আন্তর্জাতিক ইসলামী বিশ্ববিদ্যালয় চট্টগ্রাম
الجامعة الإسلامية العالمية شيتاغونغ
International Islamic University Chittagong

Computer Network

What is a Computer Network?

A computer network is a system that connects many independent computers to share information (data) and resources. The integration of computers and other different devices allows users to communicate more easily. A computer network is a collection of two or more computer systems that are linked together. A network connection can be established using either cable or wireless media. Hardware and software are used to connect computers and tools in any network.

What Do Computer Networks Do?

Computer Networks are one of the important aspects of Computer Science. In the early days, it was used for data transmission on telephone lines and had a very limited use, but nowadays, it is used in a variety of places.

Computer Networks help in providing better connectivity that helps nowadays. Modern computer networks have the following functionality:

- Computer Networks help in operating virtually
- Computer Networks integrate on a large scale
- Computer Networks respond very quickly in case of conditions change
- Computer Networks help in providing data security

Types of Computer Networks(Based on the Type of Architecture)

1. **Peer-to-Peer Networks**
2. **Client-Server Networks**

Peer-to-Peer Networks

What is P2P (Peer-to-Peer Process)?

The P2P process deals with a network structure where any participant in the network known as a node acts as both a client and a server. This means that, rather than relying on a basic server to supply resources or services, everybody from the network of nodes can trade resources and services with one another. In a P2P system, every node has an equal role to play and the same functionalities, which means that the loads are well shared.

Features of P2P Network

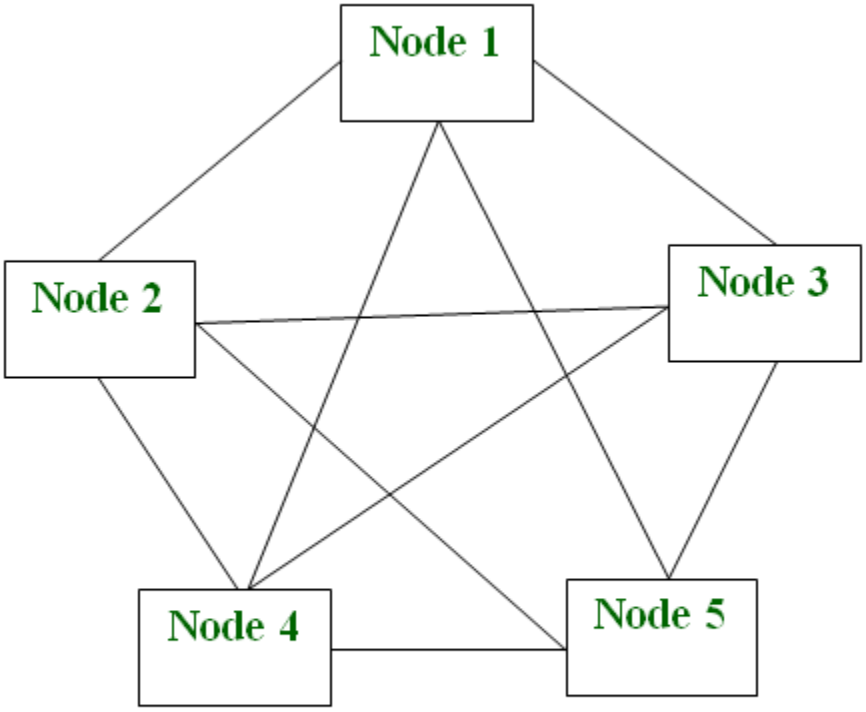
- These networks do not involve a large number of nodes, usually less than 12. All the computers in the network store their own data but this data is accessible by the group.
- Unlike client-server networks, P2P uses resources and also provides them. This results in additional resources if the number of nodes increases. It requires specialized software. It allows resource sharing among the network.
- Since the nodes act as clients and servers, there is a constant threat of attack.
- Almost all OS today support P2P networks.

P2P Network Architecture

In the P2P network architecture, the computers connect with each other in a workgroup to share files, and access to internet and printers.

- Each computer in the network has the same set of responsibilities and capabilities.
- Each device in the network serves as both a client and server.
- The architecture is useful in residential areas, small offices, or small companies where each computer act as an independent workstation and stores the data on its hard drive.
- Each computer in the network has the ability to share data with other computers in the network.

- The architecture is usually composed of workgroups of 12 or more computers.



P2P Architecture

How Does P2P Network Work?

Let's understand the working of the Peer-to-Peer network through an example. Suppose, the user wants to download a file through the peer-to-peer network then the download will be handled in this way:

- If the peer-to-peer software is not already installed, then the user first has to install the peer-to-peer software on his computer.
- This creates a virtual network of peer-to-peer application users.
- The user then downloads the file, which is received in bits that come from multiple computers in the network that have already that file.
- The data is also sent from the user's computer to other computers in the network that ask for the data that exist on the user's computer.

Thus, it can be said that in the peer-to-peer network the file transfer load is distributed among the peer computers.

Examples of P2P Networks

P2P networks can be basically categorized into three levels.

- The first level is the basic level which uses a USB to create a P2P network between two systems.
- The second is the intermediate level which involves the usage of copper wires in order to connect more than two systems.
- The third is the advanced level which uses software to establish protocols in order to manage numerous devices across the internet.

Some of the popular P2P networks are Gnutella, BitTorrent, eDonkey, Kazaa, Napster, and Skype.

Client-Server Model

The Client-server model is a distributed application structure that partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters called clients. In the client-server architecture, when the client computer sends a request for data to the server through the internet, the server accepts the requested process and delivers the data packets requested back to the client. Clients do not share any of their resources. Examples of the Client-Server Model are Email, World Wide Web, etc.

How Does the Client-Server Model Work?

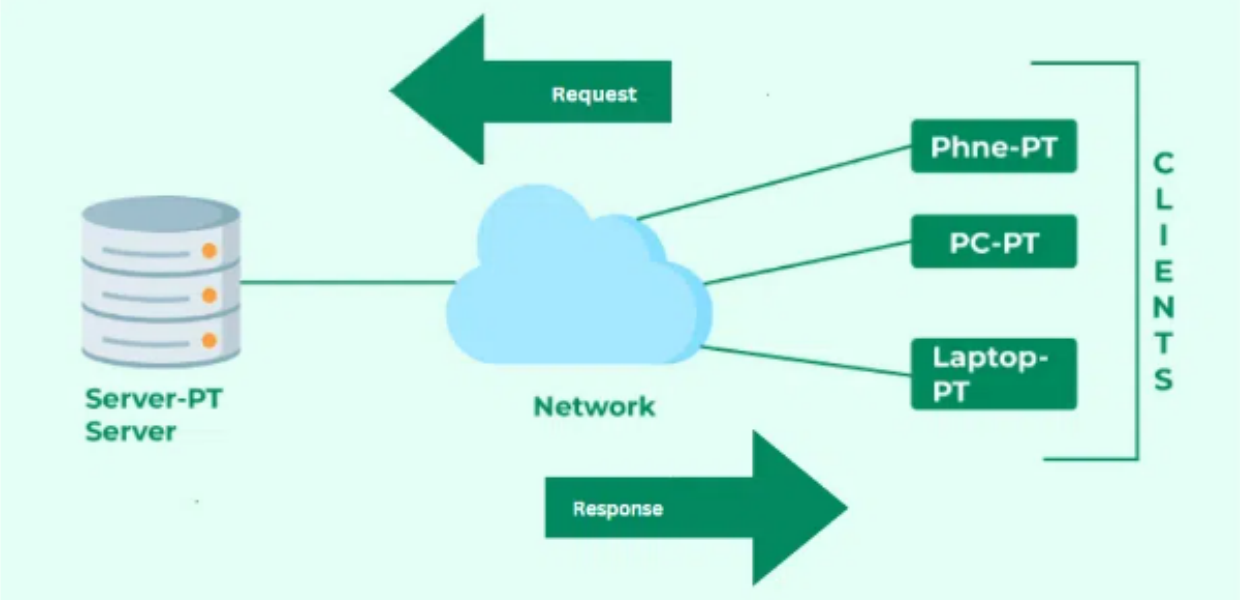
In this article, we are going to take a dive into the **Client-Server** model and have a look at how the **Internet** works via web browsers. This article will help us have a solid WEB foundation and help us easily work with WEB technologies.

- **Client:** When we say the word **Client**, it means to talk of a person or an organization using a particular service. Similarly in the digital world, a **Client** is a computer (**Host**) i.e. capable of receiving information or using a particular service from the service providers (**Servers**).

- **Servers:** Similarly, when we talk about the word **Servers**, It means a person or medium that serves something. Similarly in this digital world, a **Server** is a remote computer that provides information (data) or access to particular services.

So, it is the **Client** requesting something and the **Server** serving it as long as it is in the database.

For those new to networking concepts, the System Design Course provides a comprehensive overview of the client-server model and its applications in modern computing.



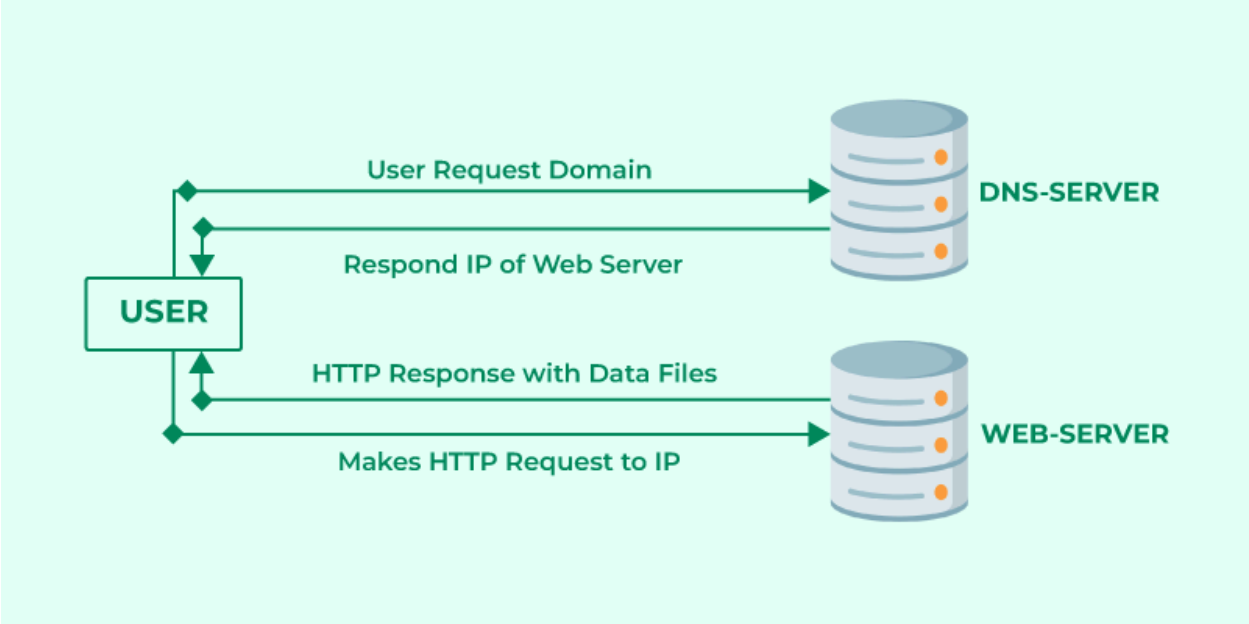
Client Server Model

How the Browser Interacts With the Servers?

There are a few steps to follow to interacts with the servers of a client.

- User enters the **URL**(Uniform Resource Locator) of the website or file. The Browser then requests the **DNS**(DOMAIN NAME SYSTEM) Server.
- **DNS Server** lookup for the address of the **WEB Server**.
- The **DNS Server** responds with the **IP address** of the **WEB Server**.

- The Browser sends over an **HTTP/HTTPS** request to the **WEB Server's IP** (provided by the **DNS server**).
- The Server sends over the necessary files for the website.
- The Browser then renders the files and the website is displayed. This rendering is done with the help of **DOM** (Document Object Model) interpreter, **CSS** interpreter, and **JS Engine** collectively known as the **JIT** or (Just in Time) Compilers.



Client Server Request and Response

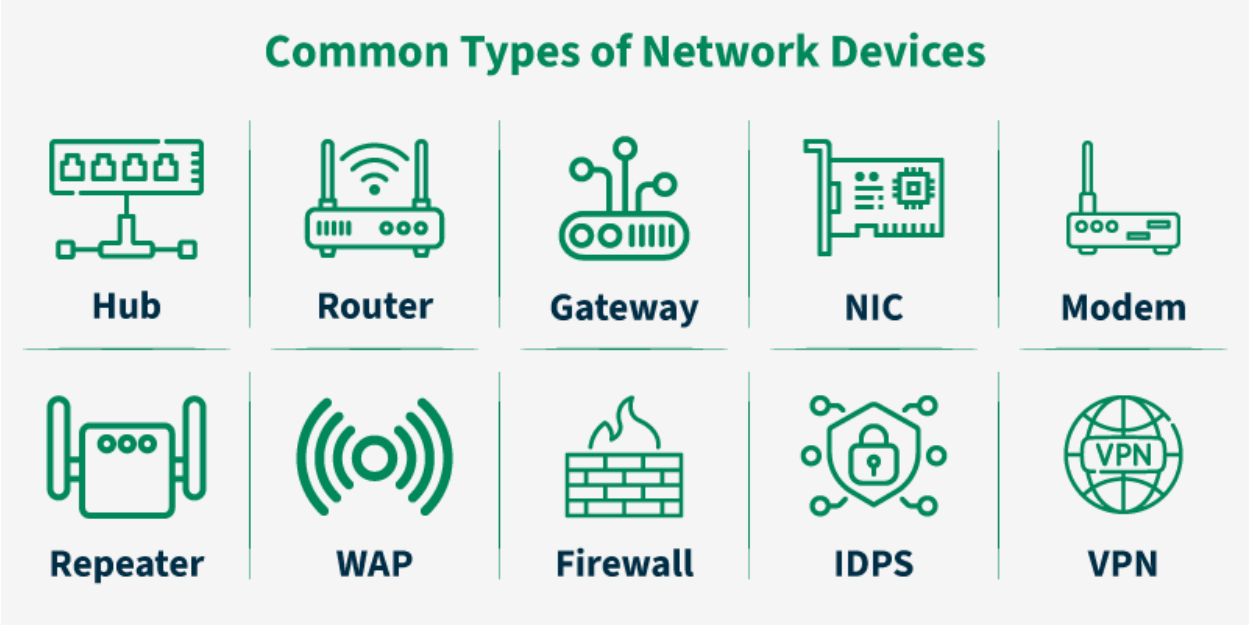
Devices

A device in a computer network is a piece of hardware or software that allows a computer to communicate with an internet network. Network devices are essential for establishing and managing networks, and they play a key role in ensuring that data is accurately routed and secured.

Common Types of Networking Devices and Their Uses

Network devices work as a mediator between two devices for transmission of data, and thus play a very important role in the functioning of a computer network. Below are some common network devices used in modern networks:

- Access Point
- Modems
- Firewalls
- Repeater
- Hub
- Bridge
- Switch
- Routers
- Gateway
- Brouter
- NIC



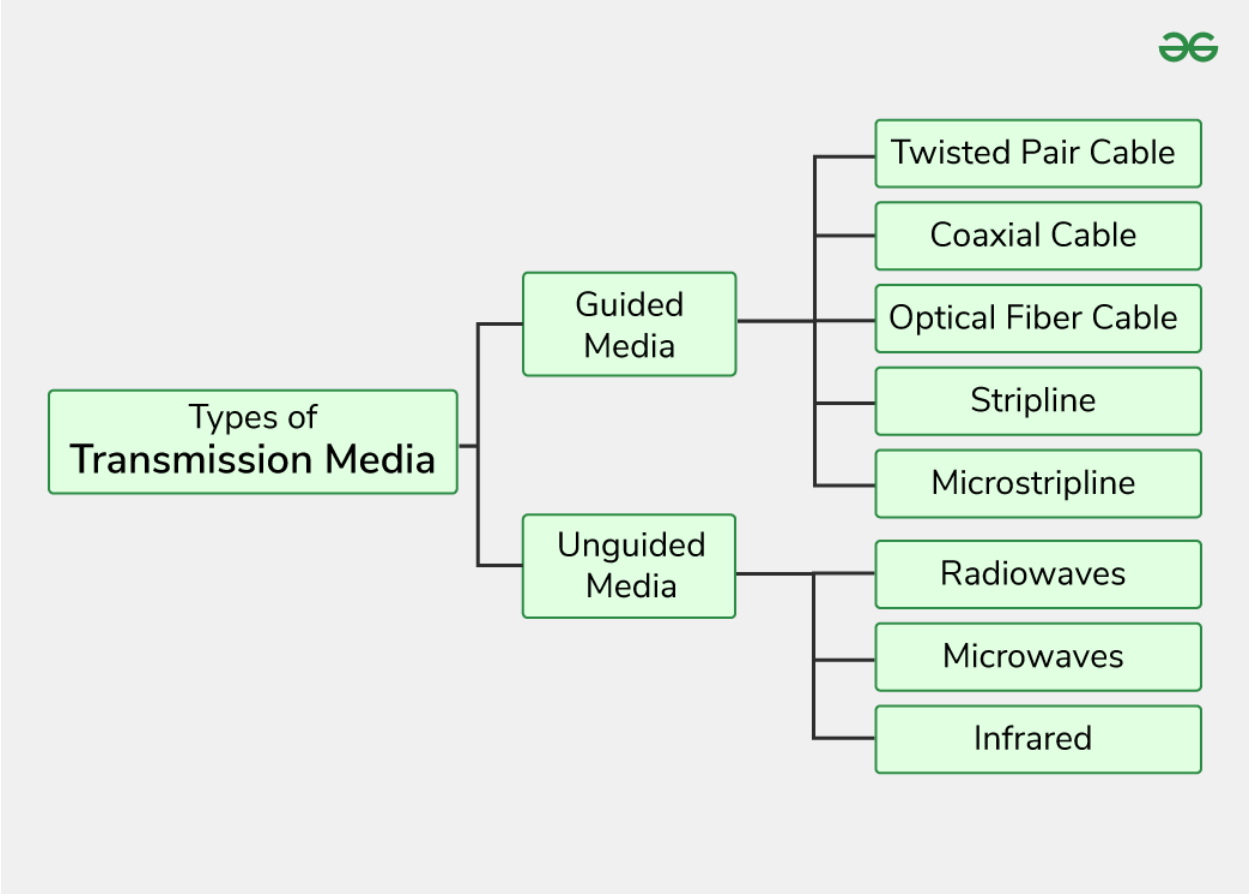
Functions of Network Devices

- Network devices help to send and receive data between different devices.
- Network devices allow devices to connect to the network efficiently and securely.

- Network devices Improve network speed and manage data flow better.
- It protects the network by controlling access and preventing threats.
- Expand the network range and solve signal problems.

Transmission Media

A transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one device to another. Transmission Media is broadly classified into the following types:



1. Guided Media

Guided Media is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure

- Used for comparatively shorter distances

2. Unguided Media

It is also referred to as Wireless or Unbounded transmission media . No physical medium is required for the transmission of electromagnetic signals.

Features:

- The signal is broadcasted through air
- Less Secure
- Used for larger distances

Addressing

Addressing in a computer network is the process of assigning unique identifiers to devices on a network. These identifiers are called network addresses and are crucial for enabling communication between devices:

Purpose

Network addresses are used to identify the location of a device on a network. They are important for:

- **Content delivery**: Web hosts can use network addresses to cache content and load assets with less bandwidth.
- **Communication**: Network addresses enable devices to communicate with each other.

Types of network addresses

Network addresses can be:

- **Flat addresses**: Contain no information about the node's location in the network, such as a MAC address
- **Structured addresses**: Contain hierarchical information for routing, such as an IP address
- **Special addresses**: Include broadcast and multicast addresses, which are not unique

How addresses are generated

The Internet Assigned Numbers Authority (IANA) mathematically generates and allocates IP addresses.

Examples of network addresses

Examples of network addresses include:

- Telephone numbers in the public switched telephone network
- IP addresses in IP networks, including the Internet
- IPX addresses in NetWare

LAN setup and configuration

LAN (Local Area Network) is a data communication network that connects locally connected network devices such as workstations, servers, routers, etc. to share the resources within a small area such as a building or campus. Physical or wireless connections are set up between workstations to share the resources. Ethernet and Wi-fi are the most important technologies of **LAN**. Personal networks at home, school, office, etc. are examples of LAN. These are generally privately-owned networks.

Requirements to set up LAN Network:

- **Workstation/Personal devices:** laptop, computer, mobile phones, etc.
- **Network devices:** router, switch, modem (if not already present in the router)
- **Sharing resources:** printers, disk drives, etc.
- **Cables:** Ethernet cables, wires for connecting other devices (in case of wired LAN)
- **Internet connection:** Wi-Fi (in case of wireless LAN)

Instructions to set up LAN Network:

Following steps should be followed to set up a LAN network:

1. **Identify services:** Identify the network services such as printers, disk drives, data, etc. that will be shared among workstations.
2. **Identify devices:** Identify devices such as computers, mobile phones, laptops, etc. with a unique address that will be connected to the network.

3. **Plan connections:** Design the network by laying out cable wires between network devices or by making wireless connections. Wired LAN is set up using Ethernet cables while wireless LAN is set up using Wi-Fi that connects network devices without making any physical connection. A wired LAN network is more secure than a wireless LAN network but it is difficult to relocate.
4. **Select networking device:** Select switch or router with enough ports to connect all workstations within the network. The choice of networking device is based on the requirements of the network.
5. **Configure ports:** Configure WAN ports according to the information provided by ISP (Internet Service Provider). Also, configure LAN ports of cable routers such that there are enough addresses available for all the workstations within the network. A cable router acts as DHCP (Dynamic Host Configuration Server) server that automatically allocates addresses to all the devices connected to the network.
6. **Make connections:** Connect all the devices using wires to configure a LAN network. Standard Ethernet cables are used to connect workstations and servers while Ethernet crossover cable is used to connect the switch to cable routers by connecting the standard port of the switch with router's LAN port. For wireless LAN, connect all the devices to Wi-Fi with SSID (Service Set Identifier) provided by the router or switch to configure the LAN network.
7. **Test the network:** Test each of the workstation connected to the network and ensure every workstation has access to network services.