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DATA COMMUNICATION AND TYPES OF NETWORKS

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Abstract: -

The objective of this paper is to introduce students of Electronics and computer engineering, computer sciences to basic concepts, principles, and practice of data communication and network and student of engineering come to know how signals are generated and devices communicate with each other and also give the importance of networking.

This paper gives the basic principles, theories and practical of data communication and networking

The paper will be very useful for the readers of different categories as in undergraduate students of university, polytechnics, colleges of education and allied institutions in areas of computer Sciences and engineering, and other related disciplines and it will be very useful to all categories of readers

Keywords: Data communication, topologies, networks, data representation, advantages, disadvantages.

INTRODUCTION

This paper gives brief introduction about data communication, data representation, components of data Data coding and networking concepts, networking topologies and types of networking topologies with advantages and disadvantages .This paper gives you clarity of all topics with neat labelled diagrams. It is very useful for engineering and science students as it gives information about what is data, how devices interact with each other, and how devices are connected in network.

1. DATA COMMUNICATION CONCEPTS

Communication can be defined as the exchange of information between two or more bodies. In engineering, exchange of information is not only between people, information exchange also takes place between machines or

systems. Communication has increased significantly in importance in recent years. Voice services have seen unprecedented increase in use throughout the world with the introduction of mobile phones, with embedded data services such as SMS, and web browsing.

Data is referred to as a piece of information formatted in a special way. Data can exist in a variety of forms, such as numbers or text on pieces of paper, as bits and bytes stored in electronic memory, or as facts stored in a person's mind. In electronics terms data is a digital bit or digitized analog signal. Signals are physical quantity that changes with time. Signal can be a voltage that is proportional to the amplitude of message. It could also be a sequence of pulses in fiber optics cable or electromagnetic wave irradiated by an antenna.

When these signals are transfer between two or more points we say data is transmitted. Transmission of data from source to destination. Data transmission always uses the form of electromagnetic waves and they are classified into guided electromagnetic waves and unguided electromagnetic waves. Examples of guided waves are twisted pair, coaxial cable and optical fiber. Unguided waves means transmitting electromagnetic waves but they are not guided as example propagation through air, vacuum and seawater.

a) Analog Signal

The entire world is full of signals, both natural and artificial. Signals can be analog or digital. Figure 1 illustrates an analog signal. The term analog signal refers to signal that is continuous and takes continuous value. The common theme among all of these analog signals is their infinite possibilities.

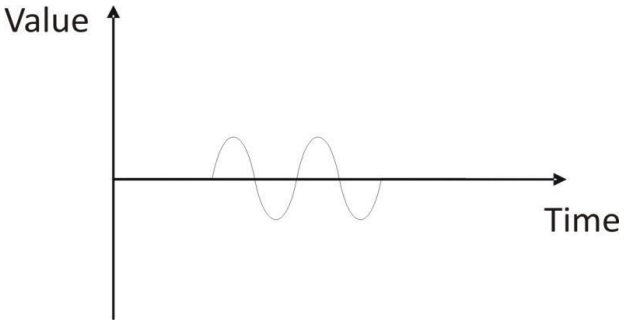

Figure 1: Typical Analog signal

Figure 1 shows a typical representation of analog signal. Because the signal varies with time, time is plotted on horizontal (x-axis), and voltage on the vertical (y-axis). While this signals may be limited to a range of maximum and minimum values. There are still an infinite number of possible values within that range.

b) Digital signal

A digital signal is a physical signal that is a representation of a sequence of discrete values. The signal must have a finite set of possible values, the number of set which can be anywhere between two and very large number that is not infinity. Digital signal is one of two voltage value (0V or 5V) timing graphs of these signals look like square waves as shown in figure 2.

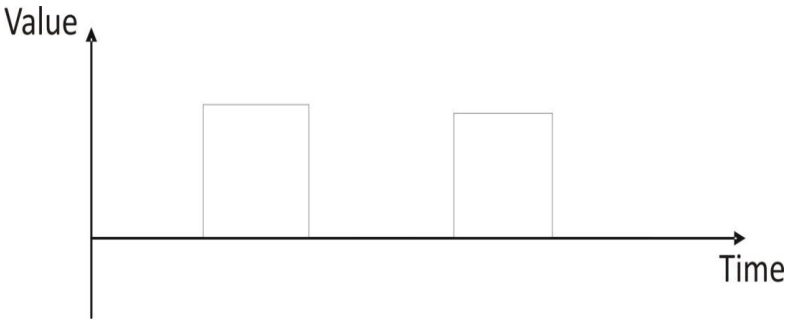

Figure 2: Typical Digital Signal

a) Why Data Communication?

Data communication refers to the movement of encoded information from one point to another by means of electronic transmission system. It can also be defined as the exchange of data between two devices via some form of transmission medium which can be wired or wireless. Another definition for data communications simply mean the transferring of digital information (usually in binary form) between two or more points (terminals). At both the source and destination, data are in digital form; however, during transmission, they can be in digital or analog form Information is carried by signal, which is a physical quantity that changes with time. The signal can be a voltage proportional to the amplitude of the voice like in simple telephone, a sequence of pulses of light in an optical fiber, or a radio-electric wave radiated by an antenna.

The fundamental purpose of data communication is to exchange information which is done by following certain rules and regulations called protocols and standards. Communications between devices are justified for the following reasons:

i. Reduces time and effort required to perform business task
ii. Captures business data at its source
iii. Centralizes control over business data
iv. Effect rapid dissemination of information
v. Reduces current and future cost of doing business
vi. Supports expansion of business capacity at reasonably incremental cost as the organization
vii. Supports organization's objective in centralizing computer system
viii. Supports improved management control of an organization.

b) Components of Data Communication

Basic Components of data communication are:

Source: It is the transmitter of data. Examples are: Terminal, Computer, Mainframe etc. Medium: The communications stream through which the data is being transmitted. Examples are: Cabling, Microwave, Fiber optics, Radio Frequencies (RF), Infrared Wireless etc

Receiver: The receiver of the data transmitted. Examples are: Printer, Terminal, Mainframe, and Computer.

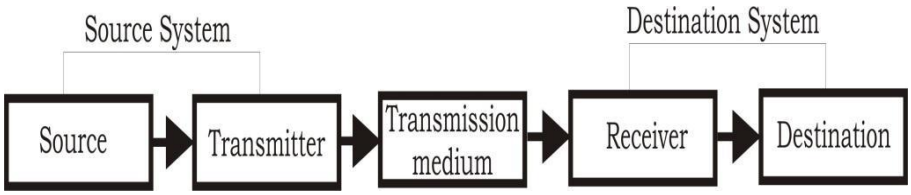

Figure 3: Basic Block Diagram of a Data Communication System

Figure 3 shows the basic block diagram of a typical data communication system. This can further be broken down to three; the source system, transmission system and destination system.

- **Source** The source generates the information or data that will be transmitted to the destination. Popular forms of information include text, numbers, pictures, audio, video or a combination of any of these. Information are put together in analog or digital form and broken into group or segment of data called packets. Each packet consists of the following:
  i. the actual data being sent
  ii. Header
  iii. Information about the type of data
  iv. Where the data came from
  v. where it is going, and
  vi. How it should be reassembled so the message is clear and in order when it arrives at the destination.
- **Transmitter** The transmitter a device used to convert the data as per the destination requirement. For example a modem, converts the analog (telephonic) signal to digital (computer) signals and alternatively digital to analog.

- **Transmission medium** the transmission medium is the physical path by which data travels from transmitter to receiver. Example of such channels is copper wires, optical fibers and wireless communication channels etc.
- **Receiver** This receives the signals from the transmission medium and converts it into a form that is suitable to the destination device. For example, a modem accepts analog signal from a transmission channel and transforms it into digital bit stream which is acceptable by computer system.
- **Destination** It is simply a device for which source device sends the data.

c) Data Communication Criteria

The effectiveness of data communications system depends on four fundamental characteristics

- **Delivery**. The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
- **Accuracy.** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
- **Timeliness.** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called real-time transmission and this occurs in a real-time system.
- **Jitter.** Jitter refers to the variation in the packet arrival time. It is the uneven delay of delivery of audio or video packets. For example, let us assume that video packets are sent every 20ms. If some of the packets arrive with 20ms delay and others with 30ms delay, an uneven quality in the video is the result.

d) Data Representation

Data representation is defined as the methods used to represent information in computers. Different types of data can be stored in the computer system. This includes numeric data, text, executable files, images, audio, video, etc. all these will look different to us as human. However, all types of information or data stored in the computer are represented as a sequence of 0s and 1s.

Decimal Numbers As human we are used to writing numbers using digits 0 to 9. This is called base 10. This number system has been widely adopted, in large part because we have 10 fingers. However, other number systems still persist in modern society.

Binary Numbers Any positive integer (whole number) can be represented by a sequence of 0s and 1s. Numbers in this form are said to be in base two, and are called binary numbers. Computers are based on the binary (base 2) number system because electrical wire can only be of two states (on or off).

Hexadecimal Numbers Writing numbers in binary is tedious since this representation uses between 3 to 4 times as many digits as the decimal representation. The hexadecimal (base 16) number system is often used as shorthand for binary. Base 16 is useful because 16 is a power of 2, and numbers have roughly as many digits as in the corresponding decimal representation. Another name for hexadecimal numbers is alpha decimal because the numbers are written from 0 to 9 and A to F. where A is 10, B is 11 up to F that is 15.

Text American Standard Code for Information Interchange (ASCII code) defines 128 different symbols. The symbols are all the characters found on a standard keyboard, plus a few extra. Unique numeric code (0 to 127) is assigned to each character. In ASCII, “A” is 65, “B” is 66, “a” is 97, “b” is 98, 22 and so forth. When a file is save as “plain text”, it is stored using ASCII. ASCII format uses 1 byte per character 1 byte gives only 256 (128 standard and 128 non-standard) possible characters. The code value for any character can be converter to base 2, so any written message made up of ASCII characters can be converted to a string of 0s and 1s.

Graphics: Graphics on computer screen are consists of pixels. The pixels are tiny dots of color that collectively paint a graphic image on a computer screen. It is physical point in a raster image, or the smallest addressable element in an all points addressable display device. Hence it is the smallest controllable element of a picture represented on the screen. The address of a pixel corresponds to its physical coordinates. LCD pixels are manufactured in two-dimensional grid, and are often represented using dots or squares, but CRT pixels correspond to their timing mechanism and sweep rates. The pixels are organized into many rows and columns on the screen.

2. COMPUTER NETWORKING CONCEPTS

a. What is Computer Network?

Computer network is interconnectivity of two or more computer system for purpose of sharing data. A computer network is a communication system much like a telephone system, any connected device can use the network to send and receive information. In essence a computer network consists of two or more computers connected to each other so that they can share resources. Networking arose from the need to share resources in a timely fashion.

Sharing expensive peripherals is often promoted as the primary reason to network. But this is not a sufficient reason. In considering the cost benefits of sharing, we find some impressive arguments against networking. With today more affordable technology, we can easily dedicate inexpensive peripherals and not bother with a network. Desktops and laptops are getting less expensive as their capacities increase. As a result the local hard disk is becoming common place and is frequently dedicated to a local desktop or laptop. Flash drives and external hard disks now has enough storage for uses.

b. Why computer networking?

These are serious considerations but only part of the picture. When viewed as a system, networking has some powerful arguments in its favor. In most cases organizations with multiple computer systems should network them for the following reasons:

- Sharing of peripherals can be justified as a "shared resource", with the result that speed and quality are improved and Mean Time between Failure (MTBF) is increased. Sharing in a properly designed network improves the reliability of the entire system. When a device fails, another one is ready to fill the void while repairs are being made.
- Better response time can be achieved through networking. The speed with which a request is answered is a crucial factor in computing. After all, most jobs performed by a computer can be done with pencil and paper. When you buy a computer, you are buying speed more than capability. Better response time through networking is in no way guarantee. In fact, inefficient use of the network will quickly result in unacceptably poor response. The elements needed for superior performance, however, are part of most networks. If properly implemented, a computer network will be more efficient that stand-alone computers or network terminals and will equal or surpass stand-alone computer performance.
- The peripherals attached to a network tend to be faster than those dedicated to stand-alone computers. The bandwidth of all the local area network far exceeds the speed capability of a stand-alone computer. For many applications the computer, not the network, is the bottleneck. But since a local area network is by definition a multiple processor system, the possibility exists for sharing the processing load across several microprocessors, which is similar to parallel processing. You may not be able to speed up the computer itself, but you can speed up the results.
- Often overlooked in an evaluation of networking is its organization benefit. Departments, companies, corporations, and institutions are all organizations, which imply interaction and team work. Without networking, the personal computer has been a powerful but isolated device. Its output has been difficult to integrate into the organization mainstream, so its value has been limited. In some instances the isolated personal computer has even created serious threats of data loss.

Protocol and Standards in Networking

In computer networks, communication occurs between entities in different systems. An entity is anything capable of sending or receiving information. However, two entities cannot simply send bit streams to each other and expect to be understood. For communication to occur, the entities must agree on a protocol.

A protocol is a set of rules that govern data communications. It defines what is communicated, how it is communicated, and when it is communicated. The key elements of a protocol are syntax, semantics, and timing.

Syntax. The term syntax refers to the structure or format of the data, meaning the order in which they are Presented. For example, a simple protocol might expect the first 8 bits of data to be the address of the sender, the second 8 bits to be the address of the receiver, and the rest of the stream to be the message itself.

Semantics. The word semantics refers to the meaning of each section of bits. How is a particular pattern to be interpreted, and what action is to be taken based on that interpretation? For example, does an address identify the route to be taken or the final destination of the message?

Timing. The term timing refers to two characteristics: when data should be sent and how fast they can be sent. For example, if a sender produces data at 100 Mbps but the receiver can process data at only 1 Mbps, the transmission will overload the receiver and some data will be lost.

- **Standards Organizations**

Standards are developed through the cooperation of standards creation committees, forums, and government regulatory agencies.

Standards Creation Committees

While many organizations are dedicated to the establishment of standards, data telecommunications in North America rely primarily on those published by the following:

International Organization for Standardization (ISO). The ISO is a multinational body whose membership is drawn mainly from the standards creation committees of various governments throughout the world. The ISO is active in developing cooperation in the realms of scientific, technological, and economic activity.

International Telecommunication Union-Telecommunication Standards Sector (ITU-T). By the early 1970s, a number of countries were defining national standards for telecommunications, but there was still little international compatibility. The United Nations responded by forming, as part of its International Telecommunication Union (ITU), a committee, the Consultative Committee for International Telegraphy and Telephony (CCITT). This committee was devoted to the research and establishment of standards for telecommunications in general and for phone and data systems in particular. On March 1, 1993, the name of this committee was changed to the International Telecommunication Union Telecommunication Standards Sector (ITU-T).

American National Standards Institute (ANSI). Despite its name, the American National Standards Institute is a completely private, non-profit corporation not affiliated with the U.S. federal government. However, all ANSI activities are undertaken with the welfare of the United States and its citizens occupying primary importance.

Institute of Electrical and Electronics Engineers (IEEE). The Institute of Electrical and Electronics Engineers is the largest professional engineering society in the world. International in scope, it aims to advance theory, creativity, and product quality in the fields of electrical engineering, electronics, and radio as well as in all related branches of engineering. As one of its goals, the IEEE oversees the development and adoption of international standards for computing and communications.

Electronic Industries Association (EIA). Aligned with ANSI, the Electronic Industries Association is a non-profit organization devoted to the promotion of electronics manufacturing concerns. Its activities include public awareness education and lobbying efforts in addition to standards development. In the field of information technology, the EIA has made significant contributions by defining physical connection interfaces and electronic signaling specifications for data communication.

a. Types of Network

There are several different types of computer networks. Computer networks can be characterized by their size as well as their purpose. The size of a network can be expressed by the geographic area they occupy and number of computers that are part of the network. Networks can cover anything from a handful of devices within a single room to millions of devices spread across the entire globe.

Personal Area Network

A personal area network (PAN) is the interconnection of information technology devices within the range of an individual person, typically within a range of 10 meters. For example, a person traveling with a laptop, a personal digital assistant (PDA), and a portable printer could interconnect them without having to plug anything in, using some form of wireless technology.

Typically, this kind of personal area network could also be interconnected without wires to the Internet or other networks. PANs can be used for communication among the personal devices themselves (intrapersonal communication), or for connecting to a higher level network and the Internet (an uplink).

However, it is possible to have multiple individuals using this same network within a residence. If this is the case we can refer to the network as Home Area network (HAN). In this type of setup, all the devices are connected together using both wired and/or wireless. All networked devices can be connected to a single modem as a gateway to the Internet. See figure 4.

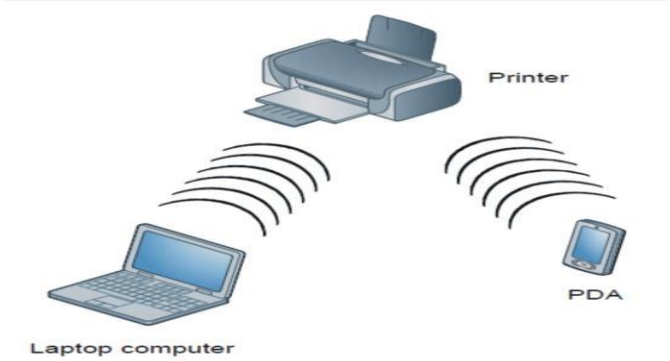

Figure 4: Personal Area Network

Local Area Network

A local area network (LAN) is usually privately owned and links the devices in a single office, building, or campus. Depending on the needs of an organization and type of technology used, a LAN can be as simple as two desktops and a printer in someone's home office; or it can extend throughout a company and include audio and video peripherals. Currently, LAN size is limited to a few kilometres. In addition to the size, LANs are distinguished from other types of networks by their transmission media and topology. In general, a given LAN will use only one type of transmission medium. LANs are designed to allow resources to be shared between personal computers or workstations. Early LANs had data rates in the 4 to 16 mega-bits-per-seconds (Mbps). Today, however, speeds are normally 100Mbps or 1000Mbps. Wireless LANs (WLAN) are the newest evolution .Early LANs had data rates in the 4 to 16 mega-bits-per-seconds (Mbps). Today, however, speeds are normally 100Mbps or 1000Mbps. Wireless LANs (WLAN) are the newest evolution in LAN technology. See figure 5.

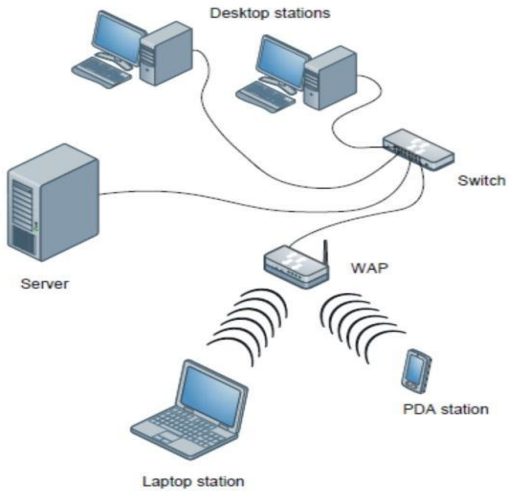

Figure 5: Local Area Network

Metropolitan Area Network

A metropolitan area network (MAN) is a network with a size between a LAN and a WAN. It normally covers the area inside a town or a city. It is designed for customers who need a high-speed connectivity, normally to the internet, and have endpoints spread over a city or part of city. A good example of a MAN is part of the telephone company network that can provide a high-speed DSL line to the customer. See in figure 6:

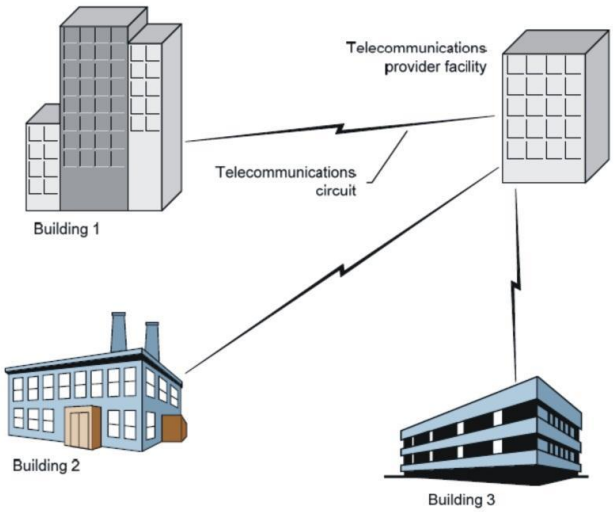

Figure 6: Metropolitan area Network

Wide Area Network

A wide area network (WAN) provides long-distance transmission of data, image, audio, and video information over large geographic areas that may comprise a country, a continent, or even the whole world. A WAN can be as complex as the backbones that connect the Internet or as simple as a dial-up line that connects a home computer to the internet.

We normally refer to the first one as a switched WAN and to the second as a point-to-point WAN.
The switched WAN connects the end systems, which usually comprise a router (internetworking connecting device) that connects to another LAN or WAN. The point-to-point WAN is normally a line leased from a telephone or cable TV provider that connects a home computer or a small LAN to an internet service provider (ISP). A good example of a switched WAN is X.25, the asynchronous transfer mode (ATM) network. See figure 7.

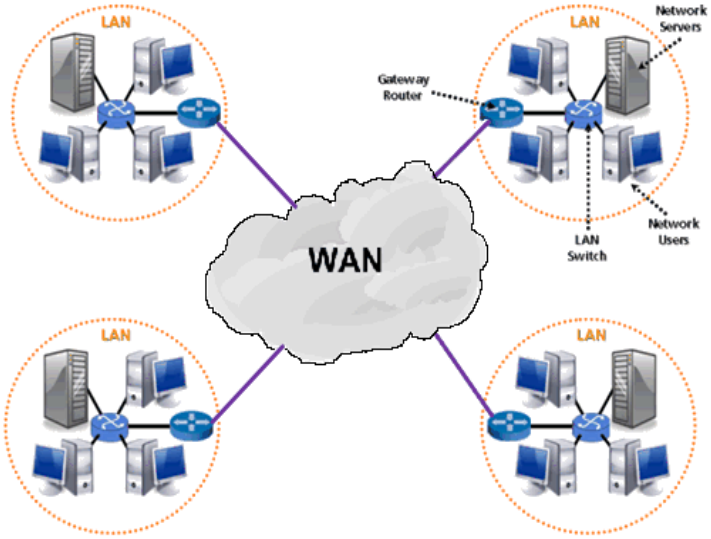

Figure 7: Wide Area Network

3. Network Topologies

The term topology in computer networking refers to the way in which a network is laid out physically. Two or more devices connect to a link; two or more links form a topology. The topology of a network is the geometric representation of the relationship of all links and linking devices (usually called nodes) to one another.

The cost and flexibility of a network installation are partly affected by as is system reliability. Many network topologies are commonly used, but they all have certain similarities. Information is carried either through space (wireless) or cable. The cable must control the movement of information on the network so that data can be transmitted in a reliable manner. There are four basic topologies possible: mesh, star, bus, and ring.

A. Bus Topology

The Bus topology consists of a single cable that runs to every work-station. See figure 10. The bus topology is also known as linear bus. In other words, all the nodes (computers and servers) are connected to the single cable (called bus), by the help of interface connectors. This central cable is the back bone of the network and every workstation communicates with the other device through this bus.

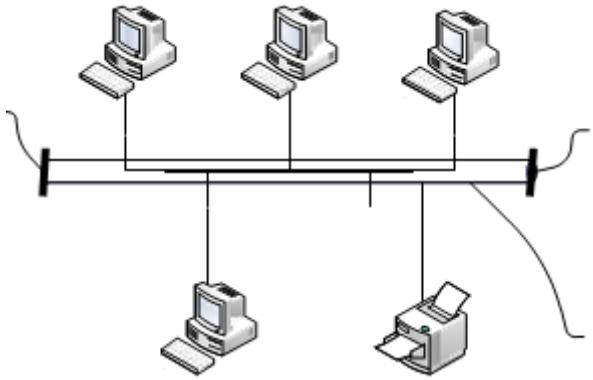

Figure 8: Bus Topology

Computers on a bus topology network communicate by addressing data to a particular computer and putting that data on the cable in the form of electronic signals. To understand how computers communicate on a bus you need to be familiar with three concepts:

Sending the signal: Network data in the form of electronic signals is sent to all of the computers on the network; however, the information is accepted only by the computer whose address matches the address encoded in the original signal. Only one computer at a time can send messages.

Because only one computer at a time can send data on a bus network, network performance is affected by the number of computers attached to the bus. The more computers on a bus, the more computers there will be waiting to put data on the bus, and the slower the network.

There is no standard measure for the impact of numbers of computers on any given network. The amount the network slows down is not solely related to the number of computers on the network. It depends on numerous factors including:

- Hardware capacities of computers on the network
- Number of times computers on the network transmit data
- Type of applications being run on the network
- Types of cable used on the network
- Distance between computers on the network

The bus is a passive topology. Computers on a bus only listen for data being sent on the network. They are not responsible for moving data from one computer to the next. If one computer fails, it does not affect the rest of the network. In active topology computers regenerate signals and move data along the network.

Signal Bounce: Because the data, or electronic signal, is sent to the entire network, it will travel from one end of the cable to the other. If the signal were allowed to continue uninterrupted, it would keep bouncing back and forth along the cable and prevent other computers from sending signals. Therefore, the signal must be stopped.

Advantages of Linear Bus Topology

1) It is easy to set-up and extend bus network.

2) Cable length required for this topology is the least compared to other networks.
3) Bus topology very cheap.
4) Linear Bus network is mostly used in small networks.

Disadvantages of Linear Bus Topology

1) There is a limit on central cable length and number of nodes that can be connected.
2) Dependency on central cable in this topology has its disadvantages. If the main cable (i.e. bus) encounters some problem, whole network breaks down.
3) Proper termination is required to dump signals. Use of terminators is must.
4) It is difficult to detect and troubleshoot fault at individual station.
5) Maintenance costs can get higher with time.
6) Efficiency of Bus network reduces, as the number of devices connected to it increases.
7) It is not suitable for networks with heavy traffic.
8) Security is very low because all the computers receive the sent signal from the source.

A. Ring Topology

The ring topology connects computers on a single circle of cable. There are no terminated ends. A ring topology connects one host to the next and the last host to the first. The signal travels around the loop in one direction and pass through each computer. Unlike the passive bus topology, each computer acts like a repeater to boost the signal and send it on to the next computer. Because the signal passes through each computer, the failure of one computer can impact the entire network.

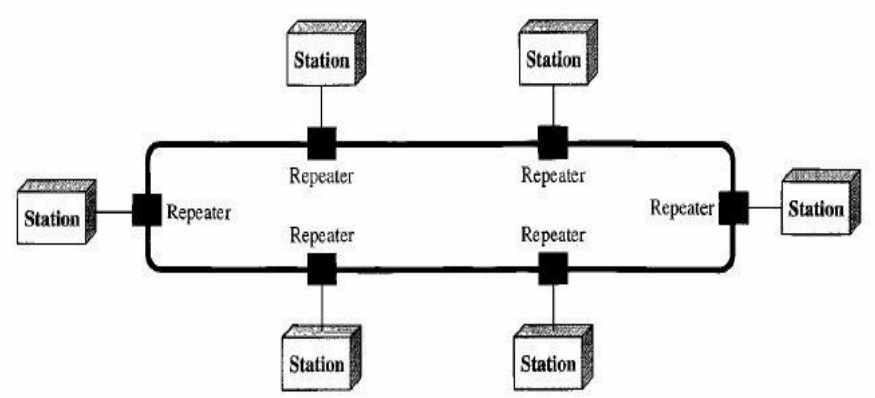

Figure 9: Ring Topology

One method of transmitting data around a ring is called token passing. The token is passed from computer to computer until it gets to a computer that has data to send. The sending computer modifies the token, puts an electronic address on the data, and sends it around the ring.

Advantages of Ring Topology

1) This type of network topology is very organized. Each node gets to send the data when it receives an empty token. This helps to reduces chances of collision. Also in ring topology all the traffic flows in only one direction at very high speed.
2) Even when the load on the network increases, its performance is better than that of Bus topology.
3) There is no need for network server to control the connectivity between workstations.
4) Additional components do not affect the performance of network.
5) Each computer has equal access to resources.

Disadvantages of Ring Topology

1) Each packet of data must pass through all the computers between source and destination. This makes it slower than Star topology.
2) If one workstation or port goes down, the entire network gets affected.
3) Network is highly dependent on the wire which connects different components.
4) MAU"s and network cards are expensive as compared to Ethernet cards and hubs.

B. Star Topology

In the star topology, computers are connected by cable segments to centralized component, called a hub or switch. Signals are transmitted from the sending computer through the hub or switch to all computers on the network. This topology originated in the early days of computing with computers connected to a centralized mainframe computer. It is now a common topology in microcomputer networking. Each device has a dedicated point-to-point link only to a central controller, usually called a hub. The devices are not directly linked to one another. Unlike a mesh topology, a star topology does not allow direct traffic between devices. The controller acts as an exchange: If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device

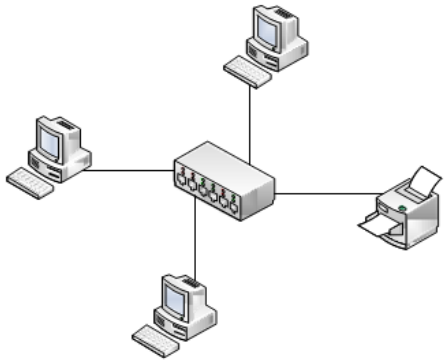

Figure 10: Star Topology

The star network offers centralized resources and management. However, because each computer is connected to a central point, this topology requires a great deal of cable in a large network installation. Also, if the central point fails, the entire network goes down.

Advantages of Star Topology

1) As compared to Bus topology it gives far much better performance, signals don't necessarily get transmitted to all the workstations. A sent signal reaches the intended destination after passing through no more than 3-4 devices and 2-3 links. Performance of the network is dependent on the capacity of central hub.
2) Easy to connect new nodes or devices. In star topology new nodes can be added easily without affecting rest of the network. Similarly components can also be removed easily.
3) Centralized management. It helps in monitoring the network.
4) Failure of one node or link doesn't affect the rest of network. At the same time it is easy to detect the failure and troubleshoot it.

Disadvantages of Star Topology

1) Too much dependency on central device has its own drawbacks. If it fails whole network goes down.
2) The use of hub, a router or a switch as central device increases the overall cost of the network.
3) Performance and as well number of nodes which can be added in such topology is depended on capacity of central device.

C. Mesh Topology

In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects. In a mesh topology, Node1 must be connected to n-1 nodes, node2 must be connected to (n – 1) nodes, and finally node n must be connected to (n – 1) nodes. We need n n n–(n - 1) physical links. In other words, we can say that in a mesh topology.

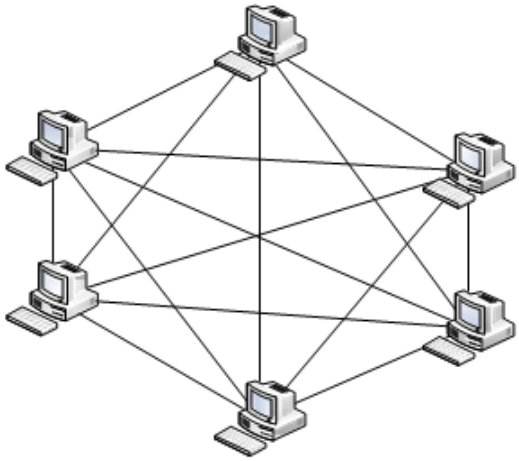

Figure 11: Mesh topology

To accommodate many links, every device on the network must have (n – 1) input/output (I/O) ports to be connected to the (n – 1) stations as shown in Figure above. For these reasons a mesh topology is usually implemented in a limited fashion, as a backbone connecting the main computers of a hybrid network that can include several other topologies. One practical example of a mesh topology is the connection of telephone regional offices in which each regional office needs to be connected to every other regional office.

Advantages of Mesh topology

1) Data can be transmitted from different devices simultaneously. This topology can withstand high traffic.
2) Even if one of the components fails there is always an alternative present. So data transfer doesn‟t get affected.
3) Expansion and modification in topology can be done without disrupting other nodes.

Disadvantages of Mesh topology

1) There are high chances of redundancy in many of the network connections.
2) Overall cost of this network is way too high as compared to other network topologies.
3) Set-up and maintenance of this topology is very difficult. Even administration of the network is tough.

4. Hybrid Topology

Before starting about Hybrid topology, we saw that a network topology is a connection of various links and nodes, communicating with each other for transfer of data. We also saw various advantages and disadvantages of Star, Bus, Ring, Mesh. Hybrid, as the name suggests, is mixture of two different things. Similarly in this type of topology we integrate two or more different topologies to form a resultant topology which has good points (as well as weaknesses) of all the constituent basic topologies rather than having characteristics of one specific topology. This combination of topologies is done according to the requirements of the organization.
For example, if there is an existing ring topology in one office department while a bus topology in another department, connecting these two will result in Hybrid topology. Remember connecting two similar topologies cannot be termed as Hybrid topology. Star-Ring and Star-Bus networks

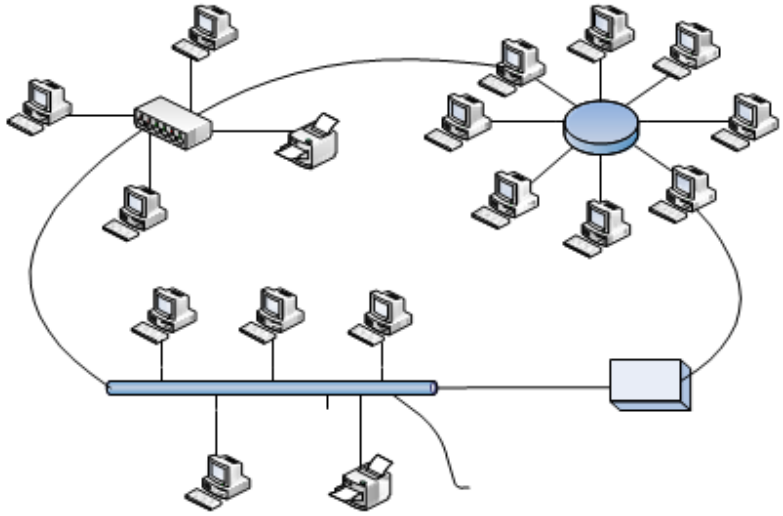

Figure 12: Hybrid Network

Advantages of Hybrid Network Topology

1*) Reliable*: Unlike other networks, fault detection and troubleshooting is easy in this type of topology. The part in which fault is detected can be isolated from the rest of network and required corrective measures can be taken, without affecting the functioning of rest of the network.
2*) Scalable*: It's easy to increase the size of network by adding new components, without disturbing existing architecture.
3*) Flexible*: Hybrid Network can be designed according to the requirements of the organization and by optimizing the available resources. Special care can be given to nodes where traffic is high as well as where chances of fault are high.
4*) Effective*: Hybrid topology is the combination of two or more topologies, so we can design it in such a way that strengths of constituent topologies are maximized while there weaknesses are neutralized. For example we saw Ring Topology has good data reliability (achieved by use of tokens) and Star topology has high tolerance capability (as each node is not directly connected to other but through central device), so these two can be used effectively in hybrid star-ring topology.

Disadvantages of Hybrid Topology

1*) Complexity of Design*: One of the biggest drawbacks of hybrid topology is its design. It is not easy to design this type of architecture and it is a tough job for designers. Configuration and installation process needs to be very efficient.
2*) Costly Hub*: The hubs used to connect two distinct networks, are very expensive. These hubs are different from usual hubs as they need to be intelligent enough to work with different architectures and should be function even if a part of network is down.
3*) Costly Infrastructure*: As hybrid architectures are usually larger in scale, they require a lot of cables; cooling systems, sophisticate network devices, etc.

Conclusion

The conclusion is that the students should be able to understand and explore the basic concepts of Data Communication and Networks and they will be in a position to understand the types of networking topologies and their advantages and disadvantages and are able to choose the type of network which they need to share the data and a student can easily understand the network security.

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