



**Birzeit University**  
**Faculty of Engineering and Technology**  
**Electrical and Computer Engineering Department**  
**ENCS4130 - Computer Networks Laboratory**

## **EXP. No. 1. Physical LAN Setup and Monitoring**

### **1. Objectives**

- Study the types of Ethernet cabling and when and how to use them.
- Installing a Peer-to-Peer local area network (Workgroup LAN) using crossover cable.
- Learn to create a simple LAN with a PC using an Ethernet switch and two straight-through cables to connect the workstations.
- Learn to configure and verify the network connectivity.
- Implementing some applications like file sharing between workstations.
- Learn about various network-related commands.

### **2. Lab Requirements**

- 2 PCs with a Network Interface Card (NIC) for each.
- One Ethernet hub and one Ethernet switch.
- Single crossover cable.
- Two CAT5 straight-wired cables.
- Cable tester.

### 3. Introduction

#### 3.1. Network Cables

There are many types of network cables used in real-world applications. Some of them are given below:

- **Unshielded twisted pair:** As the name indicates, the wires are twisted with one another and there is no shield.

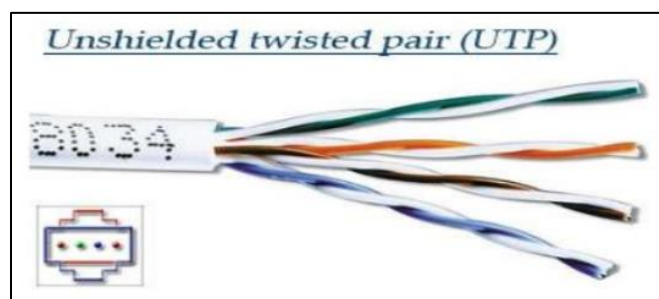


Figure 1-1: Unshielded twisted pair

- **Shielded twisted pair:** Shield with twisted pair.



Figure 1-2: Shielded twisted pair

- **Coaxial cable:** Like our TV cables.

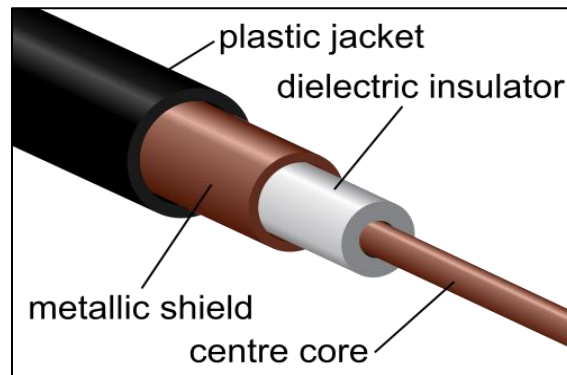


Figure 1-3: Coaxial cable

- **Fiber-optic cable:**

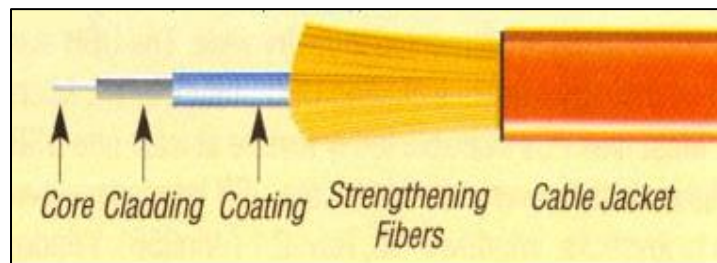


Figure 1-4: Fiber optic cable

Table 1-1: Comparison between network cables

| Type         | Max distance | Bandwidth       | Noise effect | Cost      |
|--------------|--------------|-----------------|--------------|-----------|
| Twisted pair | 100 m        | Up to 1-100 MHz | High noise   | Cheap     |
| Coaxial      | 100 m        | Up to 3 GHz     | Medium noise | Moderate  |
| Fiber Optics | 100 km       | Up to THz       | Less Noise   | Expensive |

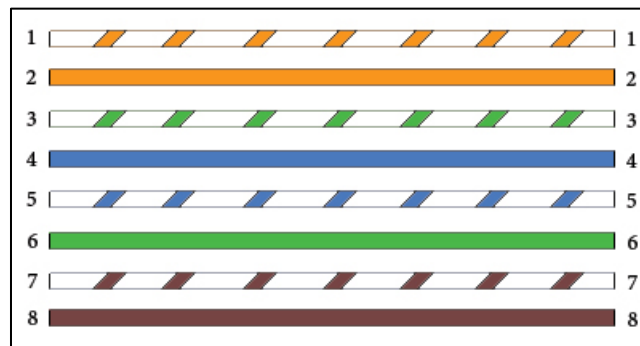
### 3.2. Cable Connection for Network Devices

Since there are a bunch of different types of devices specified at the different layers of the OSI model, it is also very important to understand the many types of cables and connectors used for connecting all those devices to a network. We will go over cabling devices, and discuss how

to connect to a router or switch along with Ethernet LAN technologies. Ethernet cabling is an important discussion, especially if you are planning on building LAN.

- **Straight Through Cable:**

This type of cable is used when we connect dissimilar devices [PC and switch, switch and router, router and hub, etc.]. Here, the connections are the same on both ends (*RJ45*) of the cable. The wires and their respective PINs are shown in Figure 1-5.



*Figure 1-5: Straight-through cable*

Note that only pins 1, 2, 3, and 6 are used. Just connect 1 to 1, 2 to 2, 3 to 3, and 6 to 6, and you will be up and networking. However, remember that this would be an Ethernet- only cable and would not work with Voice, Token Ring, ISDN, etc.

- **Cross-Over Cable:**

This type of cable is used when we connect similar devices [router and router, switch and switch, PC and PC, etc.] and with some exceptions [switch and hub, Router and PC]. Here, the connections are different with a specific pattern in the *RJ45*. The wires and their respective PINs are shown in Figure 1-6.

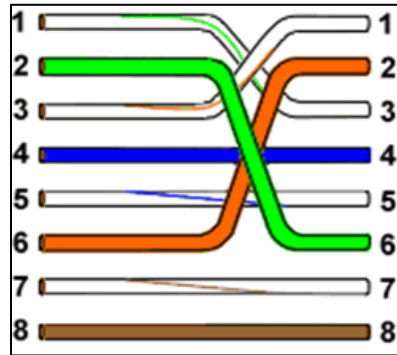


Figure 1-6: Cross-Over cable

The same four wires are used in this cable as in the straight-through cable, but we just connect different pins. Notice that instead of connecting 1 to 1, etc., here we connect pins 1 to 3 and 2 to 6 on each side of the cable.

- **Roll-over Cable:**

This type of cable is used to connect the PC to the router/switch via console port for management purposes. Here, the connections are made in reverse order, as shown in Figure 1-7.

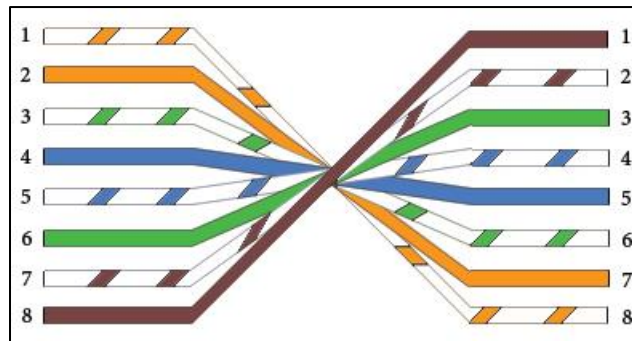


Figure 1-7: Roll-Over cable

### 3.3. Cisco Routers:

#### 3.3.1. The Cisco Router User Interface

The Cisco Internetwork Operating System (IOS) is the kernel of Cisco routers and most switches. A kernel is the basic part of an operating system that allocates resources and manages things, such as low-level hardware interfaces and security.

The Cisco IOS was created to deliver network services and enable networked applications. It runs on most Cisco routers and some Cisco Catalyst switches, such as the Catalyst 2950. The important things that the Cisco router IOS software is responsible for:

- Carrying network protocols and functions
- Connecting high-speed traffic between devices
- Adding security to control access and stop unauthorized network use
- Providing scalability for ease of network growth and redundancy
- Supplying network reliability for connecting to network resources

To access an interface the following command is used:

```
interface <TYPE> <SLOT>/<PORT>
```

### 3.3.2. *Connecting to a Cisco Router*

There are different ways to connect to a Cisco router to configure it, verify its configuration, and check statistics.

- **The console port**

The console port is usually an RJ-45 (8-pin Modular) connection located at the back of the router—by default, there is no password set.

- **Auxiliary port**

You can also connect to a Cisco router through an auxiliary port which is the same thing as a console port, so it follows that you can use it as one. But this auxiliary port also allows you to configure modem commands so that a modem can be connected to the router. This is a cool feature it lets you dial up a remote router and attach it to the auxiliary port if the router is down and you need to configure it “out-of-band” (which means, basically, “out-of-the-network”).

- **Telnet**

The third way to connect to a Cisco router is in-band, through the program, Telnet is a terminal emulation program that acts as though it is a dumb terminal. You can use Telnet to connect to any active interface on a router like an Ethernet or serial port.

## 4. Procedure

In this experiment, you will make a crossover cable and use that cable to connect a PC to a router to create a simple Peer-to-Peer network. The instructions for this lab focus on the Windows 10 operating system.

### 4.1. *Making a Crossover Cable*

To make a crossover cable we will need the following:

- Twisted pair cable, Two RJ-5, RJ45 crimping tool, Cable tester.
  - Remove the outer plastic part from the twisted pair cable using the RJ45 crimping tool.
  - Sort the inner cables according to the crossover wiring standard, where each end follows a different wiring scheme:
    - ✓ Pin 1 (T568A - White/Green) → Pin 3 (T568B - White/Orange)
    - ✓ Pin 2 (T568A - Green) → Pin 6 (T568B - Orange)
    - ✓ Pin 3 (T568A - White/Orange) → Pin 1 (T568B - White/Green)
    - ✓ Pin 4 (T568A - Blue) → Pin 4 (T568B - Blue)
    - ✓ Pin 5 (T568A - White/Blue) → Pin 5 (T568B - White/Blue)
    - ✓ Pin 6 (T568A - Orange) → Pin 2 (T568B - Green)
    - ✓ Pin 7 (T568A - White/Brown) → Pin 7 (T568B - White/Brown)
    - ✓ Pin 8 (T568A - Brown) → Pin 8 (T568B - Brown)
  - Cut off the cables to make them the same length before inserting them into the RJ45.
  - Insert the cables inside RJ45 on both ends and make sure the cables are reaching the end of the RJ45.
  - Use the RJ45 crimping tool to crimp the RJ45 with the cables. Note that when you crimp the RJ45 you will not be able to remove the cables.
  - Verify the cables by using the cable tester to make sure that all cables are connected in the correct order.
- ✓ **Note:**
- This part of the lab is given by the instructor; please follow the steps above and any steps given to you by the instructor.
  - Note that new operating systems and computers nowadays detect the cable types, so now there is no need to care a lot about the cable type.

## 4.2. *Connecting a PC to a Router*

Once the crossover cable has been successfully created and verified using the cable tester, the next step is to connect the PC to the router physically. This connection will allow the PC to communicate with the router for configuration and basic network setup.

### 4.2.1. *Verify that the Network Interface Card (NIC) is installed on the PC*

- From the device manager verify that the NIC is installed in each PC.
- Click on the Start button at the lower left of the computer screen and select “**command prompt**”
- Type “**ping 127.0.0.1**” or “**ping localhost**”. This is the diagnostic or loopback address, and if you get a successful ping, your IP stack is then considered to be initialized, and your Network Interface Card (NIC) card is functioning. If it fails, then there is a problem with the NIC card. This does not mean that a cable is plugged into the NIC, only that the IP protocol stack on the host can communicate to the NIC.

### 4.2.2. *Physically Connecting the PC to the Router*

To establish a direct connection between the PC and the router, follow these steps carefully:

#### 1. **Obtain a Crossover Ethernet Cable**

- Ensure that you are using the **crossover** Ethernet cable that was created earlier. This type of cable is required for direct PC-to-router communication.

#### 2. **Power Off the Router and PC**

- Before connecting the cables, turn off both the **router** and the **PC** to prevent electrical issues or damage to the network ports.

#### 3. **Locate the Console Port on the Router**

- Identify the **console port** on the router. This is usually a **light blue RJ-45 or USB-C** port labeled “**Console**” on the front or back of the router.

#### 4. **Connect the Crossover Cable**

- Plug one end of the **crossover cable** into the **Ethernet port** of the PC.
- Plug the other end into any **Ethernet (LAN) port** on the router.



### 5. Connect the Console Cable for Configuration

- To configure the router, you will need to use a **console cable** (RJ-45 to DB-9 serial cable or a USB-to-serial adapter if your PC lacks a serial port).
- Insert the **RJ-45 end** of the console cable into the **console port** of the router.
- Connect the **DB-9 or USB** end to the **PC's COM port** or USB port.

### 6. Power On the Router and PC

- First, turn on the **router** and wait for it to boot up completely. The process may take a few minutes.
- Next, turn on the **PC** and allow the operating system to load.

## 4.2.3. *Configuring the Router Using PuTTY*

After physically connecting the PC to the router, the next step is to configure the router using **PuTTY**, a terminal emulator used for serial communication.

### 1. Open PuTTY on the PC

- Click on the **Start Menu** and search for **PuTTY**.
- Open the **PuTTY** application.

### 2. Set Up the Serial Connection in PuTTY

- In the **PuTTY Configuration** window, locate the "Connection type" section and select "**Serial**".
- Choose the connection type to be Serial with the appropriate COM Port.
- You can check the COM Port from the device manager as shown in the figure below.

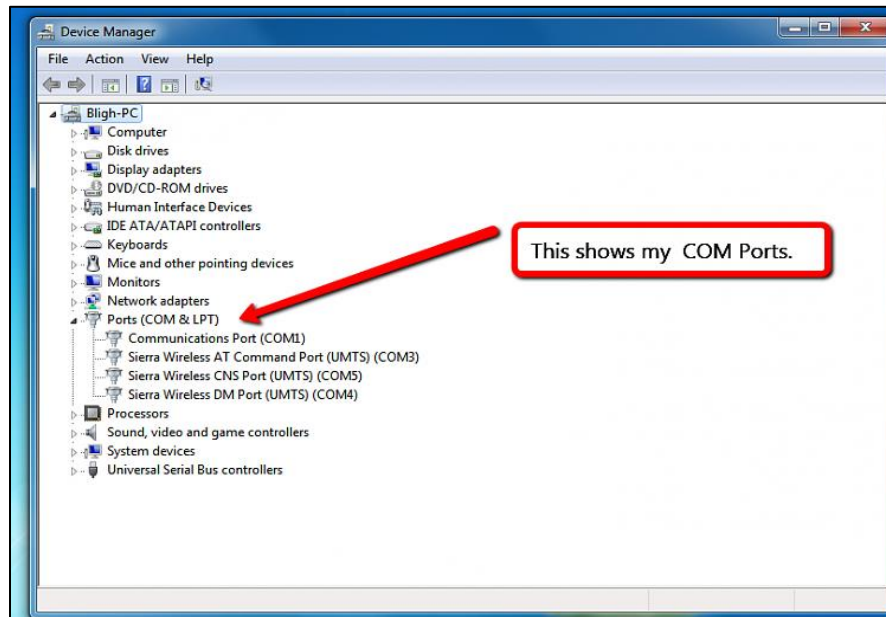


Figure 1-8: COM Port - Device Manager

- Figure 1-9 shows the COM Port for the device, we will insert it as the Serial COM Port in PuTTY.

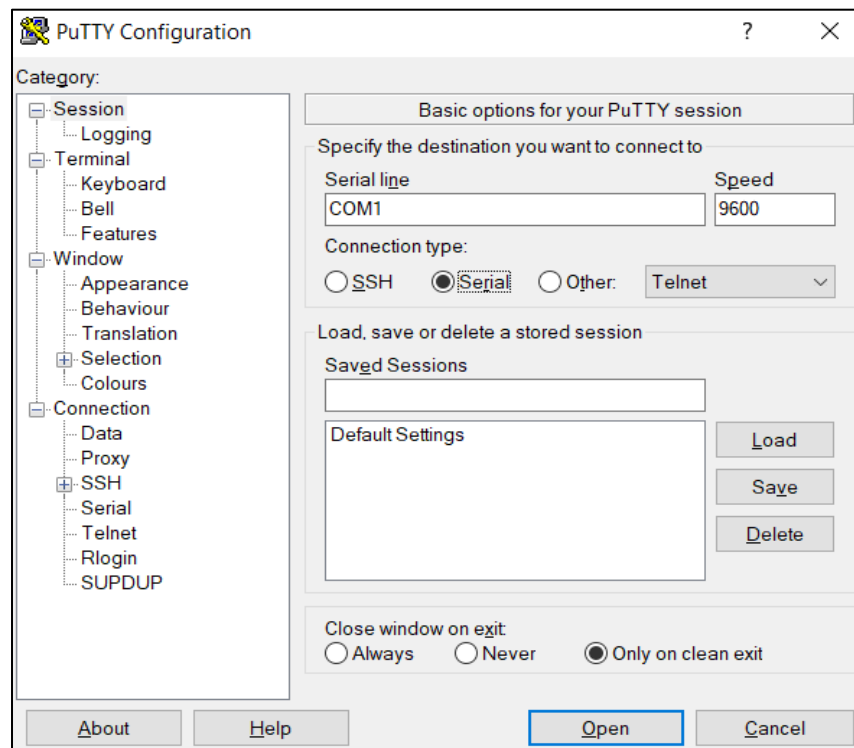


Figure 1-9: PuTTY Configuration

### 3. Start the Session

- Click "**Open**" to initiate the connection.
- A **black terminal screen** should appear.
- If the router is working correctly, you should see a **router prompt** such as:

```
Router>
```

### 4. Verify the Connection

- To check that the router's interfaces are active, enter the following command:

```
Router> enable  
Router# show ip interface brief
```

- This command will display the status of all interfaces on the router, confirming that the PC is successfully connected.

At this point, the **physical connection between the PC and the router is complete**, and the router is accessible via **PuTTY** for further configurations.

#### 4.2.4. *Assigning an IP Address to the Router and Verifying Connectivity*

Once the PC is connected to the router and PuTTY is successfully opened, the next step is to **assign an IP address to the router's interface**. This is necessary because the **ping command** requires a destination IP address, which in this case will be the router's interface that is directly connected to the PC.

- *Assign an IP Address to the Router's Interface*

In the PuTTY terminal window, follow these steps to configure the router's interface:

- **Enter privileged EXEC mode** by typing:

```
Router> enable
```

- **Enter global configuration mode:**

```
Router# configure terminal
```

- **Select the correct interface** (typically **GigabitEthernet0/0** or **FastEthernet0/0**, depending on the router model):

```
Router(config)# interface GigabitEthernet0/0
```

- **Enable the interface** (by default, interfaces may be administratively down):

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

- **Assign an IP address and subnet mask** to the interface (for example, 192.168.1.1 with a 255.255.255.0 subnet mask):

```
Router(config-if)# ip address 192.168.1.1 255.255.255.0
```

- **Exit configuration mode** and save the changes:

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

After executing these commands, the router's **GigabitEthernet0/0** interface is now active and assigned the IP **192.168.1.1**.

- ***Configure an IP address and subnet mask for the computer manually:***

At the desktop window, find the icon for the network labeled. Right-click on this icon and select "**Open Network & Internet Settings**" as shown in Figure 1-10.

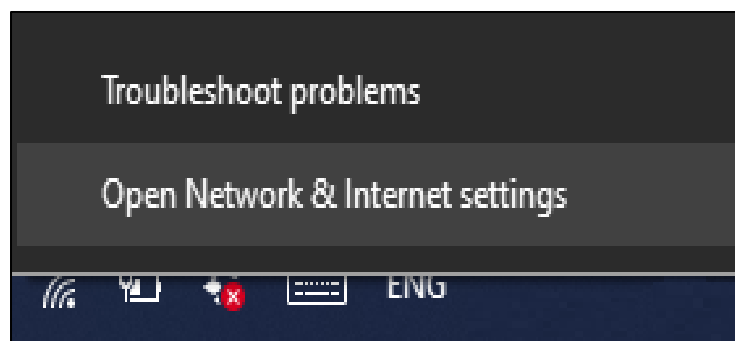


Figure 1-10: Open Network & Internet Settings

- Choose “Network and Sharing Center” for the list as shown in Figure 1-11.

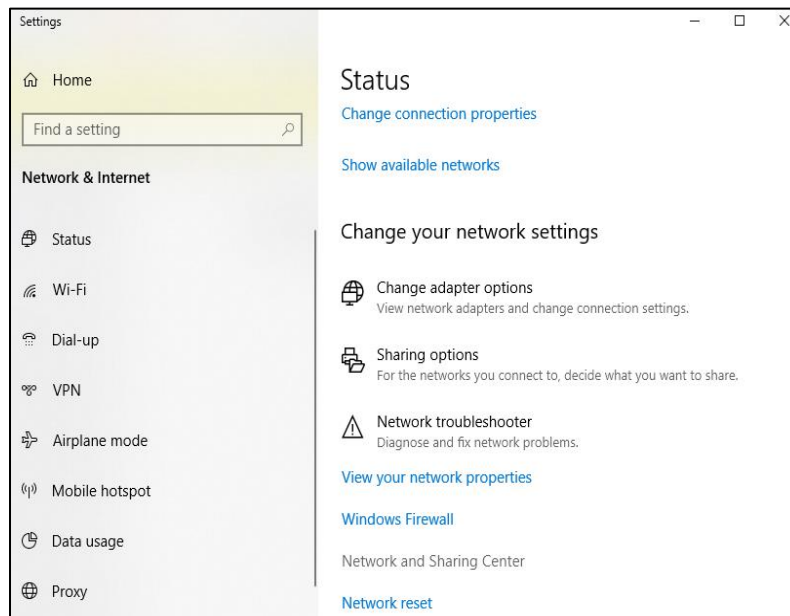


Figure 1-11: Network & Internet Settings

- From the “Network and Sharing Center” choose “Ethernet” as shown in Figure 1-12.



Figure 1-12: Network and Sharing center

- Choose properties for the ethernet settings as shown in, the choose “**Internet Protocol Version 4 (TCP/IPv4)**” and select “Use the following IP address”
- Set the IP address to 192.168.1.2 and the Subnet mask to 255.255.255.0. Clear the Default Gateway and DNS Server fields and click on OK for both windows. (what is the class of this IP address? Class A, B, or C).
- Verify that the IP Address for the computer has indeed changed. To do this, execute the **ipconfig/all** command.

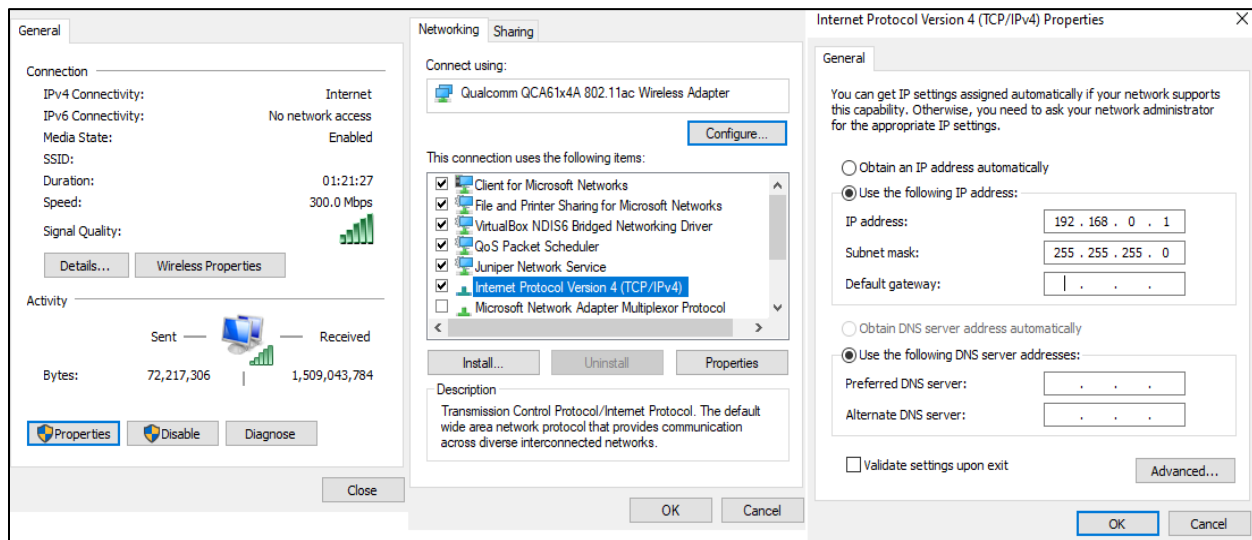


Figure 1-13: Setting IP address

#### 4.2.5. Verify Connectivity in Your Network with Ping

Now that the PC and router have properly assigned IP addresses, verify the network connection using **ping**:

1. Open the **Command Prompt** by clicking **Start**, typing **cmd**, and pressing **Enter**.
2. Type the following command and press **Enter**:

```
ping 192.168.1.1
```

3. If the connection is **successful**, you will see replies like:

```
Reply from 192.168.1.1: bytes=32 time<1ms TTL=64
```

### 4.3. *Various Network Related Commands*

To know and learn about various network-related commands [**ping**, **tracert**, **netstat**, **at**, **net**, **route**, **arp**] and a few definitions cum settings:

- **IPCONFIG Command**

This command is used to get IP configurations present in your PC.

- **PING Command**

Ping is a basic Internet program that lets you verify that a particular IP address exists and can accept requests. The verb ping means the act of using the ping utility or command. Ping is used diagnostically to ensure that the host computer you are trying to reach is operating. Various options are available in the ping command (see windows help).

- ✓ Mention the difference between fragmenting and non-fragmenting packets.
- ✓ Test the reach ability towards a Ritaj server with the fragmenting option enabled and limit the number of echoes to 5.

- **TRACERT Command**

If someone would like to know how he goes from his house to his office, he could just tell the list of the crossroads where he passes. In the same way, we can ask the data sent from your computer to the web server which way does it go, through which devices? We ask it by using the utility called **tracert**. In most computers today you can use this tool from the command line: In UNIX machines it is called **traceroute**, in MS Windows machines it is called **tracert**. Various options are available in the ping command (se windows help).

- ✓ Find the route from your PC to [ritaj.birzeit.edu]
- ✓ Using the answers above, determine what is the first device your packet reaches to move from our network lab.

- **Enhanced Ping**

**TJPing** tool is an excellent, widely acclaimed ping/lookup/traceroute utility for Win95/98/Me/NT/2000/XP. It is fully configurable, multithreaded, and is very fast. All configuration options, hosts, and interface settings are remembered from session to session. Users can log all results to the file of their choice.

- ✓ Repeat the exercises provided to you in **ping** and **tracert** commands and store the result in a file for further reference.

- **NETSTAT Command**

This command is used to get information about the open connections on your system (ports, protocols being used, etc.), incoming and outgoing data, and the ports of remote systems to which you are connected.

- ✓ Open a browser connection to the HTTP server [www.birzeit.edu] and write down the outcome of the command '**netstat -an**'.

## 5. **Todo**

How do you connect 2 computers without using a hub or switch? Test the network during the lab.