine and TensorFlow that enable customers to build and deploy machine learning models. Google's global network of data centers and edge locations provides customers with fast and reliable access to their resources, regardless of location. GCP also provides strong security, compliance, and governance capabilities that help protect customer data and comply with industry regulations.

## Conclusion

In summary, cloud computing is a way to get computing resources on demand over the Internet. Google Cloud Platform (GCP) is one of the leading cloud providers and offers a wide range of services such as storage, computing, networking, and machine learning. GCP's specific services include Google Compute Engine, Google Kubernetes Engine and Google Cloud Storage, among others. One of GCP's key differentiators is its advanced machine learning services, such as Google Cloud Machine Learning Engine and TensorFlow, which enable customers to build and deploy machine learning models. GCP also offers strong security, compliance and governance capabilities to protect customer data and meet industry regulations. In addition, GCP's global network of data centers and edge locations provides customers with fast and reliable access to their resources, regardless of location. Overall, cloud computing and GCP's services offer businesses and individuals cost savings, increased scalability, improved reliability, and the ability to access and use the latest technologies as needed.