Assignment-1

Name: Shubham Chand Roll No.: 69 Section: C2

Ans-1 Network → A network is a collection of interconnected devices (Computers, Servers, routers, Switches, etc) that communicate with each other to share resources, exchange data, and enable communication. Networks can be wired (using) or wireless (using radio waves like Wi-fi)

Computer Network

A Computer network is a system that conn multiple devices to share information and reso such as files, internet access, and printer It can range from small network (like a wifi) to large-scale global network (like the

Importance of Computer Network

① Resource sharing:
- Enables sharing of files, software and ha reducing costs.

② Communication & Collaboration:
- Supports communication through email, vi and instant messaging across the globe.

③ Internet Access

2. Explain the OSI reference model with the functionality of each layer.

The Open Systems Interconnection (OSI) model is a conceptual framework that standardizes the functions of a telecommunication into seven distinct layers. Developed by the International Organization for Standardization (ISO).

→ Physical Layer (Layer 1)
- Transmits raw bits over a medium
- Defines hardware specifications
- Manages data encoding and signaling.

→ Data Link (Layer 2)
- Error detection and correction
- Frame synchronization
- MAC addressing

→ Network Layer (Layer 3)
- Logical addressing
- Routing and forwarding
- Packet Sequencing

→ Transport Layer (Layer 4)
- Segmentation and reassembly
- Connection establishment and termination
- Flow Control and error correction

→ Session Layer (Layer 5)
- Synchronization
- Dialog control

→ Presentation Layer (Layer 6)
- Data translation
- Data compression

→ Application Layer (Layer 7)
- Network Process to application
- Identifies communication partners.

3. Define functionality of circuit and packet switching with help of diagram.

Circuit Switching

→ A dedicated communication path is establishment between sender and receiver before data transmission.

→ Entire bandwidth is reserved for this, ensuring continous data flow.

→ Steps : Connection Establishment
Data Transmission
Connection Termination

→ Advantages : Guaranteed bandwidth and low latency, reliable.

→ Disadvantages: Inefficient if channel is not used continuously, Expensive.

Packet Switching

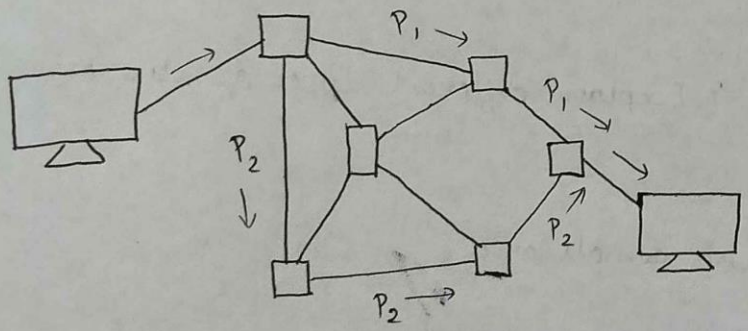
→ Data is broken into small packets, which travel independently through network.

→ Packets may take different routes and are reassembled at destination.

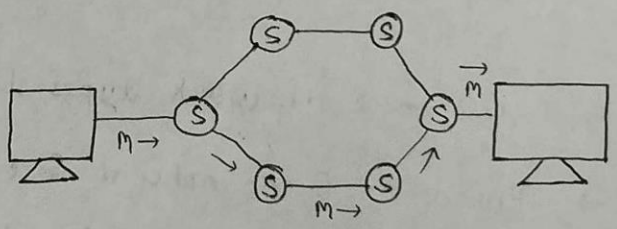
→ Steps : Packet Formation
Transmission
Reassembly

→ Advantages : Efficient utilization, more fault tolerant.

→ Disadvantages: Packets may arrive out of order, High processing time.



Packet Switching



Circuit Switching

4. Explain the involved various type of packet delay in computer networks.

Delays in packet switched networks impact overall network performance. The four major types of packet delays are:

1. Propagation Delay

Time taken for a signal to travel from sender to receiver.

Depends on - Distance and Transmission medium

Formula - $\text{Propagation Delay} = \frac{\text{Distance}}{\text{Propagation Speed}}$

2. Transmission Delay

Time required to push all bits of a packet into the transmission medium.

Depends on - Packet size and bandwidth.

Formula - $\text{Transmission Delay} = \frac{\text{Packet Size}}{\text{Bandwidth}}$

3. Queuing Delay

The waiting time of a packet in the queue before being transmitted.

Depends on - Network congestion and number of packets in queue.

4. Processing Delay

Time taken to process the packet header and determine next hop.

Depends on - Router speed and complexity of routing algorithms.

5. How are Network types classified ? Explain different types of networks.

→ Based on Geographical Size

A. Local Area Network (LAN) - Covers small area.

B. Metropolitan Area Network (MAN) - Covers a city.

C. Wide Area Network (WAN) - Covers a large geographic area.

→ Based on Transmission Type

A. Wired Networks - Uses physical cables and high speed.

B. Wireless Networks - Uses radio Waves, more flexible.

3. Based on Network Functionality

A. Client Server Network - Centralized architecture with dedicated server.

B. Peer to Peer Network - No centralized server, all devices share resources

4. Other Networks

A. PAN (Personal Area Network)

B. VPN (Virtual Private Network)

6. What is network topology ? Define different types of network topology.

Network topology is the physical or logical arrangement of devices and connections in a network.

Types :

1. Bus Topology - Single Central cable connects all devices, data travels in both directions.

2. Star Topology - Devices are connected to central hub / switch..

3. Ring Topology - Devices are connected in circular fashion, one direction.

4. Mesh Topology - Every device connects to every other device. Can be Full / Partial Mesh.

5. Tree Topology - Combination of Bus and Star Topology.

6. Hybrid Topology - Combination of two or more topology.

7. Describe the TCP / IP reference model. Define 5 different layers.

The TCP / IP model is a layered framework for networking protocols used in internet.

Layers of TCP / IP Model :

1. Physical Layer – Transmits raw bits over physical media.
2. Data Link Layer - Manages frame transmission between adj nodes.
3. Network Layer - Handles logical addressing
4. Transport Layer - Provides end to end communication, TCP/UDP.
5. Application Layer - Provides user services like email, web browsing.

8. Explain communication between source to destination using TCP/IP protocol stack.

The TCP/IP model ensures reliable communication between source and destination using five layers:

→ Application Layer
→ Transport Layer
→ Network Layer
→ Data Link Layer
→ Physical Layer

Communication Process:

1. Data is sent from application layer of sender
2. It passes through each layer, where headers are added.
3. The physical layer transmits the data in bits
4. The receiver's physical layer receives the bits and reconstructs frames.
5. Each layer processes its respective headers until the data reaches the application layer.

9. Explain different Network connecting devices.

→ Hub - A basic networking device that sends data to all devices in network. Operates at physical layer and no filtering.
→ Switch - Operates at Data Link Layer, more efficient than hub.
→ Router - Operates at Network Layer, Sends packets b/w diff. networks.
→ Gateway - A protocol converter that connects different types of networks.
→ Bridge - Operates at Data Link Layer, Connects two or more network segments.

10. Define the Communication medium. Explain types.

A communication medium is the physical path used to transmit data between devices in a network. It can be wired or wireless.

Types;

A) Wired Communication Mediums

→ Twisted Pair Cable - Two insulated copper wires twisted together.

→ Coaxial Cable - Has central conductor, insulating layer, metal shield and cover.

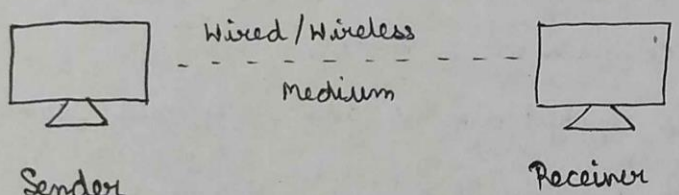
→ Fiber Optic Cable - Uses light signals for transmission.

B) Wireless Communication Mediums

→ Radio waves - Used in Wifi, Radio.

→ Microwaves

→ Infrared



13. What is the difference between a port address, a logical address and physical address?

→ Port address:

Unique identifier for specific process on a device. Helps to distinguish multiple processes.

Example - HTTP (Port 80), Port 443 (HTTPS)

Layer - Transport Layer

→ Logical Address:

The IP address assigned to a device used for identifying the source and destination across networks.

Example - 192.168.1.1 (IPv4)

Layer - Network Layer

→ Physical Address:

MAC address of network device, unique for every hardware

Example - 00:1A:2B:3C:4D:5E

Layer - Data Link Layer

14. Give 2 reasons to use layered protocols? Write advantage & disadvantages of combined session, presentation and application layer.

Reasons: → Modularity & Simplification - Each layer has some function, makes dev. and troubleshoot easy.

→ Interoperability - Different systems and devices can communicate using layers.

Advantages: → Simplifies Protocol Stack

→ Improves Performance

→ Better Integration

Disadvantages: → Less Flexibility

→ Reduced Modularity

→ Security Concerns

16. Suppose a computer sends a frame ..... situation?

→ In bus topology, all devices same communication medium.

→ If the physical destination address is corrupted, no device recognizes frame as intended.

→ Since, no acknowledgement is required in Data Link Layer, frame is discarded.

→ Sender isn't automatically informed because there's no in built error reporting.

How Sender can be notified?

→ Timeout Mechanism - If sender doesn't receive response ⇒ data loss.

→ ICMP Error Messages - If at IP error detected, ICMP can notify sender.

→ Upper Layer Protocols (TCP) - TCP uses ACKs, no ACK means data loss.

17. How long does it take a packet ..... transmision Rate?

Given,

Packet Length $L = 1000\ b = 8000$ bits

Distance $d = 2500\ Km = 2500000\ m$

Propagation speed $s = 2.5 \times 10^8\ m/s$

Transmission rate $R = 2\ Mbps$

$$\text{Propogation Delay} = \frac{d}{s} = \frac{2500000}{2.5 \times 10^8} = 10\ ms$$

Does this delay depend on packet length? No, it depends on distance & prop. speed.

Does this delay depend on transmission rate? No, it is independent of transmission rate

18. What is TDM and FDM technique also differentiate.

→ TDM (Time Division Multiplexing):

Divides the time slots and assigns each user a time slot to transmit data.

Eg- GSM, PCM networks.

→ Frequency Division Multiplexing (FDM):

Assigns diff. freq. bands to diff. users allowing them to transmit simultaneously.

Eg- AM/FM, cable TV.

Feature	TDM	FDM
Resource Allocation	Divides Time	Divides Frequency
Interference	No interference	Possible
Efficiency	Efficient in digital comm.	Good for analog signal
Example	GSM, Digital TV	FM Radio, Cable TV

19. Calculate the total time ..... and so on.

Given,

File Size = 1.5 MB = 1.5×10^6 b

Round Trip Time (RTT) = 80 ms = 0.08 sec

Packet Size = 1 KB = 1000 b

Initial Handshake Delay = 2 × RTT = 160 ms = 0.16 s

Bandwidth = 10 Mbps = 10^6 b/s

a) 1. Total packets required = $\frac{1.5 \times 10^6}{1000}$ = 1500 packets

b) 2. Total Transmission Time => Total Bits = $1.5 \times 10^6 \times 8 = 12 \times 10^6$ b

Time = $\frac{12 \times 10^6}{10 \times 10^6}$ = 1.2 s

3. Total Time = $1.2 + 0.16 = 1.36$ s

b) 1. Transmission Time Per Packet = $\frac{1000 \times 8}{10^7} = 0.0008$ s

2. Total Time Per Packet = $0.08 + 0.0008 = 0.0808$ s

3. Total Time for 1500 Packets = $1500 \times 0.0808 + 0.16 = 121.36$ s

c) 1. No. of RTTs required = $\frac{1500}{20} = 75$ RTTs

2. Total Time = $75 \times 0.08 + 0.16 = 6.16$ s

d) Packets sent in Nth RTT = 2^{N-1}

Sum of Packets Sent in N RTTs = $\sum_{K=0}^{N-1} 2^K = 2^N - 1$

Solve for N => $2^N - 1 = 1500$

$2^N = 1501 \Rightarrow N = 10.55$

Total Time = $11 \times 0.08 + 0.16 = 1.04$ s

21. Discuss the history of computer networking and the Internet.

→ Early Networking Concepts (1950s-1960s)

Mainframe computers allowed multiple users to ocess a single system via terminals.

Paul Baran and Donald Davies introduced concept of packet switching.

→ Birth of the ARPANET (1969)

ARPA funded development of ARPANET to connect research institutes.

First successful ARPANET was between UCLA and Standford Research Institute.

→ Growth of Networking (1970s)

Ray Tomlinson invented first email system.

Vinton Cerf and Robert Kahn developed TCP/IP.

→ Expansion and Birth of Internet (1980s).

Domain Name System was introduced to replace IP addresses.

NSFNET expanded networking.

→ The Rise of World Wide Web (1990s)

Tim Berners Lee invented World Wide Web.

The internet became commercialized, leading to its rise.

→ The Modern Internet (2000s - Present)

Broadband and wireless networking improvement

. Cloud Computing and IOT

Introduction of 5G networks.

22. Header and Tailor information. ..... Why ?

When data is transferred across network, each layer of OSI model adds some info to ensure proper transmission, addressing, error detection and delivery.

→ Application Layer

Adds protocol specific information to format and interpret data correctly.

→ Transport Layer

Inserts port numbers, sequence numbers, and error checking details for lost delivery.

→ Network Layer

Appends IP header with source/destination IP addresses and routing information to ensure proper delivery across networks.

→ Data Link Layer

Includes MAC address and error detection code to frame data for local network.

→ Physical Layer

Converts the data to signals for transmission over the medium without adding extra header or trailer.

Header - Added at each layer to provide information.

Trailer - Added at Data Link Layer for error detection.

23. Explain in detail ..... Specific address.

i) Physical address (MAC address)

→ 48 or 64 bit address

→ Hexadecimal number system

→ : or - separated

→ Range : 00:00:00:00:00:00 to FF:FF:FF:FF:FF:FF

ii) Logical Address (IP address)

1. IPv4 address - 32 bit address
   Decimal Number System
   . separated
   Range - 0.0.0.0 to 255.255.255.255

2. IPv6 address - 128 bit address
   Hexadecimal Number System
   : separated
   Range - 0000:0000:0000:0000:0000:0000:0000:0000 to
   FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF:FFFF

iii) Port address (16 bit address)

→ Decimal Number System

→ Plain Numeric value

→ Range - 0 - 65535

iv) Specific Address

→ Text based identifier

→ Alphanumeric

→ Uses @ , . for email and domains

→ Range - Depends on domain and email service providers.