Chapter 1

Computer Networking

Computer networking is the interconnection of various computers for the purpose of communication. The communication includes exchange of data, file transfer with the help of computer system, software applications and users. Computer networking can exist between two computers and continue to happen between hundreds and thousands of computers. Two devices are said to be networked when a process in one device is able to exchange information with a process in another device.

The computers that are involved in the network that originate, route and terminate the data are called nodes. The interconnection of computers is accomplished with a combination of cable or wireless media and networking hardware. We will discuss about this later.

This chapter includes

▶ Creating computer network
  • Network Topology
  • Star topology
  • Ring topology
  • Bus topology
▶ Network Topology
▶ Network Interface Cards (NIC)
  • Hub
  • Switch
  • Router
▶ Types of network
  • PAN
  • LAN
  • CAN
  • MAN
  • WAN
▶ What is Protocol?

Creating computer network

Networking two or more computers together require a basic understanding of computer hardware and software, but once this process is done, it allows you to share resources between the computers. If you have the right equipment, you can network two computers together in just a few moments, with minimal effort.

In order to create networking between the computers, it is necessary that the computers have access to the same network.

Network Topology

Topology is the schematic description of the arrangement of a network, including its nodes and connecting lines, while a network topology is the arrangement of the various elements such as nodes of a computer. Topology is the indication of how data flows within a network, regardless of its physical design. Depending upon the type and nature of the connection made, topologies can be of

different kinds. Although, the study of network topology recognises eight basic topologies; however, the most commonly known are:

Star Topology

Alternatively referred to as a star network, a star topology is one of the most common network setups where each of the devices and computers on a network connect to a central hub or switch. In this network, all the data transferred or shared first come to the central hub and then goes to the respective system. Star networks are relatively easy to install and manage, but bottlenecks can occur because all data must pass through the hub. The primary disadvantage of the star topology is that the hub represents a single point of failure, that is, if the central hub fails, all computers connected to that hub would be disconnected.
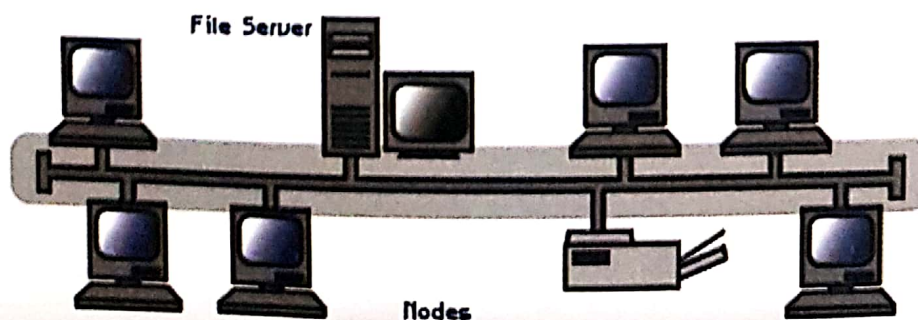

STAR TOPOLOGY
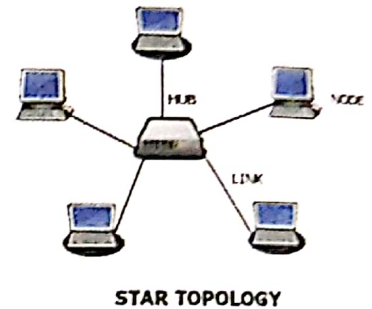
Ring Topology

As the name suggests, in ring topology, all devices are connected to one another in the shape of a closed loop to form a ring. In this network connection, each device is connected directly to two other devices, one on either side of it. Ring topologies are relatively expensive and difficult to install, but they offer high bandwidth and can span large distances. The use of ring topology is on the verge of extinction as the topology offers only one path for information flow. Thus, if any link failure happens amidst the connection, the entire ring connection will fail.
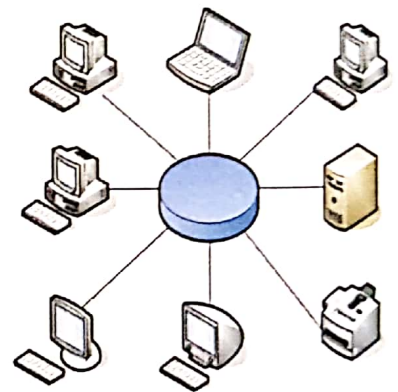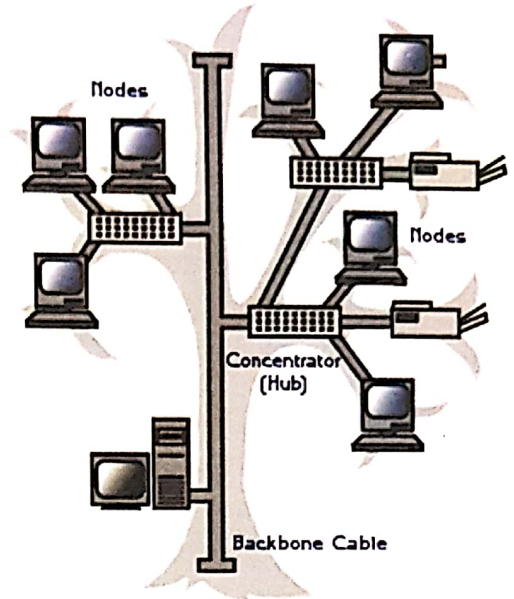

Bus Topology

In case of Bus topology, all the devices are connected to a central cable, called the bus or backbone. Bus networks are the simplest way to connect multiple users. The topology uses Ethernet systems to make the connections. Bus networks are relatively inexpensive and easy to install for small networks. The biggest advantage of Bus topology is that if one computer fails it does not affect the other computers. However, the disadvantage is that if the main cable fails, all the other connected computers will die.


Nodes

Tree Topology

Tree topology is one of the most common network setups that are similar to a bus topology and a star topology. Hence it is also referred as star bus topology. A tree topology connects multiple star networks to other star networks, that is, it consists of groups of star-configured workstations connected to a linear bus backbone cable. In a tree topology, if the main cable or trunk between each of the two star topology networks fail, those networks will be unable to communicate with each other. However, computers on the same star topology will still be able to communicate with each other.

Hybrid Topology

Justifying the name, Hybrid networks use a combination of any two or more topologies in such a way that the resulting network does not exhibit one of the standard topologies. For example, a tree network connected to a tree network is still a tree network topology. A hybrid topology is always produced when two different basic network topologies are connected.

Hybrid Topology

Backbone Cable (Chanel)
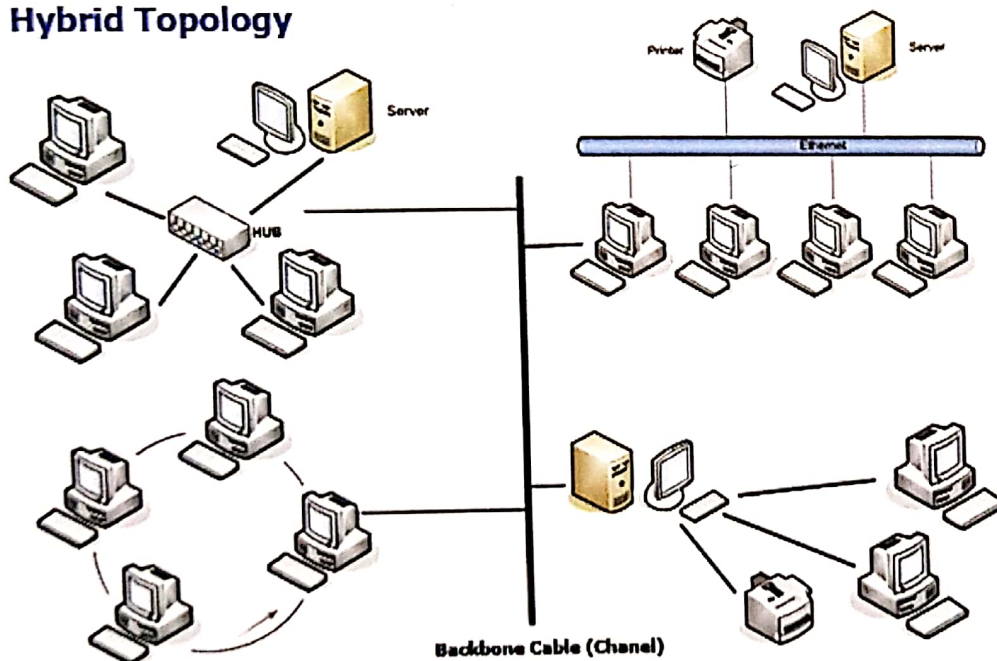
Networking Hardware

As mentioned earlier, networking hardware are important components that are required to create a computer network. Networking hardware includes all computers, peripherals, interface cards and other equipment needed to perform data-processing and communications within the network. Networking hardware includes many components. They are:

Network Interface Cards (NIC)

The network interface card (NIC) provides the physical connection between the network and the computer workstation. Most NICs are internal and they are included in the purchase of most computers. Network interface cards are a major factor in determining the speed and performance of a network. It is a good idea to use the fastest network card available for the type of workstation you are using.
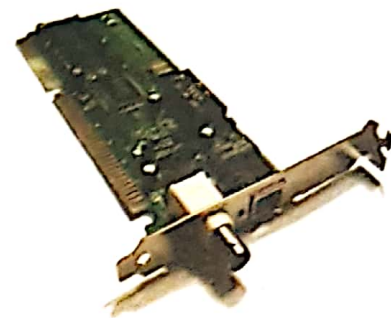
Hub

Hub is a network device that sends one signal to all the stations connected to it. All computers/devices are competing for attention because it takes the data that comes into a port and sends it out to all the other ports in the hub. Traditionally, hubs are used for star topology networks, but they are often used with other configurations to make it easy to add and remove computers without bringing down the network.

Switch

It is a device that splits large networks into small segments, decreasing the number of users sharing the same network resources and bandwidth. It understands when two devices want to talk to each other and gives them a switched connection. Besides, a switch also helps to prevent data collisions and reduces network congestion, increasing network performance.

Router

It is a device that connects any number of LANs. It uses standardized protocols to move packets efficiently to their destination. Its main function is to forward data depending on the Network address (IP), not the Hardware (MAC) address. Routers are the only devices that allow you to share a single IP address among multiple network clients.

Types of networks

One way to categorise the different types of computer network designs is by their scope or scale. It can also be characterised by its physical capacity or its organisational purpose. Use of the network, including user authorisation and access rights, differ accordingly. They are: LAN, PAN, MAN, WAN and CAN.

LAN

The local area network (LAN) is a network, which is designed to operate over a small physical area

such as an office, factory or a group of buildings. It is usually privately owned and links the devices in a single office, building or campus of upto a few kilometres in size. LAN is widely used to allow resources to be shared between personal computers or workstations. The resources to be shared can be hardware like a printer or software or data. LANs are very widely used in a variety of applications. A common example of a LAN found in many business organisations, links a work group of task related computers, e.g. accounting and finance PCs, administrative PCs or engineering workstations.
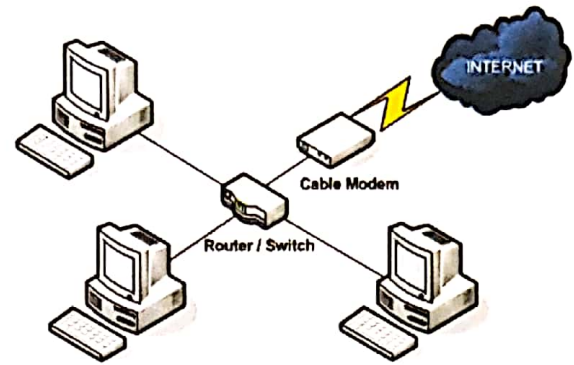
PAN

A personal area network (PAN) is a computer network used for communication among computer devices. It includes telephones mobile phones and personal digital assistants, in proximity to an individual's body. In other words, it can be defined as a network that is used for communication among computers and computer devices (including telephones) in close proximity of around a few meters within a room. PAN can be used for communicating between the devices themselves, or for connecting to a larger network such as the internet. PAN can be constructed with cables or be wireless. USB are firewire technologies link together a wired PAN, while wireless PAN uses Bluetooth or infrared connections.

MAN

A metropolitan area network (MAN) is a computer network in which two or more computers or communicating devices or networks that are geographically separated but in same metropolitan city are connected to each other. A MAN is set up for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities. A MAN might be owned and operated by a single organisation, but would be used by many individuals and organisations. This network often acts as a high-speed network to allow sharing of regional resources.
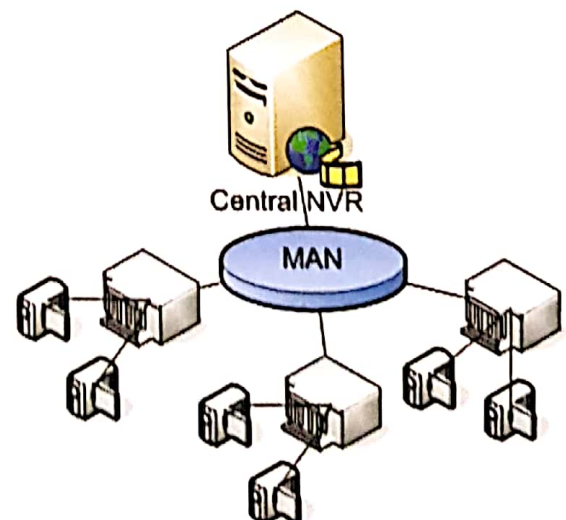
WAN

WAN stands for Wide Area Network. As the name suggests, WAN covers a large geographic area such as country, continent or even whole area of the world. A WAN is two or more LANs connected together. Multiple LANs can be connected together using devices such as bridges, routers, or gateways, which enable them to share data. WAN is more suitable to transfer data from one user to another which is not a time critical application as large distances involves the propagation delays and problems with variable signal travel times. An airline reservation system is an example of WAN.
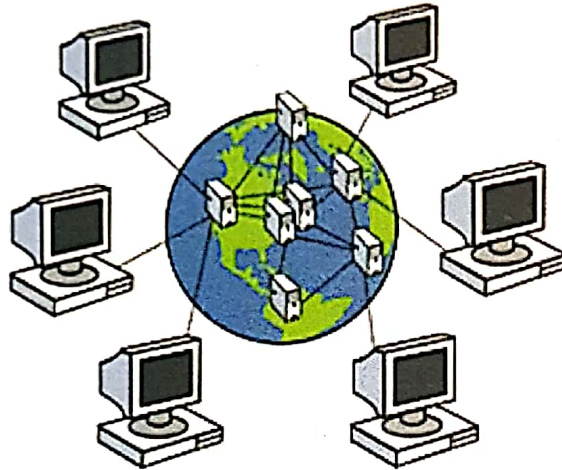
CAN

A campus area network, corporate area network or CAN is a computer network made up of an interconnection of local area networks (LANs) within a limited geographical area. CAN is usually established in university campus to establish a connection among different computer labs, library, registration office and different academic units. It is smaller than MAN.
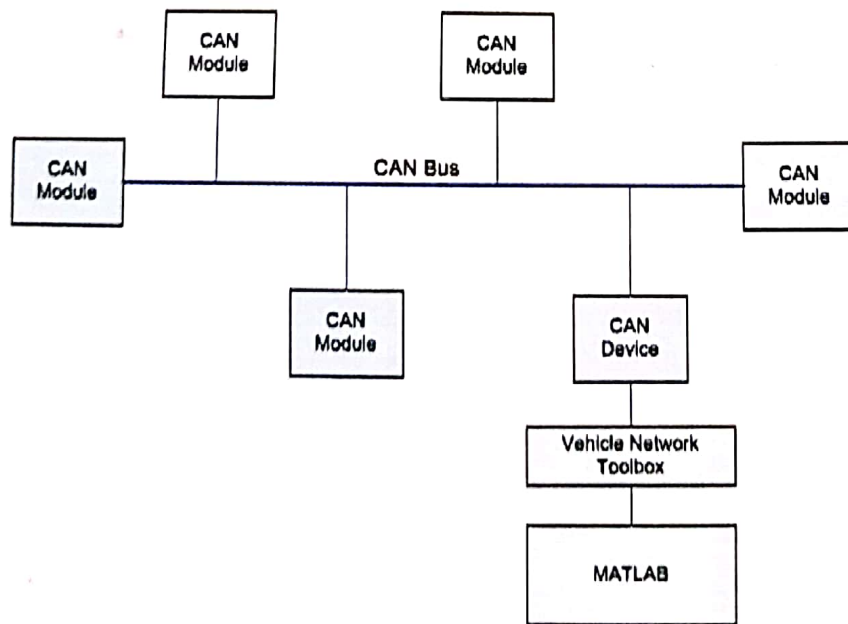
What is Protocol?

A protocol is a system of rules that defines how data is transmitted over network. In computer terminology, a protocol is usually an agreed-upon or standardized method for transmitting data and/or establishing communications between different devices. Protocols are established by international or industry wide organisations. Perhaps the most important computer protocol is OSI (Open Systems Interconnection), a set of guidelines for implementing networking communications between computers.

Internet protocol (IP)

The Internet Protocol (IP) is a network-layer (Layer 3) protocol that contains addressing information and some control information that enables packets to be routed. IP represents the heart of the Internet protocols. IP has two primary responsibilities: providing connectionless, best-effort delivery of datagrams through an internetwork and providing fragmentation and reassembly of datagrams to support data links with different maximum-transmission unit (MTU) sizes.

Transmission Control Protocol (TCP)

The TCP provides reliable transmission of data in an IP environment. TCP offers reliability by providing connection-oriented, end-to-end reliable packet delivery through an internetwork. TCP offers efficient flow control, which means, when sending acknowledgments back to the source, the receiving TCP process indicates the highest sequence number it can receive without overflowing its internal buffers.

Hyper Text Transfer Protocol

HTTP is the Hypertext Transfer Protocol that controls how Web servers and Web browsers communicate with each other. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands. HTTP is called a stateless protocol because each command is executed independently without any knowledge of the commands that came before it. This is the main reason that it is difficult to implement Web sites that react intelligently to user input.

➡ Beyond the chapter

Inventor of TCP and IP

Robert Elliot "Bob" Kahn is an American Internet pioneer engineer and computer scientist, who, along with Vint Cerf, invented the Transmission Control Protocol (TCP) and the Internet Protocol (IP), the fundamental communication protocols at the heart of the Internet.

Terms......

Protocol: A set of rules to exchange information on the network.

Topology: Schematic description of the arrangement of network.

LAN: Local Area Network (LAN) is designed to operate over a small physical area such as an office, factory or a group of buildings.

MAN: Metropolitan Area Network (MAN) is a computer network in which two or more computers are geographically separated but in same metropolitan city are connected to each other.

WAN: Wide Area Network (WAN) covers a large geographic area such as country, continent or even whole of the world.

Let's Summarise

- Computer networking is the interconnection of various computers for the purpose of communication.
- Topology is the schematic description of the arrangement of a network. Most commonly known topologies are—star topology, ring topology, bus topology, tree topology and hybrid topology.
- Networking hardware are important components that are required to create a computer network. They are: NIC, Hub, Switch and Router.
- LAN, PAN, MAN, WAN, CAN are the types of networks.
- A protocol is a system of rules that defines how data is transmitted over network.
- Internet Protocol is a network-layer that contains addressing information and some control information that enables packets to be routed.
- The TCP provides reliable transmission of data in an IP environment.
- HTTP is the Hypertext Transfer Protocol that controls how Web servers and Web browsers communicate with each other.

Exercise

Fill in the blanks.

WAN   Star Network   HTTP   Computer Workstation   IP

1. Star topology is also referred to as ....

2. The NIC provides the physical connection between the network and the ....

3. A .... is two or more LANs connected together.

4. .... controls how web servers and web browsers communicate with each other.

5. .... represents the heart of the Internet Protocols.

II Write T for true and F for false for the following statements.

1. Trace topology is also referred to as tree bus topology. ☐

2. Hub is a device that splits large networks into small segments. ☐

3. Router is a device that connects any number of LANs. ☐

4. The HTTP provides reliable transmission of data in a IP environment. ☐

III Project

1. Create a project "Types of Networking". Paste pictures of different components/organisations. Explain the type of networking used.

2. To draw figures of various topologies on chart.

IV Group Discussion

Divide the class into 4 groups. Give the following topics to each group for discussion:

1. Network Topology

2. Network devices

3. Types of Networks

4. Protocols

Students can use pictures and diagrams to explain their topic.

V Value Based Question

Your school lab has connected all the systems through a network. Describe how networking will be helpful in sharing data and resources. What precautions should be taken while sharing data?

VI Write one word for the following:

1. The schematic description of the arrangement of a network.

2. Topology that is produced when two different basic network topologies are connected.

3. The protocol that provides reliable transmission of data in an IP environment.

VII Short answer questions

1. What is a Hub?