

Course Code: COM204

Course Name: Computer Networks

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Academic Year: 2024/2025

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### Network Design Documentation

Q1: What is the **objective** of the project?

A1: The objective of the project is to create a modern network for Helwan National University.

In this initial phase, the network will not cover all faculties. Instead, it will be designed to connect only **four main buildings**:

1. The Administration Building
2. Faculty of Engineering
3. Faculty of Computer Science and Information Technology
4. Faculty of Medicine

This design aims to establish reliable communication between the buildings using modern technologies such as **VLANs**, dynamic routing (**RIP**), and securing the network for remote access through **Telnet**.

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### Network Design

I created the network topology using Packet Tracer to connect the four buildings together. Here is a visual representation of the project. I also attempted to make the design resemble the actual layout of the university buildings



### Components Used:

#### 1. Routers:

- I used **4 routers** of type **Router PT Empty** to connect the four buildings:
  - Faculty of Engineering
  - Faculty of Computer Science and Information Technology
  - Faculty of Medicine + Administration Building

#### 2. Switches:

- I deployed **4 switches** of type **2960-24TT** to manage internal network communication in each building.

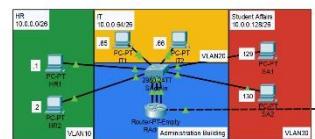
#### 3. End Devices:

- I added **24 end devices** (PCs) to represent the departments within the faculties (**e.g., IT, HR, Student Affairs**) in logical networks (**VLANs**) to improve traffic management within the network.

### Explanation of Network Components

#### • Colors in the image:

- Blue:** Represents the entire building.
- Green:** Represents the **HR (Human Resources)** department.



- **Yellow**: Represents the **IT (Information Technology)** department.
- **Red**: Represents the **Student Affairs** department.
- **Numbers next to devices:**
  - The numbers like **.1**, **.66**, or **.129** are shorthand for **IPv4 Addresses**.
  - You can identify the IPv4 Address of a device by:
    1. Accessing the device itself.
    2. Or by checking its external label in the diagram. For example:
      - ◆ The green HR department is labeled **10.0.0.0**.
      - ◆ It contains two devices, **HR1** and **HR2**.
- **Example:** ○ If you select **HR2** from the HR department, its **IPv4 Address** will be **10.0.0.2**.
- **VLAN for each department:**
  - Each department is assigned a specific **VLAN** to ensure better traffic management, as shown in the image.

**Subnetting Plan**

Building/Department	VLAN ID	Subnet	Subnet Mask	Host Range	Broadcast Address
Administration (HR)	VLAN10	10.0.0.0/26	255.255.255.192	10.0.0.1 - 10.0.0.62	10.0.0.63
Administration (IT)	VLAN20	10.0.0.64/26	255.255.255.192	10.0.0.65 - 10.0.0.126	10.0.0.127
Administration (Student Affairs)	VLAN30	10.0.0.128/26	255.255.255.192	10.0.0.129 - 10.0.0.190	10.0.0.191
Engineering (HR)	VLAN100	10.0.1.0/26	255.255.255.192	10.0.1.1 - 10.0.1.62	10.0.1.63
Engineering (IT)	VLAN110	10.0.1.64/26	255.255.255.192	10.0.1.65 - 10.0.1.126	10.0.1.127
Engineering (Student Affairs)	VLAN120	10.0.1.128/26	255.255.255.192	10.0.1.129 - 10.0.1.190	10.0.1.191
Computer Science (HR)	VLAN40	192.168.1.0/26	255.255.255.192	192.168.1.1 - 192.168.1.62	192.168.1.63
Computer Science (IT)	VLAN50	192.168.1.64/26	255.255.255.192	192.168.1.65 - 192.168.1.126	192.168.1.127
Computer Science (Student Affairs)	VLAN60	192.168.1.128/26	255.255.255.192	192.168.1.129 - 192.168.1.190	192.168.1.191
Medicine (HR)	VLAN70	192.168.2.0/26	255.255.255.192	192.168.2.1 - 192.168.2.62	192.168.2.63
Medicine (IT)	VLAN80	192.168.2.64/26	255.255.255.192	192.168.2.65 - 192.168.2.126	192.168.2.127
Medicine (Student Affairs)	VLAN90	192.168.2.128/26	255.255.255.192	192.168.2.129 - 192.168.2.190	192.168.2.191

### **Table Details:**

- **Building/Department:** Specifies the building or department to which the subnet has been assigned, such as the Human Resources (HR) department or the Information Technology (IT) department within a specific building.
- **VLAN ID:** Represents the unique identifier for the Virtual Local Area Network (VLAN) for each department. VLANs are used to separate departments within a building to improve traffic management within the network.
- **Subnet:** The subnet address assigned to this department (e.g., 10.0.0.0/26).
- **Subnet Mask:** The subnet mask used to define the subnet, such as 255.255.255.192.
- **Host Range:** Indicates the range of IP addresses that can be allocated to devices within the subnet, such as 10.0.0.1 - 10.0.0.62.
- **Broadcast Address:** The broadcast address for the subnet, which is the last address within the subnet (e.g., 10.0.0.63).

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### **Configuration Details**

#### **Router Configuration**

##### **Example Configuration for Computer Science Router:**

```
Router> enable  
Router# configure terminal  
Router(config)# hostname Amr-Yasser-CS  
Router(config)# enable password 123
```

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```
Router(config)# interface gigabitEthernet 0/0  
Router(config-if)# ip address 192.168.1.62 255.255.255.192  
Router(config-if)# no shutdown
```

```
Router(config)# interface gigabitEthernet 0/4  
Router(config-if)# ip address 12.0.0.2 255.255.255.0
```

```
Router(config-if)# no shutdown
```

These are all examples because, to be honest, I'm not quite sure what I should write!!

## Testing

```
ping 13.0.0.1 ping 192.168.1.126  
ping 12.0.0.2
```

```
telnet 192.168.1.62
```

## Challenges and Solutions

### Challenges:

1. Misconfigured VLANs causing communication failure.
2. Routing misconfigurations leading to lack of connectivity between buildings.
3. Addressing IP conflicts during manual setup.

### Solutions:

1. Double-check VLAN IDs and port assignments.
2. Test and validate routing protocols (e.g., RIP, OSPF).
3. Use DHCP where possible to avoid manual IP conflicts.

The screenshot shows a Windows Command Prompt window titled "HR2". The window contains several "ping" command outputs. The first section shows pings to 13.0.0.1 and 192.168.1.126, both of which show 0% loss. The second section shows a ping to 12.0.0.2, which shows 1 (25%) loss. The third section shows a telnet session to 192.168.1.62, which fails with a "Connection to host closed by foreign host" message.

```
Pinging 13.0.0.1 with 32 bytes of data:  
Reply from 13.0.0.1: bytes=32 time<1ms TTL=255  
Ping statistics for 13.0.0.1:  
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 0ms, Average = 0ms  
C:\>ping 192.168.1.126  
Pinging 192.168.1.126 with 32 bytes of data:  
Reply from 192.168.1.126: bytes=32 time=1ms TTL=255  
Reply from 192.168.1.126: bytes=32 time<1ms TTL=255  
Reply from 192.168.1.126: bytes=32 time<1ms TTL=255  
Reply from 192.168.1.126: bytes=32 time<1ms TTL=255  
Ping statistics for 192.168.1.126:  
Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 1ms, Average = 3ms  
C:\>ping 12.0.0.2  
Pinging 12.0.0.2 with 32 bytes of data:  
Request timed out.  
Reply from 12.0.0.2: bytes=32 time<1ms TTL=255  
Reply from 12.0.0.2: bytes=32 time<1ms TTL=255  
Reply from 12.0.0.2: bytes=32 time<1ms TTL=255  
Ping statistics for 12.0.0.2:  
Packets: Sent = 4, Received = 3, Lost = 1 (25% loss),  
Approximate round trip times in milli-seconds:  
Minimum = 0ms, Maximum = 0ms, Average = 0ms  
C:\>telnet 192.168.1.62  
Trying 192.168.1.62 ...open  
[Connection to 192.168.1.62 closed by foreign host]  
C:\>
```

## Conclusion

This network design successfully connects the four main buildings of Helwan National University with proper segmentation using VLANs and VLSM for IP efficiency. Testing confirmed reliable inter-building communication and secure remote access. This design can be expanded in the future to incorporate additional faculties and services.