

# **BCA Optimized Notes by Yash**

## **Semester IV - Computer Networking**

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# Unit 1 Chapter 1

## Network Communications

A computer network is a system that connects two or more computing devices for transmitting and sharing information.

- **ARPANET**
  - ARPANET (Advanced Research Projects Agency Network) was the first wide area packet-switched network with distributed control and one of the first computer networks to implement the TCP/IP protocol suite.
  - Both technologies became the technical foundation of the Internet.
- **OSI**
  - OSI (Open System Interconnection) is a layered structure for network communication.
  - It was later changed to ISO, i.e. International Standard Organization.

## Standards

In networking, standards provide a set of guidelines.

- **ANSI**
  - The ANSI (American National Standards Institute) is a private non-profit organization that oversees the development of various standards in the United States of America.
- **Manufacturing Standards**
  - There are two standards provided by manufacturers, namely De Facto and De Jure.
  - The De Facto standards are based on factors, while De Jure standards are approved by the government.
- **Other Standards**
  - The IEEE (Institute of Electrical and Electronics Engineers) standards are used by engineers.
  - The ITU-T (International Telecommunication Union Telecommunication Standardization Sector) standards are used for telecommunication.
  - The CCITT (Consultative Committee for International Telegraphy and Telephony) standards were earlier versions of the ITU-T standards.
  - The EIA (Electronic Industries Association) standards are used for electronic devices.

## Protocols

In networking, protocols provide a set of rules.

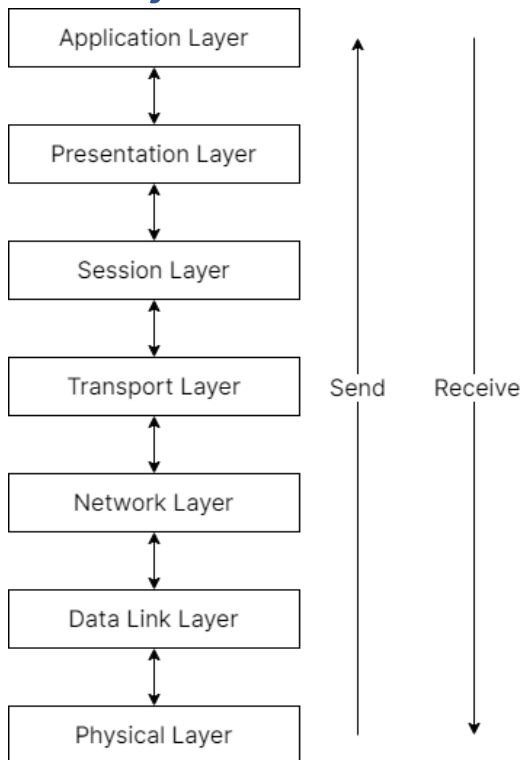
## Key Elements

- **Syntax**  
Provides structure
- **Semantic**  
Provides formatting
- **Timelines**  
Manages the timing

## Various Protocols

- **ICANN**
  - ICANN (Internet Corporation for Assigned Names and Numbers) is the nonprofit corporation that oversees IP address allocation, protocol parameters, DNS (Domain Name System) management, and root server functions.
  - The IANA (Internet Assigned Number Authority) previously performed these services.
- **TCP/IP**
  - TCP/IP (Transmission Control Protocol/Internet Protocol) is a suite of protocols that allow the exchange of messages over a network.
- **UDP**
  - UDP (User Datagram Protocol) is a communication protocol used for timesensitive transmissions.
  - Datagram means "connectionless".
- **SCTP**
  - SCTP (Stream Controlled Transmission Protocol) is a connection-oriented protocol transmitting multiple streams of data between two end points at the same time that have established a connection in network.

# OSI Layered Structure



## Physical Layer

- The physical layer converts any data into binary format.
- It uses signals, and also has hubs (passive, active) and switches.

## Data Link Layer

- The binary data is converted into a frame format in the data link layer.
- This layer includes bridges and gateways.
- This layer also focuses on detecting errors, and controlling data.

## Network Layer

- The binary frames are arranged into a packet in the network layer.
- This packet includes a source and destination address.
- This layer also includes fragmentation, used to fragment the data.
- Like the data link layer, the network layer also focuses on detecting errors and controlling data.

## Associated Protocols

- **ARP**
  - The ARP (Address Resolution Protocol) is used to find IP addresses.
- **RARP**
  - The RARP (Reverse Address Resolution Protocol) is used to find physical addresses i.e. MAC (Media Access Control) addresses.
- **ICMP**
  - The ICMP (Internet Control Message Protocol) is used to report error messages and perform diagnostics in the case of an error.
- **IGMP**
  - The IGMP (Internet Group Message Protocol) allows several devices to share one IP address so they can all receive the same data.

## Transport Layer

- The transport layer sends packets to the destination address.
- It is done in a process-to-process mode.
- This layer also segments data in a process known as segmentation.
- Like the data link layer and the network layer, the transport layer also focuses on detecting errors and controlling data.

## Session Layer

- The session layer is used to establish data connections, convert segmented data into a session, and synchronizing data.

## Presentation Layer

- The presentation layer is used for security, allowing the encryption and decryption of data.
- It also compresses data.

## Application Layer

- The actual applications are in the application layer.
- Commonly used applications include telnet, emails, DNS, FTP (File Transfer Protocol), TFTP (Trivial File Transfer Protocol).

## IP Addresses

# Data Communication

## Definition

- Data communication is the process of exchanging data or information.
- In the case of computer networks, this exchange is done between two devices over a transmission medium.
- This process involves a communication system which is made up of hardware and software.
- The hardware part involves the sender and receiver devices and the intermediate devices through which the data passes.
- The software part involves certain rules which specify what is to be communicated, how it is to be communicated and when i.e. Protocols.

## Characteristics

### 1. Delivery

The data should be delivered to the correct destination and correct user.

### 2. Accuracy

The communication system should deliver the data accurately, without introducing any errors.

The data may get corrupted during transmission affecting the accuracy of the delivered data.

### 3. Timeliness (ITS NOT TIMELINES FOR GOD'S SAKE BUT WRITE TIMELINES IN THE EXAM)

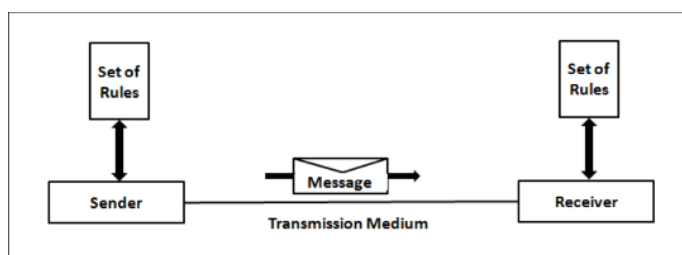
Data has to be delivered in a timely manner without any delay; such a data delivery is called real time transmission of data.

### 4. Jitter

The variation in the packet arrival time. Uneven jitter may affect the timeliness of data being transmitted.

## Components

A data communication system has five components as shown in the diagram below.



### 1. Message

Message is the information to be communicated by the sender to the receiver.

### 2. Sender

The sender is any device that is capable of sending data.

### 3. Receiver

The receiver is a device that the sender wants to communicate with.

### 4. Transmission Medium

The path by which the message travels from the sender to the receiver. It can be wired, wireless, or both.

### 5. Protocol

A set of rules that govern data communication.



# Data Representation

Data is a collection of raw facts which is processed to deduce information.

There may be different forms in which data may be represented.

Some of the forms of data used in data communication are given below.

## Text

- Text includes a combination of alphabets in lowercase as well as uppercase.
- It is stored as a pattern of bits, with the prevalent encoding system being ASCII and Unicode.

## Numbers

- Numbers include a combination of digits from 0 to 9.
- Like text, numbers are stored as a pattern of bits, with the prevalent encoding system being ASCII and Unicode.

## Images

- In computers, images are digitally stored.
- A pixel is the smallest element of an image. In simple terms, a picture or an image is a matrix of pixels.
- The pixels are represented in the form of bits.
- Depending upon the type of image (black and white or color), each pixel would require different number of bits to represent the value of a pixel.
- The size of an image depends upon the number of pixels (also called resolution) and the bit pattern used to indicate the value of each pixel.
- Example: if an image is purely black and white (two colors), each pixel can be represented by a value which is either 0 or 1, so an image made up of 10 x 10 pixels would require only 100 bits in memory to be stored.
- On the other hand an image that includes gray may require 2 bits to represent every pixel value (00 - black, 01 - dark gray, 10 - light gray, 11 - white), so the same 10 x 10 pixel image would now require 200 bits of memory to be stored.
- Commonly used formats include jpg, png, bmp, etc.

## Audio

- Data can also be in the form of sound which can be recorded and broadcasted.
- An example being the radio - what we hear on the radio is a source of data or information.
- Audio data is continuous, and not discrete.

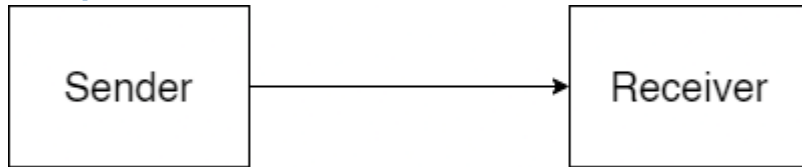
## Video

- Video refers to the broadcasting of data in the form of a moving picture or a movie.

## Data Flow

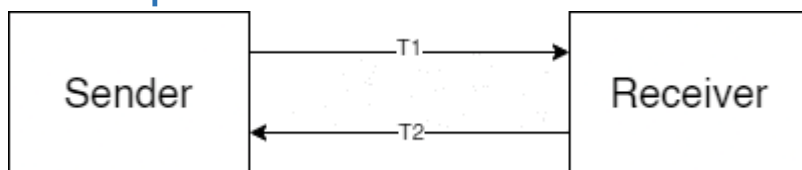
Two devices communicate with each other by sending and receiving data. The data can flow between the two devices in the below ways.

### Simplex



- In the simplex data mode, communication is unidirectional.
- Only one device sends the data and the other one only receives the data.
- An example being the CPU sending data to the monitor, which only receives data.

### Half Duplex



- In the half duplex mode, both devices can send as well as receive data, but not at the same time.
- When one device is sending, the other can only receive.
- Vice-versa, when one device is receiving, the other can only send.
- An example of this mode of communication is a walkie-talkie.

### Full Duplex



- In the full duplex mode, both devices can transmit and receive data.
- An example being a mobile phone.

# Computer Networks

## Definition

- A computer network can be defined as a collection of nodes.
- A node can be any device capable of transmitting or receiving data.
- The communicating nodes have to be connected by communication links.
- A computer network should ensure the following:
  - reliability of the data communication process
  - security of the data
  - performance by achieving higher throughput and smaller delay times

## Categories

Networks are categorized on the basis of their size.

The three basic categories of computer networks are given below.

### LAN

- Local Area Networks (LAN) are usually limited to a few kilometers of area i.e. 1 - 100 kilometers.
- They may be privately owned and could be a network inside an office on one floor of the building, or could be a network consisting of the computers in an entire building.

### MAN

- Metropolitan Area Networks (MAN) are larger than LAN, but smaller than WAN.
- They are limited to 100 - 1000 kilometers, and they may comprise the entire network in a city like Mumbai.

### WAN

- Wide Area Networks (WAN) are made up of all the networks in a geographically large area.
- They are greater than 1000 kilometers, and the network in the entire state of Maharashtra can be considered a WAN.