

What is Communication?

 Exchanging of information by speaking, writing or using some other medium

Characteristics of Communication System

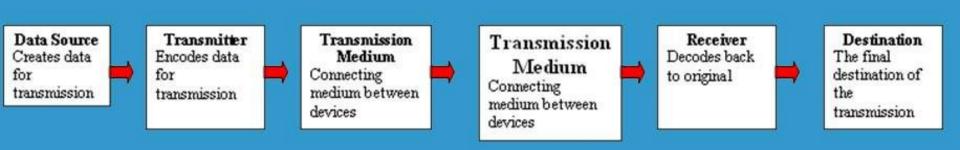
- There must be a sender and a receiver
- A protocol is a set of rules which governs the transfer of data between computers
- Protocols allow communication between computers and networks
- Handshaking is used to establish which protocols to use
- Handshaking controls the flow of data between computers
- Protocols determine the speed of transmission, error checking method, size of bytes and whether the transmission will be synchronous or asynchronous



Five Basic Components

Every communication system has 5 basic requirements:

- Data Source (where the data originates)
- Transmitter (device used to transmit data)
- Transmission Medium (cables or non-cable)
- Receiver (device used to receive data)
- Destination (where the data will be placed)



Pictorial Representation

1. Data Source

Produces the data to be transmitted. This busy person is the data source as she talks to the person on the other end.

5. Destination

Is the receiver of the information. This person is the receiver



2. Transmitter
Encodes the data to be
transmitted. In this example
the transmitter is the phone

3. Transmission Medium

Telephone cable is medium

4. Receiver:

Will decode the transmission back to the original data The phone is once again the receiver.



OSI Model

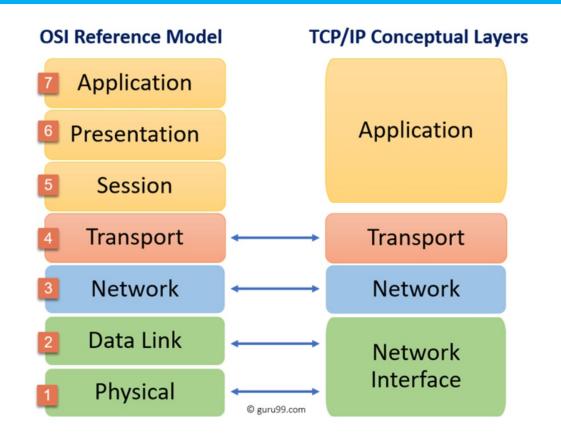
The Open Systems Interconnection model (OSI model) is a conceptual model that characterizes and standardizes the communication functions of a telecommunication or computing system without regard to its underlying internal structure and technology.

TCP/IP Model

- TCP/IP stands for Transmission Control Protocol/ Internet Protocol. It is specifically designed as a model to offer highly reliable and end-to-end byte stream over an unreliable internetwork.
- TCP/IP model is based on standard protocols around which the Internet has developed. It is a communication protocol, which allows connection of hosts over a network.
- TCP/IP helps you to determine how a specific computer should be connected to the internet and how you can transmit data between them.



OSI vs TCP/IP



https://www.guru99.com/difference-tcp-ip-vs-osi-model.html FAST NUCES, Lahore

Functions of TCP/IP Layers

Application Presentation Session	SMTP FTP DNS				
Transport	TCP UDP				
Network	IP				
Data link layer					
	Physical Layer				

https://www.javatpoint.com/computer-network-tcp-ip-model

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Application Layer

- An application layer is the topmost layer in the TCP/IP model
- It is responsible for handling high-level protocols, issues of representation
- This layer allows the user to interact with the application
- When one application layer protocol wants to communicate with another application layer, it forwards its data to the transport layer
- The main protocols used in the application layer are HTTP (Hypertext Transfer Protocol), SMTP (Simple Mail Transfer Protocol), DNS (Domain Name System) and FTP (File Transfer Protocol)



Transport Layer

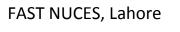
The transport layer is responsible for the reliability, flow control, and correction of data which is being sent over the network. The two protocols used in the transport layer are UDP and TCP

UDP (User Datagram Protocol)

- It provides connectionless service and end-to-end delivery of transmission
- It is an unreliable protocol as it discovers the errors but not specify the error

TCP (Transmission Control Protocol)

- It creates a virtual circuit between the sender and receiver, and it is active for the duration of the transmission.
- TCP is a reliable protocol as it detects the error and retransmits the damaged frames. Therefore, it ensures all the segments must be received and acknowledged before the transmission is completed and a virtual circuit is discarded.



Network Layer

- The main responsibility of the internet layer is to send the packets from any network, and they arrive at the destination irrespective of the route they take
- IP protocol is used in this layer, and it is the most significant part of the entire TCP/IP suite
- The main responsibility of this protocol is IP Addressing which implements logical host addresses known as IP addresses. The IP addresses are used by the internet and higher layers to identify the device and to provide internetwork routing.



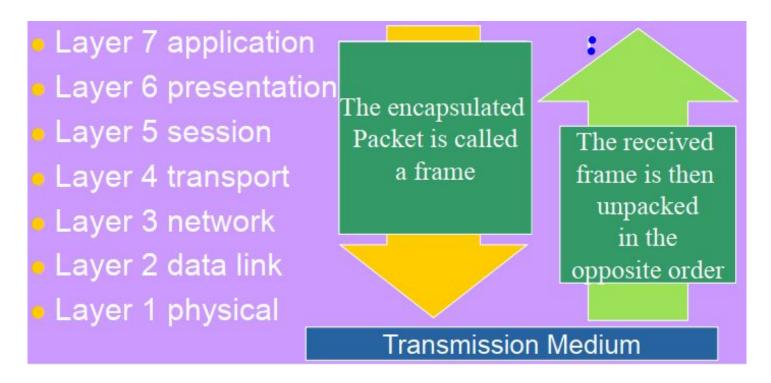
Network Access Layer

- This layer is the lowest layer of the TCP/IP model
- This layer is the combination of the Physical layer and Data Link layer defined in the OSI reference model
- It defines how the data should be sent physically through the network



OSI Model

OSI Reference Model





MAC Address vs IP Address

Key	MAC Address	IP Address
Definition	MAC Address stands for Media Access Control Address.	IP Address stands for Internet Protocol Address.
Usage	MAC Address ensure that physical address of the computer is unique.	IP Address is a logical address of the computer and is used to uniquely locate computer connected via a network.
Format	MAC Address is of six-byte hexadecimal address.	IP Address is of 4 bytes or of 16 bytes.
Provider	Chip maker manufacturer provides the MAC Address.	Internet Service Provider, ISP provides the IP Address.



Transmission and Receiving in Communication Systems

Serial Transmission

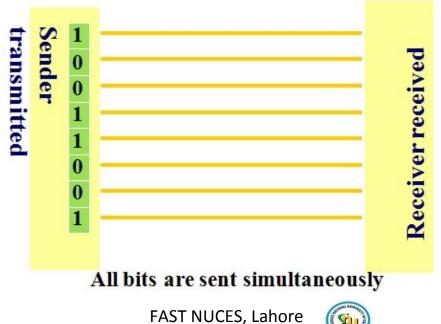
- Data is transmitted on a single channel, one bit at a time, one after another
- Much faster than the parallel transmission because of the way bits are processed (e.g. USB and SATA drives)





Parallel Transmission

- Each bit has its own piece of wire along which it travels
- Often used to send data to a printer





Why not use Parallel instead of Serial?

- Due to inconsistencies on channels, data arrives at different times
- Because of the way it is transmitted, packet switching cannot be used
- The above two points make parallel slower than serial and requires higher bandwidth
- Parallel transmissions are rarely used anymore



Synchronous vs Asynchronous Transmission

Synchronous Transmission

 All data sent at once and no packet switching (e.g. instant messaging, video conferencing)

<u>Asynchronous Transmission (e.g. Telephone line)</u>

- Most common type of serial data transfer
- Allows packet switching
- Allows sharing of bandwidth (i.e. talk on phone while another person is using internet)



Synchronous vs Asynchronous Transmission (cont.)

BASIS FOR COMPARISON	SYNCHRONOUS TRANSMISSION	ASYNCHRONOUS TRANSMISSION
Meaning	Sends data in the form of blocks or frames	Sends 1 byte or character at a time
Transmission Speed	Fast	Slow
Cost	Expensive	Economical
Time Interval	Constant	Random
Gap between the data	Absent	Present
Examples	Chat Rooms, Video Conferencing, Telephonic Conversations, etc	Letters, emails, forums, etc

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Transmission Directions

- Simplex: One direction only (e.g. radio broadcasting, television broadcasting, computer to printer communication and keyboard to computer connections)
- Half Duplex: Both directions but only one direction at a time (e.g. walkie-talkie)
- Full Duplex: Send and receive data on both directions at once (e.g. cell phone)

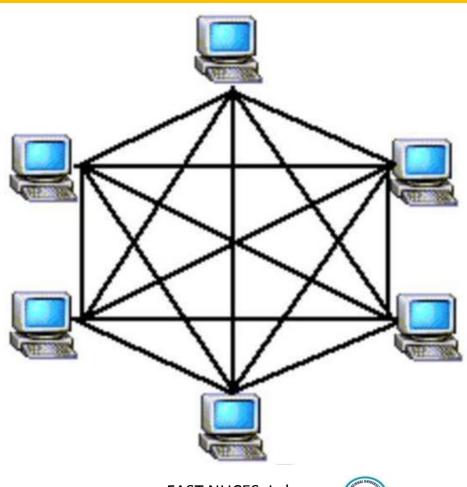


Network Topologies

- Mesh Topology
- Ring Topology
- Bus Topology
- Star Topology



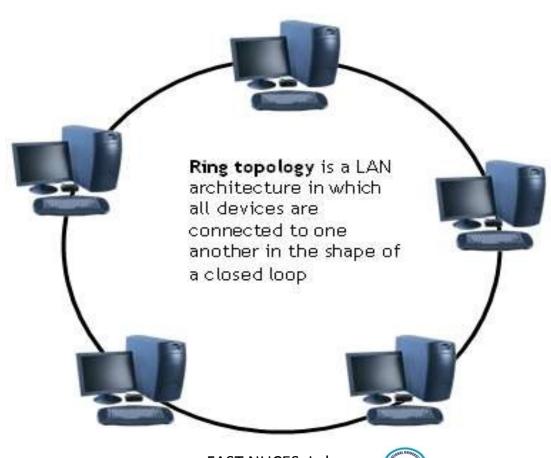
Mesh Topology



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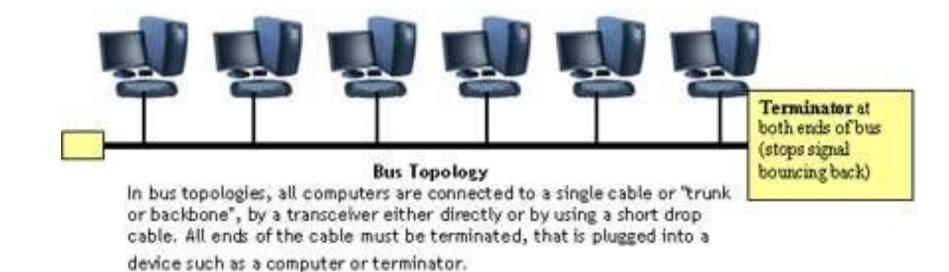
Ring Topology



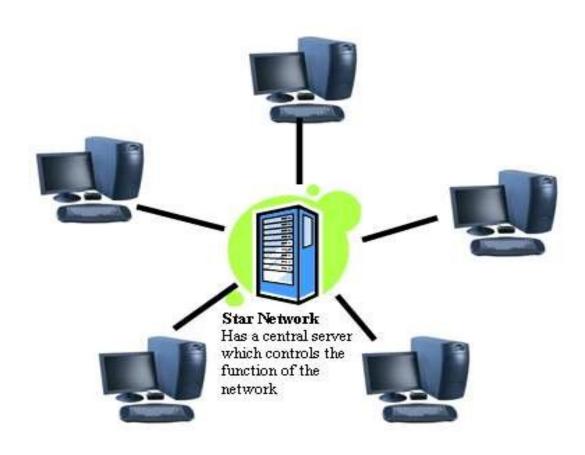
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Bus Topology



Star Topology



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Network Hardware



Bridge

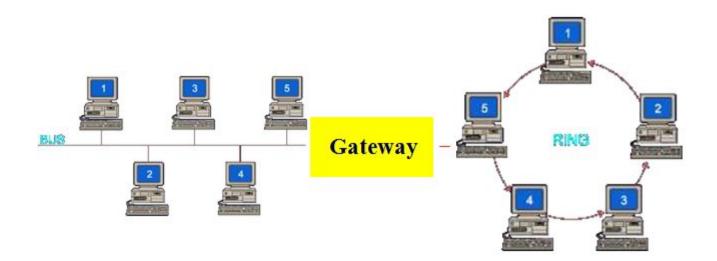
Large networks can be separated into two or more smaller networks using a bridge. This is done to increase speed and efficiency. This type of network is called a segmented LAN and has largely been superseded by the use of **switches** which can transfer data straight to a computer and thus avoid bottleneck jams which bridges were designed to fix.



THE WASHINGTON

Gateway

- Gateways join two or more different networks together
- Passage to connect two networks together that may work upon different networking models
- Often used to connect a LAN (Local Area Network) with a WAN (Wide Area Network)



Hub vs Switch vs Router

Hub: A hub is to send out a message from one port to other ports. For example, if there are three computers of A, B, C, the message sent by a hub for computer A will also come to the other computers. But only computer A will respond and the response will also go out to every other port on the hub. Therefore, all the computers can receive the message and computers themselves need to decide whether to accept the message.

https://medium.com/@fiberstoreorenda/do-you-know-the-difference-between-hub-switch-router -b74c2e8a8143



Hub vs Switch vs Router (cont.)

Switch: A switch is able to handle the data and knows the specific addresses to send the message. It can decide which computer is the message intended for and send the message directly to the right computer. The efficiency of switch has been greatly improved, thus providing a faster network speed.

https://medium.com/@fiberstoreorenda/do-you-know-the-difference-between-hub-switch-router-b74c2e8a8143



Hub vs Switch vs Router (cont.)

Router: Router is a small computer that can be programmed to handle and route the network traffic. It usually connects at least two networks together, such as two LANs, two WANs or a LAN and its ISP network. Routers can calculate the best route for sending data and communicate with each other by protocols.

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Transmission Media

Twisted Pair: Ethernet cable

Coaxial Cable: Thick black cable used for higher bandwidth

communications than twisted pair (i.e. Optus cable)

Fiber Optic: Data transferred through pulses of light. Extremely

fast.

Non-cable Methods: For example, satellite, microwave, wireless

and Bluetooth

