UNIT 1 NETWORK CLASSIFICATIONS AND TOPOLOGIES

Structure **Page No.**

1.0 INTRODUCTION

As you know that a computer network is a group of computers that are connected with each other using some media for sharing of data and resources. It may connect other devices also like printers, scanners, etc. Information travels over the cables or other media, allowing network users to exchange documents & data with each other, print the data, and generally share any hardware or software that is connected to the network. In this unit we will learn about the different types of networks, their classifications based on topologies, size and functioning. We will also examine the access methods for LAN and WAN.

1.1 OBJECTIVES

After going through this unit, you should be able to:

- Define and classify network**;**
- distinguish between different types of networks,
- differentiate between different network (LAN and WAN) topologies
- understand LAN and WAN access methods

1.2 NETWORK OVERVIEW

In the simplest form, data transfer can take place between two devices which are directly connected by some form of communication medium. But it is not practical for two devices to be directly point to point connected. This is due to the following reasons:

i) The devices are situated at remote places.

ii) There is a set of devices, each of whom may require to connect to others at various times.

Solution to this problem is to connect each device to a communication network. Computer Networks means interconnected set of autonomous systems that permit distributed processing of information.

In order to meet the needs of various applications, networks are available with different interconnection layouts and plans, methods of access, protocols and data carrying capacities. Networks can be classified on the basis of geographical coverage.

1.2.1 Classification of Networks

- Local Area Network (LAN)
- Metropolitan Area Network (MAN)
- Wide Area Network (WAN).

1.2.2 Local Area Network (LAN)

A local area network is relatively smaller and privately owned network with the maximum span of 10 km. to provide local connectivity within a building or small geographical area. The LANs are distinguished from other kinds of networks by three characteristics:

i) Size (coverage area)

ii) Transmission technology (coverage area), and

iii) Topology.

1.2.3 Metropolitan Area Network (MAN)

Metropolitan Area Network is defined for less than 50 km. and provides regional connectivity typically within small geographical area. It is designed to extend over an entire city. It may be a single network such as cable television, network, or it may be a means of connecting a number of LANs into a large network, so that resources may be shared LAN to LAN as well as device to device. For example, a company can use a MAN to connect to the LANs in all of its offices throughout a city.

1.2.4 Wide Area Network (WAN)

Wide Area Network provides no limit of distance. In most WANs, the subnet consists of two distinct components. Transmission lines are also called circuits or channels or links and switching and routing devices (switches & routers). Transmission-lines are used for moving bits between machines, whereas routers are used to connect two or more transmission lines.

A WAN provides long distance transmission of data, voice, image and video information over large geographical areas that may comprise a country, a continent or even the whole world.

In contrast to LANs (which depend on their own hardware for transmission), WANs may utilise public, leased or private communication devices usually in combination and span own unlimited number of miles.

A WAN that is wholly owned by a single company is often referred to as an enterprise network.

A Local Area Network (LAN) is generally a privately owned network within a single office, building or campus, covering a distance of a few kilometers. The main reason for designing a LAN is to share resources such as disks, printers, programs and data. It also enables the exchange of information. Classically, LANs had data rates of 4-16 Megabits

per second (Mbps). Later, 100 Mbps LANs were introduced. Today, LANs with data rates of thousands of Mbps are possible. LANs typically can use the star, bus or a ring topology. However, bus topology is popular in the Ethernet LANs and Token Bus LANs and ring topology is popular in the Token Ring LANs of IBM. A modified version of Token Ring is Fiber Distributed Data Interface (FDDI). Of these, Ethernet and Token Ring are the most popular LANs.

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1. What are various types of networks?

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2. What is the difference between Broadcasting and Multicasting?

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1.3 LAN TOPOLOGIES

A topology is a generalized geometric configuration of some class of objects that join together. Topologies are the architectural "drawings" that show the overall physical configuration for a given communications system.

In networking, the term topology refers to the layout of connected devices on a network. It can be considered as the logical "shape" of the network wiring. This logical shape does not necessarily correspond to the actual physical layout of the devices on the network. For example, the computers on a home LAN may be arranged in a circle, but it would be highly unlikely to find an actual ring topology there 'Logical' means how it looks as a pure design concept, rather than how it actually looks physically.

Topology indicates the access methods and governs the rules that are used to design and implement the communication system. It is important to make a distinction between a topology and architecture. A topology is concerned with the physical arrangement of the network components. In contrast, architecture addresses the components themselves and how a system is structured (cable access methods, lower level protocols, topology, etc.). An example of architecture is 10baseT Ethernet that typically uses the star topology. Each topology has its advantages and disadvantages usually related to cost, complexity, reliability and traffic "bottlenecks". The different types of topologies are discussed below:

Bus Topology: --In a bus topology, all stations are attached to the same cable. In the Bus Network, messages are sent in both directions from a single point and are read by the node (computer or peripheral on the network) identified by the code with the message. Most Local Area Networks (LANs) are Bus Networks because the network will continue to function even if one computer is down. The purpose of the terminators (resistors) at either end of the network is to stop the signal being reflected back. If a bus network is not terminated, or if the terminator has the wrong level of resistance, each signal may travel across the bus several times instead of just once. This problem increases the number of signal collisions, degrading network performance. The figure 1 given below shows a bus Topology:

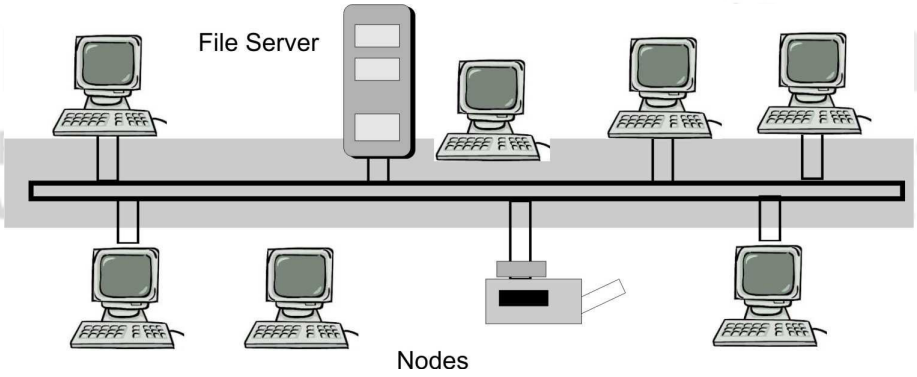

Figure 1: Bus Topology

In a bus topology, signals are broadcast to all stations. Each computer checks the address on the signal (data frame) as it passes along the bus. If the signal's address matches that of the computer, the computer processes the signal. If the address doesn't match, the computer takes no action and the signal travels down the bus.

Advantages of Bus Topology: The advantages of BUS topologies are as follows: --

i) Bus topologies are relatively easy to install and don't require much cabling compared to other topologies.

ii) Easy to connect a computer or peripheral to a linear bus.

iii) Requires less cable length than a star topology, as you only need to chain the stations together.

iv) There is no central point of failure on a bus because there is no switch. .

v) Simple and easy to implement and extend.

vi) Failure of one station does not affect others.

Disadvantages of a Linear Bus Topology: -- The disadvantages of BUS topologies are as follows: --

i) Entire network shuts down if there is a break in the main cable.

ii) Terminators are required at both ends of the backbone cable.

iii) Difficult to identify the problem if the entire network shuts down.

iv) Not meant to be used as a stand-alone solution in a large building.

v) Maintenance costs may be higher in the long run.

vi) More expensive cabling: Because the line is shared, the cable should have high bandwidth.

vii) Addition of nodes negatively affects the performance of the whole network, and if there is a lot of traffic throughput decreases rapidly.

viii) The more components share the signal, the more probable errors become. As the signal has to be multiplexed and demultiplexed and as every connected device is examining them. thus errors can more easily occur.

Star Topology: -- In a Star Network, all the nodes (PCs, printers and other shared peripherals) are connected to the central server. It has a central connection point - like a switch. A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub or concentrator as shown in figure2 below.

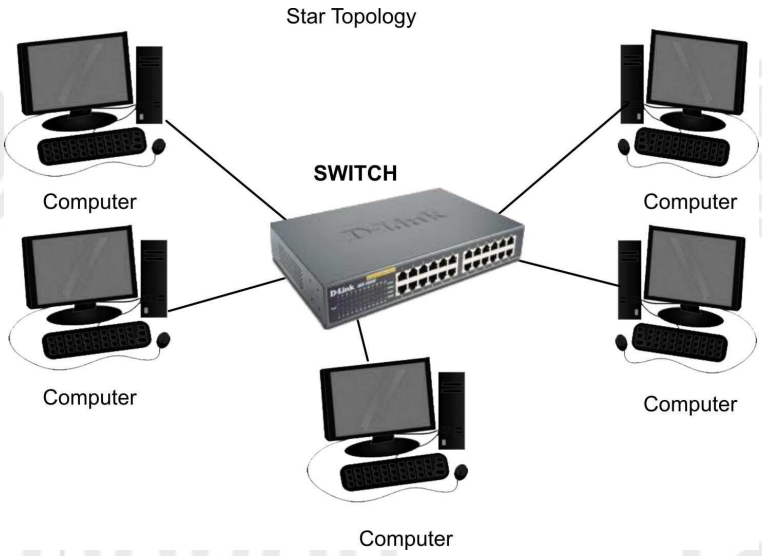

Figure 2: Star Topology

All traffic emanates from the switch of the star. Data on a star network passes through the switch or concentrator before continuing to its destination. The switch or concentrator manages and controls all functions of the network. It also acts as a repeater for the data flow. This configuration is common with twisted pair cable; however, it can also be used with coaxial cable or fiber optic cable. The switch offers a common connection for all stations on the network. Each station has its own direct cable connection to the switch.

Advantages of a Star Topology: -- The advantages of star topologies are as follows:

i) Easy to add new stations as each station has its own direct cable connection to the switch. If a cable is cut, it only affects the computer that was attached to it.

ii) It can accommodate different wiring. It can be installed using twisted pair, coaxial cable or fiber optic cable.

iii) Since all information in a star topology goes through a central point star, topologies are easy to troubleshoot. A star can simplify troubleshooting because stations can be disconnected from the switch one at a time until the problem is isolated.

iv) The main advantage is that one malfunctioning node does not affect the rest of the network.

Disadvantages of a Star Topology: --The advantages of star topologies are as follows:-

i) Depending on where the switches are located, star networks can require more cable length than a linear topology.

ii) If the switch / concentrator/switches fail, nodes attached are disabled.

iii) More expensive than linear bus topologies because of the cost of the switches.

Ring Topology: --All the nodes in a ring network are connected in a closed circle of cable as shown in figure 3. Messages that are transmitted travel around the ring until they reach the computer that they are addressed to. The signal being transmitted is refreshed by each node in the ring between the sender and receiver. In a ring network, every device has exactly two neighbors for communication purposes.

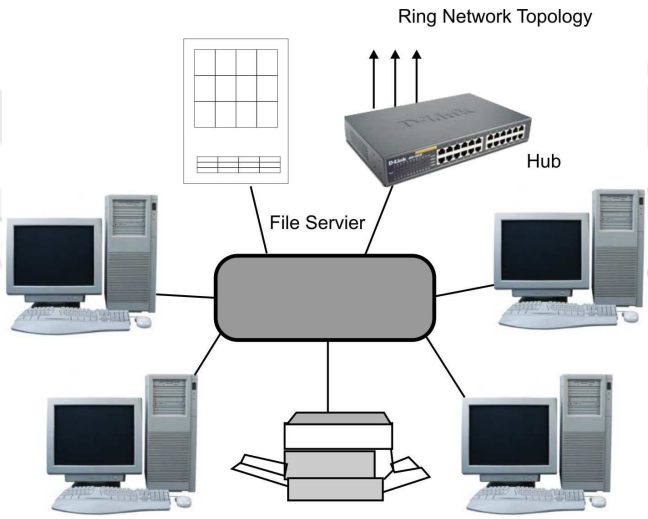

Figure 3: Ring Topology

All messages travel through a ring in the same direction. There are no terminated ends to the cable; the signal travels around the circle and terminated by the source.

Under the ring concept, a chance is given to each node sequentially via a "token" from one station to the next. When a station wants to transmit data, it "grabs" the token, attaches data and an address to it, and then sends it around the ring. The token travels along the ring until it reaches the destination. The receiving computer acknowledges receipt by stamping incoming message and passes it to the sender. The sender then releases the token to be used by another computer.

Each station in the ring has equal access but only one station can talk at a time. In contrast to the 'passive' topology of the bus, the ring employs an 'active' topology. Each station repeats or 'boosts' the signal before passing it on to the next station. Rings are normally implemented using twisted pair or fiber-optic cable.

Advantages of Ring Topology: -- The advantages of ring topologies are as follows: -

i) Growth of system has minimal impact on performance. The ring networks can be larger than bus or star because each node regenerates the signal.

ii) Degrade nicely under high utilization. Everybody gets to talk."

iii) Fault tolerance builds into the design (can bypass damaged nodes).

iv) Data packets travel at a greater speed.

Disadvantages of Ring Topology: -- The disadvantages of ring topologies are as follows: -

i) Expensive topology.

ii) Failure of one interface may impact others. A failure in any cable or device breaks the loop and will take down the entire segment.

iii) It is complex to implement and to extend the network; you must break the

iv) Ring (which brings the network down). If any device is added to or removed from the ring, the ring is broken and the segment fails.

Mesh Topology: -- In the topologies shown in figure 4, there is only one possible path from one node to another node. If any cable in the path is broken, the nodes cannot communicate. In a mesh topology, every device has a dedicated point-to point link to every other device. Such a network is called complete because between any two devices there is a special link; one could not add any non- redundant links.

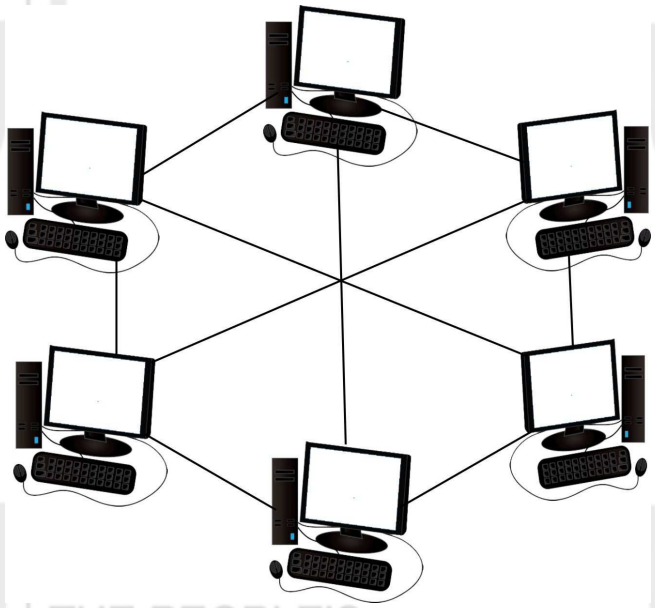

Figure 4: Mesh Topology

Mesh topology uses lots of cables to connect every node with every other node. It is very expensive to wire up, but if any cable fails, there are many other ways for two nodes to communicate. In mesh topology if we have to connect 'n' computers then we need n*(n-1)/2 cables/connections and each computer must have (n-1) Ethernet cards.

Advantages of Mesh Topology: -- The advantages of mesh topology are as follows:-

i) Redundant links between devices.

ii) Good security: If the line is not tapped only the intended recipient can see the data.

iii) Reliability: Increasing network traffic does not affect the speed of other connections.

iv) Easy fault identification and isolation, an unusable link does not incapacitate the entire system

Disadvantages of Mesh Topology: -- The disadvantages of mesh topology are as follows: -

i) Each node must have an interface for every other device.

ii) Large amounts of cable for many devices to be connected in a mesh environment. A mesh topology for n devices needs n (n - 1) connections. It is therefore hard to install and expensive because of the extensive cabling.

iii) Unless each station sends to every other station frequently, bandwidth is wasted. (Links that are not being used).

iv) Another disadvantage is that there is only limited of I/O-ports in a computer, but every connection needs one.

Tree Topology: -- The tree topology also known as the 'Hierarchical topology'. The tree topology is a combination of bus and star topologies. It consists of groups of star-configured workstations connected to' a linear bus backbone cable. Tree topologies allow for the expansion of an existing network and enable to configure a network to meet their needs. They are very common in larger networks. Figure 5 given below shows a typical tree topology.

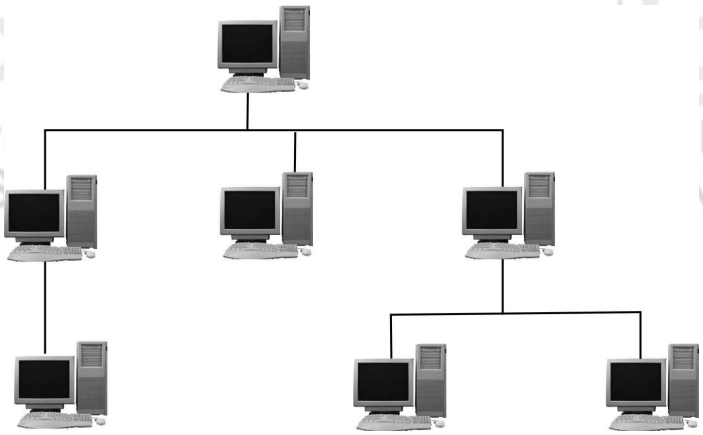

Figure 5: Tree Topology

For example, a file server is connected to a 24-port switch. A cable goes from the switch to a computer room where it connects to another switch. Many cables pass from this switch to the computers in the computer room. The node at the highest point in the hierarchy usually a file server-controls the network.

Advantages of a Tree Topology: -- The advantages of tree topology are as follows:-

i) Point-to-point wiring for individual segments.

ii) Supported by several hardware and software vendors.

Disadvantages of a Tree Topology: -- The disadvantages of tree topology are as follows:-

i) Overall length of each segment is limited by the type of cabling used.

ii) If the backbone line breaks, the entire segment goes down.

iii) More difficult to configure and wire than other topologies.

Considerations When Choosing a Topology

The considerations while choosing topologies are as follows: --

i) **Cost:** A linear bus network may be the least expensive way to install a network; you do not have to purchase concentrators

ii) **Length of cable needed:** The linear bus network uses shorter lengths of cable.

iii) **Future growth:** With a star topology, expanding a network is easily done by adding another switch.

iv) **Cable type:** The most common cable is unshielded twisted pair, which is most often used with bus, star topologies.

1.4 LAN /MAC ACCESS METHODS

Goals of MAC: Medium Access Control techniques are designed with the following goals in mind.

- **Initialisation:** The technique enables network stations, upon power-up, to enter the state required for operation.
- **Fairness:** The technique should treat each station fairly in terms of the time it is made to wait until it gains entry to the network, access time and the time it is allowed to spend for transmission.

- **Priority:** In managing access and communications time, the technique should be able to give priority to some stations over other stations to facilitate different type of services needed.
- **Limitations to one station:** The techniques should allow transmission by one station at a time.
- **Receipt:** The technique should ensure that message packets are actually received (no lost packets) and delivered only once (no duplicate packets), and are received in the proper order.
- **Error Limitation:** The method should be capable of encompassing an appropriate error detection scheme.
- **Recovery**: If two packets collide (are present on the network at the same time), or if notice of a collision appears, the method should be able to recover, i.e. be able to halt all the transmissions and select one station to retransmit.
- **Re-configurability**: The technique should enable a network to accommodate the addition or deletion of a station with no more than a noise transient from which the network station can recover.
- **Compatibility:** The technique should accommodate equipment from all vendors who build to its specification.
- **Robustness:** The technique should enable a network to confine operating in spite of a failure of one or several stations.

The MAC (Medium Access Control) techniques can be broadly divided into four categories; Contention-based, Round-Robin, Reservation-based and. Channelization-based. Under these four broad categories there are specific techniques, as shown in Figure 6 below:

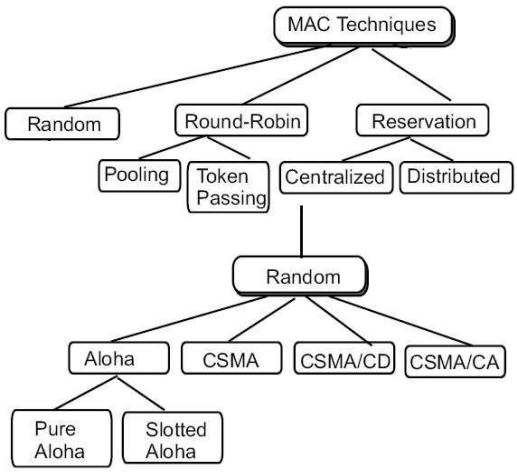

Figure 6: Classification of Medium Access Control techniques

There are different of methods used as access protocols in LANs, major techniques being token passing and CSMA/CD. Token passing can be used with ring or bus topologies. Token passing scheme is an access protocol that permits a terminal to transmit only on receipt of a special circulating bit sequence. CSMA/CD (carrier sense multiple access, with collision detected) is used with bus and some star topologies.

Random Access (Contention-based Approaches) : Round-Robin techniques work efficiently when majority of the stations have data to send most of the time. But, in situations where only a few nodes have data to send for brief periods of time, Round-Robin techniques are unsuitable. Contention techniques are suitable for bursty nature of

traffic. In contention techniques, there is no centralised control and when a node has data to send, it contends for gaining control of the medium. The principle advantage of contention techniques is their simplicity. They can be easily implemented in each node. The techniques work efficiently under light to moderate load, but performance rapidly falls under heavy load.

In the 1970s, Norman Abramson and his colleagues at the University of Hawaii devised a new and elegant method to solve the channel allocation problem. Their work has been extended by many researchers since then (Abramson, 1985). Although Abramson's work, called the ALOHA system, used ground-based radio broadcasting, the basic idea is applicable to any system in which uncoordinated users are competing for the use of a single shared channel.

ALOHA have two versions pure and slotted. They differ with respect to whether time is divided into discrete slots into which all frames must fit. Pure ALOHA does not require global time synchronization; slotted ALOHA does. These pure and slotted ALOHA schemes will be discussed further in this block.

CSMA/CD: CSMA/CD stands for Carrier Sense Multiple Access with Collision Detection. It refers to the means of media access, or deciding "who gets to talk" in an Ethernet network. In detailed mechanisms of CSMA/CD will be discussed further in this block.

Round Robin Techniques: In Round Robin techniques, each and every node is given the chance to send or transmit by rotation. When a node gets its turn to send, it may either decline to send, or it may send if it has got data to send. After getting the opportunity to send, it must relinquish its turn after some maximum period of time. The right to send then passes to the next node based on a predetermined logical sequence. The right to send may be controlled in a centralised or distributed manner. Polling is an example of centralised control and token passing is an example of distributed control.

i) **Polling:** The mechanism of polling is similar to the roll-call performed in a classroom. Just like the teacher, a controller sends a message to each node in turn. The message contains the address of the node being selected for granting access. Although all nodes receive the message, only the addressed node responds and then it sends data, if any. If there is no data, usually a “poll reject” message is sent back. In this way, each node is interrogated in a round-robin fashion, one after the other, for granting access to the medium. The first node is again polled when the controller finishes with the remaining codes. The polling scheme has the flexibility of either giving equal access to all the nodes, or some nodes may be given higher priority than others. In other words, priority of access can be easily implemented.

ii) **Token Passing:** In token passing scheme, all stations are logically connected in the form of a ring and control of the access to the medium is performed using a token. A token is a special bit pattern or a small packet, usually several bits in length, which circulate from node to node. Token passing can be used with both broadcast (token bus) and sequentially connected (token ring) type of networks with some variation.

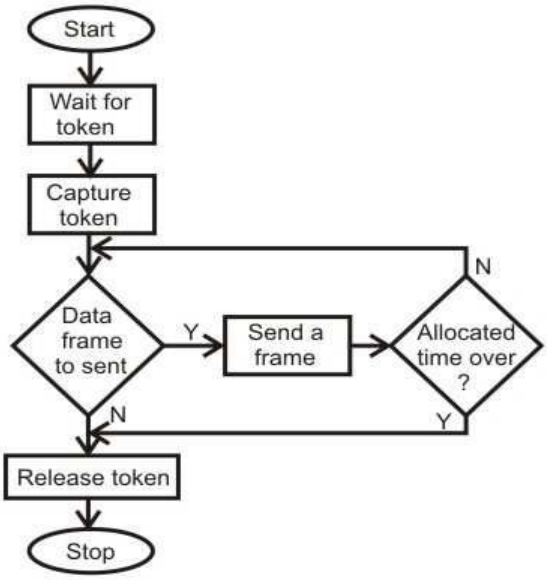

Figure 7: Mechanism of Token Passing

In case of token ring as shown in flowchart of figure 7, token is passed from a node to the physically adjacent node. On the other hand, in the token bus, token is passed with the help of the address of the nodes, which form a logical ring. In either case a node currently holding the token has the 'right to transmit'. When it has got data to send, it transmits the data and then forwards the token to the next logical or physical node in the ring. If a node currently holding the token has no data to send, it simply forwards the token to the next node. The token passing scheme is efficient compared to the polling technique, but it relies on the correct and reliable operation of all the nodes. There exists a number of potential problems, such as lost token, duplicate token, and insertion of a node, removal of a node, which must be tackled for correct and reliable operation of this scheme.

☞ Check Your Progress 2

1. Write an advantage and one disadvantage of star topology?

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2. What is the difference Considerations while Choosing a Topology for a network?

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1.5 NETWORK TYPES BASED ON SIZE

As you know that In order to meet the needs of various applications, networks are available with different interconnection layouts and plans, methods of access, protocols and data carrying capacities. Networks can be classified on the basis on size classified

are following. You have already studied the brief about LAN, MAN and WAN in the beginning of this unit. Now, in this section lets us again discuss them further.

Personal area network (PAN)

1. Local area network (LAN)
2. Metropolitan area network (MAN)
3. Wide area network (WAN)

    1. **PAN:** A personal area network (PAN) is a computer network organized around an individual person. Personal area networks typically involve network of a mobile computer, a cell phone and/or a handheld computing device such as a PDA. You can use these networks to transfer files including email and calendar appointments, digital photos and music. Personal area networks can be constructed with cables or wirelessly. USB and FireWire technologies often link together a wired PAN while wireless PANs typically use Bluetooth or sometimes infrared connections. Bluetooth PANs are also called piconets. Personal area networks generally cover a range of less than 10 meters (about 30 feet).

    2. **LAN:** A local area network (LAN) supplies networking capability to a group of computers in close proximity to each other such as in an office building, a school, or a home. A LAN is useful for sharing resources like files, printers, games or other applications. A LAN in turn often connects to other LANs, and to the Internet or other WAN. Most local area networks are built with relatively inexpensive hardware such as Ethernet cables, network adapters, and hubs. Wireless LAN and other more advanced LAN hardware options also exist. Specialized operating system software may be used to configure a local area network. For example, most flavors of Microsoft Windows provide a software package called Internet Connection Sharing (ICS) that supports controlled access to LAN resources.

    3. **MAN**: A Metropolitan Area Network (MAN) is a network that is designed to cover an entire city. As we have seen, organizations create smaller networks called as Local Area Networks (LANs). LANs are privately owned networks within the premises of an organization. However, suppose that an organization wants to connect the computers in its three city offices to each other. In such a case, the organization cannot obviously lay a private network all around the city. **WAN**: A Wide Area Network (WAN) is huge compared to a LAN or a MAN. A WAN spans across city, state, country or even continent boundaries. For instance, a WAN could be made up of a LAN in India, another LAN in the US and a third LAN in Japan, all connected to each other to form a big network of networks. The technical specifications of WAN differ from that of a LAN, although in principle, a WAN looks like a very big LAN.

1.6 FUNCTIONAL CLASSIFICATION OF NETWORKS

On the basis of functional relationship network is classified as follows:

1. Peer-to-peer
2. Client-server

    1. **Peer-to-Peer: --** Peer-to-peer network operating systems allow users to share resources and files located on their computers and to access shared resources found on other computers. However, they do not have a file server or a centralized management source (See figure 8 given below). In

a peer-to-peer network, all computers are considered equal; they all have the same abilities to use the resources available on the network. Peer-to-peer networks are designed primarily for small to medium local area networks. AppleShare and Windows for Workgroups are examples of programs that can function as peer-to-peer network operating systems.

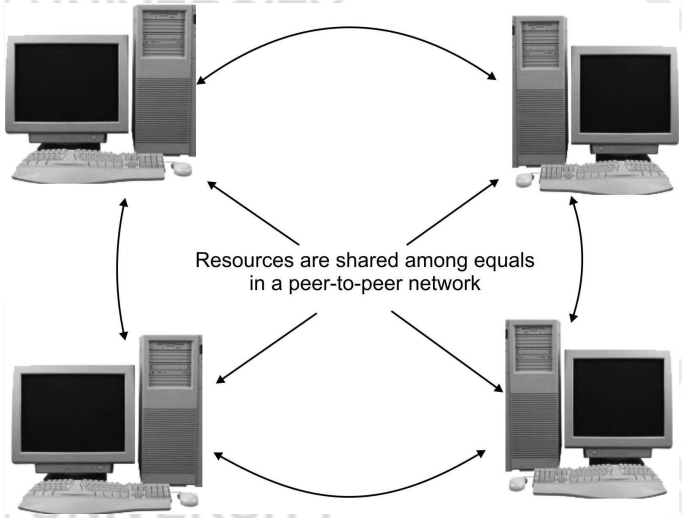

Figure 8: Peer to Peer network

The advantages of peer-to-peer over client-server NOSs include:

i) No need for a network administrator

ii) Network is fast/inexpensive to setup & maintain

iii) Each PC can make backup copies of its data to other PCs for security.

By far the easiest type of network to build, peer-to-peer is perfect for both home and office use.

2. **Client/Server: --** Client/server network operating systems allow the network to centralize functions and applications in one or more dedicated file servers. The file servers become the heart of the system, providing access to resources and providing security. Individual workstations (clients) have access to the resources available on the file servers. The network operating system provides the mechanism to integrate all the components of the network and allow multiple users to simultaneously share the same resources irrespective of physical location. Novell Netware and Windows NT Server are examples of client/server network operating system.

   In a client-server environment like Windows NT or Novell NetWare, files are stored on a centralized, high speed file server PC that is made available to client PCs. Network access speeds are usually faster than those found on peer-to-peer networks, which is reasonable given the vast numbers of clients that this architecture can support. Nearly all network services like printing and electronic mail are routed through the file server, which allows networking tasks to be tracked. Inefficient network segments can be reworked to make them faster, and users' activities can be closely monitored. Public data and applications are stored on the file server, where they are run from client PCs' locations, which make upgrading software a simple task network administrators can simply upgrade the applications stored on the file server, rather than having to physically upgrade each client PC.

1.7 WAN TOPOLOGIES

A wide area network (WAN) is a network connecting geographically distinct locations, which may or may not belong to the same organization. WAN topologies use both LAN add enterprise-wide topologies as building blocks, but add more complexity because of the distance they must cover, the larger number of users they serve, and the heavy traffic they often handle. For example, although a simple ring topology may suffice for a small office with 10 users, it does not scale well and therefore cannot serve 1000 users. The particular WAN topology you choose will depend on the number of sites you must connect, the distance between the sites, and any existing infrastructure.

WAN Ring Topology: In a ring WAN topology, each site is connected to two other sites so that the entire WAN forms a ring pattern. This architecture is similar to the ring LAN topology, except that a ring WAN topology connects locations rather than local nodes. The advantages of a ring WAN over a peer-to-peer WAN are twofold: a single cable problem will not affect the entire network, and routers at any site can redirect data to another route if one route becomes too busy. On the other hand, expanding a peer-to-peer WAN because it requires at least one additional link. For those reasons, WANs that use the ring topology are only practical for connecting fewer than four or five locations.

WAN Star Topology: The star WAN topology mimics the arrangement of a star LAN. A single site acts as the central connection point for several other points. This arrangement provides separate routes for data between any two sites. As a result, star WANs are more reliable than the peer-to-peer or ring WANs. As a general rule, reliability increases with the number of potential routes data can follow. Another advantage of a star WAN is that when all of its dedicated circuits are functioning, a star WAN provides shorter data paths between any two sites.

WAN Mesh Topology: Like an enterprise-wide mesh, a mesh WAN topology incorporates many directly interconnected nodes--in this case, geographical locations. Because every site is interconnected, data can travel directly from its origin to its destination. If one connection suffers a problem, routers can redirect data easily and quickly. Mesh WANs are the most fault-tolerant type of WAN configuration because they provide multiple routes for data to follow between any two points.

One drawback to a mesh WAN is the cost; connecting every node on a network to every other entails leasing a large number of dedicated circuits. With larger WANs, the expense can become enormous. To reduce costs, you might choose to implement a partial mesh, in which critical WAN nodes are directly interconnected and secondary nodes are connected through star or ring topologies. Partial-mesh WANs are more practical and therefore more common in today's business world, than full-mesh WANs.

1.8 WAN ACCESS METHODS

WAN access methods are as follows:

1. **Lease Line:** A permanent telephone connection between two points set up by a telecommunications common carrier. Typically, leased lines are used by businesses to connect geographically distant offices. Unlike normal dial-up connections, a leased line is always active. The fee for the connection is a fixed monthly rate. The primary factors affecting the monthly fee are distance between end points and the speed of the circuit. Because the connection doesn't carry anybody else's communications, the carrier can assure a given level of quality.

For example, a T-1 channel is a type of leased line that provides a maximum transmission speed of 1.544 Mbps. You can divide the connection into different lines for data and voice communication or use the channel for one high speed data circuit. Dividing the connection is called multiplexing.

Increasingly, leased lines are being used by companies, and even individuals, for Internet access because they afford faster data transfer rates and are cost-effective if the Internet is used heavily.

2. **Packet Switching: --**Packet switching is used to overcome from limitations of circuit switching, packet switching has emerged as the standard switching technology for computer-to-computer communications, and therefore, used by most of the communication protocols such as X.25, TCP/IP, Frame Relay, ATM, etc. Unlike in a circuit switching, in packet switching, data to be sent is divided into and then sent as discrete blocks, called packets, which are of potentially variable length. The underlying network mandates the maximum size of data called packet size or packet length-that can be transmitted at a given time. Each packet contains data to be transferred, and also the control information such as the sender's address and the destination's address. Packets also help in recovering from erroneous transmission quicker and more easily. This is because, in this case, only the packers in error need to be retransmitted.

3. **ISDN:** Integrated Services Digital Network (ISDN) was developed by ITU- Tin 1976. It is a set of protocols that combines digital telephony and data transport services. The whole idea is to digitize the telephone network to permit the transmission of audio, video, and text over existing telephone lines.

   ISDN is an effort to standardize subscriber services, provide user/network inter-faces, and facilitate the internetworking capabilities of existing voice and data networks. The goal of ISDN is to form a wide area network that provides universal end-to end connectivity over digital media. This can be done by integrating all of the separate transmission services into one without adding new links or subscriber lines.

   DSL: Digital subscriber line (DSL) is a family of technologies that provide Internet access by transmitting digital data over the wires of a local telephone network. It is a high-speed Internet service like cable Internet. DSL provides high-speed networking over ordinary phone lines using broadband modem technology. DSL technology allows Internet and telephone service to work over the same phone line without requiring customers to disconnect either their voice or Internet connections. DSL technology theoretically supports data rates of 8.448 Mbps, although typical rates are 1.544 Mbps or lower. DSL Internet services are used primarily in homes and small businesses. DSL Internet service only works over a limited physical distance and remains unavailable in many areas where the local telephone infrastructure does not support DSL technology.

☞ Check Your Progress 3

1. Write the advantage of peer-to-peer over client-server.

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2. List any three WAN access methods.

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1.9 SUMMARY

A communication system that supports many users is called a network. In a network many computers are connected to each other by various topologies like star, ring, complete, interconnected or irregular. Depending on the area of coverage a network can be classified as LAN, MAN or WAN. A network is required for better utilisation of expensive resources, sharing information, collaboration among different groups, multimedia communication and video conferencing.

The two different types of networking models OSI and TCP/IP are existing. The difference between these models was discussed in detail.

1.10 REFERENCES/FURTHER READING

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1.11 SOLUTIONS/ANSWERS

☞ Check Your Progress 1

1. There are basically two types of networks:
   i) Point to point network or switched networks
   ii) Broadcast Networks.
2. Broadcasting refers to addressing a packet to all destinations in a network whereas multicasting refers to addressing a packet to a subset of the entire network.

☞ Check Your Progress 2

1. **Advantages of a Star Topology: --** The advantages of star topologies are as follows:
   i) Easy to add new stations as each station has its own direct cable

connection to the switch. If a cable is cut, it only affects the computer that was attached to it.

ii) It can accommodate different wiring. It can be installed using twisted pair, coaxial cable or fiber optic cable.

Disadvantages of a Star Topology: --The advantages of star topologies are as follows:-

i) Depending on where the switches are located, star networks can require more cable length than a linear topology.

ii) If the switch / concentrator/switches fail, nodes attached are disabled.

2. The considerations while choosing topologies are as follows: --

i) **Cost:** A linear bus network may be the least expensive way to install a network; you do not have to purchase concentrators

ii) **Length of cable needed:** The linear bus network uses shorter lengths of cable.

iii) **Future growth:** With a star topology, expanding a network is easily done by adding another switch.

iv) **Cable type:** The most common cable is unshielded twisted pair, which is most often used with bus, star topologies.

☞ Check Your Progress 3

1. The advantages of peer-to-peer over client-server based networks are:

i) No need for a network administrator

ii) Network is fast/inexpensive to setup & maintain

iii) Each PC can make backup copies of its data to other PCs for security.

By far the easiest type of network to build, peer-to-peer is perfect for both home and office use.

2. WAN access methods are as follows:

i) **Packet Switching: --**Packet switching is used to overcome from limitations of circuit switching, packet switching has emerged as the standard switching technology for computer-to-computer communications, and therefore, used by most of the communication protocols such as X.25, TCP/IP, Frame Relay, ATM, etc.

ii) **Lease Line:** A permanent telephone connection between two points set up by a telecommunications common carrier.

iii) **ISDN:** Integrated Services Digital Network (ISDN) was developed by ITU- Tin 1976. It is a set of protocols that combines digital telephony and data transport services.

iv) **DSL**: Digital subscriber line (DSL) is a family of technologies that provide Internet access by transmitting digital data over the wires of a local telephone network.