

Components of data communication.

→ Sender, message, medium, protocol, receiver.

define data communication

→ The transfer or exchange of information from one computer to another is known as data communication.

define protocols.

→ A protocol is a set of rules that governs data communication.

2 ex of channelisation protocols.

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- 1) FDMA (Frequency division multiple access)
  - 2) TDMA (Time division multiple access)

2 applications of wireless LAN.

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- 1) access the internet without need of physical cables
  - 2) LANs are used in business environments to create wireless networks within offices.

bandwidth

→ Bandwidth refers to capacity of communication channel to transmit data over a specific period.



## Congestion

→ Congestion in a network occurs when the volume of data being transmitted exceeds the capacity of network, leading to the degradation of performance.

## Routing

→ Routing is the process of selecting the optimal path for data to travel from source to destination.

## port number

→ A port number is like a specific door on a computer through which data travels for different services or applications.

## Internetworking

→ internetworking is like linking different neighbourhoods so that people can easily visit friends, share information & do things together, creating a larger & more connected community.



## Computer Networks

A computer network is a collection of 2 or more computers which are connected together to share information & resources.

### Characteristics of computer network

- 1) Cost :- Includes the cost of network components, their installation & their ongoing maintenance.
- 2) Security :- Includes the protection of network components & the data they contain and/or data transmitted betn them.
- 3) Speed :- Includes how fast data is transmitted between network endpoint.
- 4) Topology :- Describing the physical cabling layout and the logical way data moves betn components.

## LAN

LAN stands for Local Area Networks.

It is a network of interconnected computers & devices within a limited geographical area, such as home, office or campus.

Consider a noiseless channel with a bandwidth of 4000 Hz transmitting a signal with 2 signal levels. What will be the maximum bit rate?

→ The maximum bit rate (R) of a noiseless channel can be calculated using Nyquist formula.

$$R = 2 \times \text{Bandwidth} \times \log_2(L)$$

L is a number of signal levels.

$$\begin{aligned} R &= 2 \times 4000 \times \log_2(2) \\ &= 8000 \text{ bps} \end{aligned}$$

4 applications of bluetooth technology

1. Wireless Headsets & Audio devices
2. Hands free calling in Vehicles
3. File & Data transfer
4. Wireless keyboards & Mice

Change the following IPv4 address from binary notation to dotted decimal notation

1) 10000001 00001011 00001011 11101111

2) 11000001 10000011 00011011 11111111

To convert binary notation to dotted decimal notation, group the binary bits into sets of eight, & then convert each set to its decimal equivalent.



1) 10000001 00001011 00001011 11101111  
129.11.11.239

2) 11000001 10000011 00011011 11111111  
193.131.27.255

## Osi reference Model

## Tcp/ip model

- Osi refers to open system interconnection.
- TCP refers to Transmission control protocol / internet protocol.
- Osi model has 7 layers.
- 5 layers.
- less reliable.
- more reliable.
- Developed by ISO (International standard organisation).
- DoD (Department of defence).
- OSI is conceptual model.
- TCP/IP is client-server model.
- OSI follows horizontal approach.
- follows vertical approach.

Important design issues of data link layer.

→ Data link layer is the 2<sup>nd</sup> layer of OSI model, responsible for the reliable transmission of data across a physical link.

Issues

1. How to distinguish the start & end of a frame.

2. Detecting & correcting errors introduced during data transmission
3. Managing the flow of data bet<sup>n</sup> sender & receiver to avoid congestion or overload.
4. How to identify devices on same network
5. Defining the protocols & services that operate at this layer.

Services offered by Network layer

→ The network layer, 3<sup>rd</sup> layer of OSI model, provides services that facilitate communication & routing bet<sup>n</sup> devices in different networks.

1. Routing - Determining the optimal path for data to travel from the source to destination across multiple networks.
2. Logical Addressing - Assigning a logical addresses (such as IP addresses) to devices for ~~identification~~ identification on a network.
3. Error Handling :- Detecting and in some cases correcting errors in data packets during transmission.
4. Traffic Control :- Managing the flow of data to prevent congestion & ensure efficient network utilization.



## Fast ethernet

operates at max data transfer rate of 100 mbps

uses a max frame size of 1518 bytes including the payload & header.

effective over short distances typically upto 100 meters

Generally more cost effective than gigabit ethernet in terms of equipment & cabling

## Gigabit Ethernet

operates at significantly higher data transfer rate of 1000 mbps ten times faster than fast ethernet.

supports large frame sizes often upto 9000 bytes, which is known as jumbo frames

can operate over both short & long distance especially with fibre optic cables which can extend to several kilometers

Usually involves higher costs for hardware & cabling due to its enhanced speed

## Features of IPv6 protocols

- 1. Larger Address Space
- 2. Simplified header format
- 3. Improved Security
- 4. Stateless Address Configuration
- 5. Multicast enhancements
- 6. Mobility Support
- 7. No more NAT (Network Address Translation)
- 8. Header chain simplification

## Features of TCP

- 1. Reliability
- 2. Connection - oriented
- 3. Flow Control
- 4. Ordered data delivery

## Explain datagram format of UDP

- User Datagram protocol uses a simple datagram format for its packet structure

1. Source port - Identifies the port on sender's machine from which the message is being sent.
2. Destination port - Specifies the port on destination machine where the messages should be delivered
3. Length - Indicates the total length of UDP packet, including the header & the data.



Define Pulling

→ Pulling generally refers to the action of retrieving or obtaining something by applying force or effort towards oneself.

In computing, pulling can refer to retrieving data or information from a source.

Size of IPv4 is 32 bits

IPv6 → 128 bits

List application layer protocols

→ HTTP, HTTPS, FTP, SMTP, TELNET, SSH, NTP

UDP is connection oriented protocol. State true or false

→ false

What is the function of presentation layer

proper data format translation, encryption & compression for effective communication

Which devices operates at physical layer?  
hubs, repeaters, network interface cards, cables, connectors, modems & transceivers.



## CSMA/CD

→ stands for Carrier Sense Multiple access with collision detection.

It is network protocol used in ethernet network to manage access to communication channel & handle potential collisions.

## Masking

→ Masking in general sense is protect something.

In the context of data privacy masking involves replacing, encrypting or anonymizing sensitive information within a dataset to protect individual privacy.

## Jitter

→ Jitter refers to variability in the delay of received packets in a network.

## Latency

→ Latency is the time it takes for data to travel from source to destination.

Write Nyquist & Shannon formula for calculating data rate of a channel.

→ Nyquist Formula

Max data rate (Baud rate)

$$= 2 \times \text{Bandwidth}$$



The Nyquist formula calculates the maximum data rate (baud rate) for a communication channel by taking twice the bandwidth of channel Shannon formula.

Max data rate (bps)

$$= \text{Bandwidth} \times \log_2 \left( 1 + \frac{\text{Signal power}}{\text{Noise power}} \right)$$

The Shannon formula calculates max data rate (in bits per second) for a communication channel in the presence of noise.

### Data Communication Standards

1. De facto - Evolves through widespread use without formal planning
2. De jure - Formally recognized & endorsed by standards organisation or regulatory body

### Apply bit stuffing on Pattern

011011111111110010

→ Bit stuffing is a technique used in data communication to avoid unintended errors when a specific pattern appears in the data being transmitted.

In the context of bit stuffing '0' is inserted after a consecutive sequence of five 1 bits.



Original Pattern : 01101111111110010  
After bit stuffing : 0110111111101110010

Explain multiplexing & demultiplexing in transport layer.

→ Multiplexing in transport layer involves combining multiple data streams into single, composite stream for transmission over a network. This is typically done to optimise the use of network resources & improve efficiency.

Demultiplexing is the process of separating the multiplexed data at the receiving end back into individual data streams.

Taxonomy for media access protocols

→ The taxonomy for media access protocols categorizes various methods used to control access to the communication medium in computer networks. These protocols determine how devices share, contend or manage access to the network's channel.



## Methods of Framing

→ Framing is a process of breaking down a stream of bits into smaller, manageable frames for communication.

1. Byte Count Framing
2. Character Count Framing
3. Flag Byte delimiting
4. Bit stuffing
5. Byte stuffing
6. Length field Framing

## Circuit switching

Circuit switching is a traditional method of communication in which a dedicated communication path or circuit is established between 2 devices for the duration of their conversation.

This path remains exclusively reserved for the duration of the call, ensuring a consistent & continuous connection.

For a given IP address  $205.16.37.79/28$  in some blocks of address calculate

- 1) Address Mask
- 2) First address of block
- 3) Last address of block
- 4) Number of addresses in block



### 1. Address Mask

subnet mask is determined by  
128 port the first 28 bits are  
set to 1 & remaining 4 bits set  
to 0.

11111111 11111111 11111111 11110000

(255.255.255.240)

### 2. First address of block

To find first address the subnet  
mask is applied to the given  
IP address using Bitwise AND  
operation.

IP address	&	11001101	00010000	00100101	00100111
subnet mask		11111111	11111111	11111111	11110000

Network ID    11001101    00010000    00100101    00100000  
(205.16.37.32)

### 3. Last address of block

To find the last address you  
calculate the broadcast address for  
the subnet & then subtract one.

broadcast	11001101	00010000	00100101	00101111
address	205	16	37	47

So the last address is  
(205.16.37.46)



4. Number of addresses in the block.

→ (-20

To find the no of addresses in the block subtract the network ID from broadcast address & add 1

$$(205.16.37.47 - 205.16.37.32) + 1 \\ = 15 + 1 = 16.$$

Therefore, there are 16 addresses in the given block.

\* What is BSS & ESS

BSS (Basic service set)

Imagine a BSS as small wifi group. It's like your own wifi at home, where your phone connects directly to your router.

ESS (Extended service set)

Now think of an ESS as big wifi networks made up of many small groups (BSS). It's like when you move around in a big building, & your phone seamlessly switches between different wifi routers while staying connected to the same networks.