Unit 5: Communication and Network Concepts

Network

The collection of interconnected computers is called a computer network.

Need for networking

- Resource sharing (Processing, Peripherals, Information and software)
- Communication medium
- Information discovery and retrieval
- Cost factor
- Reliability

Resource Sharing means to make all programs, data and peripherals available to anyone on the network irrespective of the physical location of the resources and the user. **Reliability** means to keep the copy of file on two or more different machines, so if one of them is unavailable (due to some hardware crash or any other) them its other copy can be used. **Cost factor** means it greatly reduces the cost since the resources can be shared **Communication Medium** means one can send messages and whatever the changes at one end are done can be immediately noticed at another

Evolution of Networking:

The **Advanced Research Projects Agency NETwork (ARPANET)** was an experimental project, which connected a few computers from some of the reputed universities of USA and Defense agencies.

Internet: A Network of computers that share a common communication protocol (Transfer Control Protocol / Internet Protocol – TCP/IP) that allows computers of different types to exchange information.

Interspace: The Interspace helps users cross-correlate information in multiple ways from multiple sources. The Interspace offers distributed services to transfer concepts across domains, just as ARPANET used distributed services to transfer objects across repositories.

Node: A computer attached to a network.

Server: A computer that facilitates sharing of data, software and hardware resources on the network.

Network Interface Unit (NIU): A device that helps to establish communication between the server and workstations.

Network switching techniques:

It provides communication between two computers. There are three types of network switching techniques.

1. Circuit switching: In the Circuit Switching technique a dedicated and complete physical connection is established between two nodes for communication.

2. Message switching: In the Message switching technique, no physical path is established between sender and receiver in advance. This technique follows the store and forward mechanism.

3. Packet Switching: In this switching technique fixed size of packet can be transmitted across the network.

Types of Networks:

1. LAN (Local Area Network): A Local Area Network (LAN) is a network that is confined to a relatively small area, It is generally limited to a geographic area such as writing lab, school or a building. It is generally privately owned networks over a distance not more than 5 Km.

- **2. MAN (Metropolitan Area Network)**: MAN is the networks cover a group of nearby corporate office or a city and might be either private or public.
- **3.** WAN (Wide Area Network): These are the networks Spread over large distances, say across countries or oven continents through cabling or satellite uplinks are called WAN.
- **4. PAN (Personal Area Network)**: A Personal Area Network is computer network organized around an individual person. It generally covers a range of less than 10 meters; Persona Area Networks can be constructed with cables or wirelessly.

Data Communication terminologies

Baud and bits per seconds (bps): Baud, also known as Baud rate, is a unit of signalling speed equal to the number of discrete signal elements transmitted per second. Baud is synonymous with bits per seconds (bps), if each signal element represents exactly 1 bit.

Data transfer rate: The amount of data transferred in one direction over a link divided by the time taken to transfer it. DTR is often measured in bits per second (bps)

Measurement Units: bit

1 Byte = 8 bits 1 Kbps (Kilo bytes Per Second) = 1024 Bytes 1 kbps (Kilo bits Per Second) = 1024 bits 1 Mbps (Mega bytes Per Second) =1024 Kbps 1 mbps (Mega bits Per Second)

Bandwidth: The amount of data that can be passed along a communications channel in a given period of time (1 Seconds). The units used for it are Hertz (Hz).

Transmission media

1. Twisted pair cable: It consists of two identical 1 mm thick copper wires insulated and twisted together. The twisted pair cables are twisted in order to reduce crosstalk and electromagnetic induction. **Advantages**:

- i. It is easy to install and maintain.
- ii. It is very inexpensive

Disadvantages:

- i. It is incapable to carry a signal over long distances without the use of repeaters.
- ii. Due to low bandwidth, these are unsuitable for broadband applications.

2. Co-axial Cables: It consists of a solid wire core surrounded by one or more full or braided wire shields each separated from the other by some kind of plastic insulator. It is mostly used in the cable wires. **Advantages:**

i. Data transmission rate is better than twisted pair cables.

ii. It provides a cheap means of transporting multi-channel television signals around metropolitan areas.

Disadvantages:

- i. Expensive than twisted pair cables.
- ii. Difficult to manage and reconfigure.

3. **Optical fiber**: Optical fiber consists of thin glass fibers that carry information in the form of visible light. **Advantages**:

- i. Transmit data over long distance with high security.
- ii. Data transmission speed is high
- iii. Provide better noise immunity
- iv. Bandwidth can be up to 10 Gbps.

Disadvantages:

- i. Expensive as compared to other guided media.
- ii. Need special care while installation.

4. Infrared: The infrared light transmits data through the air and can propagate throughout a room, but will not penetrate walls. It is a secure medium of signal transmission. The infrared transmission has become common in TV remotes, automotive garage doors, wireless speakers etc.

5. **Radio Wave**: Radio Wave an electromagnetic wave with a wavelength between 0.5 cm and 30,000 m. The transmission makes use of radio frequencies is termed as radio-wave transmission **Advantages**:

- i. Radio wave transmission offers mobility.
- ii. It is cheaper than laying cables and fibres.
- iii. It offers ease of communication over difficult terrain.

Disadvantages:

- i. Radio wave communication is insecure communication.
- ii. Radio wave propagation is susceptible to weather effects like rains, thunder storms etc.

5. **Microwave Wave**: The Microwave transmission is a line of sight transmission. Microwave signals travel at a higher frequency than radio waves and are popularly used for transmitting data over long distances. **Advantages**:

- i. Is cheaper than laying cable or fiber.
- ii. It has the ability to communicate over oceans.

Disadvantages:

- i. Microwave communication is an insecure communication.
- ii. Signals from antenna may split up and transmitted in different way to different antenna which leads to reduce to signal strength.
- iii. Microwave propagation is susceptible to weather effects like rains, thunder storms etc.
- iv. Bandwidth allocation is extremely limited in case of microwaves.

7. **Satellite link**: The satellite transmission is also a kind of line of sight transmission that is used to transmit signals throughout the world.

Advantages:

- i. Area covered is quite large.
- ii. No line of sight restrictions such as natural mountains, tall building, towers etc.
- iii. Earth station which receives the signals can be fixed position or relatively mobile.

Disadvantages:

- i. Very expensive as compared to other transmission mediums.
- ii. Installation is extremely complex.
- iii. Signals sent to the stations can be tampered by external interference.

Network Topology refers to the logical arrangement or layout of a network and a description of how various nodes (sender or receiver) are connected and communicate with each other.

Bus Topology: A network in which all the computer nodes and network system are connected to a single transmission channel.

Advantages:

- i. It is easy to connect a device and handle
- ii. Take less time to set up
- iii. It is best-suited for small networks.
- iv. Easy to expand.

Disadvantages:

- i. If the backbone cable fails, then the whole network will be down.
- ii. Not suitable for heavy traffic data transmission as it increases the chance of collision.



Star Topology: all the computers are connected to a single central node called a hub through a cable. All the transmission of data is through the hub.

Advantages:

- i. Failure of one node won't affect other nodes in a network.
- ii. Easy to troubleshoot.
- iii. Easy to add or remove the computer in a network.
- iv. Hub can be easily replaced.

Disadvantages:

- i. Performance of transmission depends on the hub.
- ii. Installation cost is high.
- iii. Failure of the hub will stop the transmission.

Tree topology: This topology has a root node and other two nodes are connected to the root node. There is only one connection between any two connected nodes. It has a parent-child hierarchy.

Advantages:

- i. Adding a computer to a node is easy.
- ii. Easier fault finding and maintenance.
- iii. Features of star and bus topology.

Disadvantages:

- i. Require huge cable.
- ii. Expensive to implement due to cable and hardware requirements.
- iii. If the root node fails then the whole network will fail and will stop its processing.

Network Devices

• **MODEM (Modulator Demodulator)**: It is a device used to convert the digital signals into analog signals and vice versa. It is mainly used to connect a telephone to a computer terminal.

• **RJ11 Connector**: RJ-11 is the standard connector utilized on 2-pair (4-wire) telephone wiring, and RJ stands for "Registered Jack" – physical connector interface most often used for telephone wire terminals.

• **RJ45 Connector**: RJ45 is a standard type of connector for network cables and networks. It is an 8-pin connector usually used with Ethernet cables.

• **Ethernet Card**: Network Interface Card, a card you insert into a computer that enables it to be connected to a network. NICs are designed for a particular type of network and/or protocol. (i.e. Ethernet, ATM, etc)

• **Hub**: It is an unintelligent network device that connects multiple nodes together. They can either be passive or active.

• **Switch**: A switch (switching hub) is a network device which is used to interconnect computers or devices on a network. It filters and forwards data packets across a network.

• **Repeater**: A repeater is a network device that amplifies and restores signals for long-distance transmission.

The main difference between hub and switch is that hub replicates what it receives on one port onto all the other ports while switch keeps a record of the MAC addresses of the devices attached to it.

• **Gateway**: A Gateway is a network device that connects dissimilar networks. It establishes an intelligent connection between a local networks and external networks with completely different structures.

• **Router**: The purpose of a router is to examine incoming packets, choose the best path, and regulate network traffic. Router can handle multiple protocol and works with IP addresses.

• **Bridge**: A bridge is a device designed to connect two LAN segments.





Network protocol

In networking, a protocol is a set of rules for formatting and processing data. Network protocols are like a common language for computers. The computers within a network may use vastly different software and hardware; however, the use of protocols enables them to communicate with each other regardless. A protocol is a formal description of message formats and the rules that two or more machines must follow to exchange those messages.

Hypertext Transfer Protocol (HTTP) is a communications protocol for the transfer of information on the intranet and the World Wide Web. HTTP is a request/response standard between a client and a server. Usually, the client is an end-user while the server is a website.

FTP (File Transfer Protocol) is a standard communication protocol used for the transfer of computer files from a server to a client on a computer network. The objectives of FTP are:

- i. To promote sharing of files (computer programs and/or data).
- ii. To encourage indirect or implicit use of remote computers.
- iii. To shield a user from variations in file storage systems among different hosts.
- iv. To transfer data reliably, and efficiently.

TCP/IP (Transmission Control Protocol / Internet Protocol)

TCP is responsible for verifying the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.

The **Internet Protocol (IP)** handles the address part of each packet so that it reaches to the right destination. It gives distinct address (called IP address) to each data packet.

Point-to-Point Protocol (PPP): It is used for direct communication between two computers/nodes. Example: using a serial interface mostly a personal computer connected by phone line to a server.

Simple Mail Transfer Protocol (SMTP): This is an internet standard communication protocol for electronic mail transmission. Mail servers and other message transfer agents (MTA) use SMTP to send and receive mail messages.

Extended Simple Mail Transfer Protocol (ESMTP): This is an extension to the SMTP protocol to allow additional features in emails such as multimedia support, multiple recipients and encryption.

Post Office Protocol 3 (POP3) is used for storing and retrieving messages from a remote mail server over a TCP/IP connection.

Telnet stands for **tel**etype **Net**work. It is a protocol that enables terminal communication between computers in a network.

Internet Relay Chat (IRC) is a text-based chat (instant messaging) protocol. It is based on client/server model.

Voice over Internet Protocol (VOIP) enables the transfer of voice using packet switched network rather than using public switched telephone network.

The basic hardware requirements are as follows:

- i. Computer
- ii. Internet
- iii. Speakers
- iv. Microphone
- Wireless/Mobile Computing is simply data communication without the use of landlines. Mobile computing means that the computing device is not continuously connected to the base or central network.
- **GSM (Global System for Mobile communication)**: It is leading digital cellular system. In covered areas, cell phone users can buy one phone that will work any where the standard is supported. It uses narrow-band TDMA, which allows eight simultaneous calls on the same-radio frequency.
- **CDMA (Code Division Multiple Access)**: It is a digital cellular technology that uses spread spectrum techniques. CDMA does not assign a specific frequency to each user. Instead, every channel uses the full available spectrum.
- WLL (Wireless in Local Loop) is a system that connects subscribers to the public switched telephone network using radio signals as a substitute for other connecting media.
- **SMS (Short Message Service)** is the transmission of short text messages to and from a mobile phone, fax machine and or IP address.
- **1G Mobile Systems**: The 1G Mobile System was introduced in late 1970s and early 1980s. The 1G mobile system was based on the analog cellular technology. They only had voice facility available.
- **2G Mobile Systems**: They used digital signals for transmissions of voice. 2G enabled the mobile systems to provide paging, SMS, voicemail and fax services.
- **3G Mobile Systems**: The 3G technology adds multimedia facilities to 2G phones by allowing video, audio, and graphics applications.
- **EDGE (Enhanced Data rates for Global Evolution)** is a radio based high speed mobile data standard.

Copyrights

Copyright is the term used for a written document. A legal action can be taken, if copyrights are violated. The following category of work can be considered for copyrights.

- ✓ literary works
- ✓ musical works, including any accompanying words
- ✓ dramatic works, including any accompanying music
- ✓ pantomimes and choreographic works
- ✓ pictorial, graphic and sculptural works
- ✓ motion pictures and other audio visual works
- ✓ sound recordings
- ✓ architectural works
- ✓ computer programs and websites

Hacking: Hacking is an unauthorized access to computer in order to exploit the resources.

A hacker accesses the computer without the intention of destroying data or maliciously harming the computer

Cracking : Cracking can be defined as a method by which a person who gains unauthorized access to a computer with the intention of causing damage

A cracker a person who gains unauthorized access to a computer with the intention of causing damage

Web Services:

WWW: The World Wide Web or W3 or simply the Web is a collection of linked documents or pages stored on millions of computers and distributed across the Internet.

HTML (Hyper Text Markup Language):- HTML is a computer language that describes the structure and behavior of a web page. This language is used to create web pages.

XML (eXtensible Markup Language):- Extensible Markup Language (XML) is a meta language that helps to describe the markup language.

HTTP (Hyper Text Transfer Protocol):- A protocol to transfer hypertext requests and information between servers and browsers.

Domain Names: A domain name is a unique name that identifies a particular website and represents the name of the server where the web pages reside.

URL:- The Uniform Resource Locator is a means to locate resources such as web pages on the Internet. URL is also a method to address the web pages on the Internet. There are two types of URL, namely, absolute URL and relative URL.

Website: A collection of related web pages stored on a web server is known as a website.

Web browser: A software application that enables to browse, search and collect information from the Web is known as Web browser.

Web Servers: The web pages on the Internet are stored on the computers that are connected to the Internet. These computers are known as web servers.

Web Hosting: - Web Hosting or website hosting is the service to host, store and maintain the websites on the World Wide Web.

Web Scripting: - The process of creating and embedding scripts in a web page is known as Web Scripting. Types of Scripts:-

ii) Client Side Scripts: - Client side scripts supports interaction within a webpage.
E.g. VB Script, Java Script, PHP (PHP Hypertext Preprocessor).

(iii) Server Side Scripts: - Server side scripting supports execution at server - end. E.g. ASP, JSP, PHP

Web 2.0: Web 2.0 refers to new generation of dynamic and interactive websites. Web 2.0 websites uses a new programming language called AJAX (Asynchronous JavaScript and XML).

Applications supported by web 2.0 are as followings:

- 🖌 blogging
- ✓ social bookmarking
- ✓ wikis and other collaborative applications
- interactive encyclopaedias and dictionaries
- ✓ Advanced Gaming

Where the following devices be placed:

- i MODEM:-
- = HUB / SWITCH:- In all the wings
- E BRIDGE:
- The **REPEATER**: It is used if the distances higher than 70 m. It regenerates data and voice signals.
- ROUTER: When one LAN will be connected to the other LAN.

4 Marks Questions (Communication and Network Concepts)

Enowledge Supplement Organisation has set up its new center at Mangalore for its office and web based activities. It has 4 blocks of buildings as shown in the diagram below: Center to center distances between various blocks.



Distances between various blocks

| Block A to Block B | 50 m |
|--------------------|-------|
| Block B to Block C | 150 m |
| Block C to Block D | 25 m |
| Block A to Block D | 170 m |
| Block B to Block D | 125 m |
| Block A to Block C | 90 m |

Number of Computers

| Block A | 25 |
|---------|-----|
| Block B | 50 |
| Block C | 120 |
| Block D | 10 |

- 1. Suggest a cable layout of connections between the blocks.
- 2. Suggest the most suitable place (i.e. block) to house the server of organisation with a suitable reason.
- Suggest the placement of the following devices with justification Repeater Hub/Switch
- 4. The organization is planning to link its front office situated in the city in a hilly region where cable connection is not feasible, suggest an economic way to connect it with reasonably high speed?