

Unit 5: Computer Networks (07 Marks)

Topics:

- *Networks: Definition, Components (Nodes, Server, NIU), Need for Networking.*
- *Types of Networks: LAN, MAN, WAN- Basic concepts.*
- *Communication Channels:*
 - Physical Channel: Twisted Pair Cable, Co-axial Cable, Optical Fibre Cable (Diagram, description, application).*
 - Wireless Channel: Microwave, Radio wave, Satellite Links.*
- *Data Switching Techniques: Circuit Switching, Message Switching and Packet Switching.*
- *Data Communication Terminologies: Baud, Baud rate, Bit rate, Bandwidth, Data Transfer rate,*
 - Bit rate (KBPS, MBPS, GBPS, TBPS)*
- *Network Devices and their uses: Modem, Hub, Repeaters, Bridge, Router, Gateway, Switch.*
- *Network Topologies: Definition, Types of Topologies (Bus, Tree, Star, Ring).*
- *Client Server Model: Concept of Client, Server, Client Server Model, and Backbone Network.*
- *Protocols: Definition, File Transfer Protocol (FTP), Hyper Text Transfer Protocol (HTTP),*
 - Transmission Control Protocol/Internet Protocol (TCP/IP), Simple Mail Transfer Protocol (SMTP), Post Office Protocol (POP), Remote Login (Telnet).*
- *Application of Networks: Email, E-commerce, Chat Services, Video Conferencing, Usenet.*
- *Internet Related Terminologies: Internet, Requirements of Internet, Internetworking,*
 - Internet Service Providers, Internet Addressing, World Wide Web (WWW), Uniform Resource Locator (URL), Web Server, Webpage, Website, Web Browser, Hyper Text Mark-up Language (HTML), Dynamic Hyper Text Mark-up Language (DHTML), Extended Mark-up Language (XML), Search Engine, Downloading and Uploading files on/from the net, Hacking, Cracking, Cookies.*

Networks: Definition, Components (Nodes, Server, NIU), Need for Networking.

Computer Network

A computer network consists of two or more computing devices that are connected in order to share resources and information. Tanenbaum defines a network as “an interconnected collection of autonomous computers”. Interconnected means that the devices must be able to communicate with each other and autonomous means that no device on the network can start, stop or control another device.

Need for Networking

- 1) **Resource Sharing:** The aim is to make all programs, data and peripherals like printers, secondary storage devices etc available to any user on the network irrespective of the physical location of the resources and the user.
- 2) **Reliability:** If one of the devices Eg. workstations, printers stops functioning, the other similar devices on the network can be used. Similarly, multiple copies of important databases are stored on different storage devices so that if one device crashes, other copies can be used.
- 3) **Communication:** Networking allows devices to communicate with each other. This feature can be used to send messages, emails, share information, access remote databases to make transactions and obtain reports etc.

Advantages of Networking

- Share resources such as printers and scanners. This is cheaper than buying equipment for each computer.
- Share storage - Be able to access files from storage devices on the network.
- Access remote databases for doing transactions, obtaining reports Eg banking, railway and airline reservation
- Share programs - Software can be installed centrally rather than on each machine with the number of user licenses specified. This is cheaper than buying licenses for every machine.
- Improve communications - Messages, emails can be sent and received speedily.

Disadvantages of Networks

- Costs - Networked systems are more sophisticated and complex to set up and run. This can add to costs and you may need specialist staff to run the network.
- Maintenance - If networks are badly managed, services can become unusable and productivity falls
- Dependence on server - If software and files are held centrally, the system may become un-operational if the central server fails.
- Security - Protection of data from hackers, prevention of access to resources from unauthorized users, protection from viruses become important in networks.

Elementary Terminology of Networks

Node

A node is any physical device within a network that's able to send, receive, and/or forward information. The computer is the most the common node and is also called a workstation. Modems, switches, hubs, bridges, servers, and printers are also nodes. For example, a network connecting three computers and one printer, along with two other wireless devices, has six total nodes.

Nodes within a computer network must have some form of identification, like an IP address or MAC address, for it to be recognized by other network devices.

Network Server

A network server is a computer designed to act as central repository and helps in providing various resources like hardware access, disk space, printer access, etc to other computers in the network.

Network servers help in simplifying the different tasks related to sharing of resources and network management. Any configuration or security updates can be applied to a network server instead of individually passing to different computers connected to the network. A server has a unique name on the network which is used to identify the server on the network.

Non-dedicated server is a computer that can be used simultaneously as a workstation and as a server that provides sharing of its resources to other computers in the network. Such servers are slower and are generally used in smaller peer-to-peer networks.

Dedicated server is a computer reserved for providing services such as access to data, software and hardware resources to other workstations. It does not double up as workstation. Networks using such a server are known as Master-Slave networks, where the server is the Master and the workstations are Slaves. Dedicated servers may allow sharing of specific resources. For example, a file server will exclusively serve file-related requests like storing files, regulating the amount of space allowed for each user. A printer server will take care of printing requirements of a number of workstations.

Network Interface Card (NIC)

A Network Interface Card or Unit (NIC or NIU) is a computer hardware component that allows a computer to connect to a network. NICs may be used for both wired and wireless connections. Each NIC has a unique physical address assigned by the manufacturer known as the Media Access Control (MAC) address. The NIU is also called Terminal Access Point (TAP).

Types of Networks: LAN, MAN, WAN- Basic concepts

Networks vary in size, complexity and geographical spread. Mostly networks are classified based on geographical spread and on this basis there are four type of networks.

- 1) **Local Area Network (LAN)** - Small computer networks that are confined to a localized area (approx km radius) eg an office, a building or a factory are known as LANs. The key purpose of a LAN is to serve its users in resource sharing. Hardware as well as software resources are shared through LAN. For instance, LAN users can share data, information, programs, printers, hard disks, modems etc.

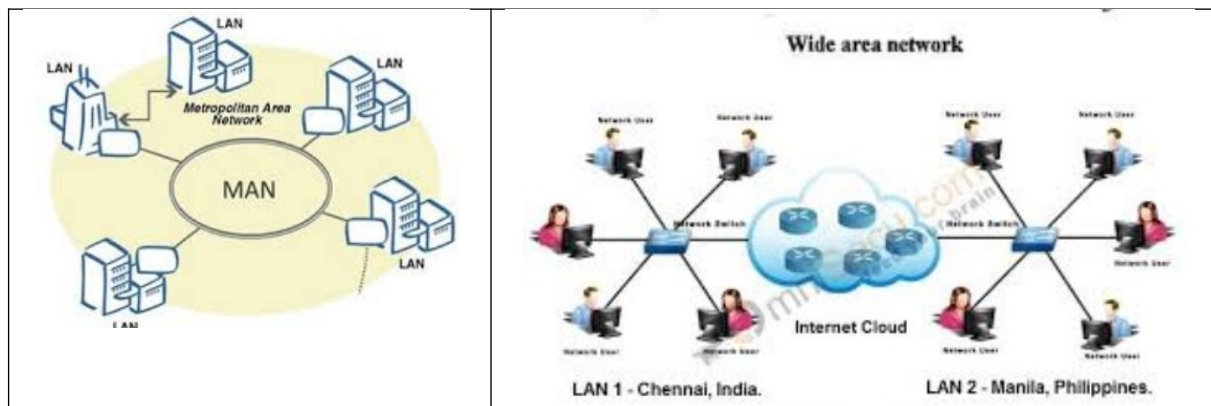
In a typical LAN configuration, one computer is designated as the file server. It stores all of the software that controls the network (that is, a networking operating system), as well as the application software needed by the workstations attached to the network. The workstations can be less powerful than the file server and they may have additional software on their local hard drives. On most LANs, cables are used to connect the Network Interface Cards in each node.



- 2) **Metropolitan Area Network (MAN)** are the networks spread over a city Eg cable TV networks. A MAN is the interconnection of networks in a city into a single larger network. The purpose of a MAN is also sharing of hardware and software resources among its users. MANs are extremely efficient and provide fast communication via high speed carriers such fibre optic cables.

There are three important features which discriminate MANs from LANs or WANs:

- The network size falls intermediate between LANs and WANs. A MAN typically covers an area of between 5 and 50 km diameter. Many MANs cover an area the size of a city.
- A MAN (like a WAN) is not generally owned by a single organisation. The MAN, its communications links and equipment are generally owned by either a consortium of users or by a single network provider who sells the service to the users.
- A MAN often acts as a high speed network to allow sharing of regional resources (similar to a large LAN). It is also frequently used to provide a shared connection to other networks using a link to a WAN.



- 3) **Wide Area Network (WAN)** are networks spread across vast geographical areas such as entire countries. Computers connected to a WAN are often connected through public networks such as the telephone system. Sometimes

they can be connected through leased lines or satellites. The largest WAN in existence is the Internet.

- 4) 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. A PAN can be used to transfer files between one's personal devices such as phones, tablets, PCs and printers.

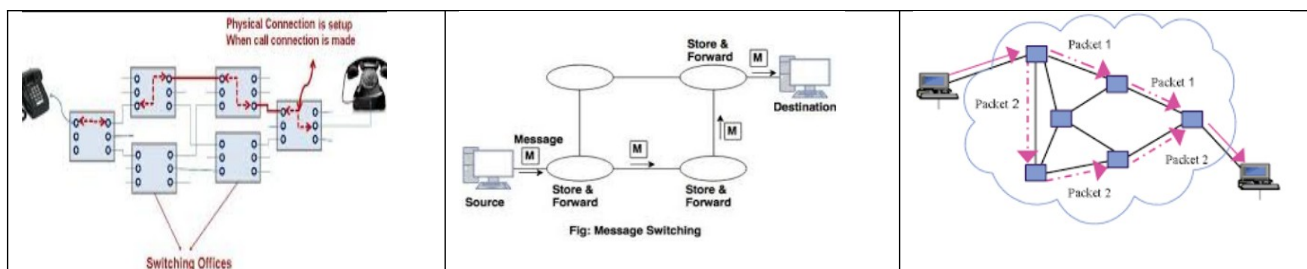
Difference between LAN and WAN

- In a LAN, The distance between the nodes is limited (approx between 1 meter to a few kms) whereas WAN are spread over 1000s of kms.
- WANs operate at speeds of less than 1 mbps (1 mega bits per second). Whereas, LANs operate between 1 and 10 mbps. Using optical fiber technology, it is possible to achieve speed of the order of 100s of mbps
- Because of short distances involved, error rates in LANs are much lower.
- LAN - the entire network is under the ownership and control of a single organization. WAN - the network is operated by a countries' telecom dept or private service providers rather than by its users.

Data Switching Techniques: Circuit Switching , Message Switching and Packet Switching

Circuit switching is a method of implementing a telecommunications network in which two network nodes establish a dedicated communications channel (circuit) through the network before the nodes can communicate. The circuit guarantees the full bandwidth of the channel and remains connected for the duration of the communication session. The circuit functions as if the nodes were physically connected as with an electrical circuit.

An example of a circuit-switched network is the early analog telephone network. When a call is made from one telephone to another, switches within the telephone exchanges create a continuous wire circuit between the two telephones, for as long as the call lasts.



Circuit switching	Message switching	Packet switching
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Message switching: In message switching, messages are routed in their entirety, one hop at a time. It was first built by Collins Radio Company, Newport Beach, California, during the period 1959-1963. Each message is treated as a separate entity. Each message contains addressing information, and at each switch this information is read and the transfer path to the next switch is decided. Each message is stored (usually on hard drive due to RAM limitations) before being transmitted to the next switch. Because of this it is also known as a 'store-and-forward' network. Email is a common application for message switching. A delay in delivering email is allowed, unlike real-time data transfer between two computers.

Packet switching is a method of dividing data to be transmitted over a digital network into *packets* which travel through the network independently and are reassembled at the destination to obtain the complete message. The packets are composed of a header and a payload. The payload is the message to be transmitted. Data in the header is used by networking hardware to direct the packet to its destination where the payload is extracted and used by application software. The header generally contains source and destination network addresses, error detection codes, and sequencing information for reassembling the packets at the destination.

Packet switching is the primary basis for data communications in computer networks worldwide. In packet switching, instead of being dedicated to one communication session at a time, network links are shared by packets from multiple competing communication sessions. This may result in poor quality of service but makes efficient use of the communication links.

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