Networking: Networking refers to the linking of computers and communication network devices (also referred to as **hosts**), which interconnect through a network (Internet or Intranet) and are separated by unique device identifiers (Internet protocol, IP addresses and media access control, MAC addresses). These hosts may be connected by a single path or through multiple paths for sending and receiving data. The data transferred between the hosts may be text, images, or videos, which are typically in the form of binary bit streams.

Network Types: i) Connection types: Point-to-point: Point-to-point connections are used to establish direct connections between two hosts. Day-to-day systems such as a remote controlfor an air conditioner or television is a point to point connection, where the connection has the whole channel dedicated to it only. These networks were designed to work over duplex links and are functional for both synchronous as well as asynchronous systems. Regarding computer networks, point to point connections find usage for specific purposes such as in optical networks.

Point-to-multipoint: In a point-to-multipoint connection, more than two hosts share the same link. This type of configuration is similar to the one-to-many connection type. Point-to-multipoint connections find popular use in wireless networks and IP telephony. The channel is shared between the various hosts, either spatially or temporally. One common scheme of spatial sharing of the channel is frequency division multiple access (FDMA). Temporal sharing of channels include approaches such as time division multiple access (TDMA).

ii) Physical topology: physical manner in which communication paths between the hosts are connected.

1. star: In a star topology, every host has a point-to-point link to a central controller or hub. The hosts cannot communicate with one another directly; they can only do so through the central hub. The hub acts as the network traffic exchange. For large-scale systems, the hub, essentially, has to be a powerful server to handle all the simultaneous traffic flowing through it. However, as there are fewer links (only one link per host), this topology is cheaper and easier to set up. The main advantages of the star topology are easy installation and the ease of fault identification within the network. If the central hub remains uncompromised, link failures between a host and the hub do not have a big effect on the network, except for the host that is affected. However, the main disadvantage of this topology is the danger of a single point of failure. If the hub fails, the whole network fails.
2. Mesh: In a mesh topology, every host is connected to every other host using a dedicated link (in a point-to-point manner). This implies that for n hosts in a mesh, there are a total of **n(n − 1)/2 dedicated** full duplex links between the hosts. This massive number of links makes the mesh topology expensive. However, it offers certain specific advantages over other topologies. The first significant advantage is the **robustness and resilience** of the system. Even if a link is down or broken, the network is still fully functional as there remain other pathways for the traffic to flow through. The second advantage is the **security and privacy of the traffic** as the data is only seen by the intended recipients and not by all members of the network. The third advantage is the **reduced data load on a single host,** as every host in this network takes care of its traffic load. However, owing to the complexities in forming physical connections between devices and the cost of establishing these links, mesh networks are used very selectively, such as in backbone networks.

3. Bus: A bus topology follows the point-to-multipoint connection. A **backbone cable or bus** serves as the primary traffic pathway between the hosts. The hosts are connected to the main bus employing **drop lines or taps.** The main advantage of this topology is the ease of installation. However, there is a restriction on the length of the bus and the number of hosts that can be simultaneously connected to the bus due to signal loss over the extended bus. The bus topology has a simple cabling procedure in which a single bus (backbone cable) can be used for an organization. Multiple drop lines and taps can be used to connect various hosts to the bus, making installation very easy and cheap. However, the main drawback of this topology is the **difficulty in fault localization** within the network.
4. **Ring:** A ring topology works on the principle of a point-to-point connection. Here, each host is configured to have a dedicated point-to-point connection with its two immediate neighboring hosts on either side of it through repeaters at each host. The repetition of this system forms a ring. The **repeaters** at each host capture the incoming signal intended for other hosts, regenerates the bit stream, and passes it onto the next repeater. Fault identification and set up of the ring topology is quite simple and straightforward. However, the main disadvantage of this system is the high probability of a single point of failure. If even one repeater fails, the whole network goes down.

iii) Network reachability: Computer networks are divided into four broad categories based on network reachability: personal area networks, local area networks, wide area networks, and metropolitan area networks.

(i) Personal Area Networks (PAN): PANs, as the name suggests, are mostly restricted to individual usage. A good example of PANs may be connected wireless headphones, wireless speakers, laptops, smartphones, wireless keyboards, wireless mouse, and printers within a house. Generally, PANs are wireless networks, which make use of low-range and low-power technologies such as **Bluetooth**. The reachability of PANs lies in the range of a few centimeters to a few meters.

(ii) Local Area Networks (LAN): A LAN is a collection of hosts linked to a single network through wired or wireless connections. However, LANs are restricted to buildings, organizations, or campuses. Typically, a few leased lines connected to the Internet provide web access to the whole organization or a campus; the lines are further redistributed to multiple hosts within the LAN enabling hosts. The hosts are much more in number than the actual direct lines to the Internet to access the web from within the organization. This also allows the organization to define various access control policies for web access within its hierarchy. Typically, the present-day data access rates within the LANs range from **100 Mbps to 1000 Mbps**, with very high fault-tolerance levels. Commonly used network components in a LAN are **servers, hubs, routers**, switches, terminals, and computers.

(iii) Metropolitan Area Networks (MAN): The reachability of a MAN lies between that of a LAN and a WAN. Typically, MANs connect various organizations or buildings within a given geographic location or city. An excellent example of a MAN is an Internet service provider (ISP) supplying Internet connectivity to various organizations within a city. As MANs are costly, they may not be owned by individuals or even single organizations. Typical networking devices/ components in MANs are modems and cables. MANs tend to have **moderate fault tolerance levels**.

(iv) Wide Area Networks (WAN): WANs typically connect diverse geographic locations. However, they are **restricted within the boundaries of a state or country**. The data rate of WANs is in the order of a fraction of LAN's data rate. Typically, WANs connecting two LANs or MANs may use public switched telephone networks **(PSTNs)** or **satellite-based links**. Due to the long transmission ranges, WANs tend to have more errors and noise during transmission and are very costly to maintain. The **fault tolerance of WANs are generally low**.