BACHELOR OF COMPUTER APPLICATIONS

SEMESTER 3

DCA2104

BASICS OF DATA COMMUNICATION

Unit 1

Introduction to Data Communication and Networking

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1. INTRODUCTION

This unit introduces the concept of data communication and networking. Data communication deals with the transmission of signals in a reliable and efficient manner. Networking deals with the technology and architecture of the communications networks used to interconnect communicating devices. The fields of computer science and data communication merged together in 1970 and 1980, which varied the technology, products and companies of the computer and communication industry. In this unit, we will define and discuss the data communication and networking for today's enterprise.

1.1 Objectives:

After studying this unit, you should be able to:

- *Describe data communication and networking for today's enterprise*
- *Explain communication model*
- *Classify network by its topology and range.*
- *Explain the Internet*

2. DATA COMMUNICATION AND NETWORKING FOR TODAY'S ENTERPRISE

In any enterprise or organization, efficient data communication and networking facilities are very essential. In this section, we will discuss the trends that challenge the business manager in planning and managing such facilities. Then we look specifically at the requirement for high transmission speeds and network capacity.

Trends

The three different factors which drive the architecture and evolution of data communication and networking facilities are i) The traffic growth

ii) Introduction of new services, and iii) Technology advancements.

Communication traffic has been growing at a high and steady rate due to distance (both local and long) and data types (voice and data). Growth in internet traffic has been increased six times over 2008–2014. This growth will continue due to the increasing emphasis on office automation, remote access, online transactions and other productivity measures. So, managers constantly struggle in maximizing the capacity and minimizing the transmission costs.

Due to different trends in technology, traffic capacity increases and support wide range of services. Four technology trends are widely known.

1. The trend to get faster and cheaper technical products, both in computing and in communications goes on. In case of computing, this means more powerful computers and clusters of computers are able to support more demanding applications. In terms of communication, the increasing use of optical fiber greatly increases the capacity and has brought transmission prices down. In a system with each channel carrying 2.5 Gbps (billion bits per second), up to 200 billion bits can be delivered within a second by the optical fiber. For local area networks, many enterprises now have gigabit Ethernet backbone networks.
2. Both voice-oriented telecommunications networks such as Public Switched Telephone Network (PSTN) and data networks including the Internet shows more intelligence. In that, two areas of intelligence are remarkable. First, today's networks can offer differing

levels of quality of service, which include specifications for maximum delay, minimum throughput and so on. Second, today's networks provide a variety of customizable services in the areas of network management security.

3. In both business and personal world, the internet, the web and associated applications have emerged as dominant features. The number of Internet users has risen from 35 million in 1995 to more than2.8 billion today. This creates many opportunities and challenges for managers.
4. Another trend is the trend towards increasing mobility. For the last 15 years in both, the business and the personal world mobile devices are primarily used to communicate and collaborate. Today's mobile devices are pocket capable super computers, and when they are combined with broadband networks and public cloud services, they turn out to be an extremely powerful business tools.

Data transmission and network capacity requirements

In this section, we discuss the need for high-speed Local Area Networks (LANs) in the business environment, because this need has appeared first and has forced the pace of networking development. Then we look at business Wide Area Network (WAN) requirements and finally the effect of changes in commercial electronics on network requirements.

The emergence of high-speed LANs

Personal computers and microcomputer workstations began to achieve widespread acceptance in business computing in the early 1980s and have now become an essential tool for office workers. Today's office LANs provide basic connectivity services that connects personal computers to main servers and midrange systems which provide workgroup connectivity at the departmental or divisional level. Primarily Fast Ethernet and Gigabit Ethernet, were the LANs well suited to this type of connection. Fast Ethernet providing data transfer rates as high as 100 megabits per second (Mbps) andGigabit Ethernet increasing transmission speed on a standard Ethernet network to 1000 Mbps, or ten times that of Fast Ethernet. In recent days, two significant trends changed the role of personal computer and therefore the requirements on the LAN. They are:

1. The speed and computing power of personal computers has increased. These more powerful platforms support graphics intensive applications and graphical user interfaces to the operating system.
2. Management Information Systems (MIS) organizations have recognized the LAN as an essential and capable computing platform, resulting in the focus on network computing. This trend began with client/server computing. Both of these approaches involve the frequent transfer of potentially large volumes of data in a transaction-oriented environment.

These trends result in the increase of data transmitted over LANs to adjust with the speed, and avoid data transfer delay in case of more interactive applications. To reduce the delay in data transfer, the earlier used LANs (100Mbps Ethernet and 16Mbps token Ring) are simply not acceptable to meet these requirements. The following are examples of requirements that demand higher speed LANs.

- Centralized server farms: In many server applications, client system should be able to draw huge amount of data from multiple centralized servers, called server farms. For example, servers typically contain tens of gigabytes of image data that must be downloaded to imaging workstations.
- Power workgroups: These groups include a small number of cooperating users who need to draw massive data files across the network. For example, a software development group runs tests on a new software version, in such cases, large amount of data are distributed to several workstations, processed and updated at very high speed for multiple iterations.
- High-speed local backbone: As processing demand grows, LANs multiply at a site and high-speed interconnection is necessary.

Corporate wide area networking needs:

Nowadays, centralized data processing model is used in many organizations. Important computing facilities might be available in few regional offices and these centralized facilities could handle most corporate applications.

Smaller outlying offices (e.g., a bank branch) could be equipped with terminals or basic personal computers linked to one of the regional centers in a transaction-oriented environment.

WANs typically are used by corporations or organizations to facilitate the exchange of data between their computers in dispersed offices. First client/server computing and now intranet computing have restructured the organizational data processing environment. Increased traffic load, application load, collaboration, distance, separation of data and applications and security requirements are all dynamics that are completely altering the design requirements for the WAN. So, the requirement of WAN in corporate is to reduce complexity, mitigate and defend security threats, improved user experience. Addressing these four requirements will increase the IT experience of branch office employees allowing them to be productive while reducing IT operational cost and complexity.

Digital electronics

Consumer electronics has been converted into digital technology and this created impact on both the Internet and corporate intranets. These digital electronic devices increase the amount of image and video traffic carried by networks. Two major examples of this trend are digital cameras and Digital Versatile Disks (DVDs). DVD has replaced the CD-ROM in personal computers and servers and replaced the videotape used in Video Cassette Recorders (VCRs). In DVD, huge volume of data can be loaded which is seven times as much as a CD ROM. Because of DVD's bright quality and huge storage capacity, computer games have become more realistic and educational software incorporates more video. A similar product development is the digital camcorder. This product has made it easier for individuals and companies to make digital video files to be placed on corporate and Internet web sites, that again adds to the traffic load.

Self-Assessment Questions - 1

1. Trends in technology enable the provision of increasing traffic capacity and the support of a wide range of services. State True or false
   a) True b) false
2. Choose the expansion of PSTN.
   a) Public switched telephone network
   b) Public service telephone network
   c) Private switched telephone network
   d) Private service telephone network
3. Primarily _____and_____ are the LANs well suited to connect personal computers to main servers.
4. _____Groups include a small number of cooperating users who need to draw massive data files across the network.

3. COMMUNICATION MODEL

The fundamental purpose of a communication system is the exchange of data between two parties. This section introduces a simple model of communication, illustrated by General block diagram in figure 1.1(a). Figure 1.1(b) shows the communication between a workstation and a server over a public telephone network, as an example.

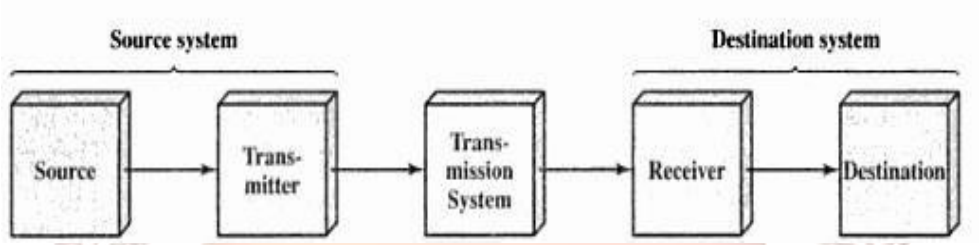


Figure 1.1 (a): General block diagram

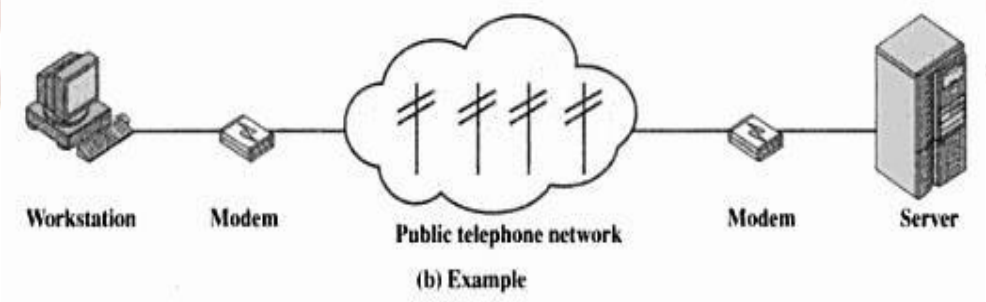


Figure 1.1 (b): Simplified Communications Model

The key elements of the model are as follows:

- **Source:** This device generates the data to be transmitted; examples are telephones and personal computers.
- **Transmitter:** The data generated by a source system are not transmitted directly in the form in which they were generated. A transmitter transforms and encodes the information to electromagnetic signals that can be transmitted across a transmission system. For example, in figure 1.1(b), a modem takes a digital bit stream from an attached device such as personal computer and transforms that bit stream into an analog signal that can be handled by the
  telephone network.

- **Transmission system:** This can be a single transmission line or a complex network connecting source and destination.
- **Receiver:** The receiver accepts the signal from the transmission system and converts it into a form that can be handled by the destination device. For example, a modem will accept an analog signal coming from a network or transmission line and convert it into a digital bit stream.
- **Destination:** It is the term used for devices that takes the incoming data from the receiver.

Table 1.1 shows some of the key tasks that must be performed in a data communication system.

Table 1.1: Communication tasks

Transmission system utilization	Addressing
Interfacing	Routing
Signal generation	Recovery
Synchronization	Message formatting
Exchange management	Security
Error detection and correction	Network management
Flow control	Data Management

Transmission system *utilization* refers to the need to make efficient use of transmission facilities that are typically shared among a number of communicating devices. A device must interface with the transmission system for data communication. Data is transmitted in the form of electromagnetic signals over a transmission medium. Thus, once the interface is established, signal generation is required for communication. This signal is capable of being propagated through transmission medium and interpretable as data at the receiver. Signals get generated based on

the requirements of transmission system and receiver and there should be some form of synchronization between transmitter and receiver. That is, the receiver must be able to determine when a signal begins to arrive and when it ends. It must also know the duration of each signal element.

Exchange management is another requirement for communication. This means, if data are to be exchanged in both directions over a period of time, the two parties (sender and receiver) must follow some common format and amount of data, time required etc. For example, in case of a telephone communication, one party must dial the number of the other, causing signals to be generated that result in the ringing of the called phone. Called party completes a connection by lifting the receiver.

In all communication system, there is a chance of error in data that is being communicated. Transmitted signals are distorted to some extent before reaching destination. In this situation, error detection and correction is required. For example, in case of a file transfer, it is not acceptable for the contents of the file to be accidently modified. In case of a fast sender and slow receiver, flow control is required to assure that source does not flood out the receiver by sending data faster than they can be processed or absorbed.

The terms addressing and routing are related but with distinct concepts. When more than two devices share a transmission facility, a source system must indicate the identity of the intended destination. For that, addressing is required. Further, the transmission system must assure that the destination system, and only that system receives the data. This is done with routing. Another concept is recovery which is distinct from error detection. Recovery techniques are required during a file transfer which is interrupted due to a fault somewhere in the system. During recovery, the aim is either to be able to resume activity at the point of interruption or at least to restore the state of the systems involved to the condition prior to the beginning of the exchange.

Message formatting is an agreement with sender and receiver on the form of the data to be exchanged or transmitted. Security is another important measure in a data communications system. That is, sender has to be assured that only the intended receiver actually receives the data and the receiver of the data wish to be assured that the received data have not been modified in transit and that the data actually comes from the proposed sender. Another task is network management. Data communication facility is a complex system that cannot create or run itself. Network management capabilities are needed to configure the system, monitor its status, react to failures and overloads and plan intelligently for future growth.

Self-Assessment Questions - 2

5. The fundamental purpose of a_____ is the exchange of data between two parties.
6. A_____ transforms and encodes the information to electromagnetic signals.
7. Message formatting is done with an agreement with sender and receiver on the form of the data to be exchanged or transmitted. State true or False.
   a) True b) False
8. _____ is done when the transmission system must assure that the destination system, and only that system receives the data.

4. DATA COMMUNICATIONS

A computer network is the infrastructure that allows two or more computers to communicate with each other. The network achieves this by providing a set of rules for communication called protocols which should be followed by all participating hosts. In this section, we will discuss the criteria for a data communication and classification of computer networks.

4.1 Criteria for a Data Communication Network

A data communication network should meet following five criteria:

- Performance
- Consistency
- Reliability
- Recovery
- Security

Performance is defined as the rate of transferring error free data. It is measured by response time, which is the time between the end of an inquiry and the beginning of its response. For example, time between a file transfer request and starting of the file transfer. Various factors can affect this response time. They are:

1. Number of users: Response time of the network may degrade when the number of users connected to the network increases.
2. Transmission speed: Speed of the data that will be transferred and is measured in bits per second (bps).
3. Transmission Media: The data transmission speed varies with the type of transmission medium. The bandwidth requirement and the type of transmission media can be decided depending on the size and the application of the network.
4. Hardware type: The different types of hardware can be used in a network. It affects both the speed and capacity of the system in a network.
5. Software program: Response time also depends on the software program such as Network operating system (NOS). It controls the operation of a networking device. It is used to process data at the sender, receiver and intermediate nodes in a network.

Consistency is the predictability of response time and accuracy of data. User prefers to have a consistent response time. For instance, in case of printing to a network printer, if the normal response time is 3 sec and suddenly there is a delay in response and it took 30 sec, then we can conclude that there is a problem in the system. Accuracy of data determines the dependability of the system. User will not prefer a system, if data loses frequently.

Reliability is the measure of how often a network is usable. The average time a component is expected to operate between failures is known as MTBF (Mean Time between Failures). Networking devices ensures that data reaches the appropriate destination. A network failure can happen due to hardware, network operating system or data carrying medium.

The network's ability to return to a prescribed level of operation after a network failure is known as recovery. Recovery is carried out using back up files.

Security is prevention of unauthorized access. Restricted access to computers, password protection, limiting user privileges and data encryption are common security methods. Antivirus software are used to prevent computer viruses and ensure security.

4.2 Classification of Computer Network

Computer networks can be categorized by range and network topology. By network topology, networks are classified as bus network, star network, ring network and tree network. Networks are classified by range as Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN).

4.3 Classification by Network Topologies

Topology describes how computers are connected in a network. Physical topology represents the configuration of cables, computers and other peripherals. Each topology has its own advantages and disadvantages and each topology is suitable for specific tasks. The selection of topology depends upon different factors such as type and number of equipment being used, reliability, scalability, cost, bandwidth capacity and required response times. There are mainly 4 types of physical topologies used for networking computers, which are given below.

1) Bus topology

In bus topology, all the nodes of the network are connected to a common transmission medium which has exactly two endpoints'. Transmission takes place over this common transmission medium and is received by all nodes in the network. It consists of a single main cable which connects each node as shown in figure 1.2.

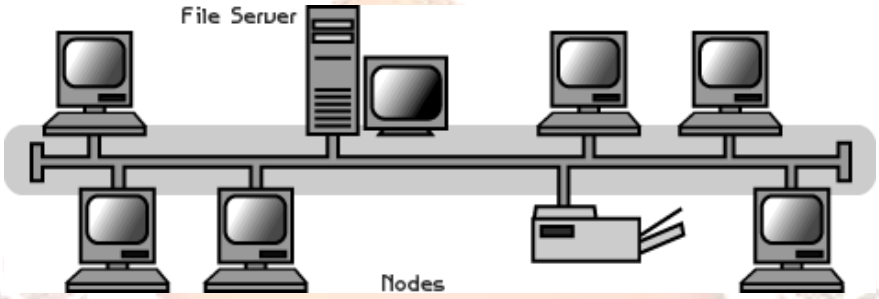


Figure 1.2: Bus topology

In case of bus topology, the network OS keeps track of unique electronic address for each node and manages the flow of information. Performance can degrade at times because a single cable is dedicated to all the information traffic. In this topology, nodes can be easily expandable as the network grows, so this topology is most commonly used. This topology is commonly used in client/server systems.

Advantages:

- Easy to connect a computer or peripheral to a linear bus
- When compared to a star topology, less cable length is required.

Disadvantages:

- Entire network shuts down if there is a break in the main cable
- At both ends of the backbone cable, terminators are required
- Cannot be used as a stand-alone solution in a large building.
- Difficult to identify the problem if the entire network shuts down.

2) Ring topology

In ring topology, each of the nodes of the network is connected to two other nodes in the network and the first and last nodes being connected to each other forming a ring. The nodes

are connected in a circle using cable segments, each node is physically connected only to two other nodes. Figure 1.3 shows ring topology.

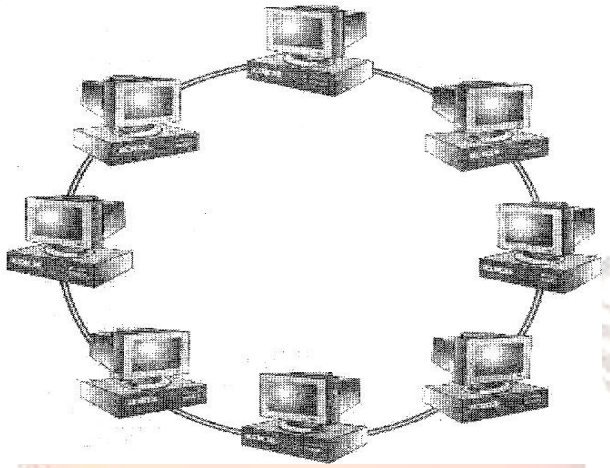


Figure 1.3: Ring topology

Data transmitted between nodes travels from one node to another in a circular manner and data generally flows in a single direction. This topology is seen in peer-to-peer networks.

Advantages:

- Very orderly network where each device has access to the token and the opportunity to transmit
- It performs better than a bus topology under heavy network load
- Does not require network server to manage the connectivity between computers

Disadvantages:

- In ring topology, one malfunctioning node/workstation can create problems for the entire network
- Movement or changes of devices can affect the network
- When compared to Ethernet network, ring networks are much slower under normal load

3) Star topology

In this type of topology all the computers are connected to a single hub or concentrator through a cable. This hub is the central node and all other nodes are connected to the central node. Data on a star network passes through the hub before continuing to its destination.

Star configuration is common with twisted pair cable, it can also be used with coaxial or fiber optic cable. Figure 1.4 shows a star topology.

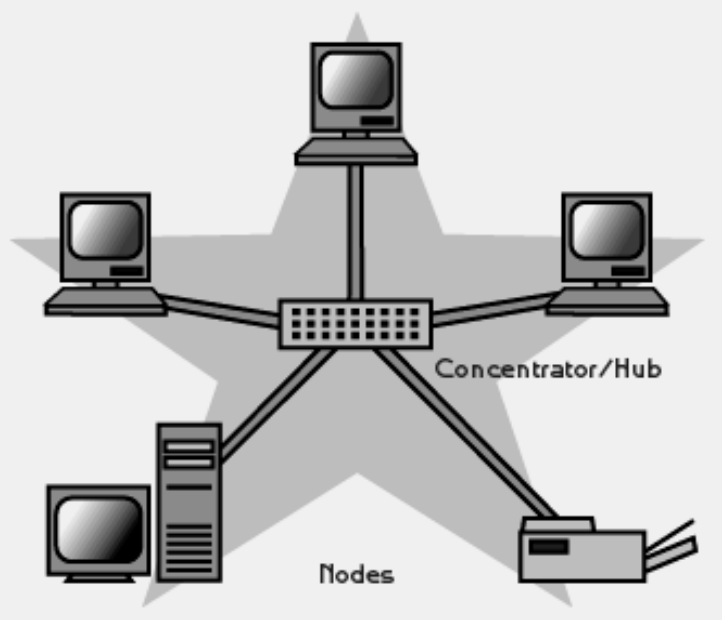


Figure 1.4: Star topology

Advantages:

- Easy to install
- While connecting or removing workstations it does not create any disruptions
- Error detection and correction is easy
- Star topology has the advantage of minimum data traffic along the cables

Disadvantages:

- It requires more cable length than a linear topology
- If there is a failure in the hub, the nodes attached are disabled
- Due to cost of hub, star topology is more expensive than a bus topology
- It needs an extremely powerful file server and additional cable.

4) Tree topology

A tree topology combines characteristics of linear bus and star topologies. It consists of groups of star-configured workstations connected to a linear bus backbone cable as shown in figure 1.5. It is easy to expand tree topologies.

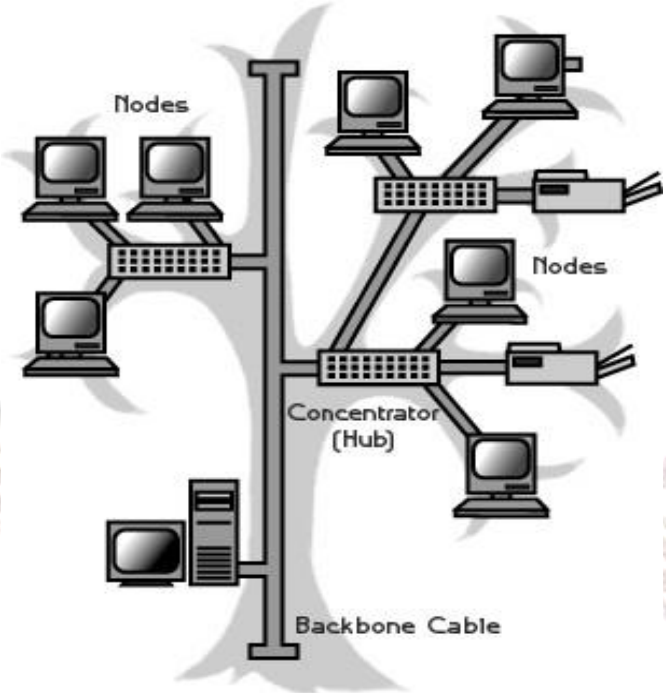


Figure 1.5: Tree topology

Advantages:

- Point-to-point wiring for individual segments
- Supported by several hardware and software venders

Disadvantages:

- The type of cabling used limits overall length of each segment
- The entire segment goes down, if the backbone line breaks
- More difficult to configure and wire than other topologies

4.4 Classification by Range

Computer networks can be classified on the basis of the area which they cover or in other words, on the basis of the range they have. Networks are classified by range as LAN (Local area network), MAN (Metropolitan area network) and WAN (Wide area networks).

1) LAN (Local Area Network)

A Local-Area Network (LAN) is a computer network for relatively small area. LANs are fit for transmitting data at very fast rates, but the distances are limited, it only connects devices which are located inside a building or buildings close together. In this case, computers share resources such as hard-drives, printers, data, CPU power, applications etc. LAN usually have distributed processing. Figure 1.6 shows a Local area network.

Figure 1.6: Local Area Network (LAN)

Components of a LAN are the components used by LANs. These are divided into cabling standards, hardware and protocols.

Examples of cabling standards are: cat 3, 4 and 5 cables, IBM type 19 cabling standards, EIA568A and 568B, Ethernet standards such as IEEE 802.3, IEEE802.3a, IEEE 802.3i, Unshielded Twisted Pair, shielded twisted pair, connectors such as RJ45, RJ11, Hermaphroditic connectors, RS232, DB25, BNC.

Examples of hardware devices are: Network Interface Cards NICs, Repeaters, Ethernet Hubs or multiport repeaters, Token Ring Multi-Station Access Units (MSAUs), Control Access Units (CAUs) and Lobe Access Modules (LAMs), Bridges, Level 3 Switches, Routers, Gateways, Print servers, File servers and Switches.

Examples of LAN protocols are: Ethernet frame types such as Ethernet_II, Ethernet_SNAP, Ethernet_802.2, Ethernet_802.3, Media Access Control layer (MAC layer), Token Ring: IBM

and IEEE 802.5, Logical Link Control Layer (LLC) IEEE 802.2, TCP/IP, SMB, NetBIOS and NetBeui, IPX/SPX,

Fiber Distributed Data Interchange (FDDI), Asynchronous Transfer Mode (ATM).

2) MAN (Metropolitan Area Network)

These are the networks which connects LANs together within a city. Figure 1.7 shows a metropolitan area network. In case of a metropolitan area network, the connection between LANs is through a local exchange carrier (local phone company/Internet service provider (ISP)).

Figure 1.7: Metropolitan Area Network

It normally covers the area inside a town or a city. It is designed for users who need a high-speed connectivity, and have endpoints spread over a city or part of city. One good example of a MAN is the part of the telephone company network that can provide a high-speed DSL line to the customer. Another example is the cable TV network that was designed for cable TV, but today high-speed data connection to the internet is also possible.

3) WAN (Wide Area Networks)

Wide area networks links LANs between cities, countries and continents. The main difference between metropolitan area network and WAN is that the WAN uses long distance carriers rather than local exchange carriers. In case of wide area network, there is a subnet consisting of several computers. These subnets are capable of storing incoming packets, taking a routing decision according to a previously designed algorithm and forwarding the packets to the next node in the path according to the decision taken. There are multiple path

options between the source and destination. The end users are connected to the wide area network via a router or a gateway that allows entry to the subnet. Figure 1.8 shows a WAN.

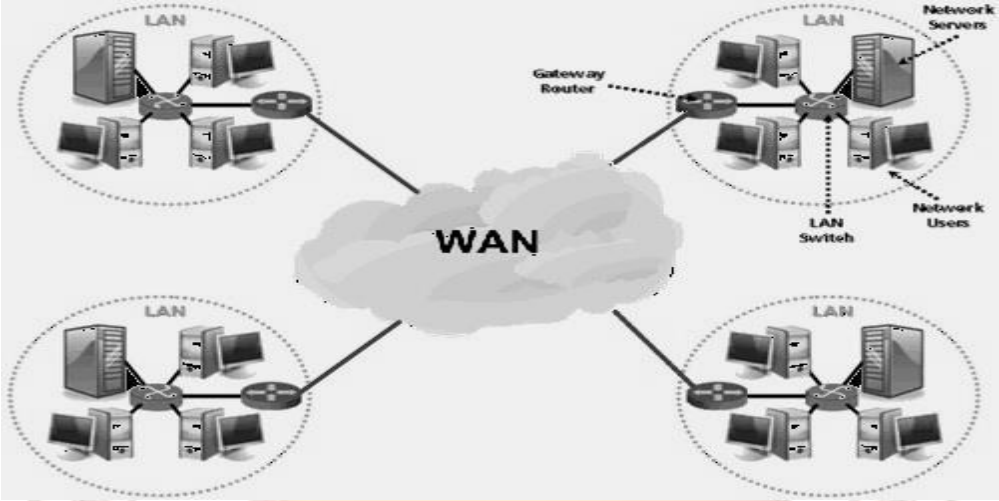


Figure 1.8: Wide area networks

A WAN usually consists of many LANs and MANs. It is basically a network of networks. So, it is rightly called an internetwork. The commercial internetwork that also supports the World Wide Web is the Internet.

Self-Assessment Questions - 3

9. Which among the following is/are the criterion/criteria that a data communication network should meet?
   a) Performance
   b) Consistency
   c) Reliability
   d) All of the above
10. The average time a component is expected to operate between failures is known as_____.
11. Based on_____ criteria networks are classified as bus network, star network, ring network and tree network.
12. Networks are classified by_____ as local area network (LAN),metropolitan area network (MAN) and wide area network (WAN).
13. In_____ topology, each node is connected directly to a central network hub or concentrator.
14. A_____ topology combines characteristics of linear bus and star topologies.
15. _____Networks links LANs between cities, countries and continents.

5. THE INTERNET

Internet has become an essential part in our daily lives. It has affected in our business and the way we spend our leisure time. Internet is a communication system that has brought a treasure of information to our fingertips and organized it for our use. Internet is a structured and organized system.

A brief history

Internet is network of networks. Private individuals as well as various organizations such as government agencies, schools, research facilities, corporations and libraries in every country in the world use the Internet. Internet has come into being in 1969. In the mid-1960s, mainframe computers in research organizations were stand-alone devices i.e., computers from different manufacturers were unable to communicate with each other. The Advanced Research Projects Agency (ARPA) in the Department of Defense (DoD) was interested in finding a way to connect computers so that the researchers they funded could share their finding, thereby reducing costs and eliminating duplication of work.

In 1967, at an Association for Computing Machinery (ACM) meeting, ARPA presented its ideas for ARPANET, a small network of connected computers. In ARPANET, each host computer would be attached to a specialized computer called an Interface Message Processor (IMP). The IMPs, in turn would be connected to each other. Each IMP had to be able to communicate with other IMPs and with its own attached host.

By 1969, ARPANET was a reality, four nodes at the University of California at Los Angeles (UCLA), the University of California at Santa Barbara (UCSB), Stanford Research Institute (SRI), and the University of Utah were connected via the IMPs to form a network. Software called the Network Control Protocol (NCP) provided communication between the hosts.

In 1972, Vint Cerf and Bob Kahn, both of whom were part of the core ARPANET group, collaborated on what they called the Internetting Project. Cerf and Kahn's publication in 1973 outlined the protocols to achieve end- to-end delivery of packets. This paper on Transmission Control Protocol (TCP) included concepts such as encapsulation, datagram and the functions of a gateway. After a small period, authorities made a decision to split TCP into two protocols. Transmission control protocol (TCP) and Internetworking protocol (IP). IP would handle datagram routing while TCP would be responsible for higher level functions

such as segmentation, reassembly and error detection. The internetworking protocol became known as TCP/IP. The International Organization for Standardization (ISO) created the Open Systems Interconnection (OSI) reference model as a framework for defining standards for connecting computers. Released in 1984, the model a first step towards standardizing the actual protocols that people used to communicate via computers.

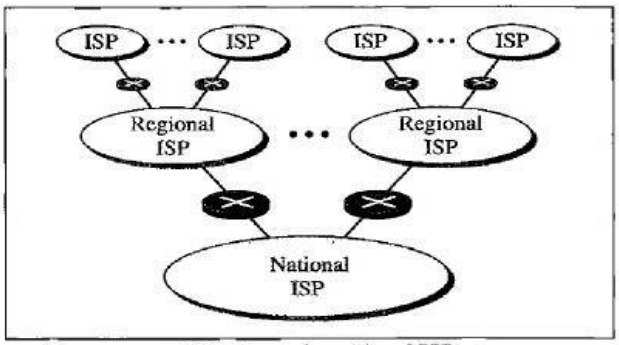
In 1990, Tim Berners-Lee and Robert Cailliau created first World Wide Web. They developed a shared format for hypertext documents which was named Hypertext Markup Language or HTML. They created uniform resource locator (URL) as a standard address format that specify the computer being targeted and the data being asked. URL and HTML increases the possibility of interaction between users and networks across the Internet.

The internet today

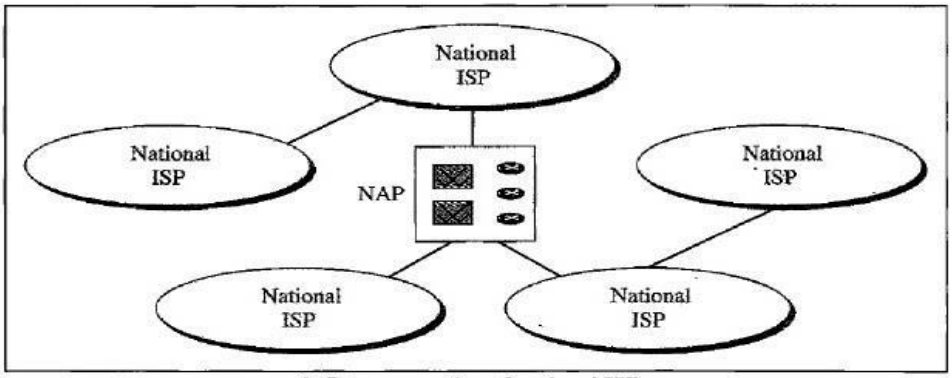
The internet today is not a simple hierarchical structure, it has come a long way since the 1960s. Internet is made up of many wide and local area networks joined by connecting devices and switching stations. Internet is continually changing as new networks are being added, existing networks are adding addresses and dead networks are being removed. Today, most users who want internet connection use the services of Internet Service Providers (ISPs). There are international service providers, national service providers, regional service providers and local service providers. The Internet today is run by private companies, not the government. Figure 1.9 shows a conceptual view of Internet.

In this figure, top of the hierarchy are the International Service Providers (ISP) that connect nations together. The national Internet service providers are backbone networks created and maintained by specialized companies. There are many national ISPs. For example, some of the most well-known national ISPs operating in India are: BSNL, MTNL, Bharti Airtel, HCL Infinet Ltd and Reliance Communication Infrastructure Ltd. To provide connectivity between end users, these backbone networks are connected by complex switching stations called network access points (NAPs). Some national ISP networks are also connected to one another by private switching stations called peering points or Internet Exchange Points (IXPs).

Regional internet service providers or regional ISPs are smaller ISPs that are connected to one or more national ISPs. They are at the third level of the hierarchy with a smaller data rate.



a. Structure of a national ISP



b. Interconnection of national ISPs

Figure 1.9: Hierarchical organization of the Internet

Local internet service providers provide direct service to the end users. The local ISPs can be connected to regional ISPs or directly to national ISPs. Most end users are connected to the local ISPs. A local ISP can be a company that provides internet services, a corporation with a network that supplies services to its own employees or a non-profit organization such as a college or university which runs its own network. Each of these local ISPs can be connected to a regional or national service provider.

Self-Assessment Questions - 4

16. A_____ is a group of connected communicating devices.
17. In ARPANET, each host computer would be attached to a specialized computer called_____.
18. TCP is split into two protocols, they are _____ and_____.

6. SUMMARY

Let us recapitulate the important concepts discussed in this unit:

- Data communication deals with the transmission of signals in a reliable and efficient manner.
- The three different factors which consistently driven the architecture and evolution of data communication and networking facilities are traffic growth, development of new services, and advances in technology.
- The fundamental purpose of a communication system is the exchange of data between two parties.
- A computer network is the infrastructure that allows two or more computers to communicate with each other.
- A data communication network should meet following five criteria, they are performance, consistency, reliability, recovery and security.
- Computer networks can be categorized by range and network topology.
- By network topology, networks are classified as bus network, star network, ring network and tree network.
- Networks are classified by range as local area network (LAN), metropolitan area network (MAN) and wide area network (WAN).
- In 1967, at an association for computing machinery (ACM) meeting, ARPA presented its ideas for ARPANET, a small network of connected computers.

7. TERMINAL QUESTIONS

1. Describe trends in data communication and networking technology.
2. Explain communication model.
3. List and explain criteria for a data communication network.
4. Describe the classification of networks based on topology.
5. Write short note on Internet.

8. ANSWERS

Self-Assessment Questions

1. (a) True
2. (a) Public Switched Telephone Network
3. Ethernet, tokenring
4. Power workgroups
5. Communication system
6. Transmitter
7. (a) true
8. Routing
9. (d) All of the above
10. Mean Time Between Failures (MTBF)
11. Network topology
12. Range
13. Star
14. Tree
15. Wide area network
16. Network
17. Interface message processor (IMP)
18. Transmission control protocol (TCP), Internetworking Protocol (IP)

Terminal Questions

1. The three different factors which consistently driven the architecture and evolution of data communication and networking facilities are traffic growth, development of new services, and advances in technology. Trends in technology enable the provision of increasing traffic capacity and the support of a wide range of services. (Refer section 2 for more details).
2. The fundamental purpose of a communication system is the exchange of data between two parties. The key elements of the model are source, transmitter, transmission system, receiver and destination. (Refer section 3 for more details).
3. A data communication network should meet five criteria such as performance, consistency, reliability, recovery, security. (Refer section 4.1 for more details).
4. By network topology, networks are classified as bus network, star network, ring network and tree network. Topology describes how computers are connected in a network. Physical topology represents the configuration of cables, computers and other peripherals. Logical topology is the method used to pass information between workstations. (Refer section 4.2 for more details).
5. Internet has become an essential part in our daily lives. It has affected in our business and the way we spend our leisure time. The internet is a communication system that has brought a treasure of information to our fingertips and organized it for our use. The internet is a structured, organized system. (Refer section 5 for more details)

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