Introduction to Information & Communication Technologies

CL-1000

Lab 08

Packet Tracer Intro | Basic Network Connectivity

National University of Computer & Emerging Sciences – NUCES – Karachi

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Course Code: CL-1000	Introduction to Information & Communication Technologies

Contents

1. Introduction to Computer Networks

1.1 Network

A group or system of interconnected people or things.

1.2 Computer Network

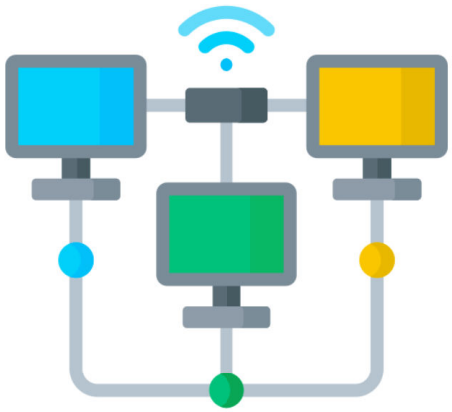
A computer network or data network is a telecommunications network which allows nodes to share resources. In computer networks, networked computing devices exchange data with each other using a data link. The connections between nodes are established using either cable media or wireless media.

1.3 Types of Networks

Some of the different networks based on size are LAN, MAN, WAN.

1.3.1 Local Area Networks

LAN is the most frequently used network. A LAN is a computer network that connects computers through a common communication path, contained within a limited area, that is, locally. A LAN encompasses two or more computers connected over a server. The two important technologies involved in this network are Ethernet and Wi-fi. It ranges up to 2km & transmission speed is very high with easy maintenance and low cost. Examples of LAN are networking in a home, school, library, laboratory, college, office, etc.



1.3.2 Metropolitan Area Network

A MAN is larger than a LAN but smaller than a WAN. This is the type of computer network that connects computers over a geographical distance through a shared communication path over a city, town, or metropolitan area. This network mainly uses FDDI, CDDI, and ATM as the technology with a range from 5km to 50km. Its transmission speed is average. It is difficult to maintain and it comes with a high cost. Examples of MAN are networking in towns, cities, a single large city, a large area within multiple buildings, etc.

1.3.3 Wide Area Network

WAN is a type of computer network that connects computers over a large geographical distance through a shared communication path. It is not restrained to a single location but extends over many locations. WAN can also be defined as a group of local area networks that communicate with each other with a range above 50km. Here we use Leased-Line & Dial-up technology. Its transmission speed is very low and it comes with very high maintenance and very high cost. The most common example of WAN is the Internet.

2. Internet

The internet is a global network of interconnected computers and devices that allows for the exchange of information and communication through various protocols and technologies.

3. Protocol

A protocol is a set of rules and conventions that dictate how data is transmitted and received in a communication system. It ensures that different devices and systems can understand and interact with each other effectively. Protocols are essential for various communication domains, such as networking and the internet, and they define aspects like data format, connection establishment, and error handling procedures. Common examples include Internet Protocol (IP), Transmission Control Protocol (TCP), and Hypertext Transfer Protocol (HTTP).

4. Search Engine

A search engine is a kind of website through which users can search the content available on the Internet. Then the search engine looks through its index for relevant web pages and displays them in the form of a list.

Example: Google, Bing, Yahoo, Duck duck go, Baidu, etc.

4.1 Three main components of the Search engine

- **Crawler**: program that regularly scans the websites automatically for URLs, keywords, and links in order to discover the new updates.
- **Index**: the Crawler continuously scans the websites, it develops an index of URLs, links and keywords to make the search results more effective
- **Search Algorithm:** It is working by searching for the index and finding for the most suitable webpages by matching keywords that are searched by the users.

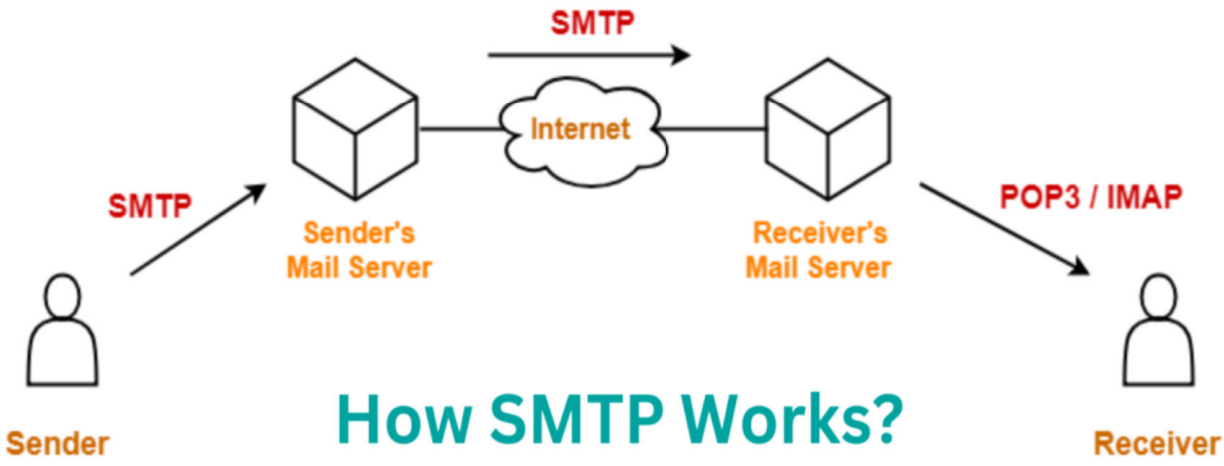
5. Web Browser

The web browser is an example of application software that is developed to retrieve and view the information from web pages or HTML files present on the web servers

Example: Microsoft's internet explorer, Google Chrome, Mozilla Firefox, Opera and Apple safari.

Email (Electronic mail):

It is a communication method that uses electronic devices to deliver messages across computer networks.



5.1 Why we need IT Security

- Reducing the risk of data breaches and attacks in IT systems.
- Applying security controls to prevent unauthorized access to sensitive information.
- Preventing disruption of services, e.g., denial-of-service attacks. Protecting IT systems and networks from exploitation by outsiders

6. Key Security concept (CIA)

- **Confidentiality** measures are designed to prevent sensitive information from unauthorized access attempts. Such as photo, videos, transaction etc.
- **Integrity** means that data or information in your system is maintained so that it is not modified or deleted by unauthorized parties.
- **Availability** means that systems and data are available to individuals when they need it under any circumstances, including power outages or natural disasters.

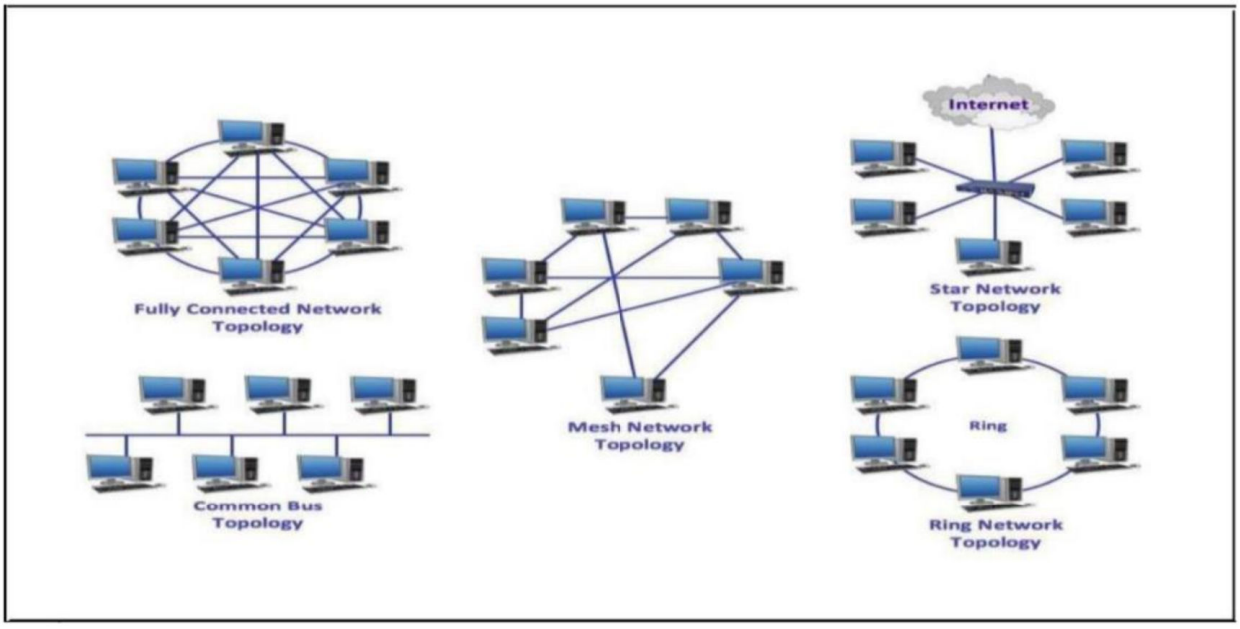
Threat - Represents Potential security harm to an Asset

Vulnerabilities

- **Corrupt**: loss of integrity
- **Leaky:** loss of confidentiality
- **Unavailability**: Loss of availability

7. Network Topology

Network topology is the arrangement of the various elements (links, nodes, etc.) of a computer network. Essentially, it is the topological structure of a network and may be depicted physically or logically. The basic examples of network topologies used in local area networks include bus, ring, star, and tree and mesh topologies as shown below.



7.1 Types of Network Topology

- **Star Topology:** A star topology, the most common network topology, is laid out so every node in the network is directly connected to one central hub via coaxial, twisted-pair, or fiber-optic cable. Acting as a server, this central node manages data transmission—as information sent from any node on the network has to pass through the central one to reach its destination—and functions as a repeater, which helps prevent data loss.
- **Bus Topology:** A Bus Topology is a network type in which every computer and network device is connected to a single cable. It is bi-directional. It is a multi-point connection and a non-robust topology because if the backbone fails the topology crashes.
- **Ring Topology:** Ring topology is where nodes are arranged in a circle (or ring). The data can travel through the ring network in either one direction or both directions, with each device having exactly two neighbors.
- **Mesh Topology:** A mesh topology is an intricate and elaborate structure of point-to-point connections where the nodes are interconnected. Mesh networks can be full or partial mesh. Partial mesh topologies are mostly interconnected, with a few nodes with only two or three connections, while full-mesh topologies are fully interconnected.

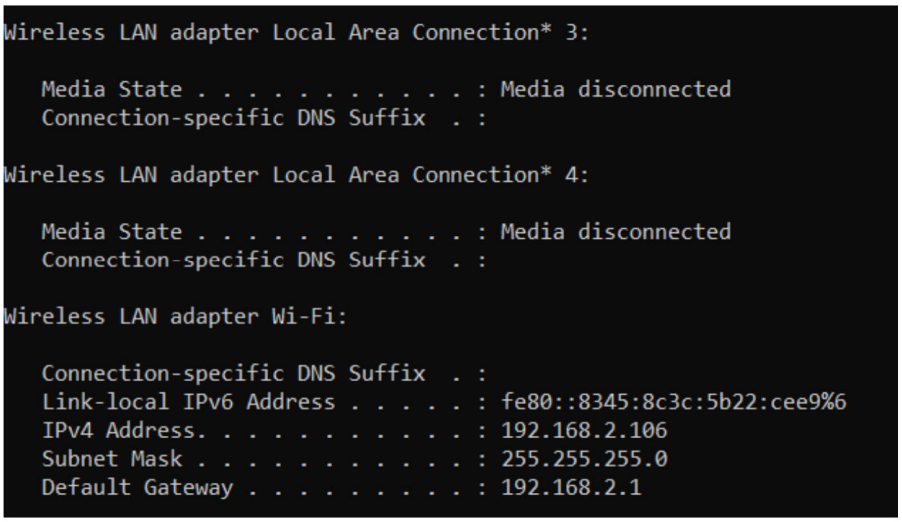
8. IP Address

An IP address, which stands for Internet Protocol address, is a numerical label assigned to each device (such as a computer, smartphone, or networked printer) participating in a computer network that uses the Internet Protocol for communication. It serves two main functions:

1. **Host or Network Identification**: IP addresses are used to uniquely identify a device or a network on the internet. They are similar to street addresses for mail delivery but for digital data packets. An IP address provides a way for data to be sent to and received from specific devices or networks.

2. **Routing**: IP addresses play a crucial role in routing data across the internet. Routers and other networking equipment use these addresses to determine the best path for data to travel from the source to the destination.

Type “ipconfig” in Command Prompt to display the IP configuration for all network interfaces on a Windows computer.



9. Subnet

A subnet (short for "subnetwork") is a logical division of an IP network into smaller, more manageable, and isolated networks. Subnetting is a technique used in IP networking to improve network efficiency, security, and organization. It involves dividing a larger IP network into smaller, more manageable segments, known as subnets, by allocating a portion of the original network's IP address space to each subnet.

10. Router

A router in a computer network is a device that forwards data between different networks. It plays a key role in connecting devices and ensuring efficient data transmission.

11. Switch

A switch in computer networks is a hardware device that connects multiple devices, such as computers, printers, and servers, within a local area network (LAN). It uses MAC addresses to forward data only to the device for which the data is intended, making network communication more efficient and secure compared to traditional hubs.

An **IP address class** is a categorical division of internet protocol addresses in IPv4-based routing. Separate IP classes are used for different types of networks. Some are used for public internet-accessible IPs and subnets, that is, those networks behind a router (as in classes A, B and C).

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing) Leading bit pattern 0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern 10	10000000.00000000.00000000.00000000 Network . Network . Host . Host
Class C	192 – 223	Leading bit pattern 110	11000000.00000000.00000000.00000000 Network . Network . Network . Host
Class D	224 – 239	(Reserved for multicast)	
Class E	240 – 255	(Reserved for experimental, used for research)	

Private Address Space

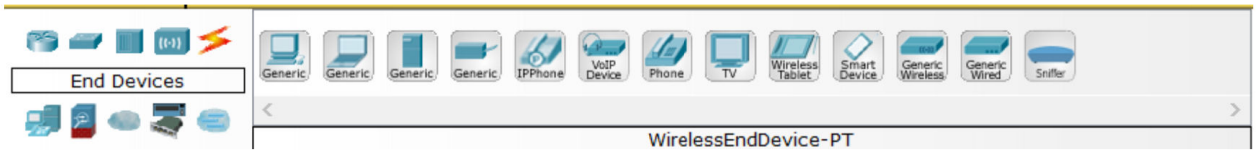
Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

12. Cisco Packet Tracer

Cisco Packet Tracer is a network simulation and visualization tool developed by Cisco Systems. Packet Tracer allows users to create virtual networks and experiment with various network configurations without the need for physical networking equipment.

12.1 Setting up a Basic Network on Cisco Packet Tracer

1. Open Cisco Packet Tracer

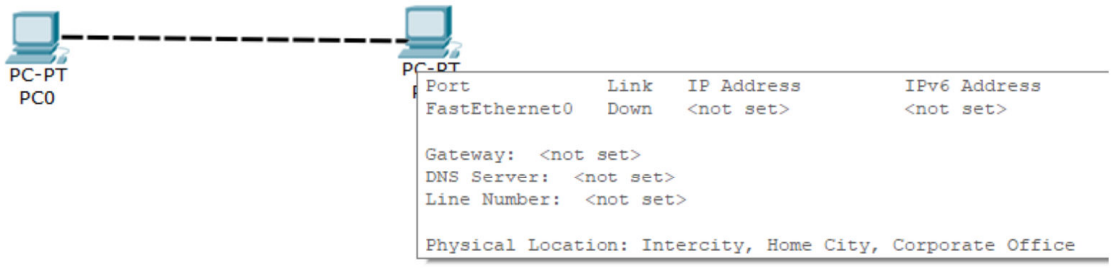


2. In bottom left portion we can pick end devices, routers, switches, hubs, and wires etc.

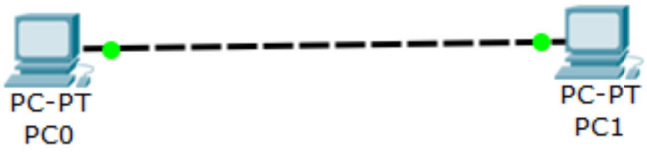
We have picked generic two PCs to set up a network connection between them.

3. Click on the connections tab and pick Copper Cross over cable.

4. After picking the cable click on the PC and Select FastEthernet0

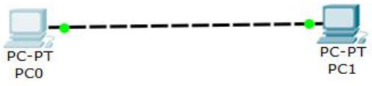


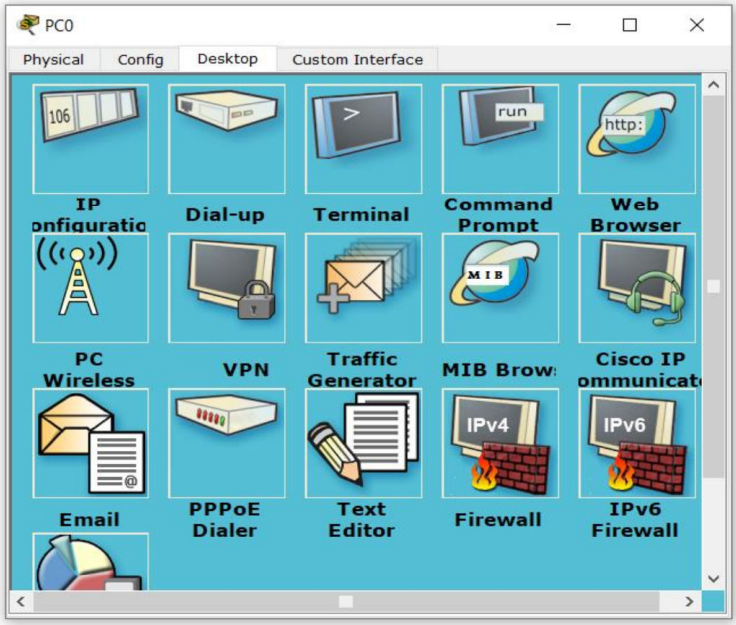
5. Drag the cable towards the other PC.



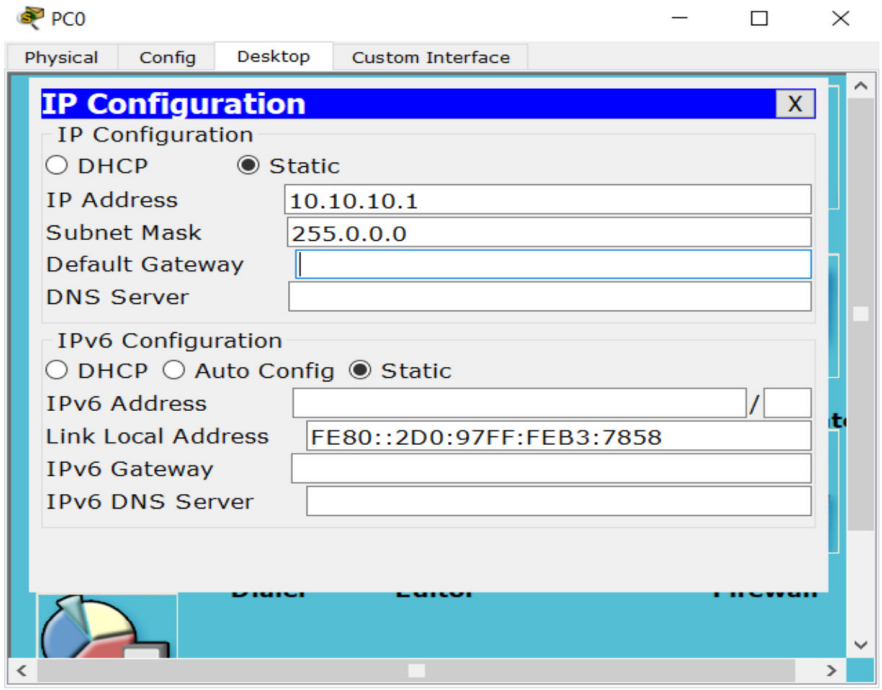
Wires Connected!

6. Now we will assign IP Addresses to our Systems.

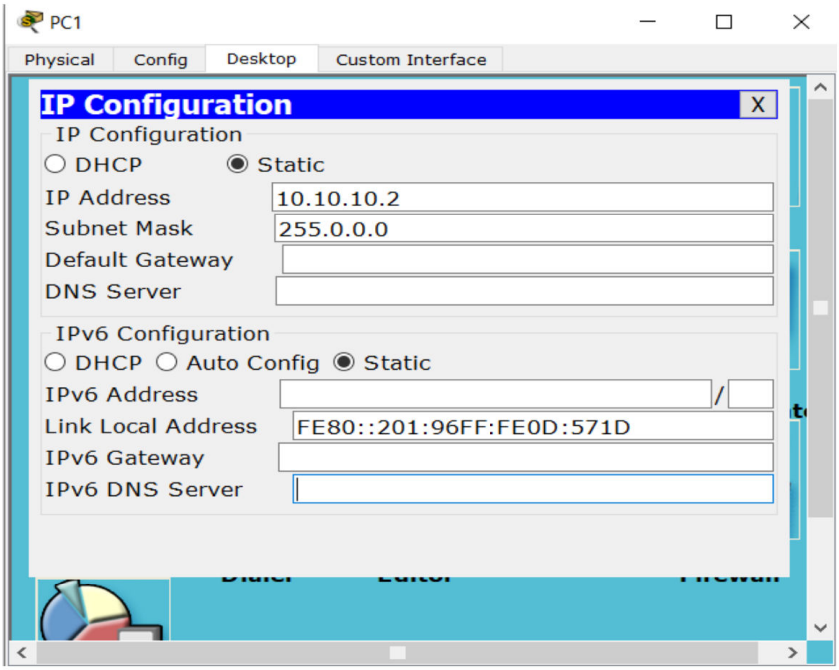




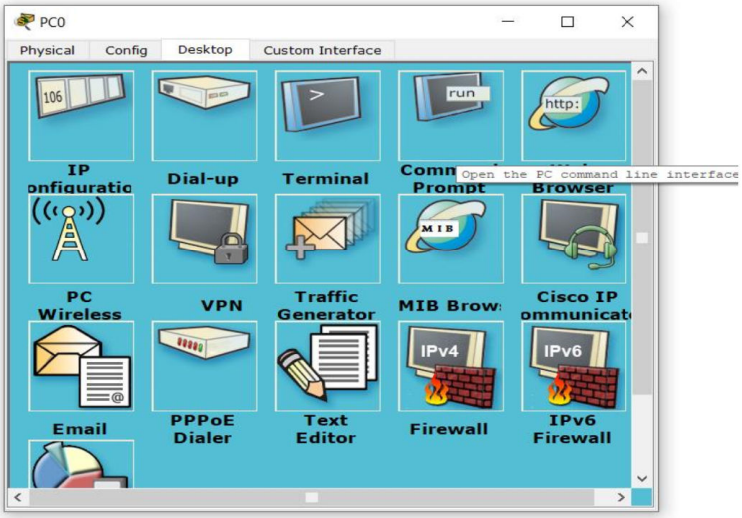
7. Click on PC0 and it will open a Menu with various configuration Options in Desktop Tab. Pick IP Configuration.



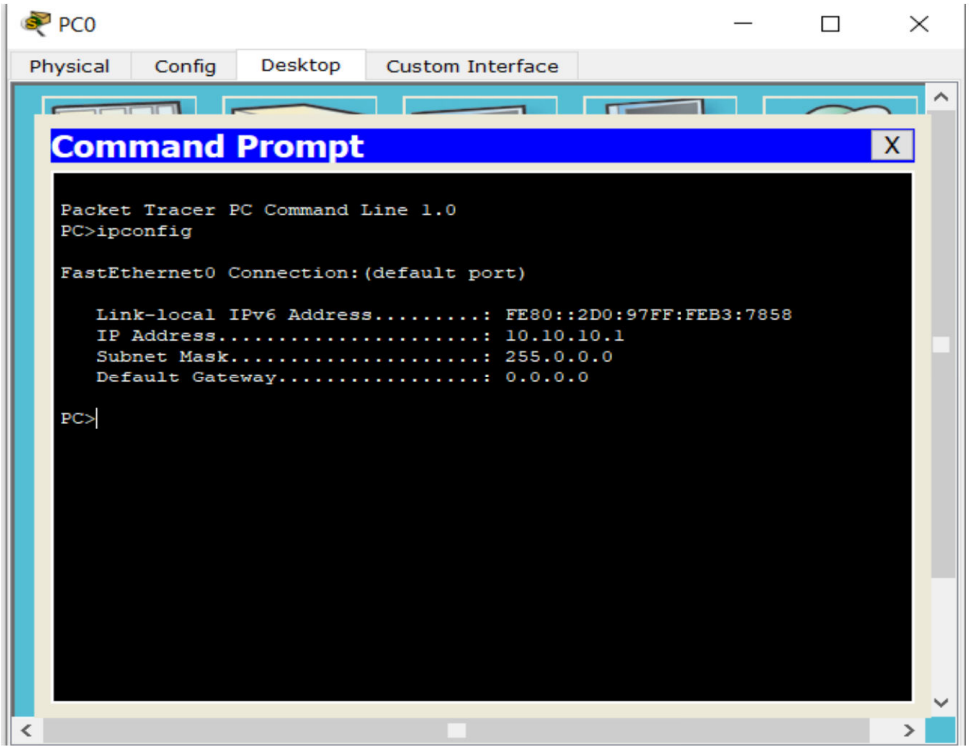
8. Add the following IP Address and Subnet Mask for PC0.



9. Repeat the same steps for PC1 with a different IP Address.



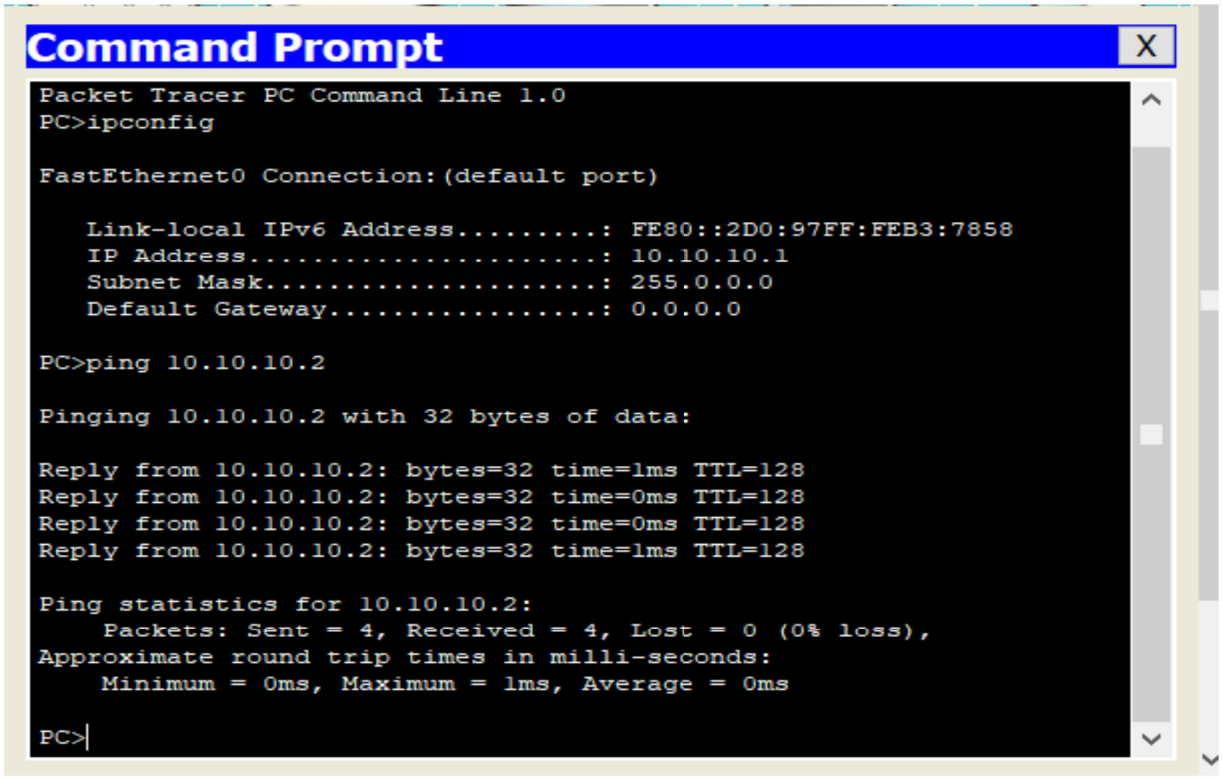
10. Open the menu for PC0 again and this time click on Command Prompt



11. Type “ipconfig”. We can see that the IP has been assigned. You can check it again for PC1

Now we will ping PC1 from PC0. When you run the "ping" command, it sends a series of ICMP (Internet Control Message Protocol) echo requests to the specified target. The target, in response, should send back ICMP echo replies. This process helps you determine whether the connection is established and how quickly it responds.

The output of the "ping" command typically includes information such as the number of packets sent, received, lost, the round-trip time (ping time) in milliseconds, and some statistics about the connection quality.



“ping 10.10.10.2” sent 4 packets and received 4 packets which shows that Connection is established from PC0 to PC1 AND PC1 is reachable from PC0.