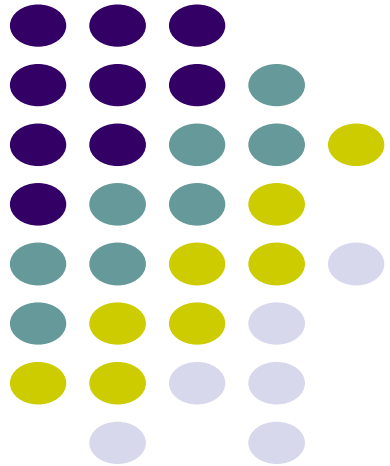
18ECC303J – Computer Communication Networks

Course Credit : 4

Theory : 9 Hours

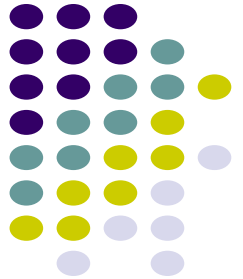


1. Behrouz A. Fehrouzan, "Data communication & Networking", Mc-Graw Hill, 5th Edition Reprint, 2014.

2. Andrew S. Tanenbaum, "Computer Networks", Pearson Education India, 5th Edition, 2013.

3. William Stallings, "Data & Computer Communication", Pearson Education India, 10th Edition, 2014.

Unit 1 – Data Communication and Networking Basics



- Introduction to Data Communication and Networking
- Data transfer modes-Serial and Parallel transmission
- Protocols & Standards
- Layered Architecture; Principles of Layering & Description
- Brief description of concepts in OSI & TCP/IP model
- Switching Types: Circuit & Packet switching, Message switching, Comparison of switching types
- LAN, MAN & WAN
- Network topologies-Types, Comparison of topologies
- IEEE standards for LAN-Ethernet; Types of Ethernet
- Token Bus, Token Ring and FDDI

Unit 1 – Week 1

Session 1

- Introduction to Data Communication and Networking
- Data transfer modes- Serial and Parallel transmission

Session 2

- Protocols & Standards
- Layered Architecture

Session 3

- Principles of Layering & Description
- Brief description of concepts in OSI & TCP/IP model

Reference Text Books:

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❖ Introduction to Data Communication and Networking

Objectives :

- ✓ To Introduce the students to data communication, networking and its fundamentals
- ✓ To understand the concept of layered architecture

The main objective of data communication and networking is to enable seamless exchange of data between any two points in the world.

This exchange of data takes place over a computer network.

❖ Introduction

❖ Data & Information

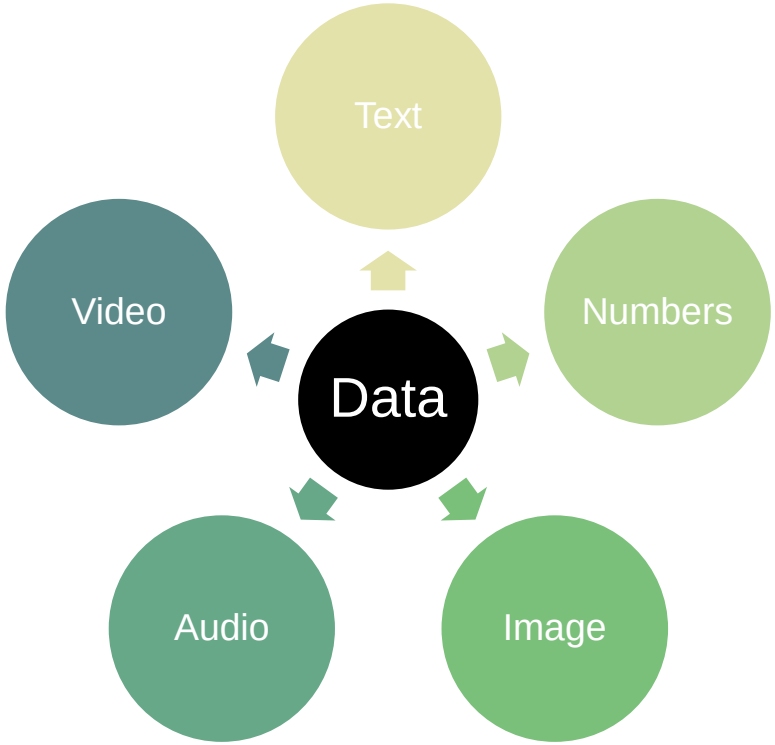
Data refers to the raw facts that are collected while **information** refers to processed data that enables us to take decisions.

Example:

When result of a particular test is declared it contains data of all students, when you find the marks you have scored you have the information that lets you know whether you have passed or failed.

The word **data** refers to any information which is presented in a form that is agreed and accepted upon by is creators and users.

❖ Data Representation



Data Representation

Text
- Combination of alphabets in small case/ upper case
- Stored as a pattern of bits. Prevalent encoding system : ASCII, Unicode

Numbers
- Combination of digits from 0 to 9.
- Stored as a pattern of bits. Prevalent encoding system : ASCII, Unicode

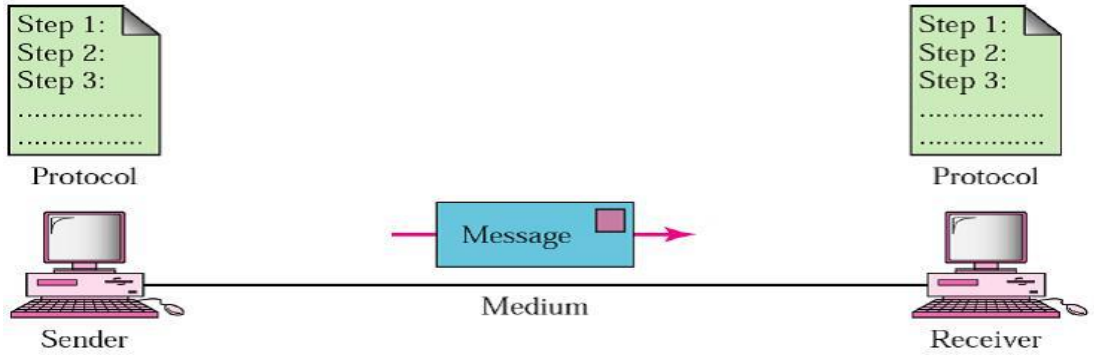
Image
- An image is composed of a matrix of pixels (picture elements).
- Each pixel is assigned a bit pattern. The size and the value of the pattern depend on whether the image is binary, gray or color.

Audio
- Data can also be in the form of sound which can be recorded and broadcasted.
- Audio data is continuous, not discrete.

Video
- Video refers to broadcasting of data in form of picture or movie
- Video can either be produced as a continuous entity, or it can be a combination of images in motion

Data Communication and its Components

Data Communication is a process of exchanging data or information.



Components of Data Communication Systems

In 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**.

- Hardware part involves the sender and receiver devices and the intermediate devices through which the data passes.
- Software part involves certain rules which specify what is to be communicated, how it is to be communicated and when. It is also called as a **Protocol.**

Components:

Message: Information/ data to be communicated. (texts, numbers, pictures, audio, and video)

Sender: Device that sends the data message. (video camera, computer, workstation, telephone handset, etc.)

Receiver: Device that receives the message. (TV, computer, workstation, telephone handset, etc.)

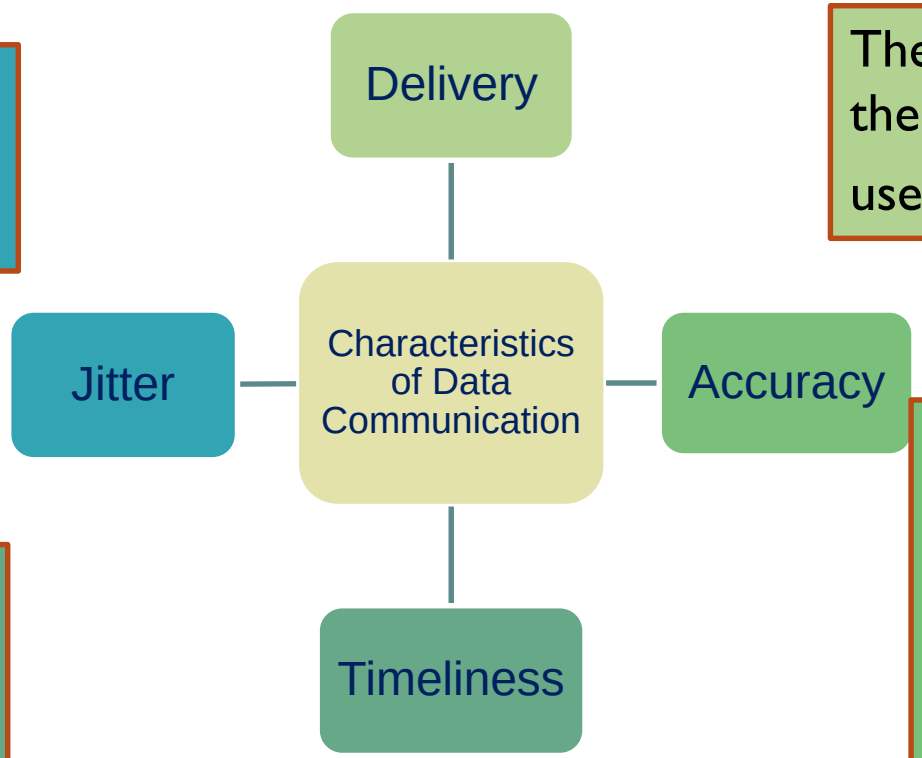
Transmission medium: Physical path by which a message travels from sender to receiver. (twisted-pair wire, coaxial cable, fiber optic cable, and radio waves).

Protocol: Set of rules that govern data communications between the communicating devices. (Key elements of a protocol are syntax, semantics, and timing)

Without a protocol, two devices may be connected but not communicating.

Characteristics of Data Communication

The effectiveness of any data communications system depends upon the following four fundamental characteristics



Variation in the packet arrival time. Uneven Jitter may affect the timeliness of data being transmitted.

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

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

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

The data may get corrupted during transmission. affecting the accuracy

Data Transfer Modes

Data Transmission mode defines the direction of the flow of information between two communication devices. It is also called Data Communication or Directional Mode.

It specifies the direction of the flow of information from one place to another in a computer network.

Direction of exchange of information

- Simplex
- Half-Duplex
- Full-Duplex

Synchronization between the transmitter and the receiver

- Synchronous
- Asynchronous

Number of bits sent simultaneously in the network

- Serial
- Parallel

Data Transfer Modes: Exchange of Information

Simplex – data can flow only in one direction (unidirectional)

Ex: Radio and TV transmission, keyboard, mouse, monitor

Advantages:

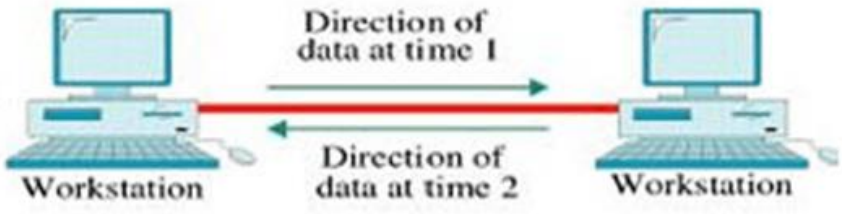
* Utilizes full capacity of the communication channel

* No data traffic issues as data flows only in one direction.

Disadvantages

*Unidirectional- having no intercommunication between devices and no mechanism for acknowledging back to the sender.

Half-Duplex or Semi-Duplex - data can flow in both directions but in one direction at a time.



Ex. Walkie-Talkie

Advantages:

* Facilitates the optimum use of the communication channel.

* Provides two-way communication.

Disadvantages

* Two-way communication cannot be established simultaneously at the same time.

* Delay in transmission may occur as only one way communication can be possible at a time.

Full-Duplex - data can flow in both directions at the same time. It is bi-directional in nature.

Ex. Telephone Network,

Advantages:

* The two-way communication can be carried out simultaneously in both directions.

* Fastest mode of communication between devices.

Disadvantages

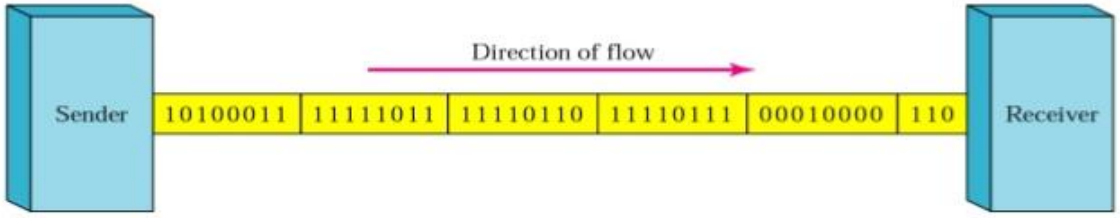
* The capacity of the communication channel is divided. Also, no dedicated path exists for data transfer.

Data Transfer Modes: Synchronization

Synchronous Transmission:

Mode of communication in which the bits are sent one after another without any start/stop bits or gaps between them.

(Ex. communication in CPU, RAM)



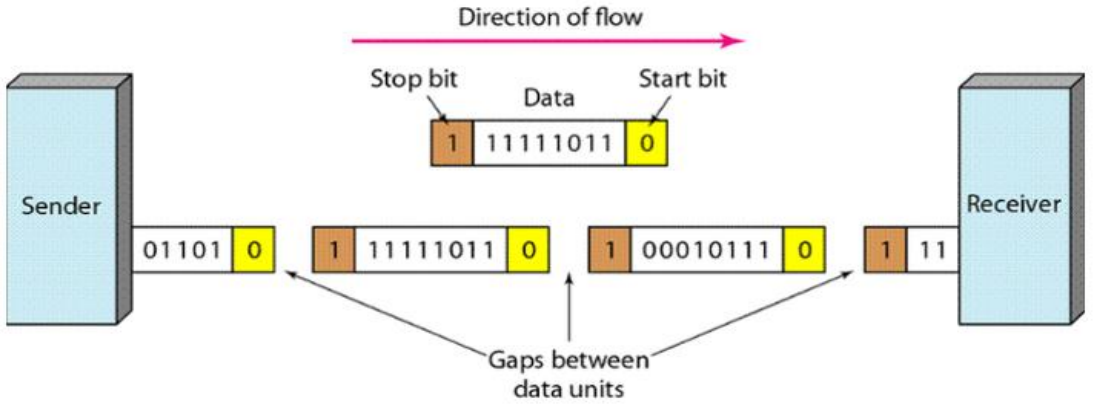
Advantages: Transmission speed is fast as there is no gap between the data bits.

Disadvantages : Very Expensive

Asynchronous Transmission:

Mode of communication in which a start and the stop bit is introduced in the message during transmission.

(Ex. Data input from a keyboard to the computer)



Advantages: Cheap and effective mode of transmission.

Data transmission accuracy is high due to the presence of start and stop bits.

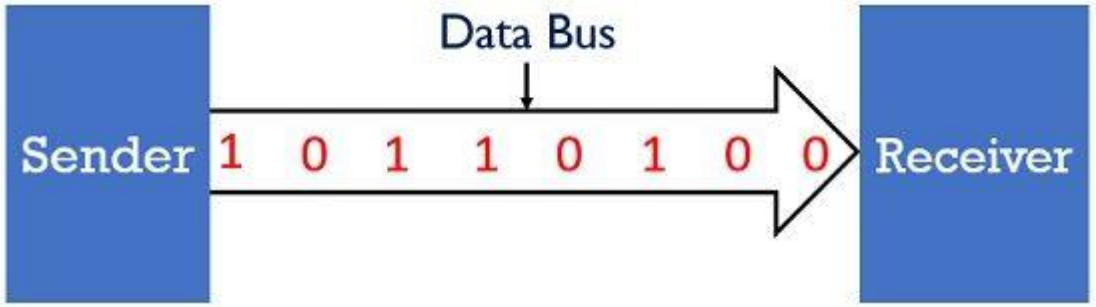
Disadvantages : Data transmission can be slower due to the gaps.

Data Transfer Modes: No. of bits Transmitted

Serial Transmission:

Mode of transmission in which the data bits are sent serially one after the other at a time over the transmission channel.

(Ex. Data transmission between two computers using serial ports)



Advantages.

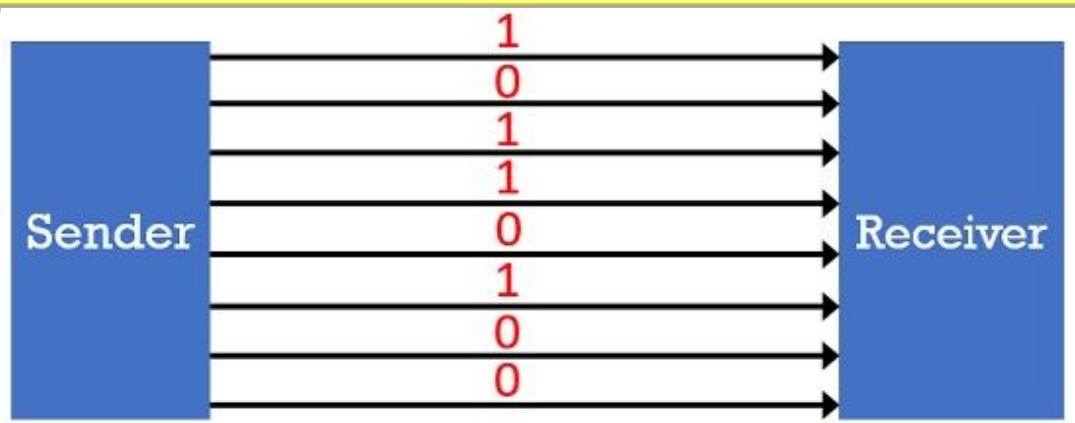
* long-distance data transmission as it is reliable.
* Number of wires and complexity is less.
* cost-effective.

Disadvantages :The Data transmission rate is slow due to a single transmission channel

Parallel Transmission:

Mode in which the data bits are sent parallelly at a time

(Ex. Data transmission between computer and printer.)



Advantages:

Easy to program or implement.

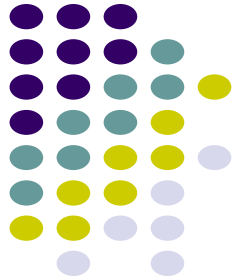
Data transmission speed is high due to the n-transmission channel.

Disadvantages :

Requires more transmission channels, and hence cost-ineffective.

Interference in data bits, likewise in video conferencing.

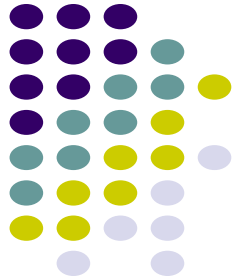
Selection of data transmission mode



Parameters need to be considered when selecting a data transmission mode:

- ✓ Transmission Rate
- ✓ The Distance that it covers
- ✓ Cost and Ease of Installation
- ✓ The resistance of environmental conditions

Review Questions



Q1. Communication between a computer and a keyboard involves _____ transmission.

Q2. The information to be communicated in a data communications system is the _____.

Q3. In _____ transmission, the channel capacity is shared by both communicating devices at all times.

Q4. Computer Network is _____.

(a) Sharing of resources and information

(b) Collection of hardware components and computers

(c) Interconnected by communication channels

(d) All of the above

Q5. A _____ is the physical path over which a message travels.

Answers

- 1. Communication between a computer and a keyboard involves *Simplex* transmission.
- **2.** The information to be communicated in a data communications system is the *Message*.
- 3. In *full-duplex* transmission, the channel capacity is shared by both communicating devices at all times
- 4. Computer Network is *(option d: All the above)*
- 5. A *medium* is the physical path over which a message travels.

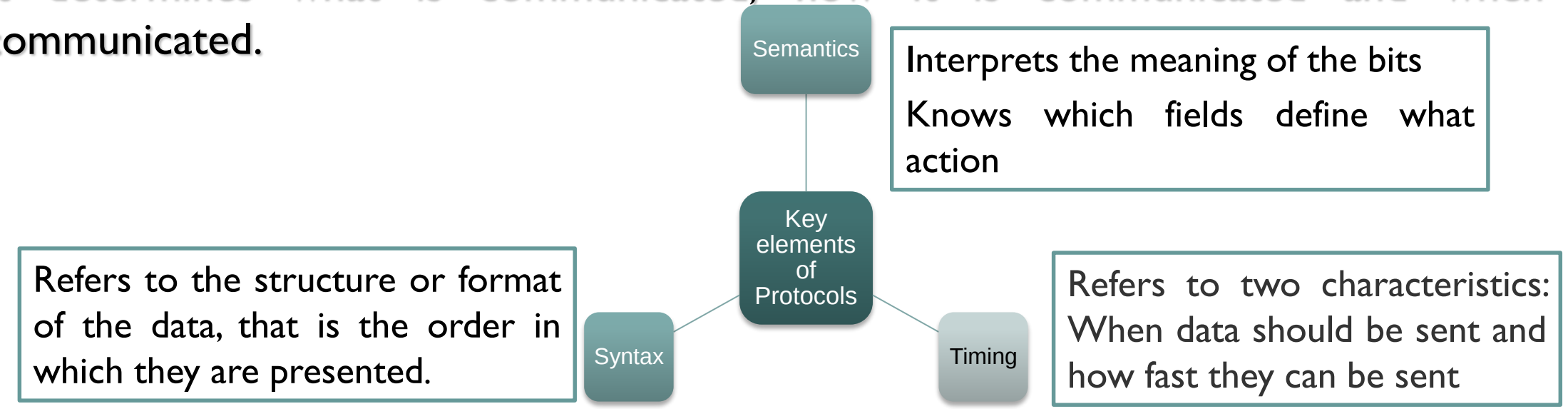
Protocols

A protocol: the rules that both the sender and receiver and all intermediate devices need to follow to be able to communicate effectively.

When communication is simple, it needs only one simple protocol; when the communication is complex, it needs a protocol at each layer, or protocol layering

A protocol consists of a set of rules that govern data communications.

It determines what is communicated, how it is communicated and when it is communicated.



Common Protocols Used

Protocol	Acronym	Remarks
Point To Point	PPP	Used to manage network communication over a modem
Transfer/Transmission Control Protocol	TCP / IP	Backbone protocol. The most widely used protocol.
Internetwork package exchange	IPX	Standard protocol for Novell NOS
NetBIOS extended user interface	NetBEUI	Microsoft protocol that doesn't support routing to other network. Running only Windows-based clients.
File transfer Protocol	FTP	used to send and received file from a remote host
Simple mail Transfer protocol	SMTP	Used to send Email over a network
Hyper text transfer protocol	HTTP	Used for Internet to send document that encoded in HTML
Apple Talk	Apple Talk	Protocol suite to network Macintosh computer and a peer-to-peer network protocol
OSI Model	OSI Layers	A way of illustrating how information functions travels through network of its 7 layers.

Standards

Standards are necessary in networking to ensure interconnectivity and interoperability between various networking hardware and software components.

Concept of Standard

Standards provide guidelines to product manufacturers and vendors to ensure national and international interconnectivity.

Without standards we would have proprietary products creating isolated islands of users which cannot interconnect.

Standards

Data communications standards are classified into two categories:

1. **De facto Standard**
   - These are the standards that have been traditionally used and mean by fact or by convention
   - These standards are not approved by any organized body but are adopted by widespread use.
2. **De jure Standard**
   - It means by law or by regulation.
   - These standards are legislated and approved by an body that is officially recognized.

Standards Organizations in Networking Field

Standards are created by standards creation committees, forums, and government regulatory agencies.

Examples of Standard Creation Committees :

1. International Organization for Standardization(ISO)
2. International Telecommunications Union-Telecommunications Standard (ITU-T)
3. American National Standards Institute (ANSI)
4. Institute of Electrical & Electronics Engineers (IEEE)
5. Electronic Industries Associates (EIA)

Examples of Forums

1. ATM Forum
2. MPLS Forum
3. Frame Relay Forum

Examples of Regulatory Agencies:

Federal Communications Committee (FCC)

Layered Architecture

Computer networks are operated by network models; most prominently the Open System Interconnect Reference Model (OSIRM) and the TCP/ IP Model.

Concept of Layered Task

- The main objective of a computer network is to be able to transfer the data from sender to receiver. This can be done by breaking it into small sub tasks, each of which are well defined.
- Each subtask will have its own process or processes to do and will take specific inputs and give specific outputs to the subtask before or after it.

(*In more technical terms we can call these sub tasks as layers*)

In general, every task or job can be done by dividing it into sub task or layers.

Principles of Protocol Layering

Two principles of protocol layering.

- The first principle dictates that if bidirectional communication, is required, then each layer is made responsible to perform two opposite tasks, one in each direction.
- The second principle that to be followed in protocol layering is that the two objects under each layer at both sites should be identical.

Layered Architecture

Open System Interconnection Reference Model (OSIRM)

The OSIRM or OSI Model was developed by International Organization for Standardization (ISO).

- ISO is the organization, OSI is the model.
- It was developed to allow systems with different platforms to communicate with each other. Platform could mean hardware, software or operating system.
- It is a network model that defines the protocols for network communications.
- It is a hierarchical model that groups its processes into layers. It has 7 layers.
- Each layer has specific duties to perform and has to cooperate with the layers above and below it.

Layered Architecture – OSI Layer

The OSI model has 7 layers each with its own dedicated task.. (Top to Bottom Layers)

Application Layer:

This layer is responsible for providing interface to the application user.

This layer encompasses protocols which directly interact with the user.

Presentation Layer:

This layer defines how data in the native format of remote host should be presented in the native format of host.

Session Layer: This layer maintains sessions between remote hosts.

Transport Layer: This layer is responsible for end-to-end delivery between hosts.

Network Layer:

This layer is responsible for address assignment and uniquely addressing hosts in a network.

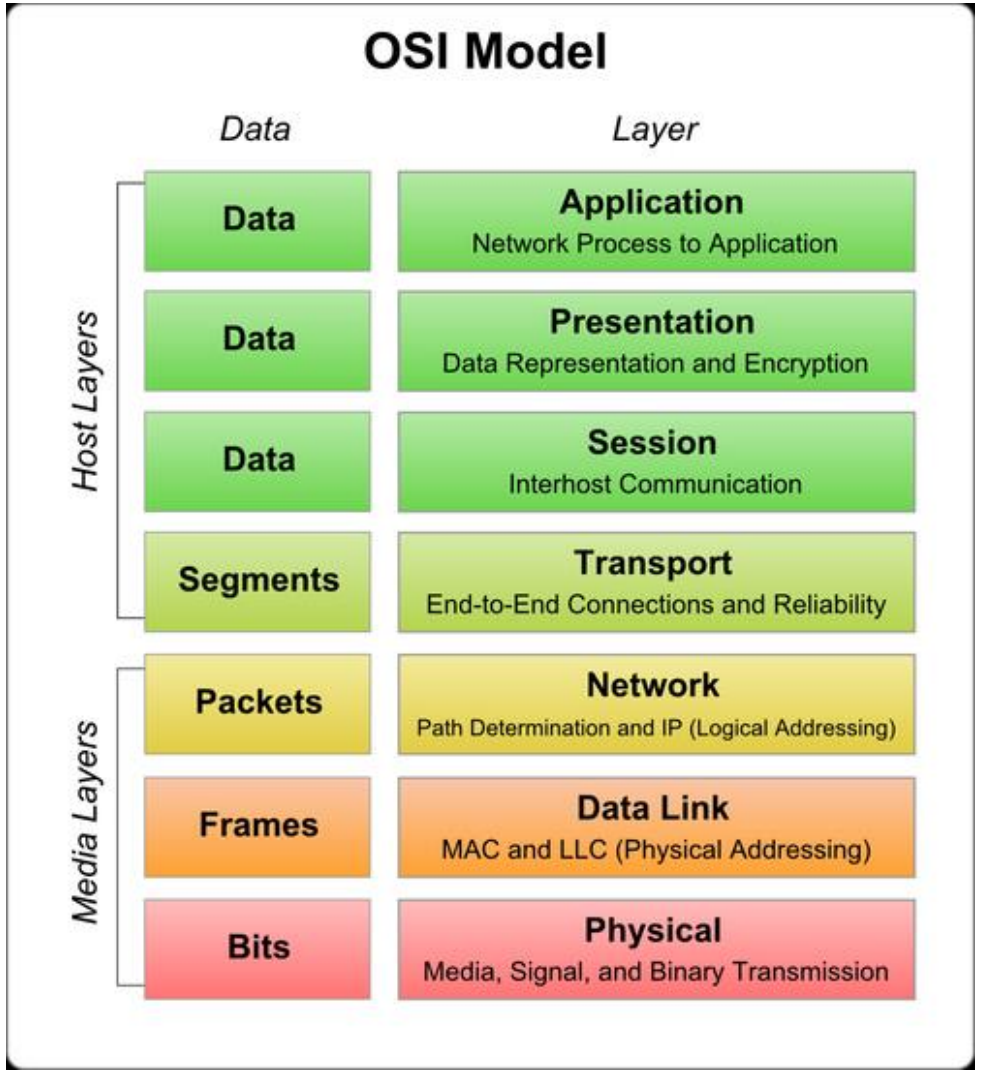
Data Link Layer:

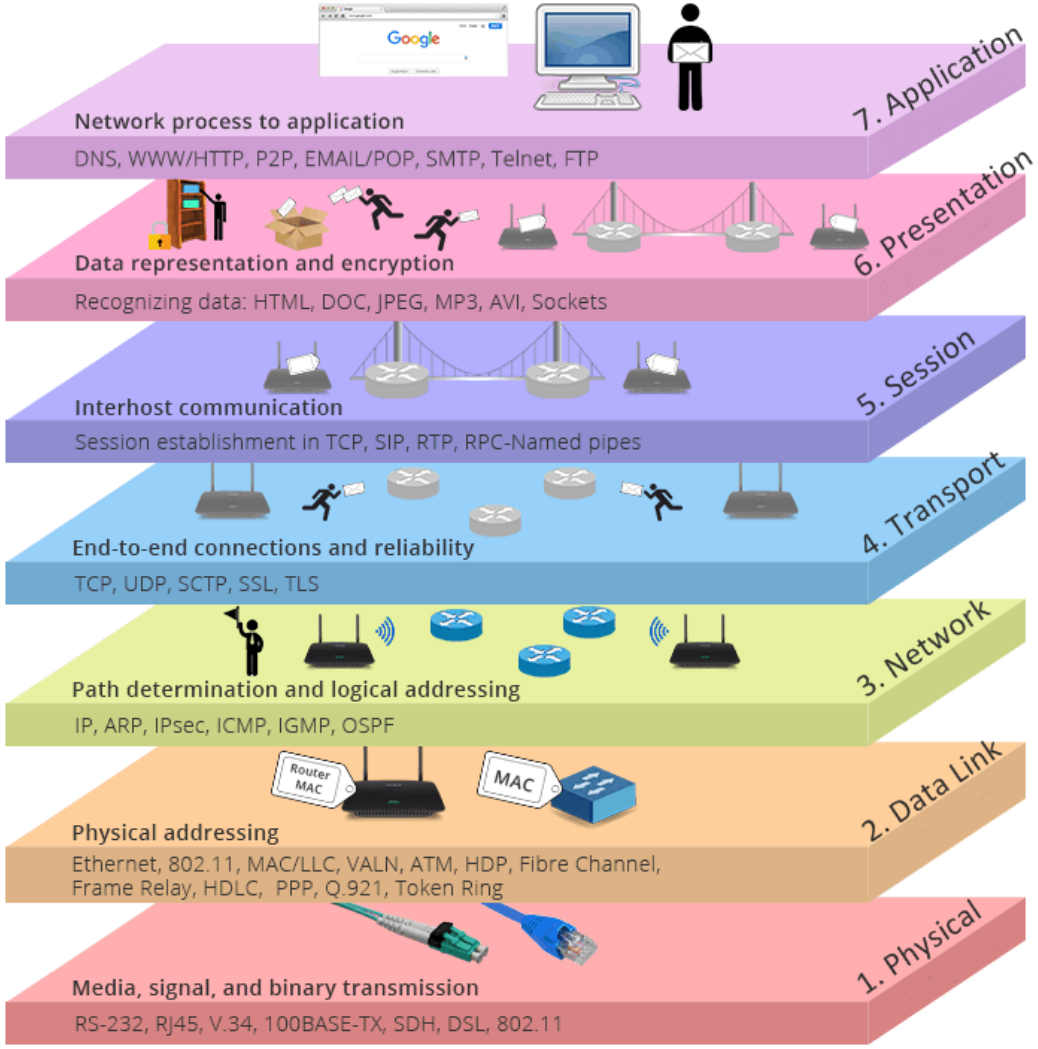
This layer is responsible for reading and writing data from and onto the line.

Link errors are detected at this layer.

Physical Layer: This layer defines the hardware, cabling wiring, power output, pulse rate etc.

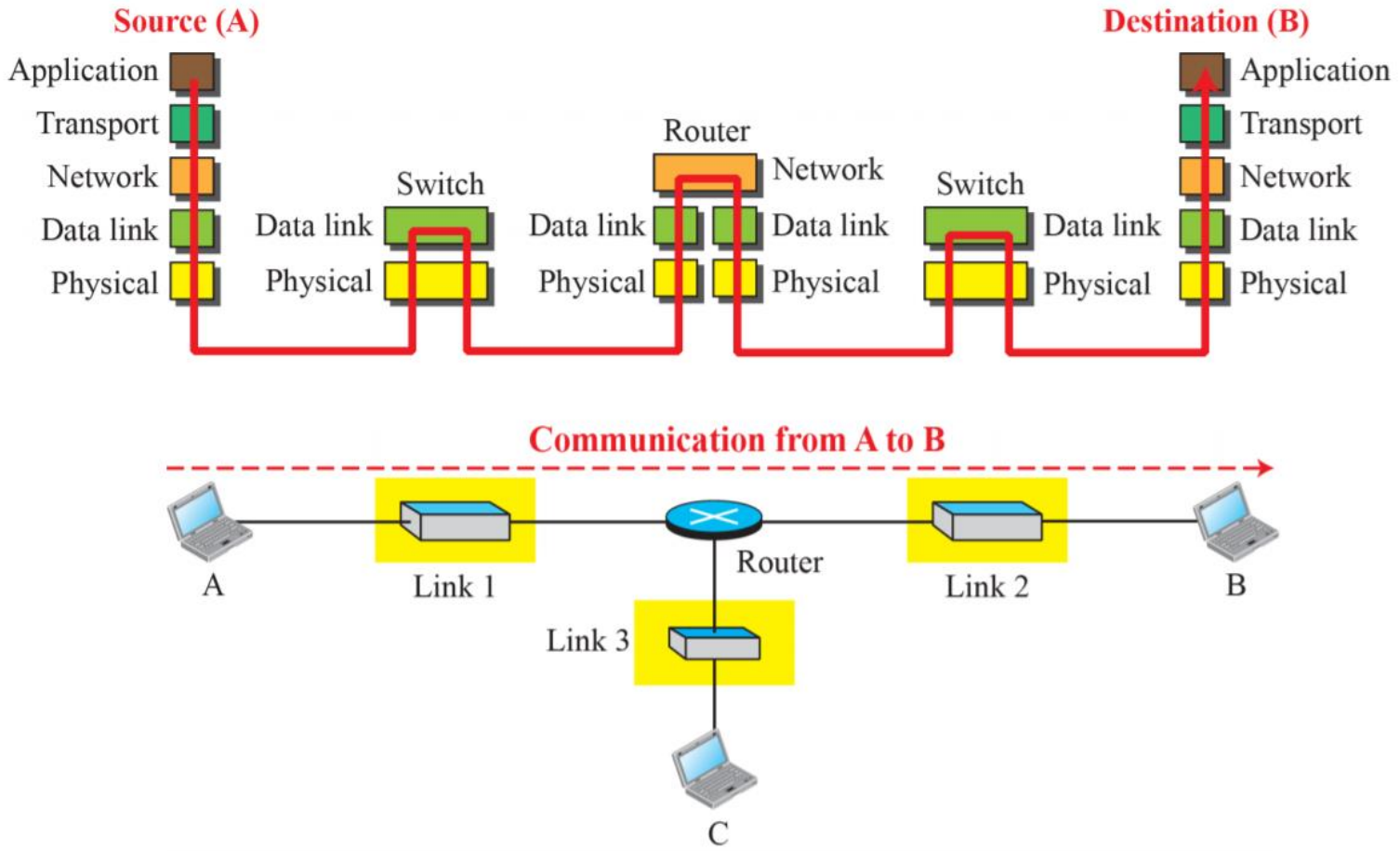
Layered Architecture – OSI Layer





Layered Architecture – OSI Layer

Example : Communication through an Internet

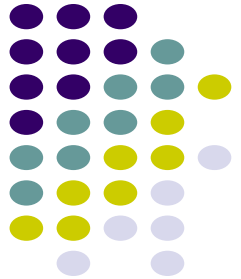


Layered Architecture – OSI Layer

The responsibilities of the 7 layers of OSI model can be summarized as follows:

1. Application Layer	To provide the users access to network resources
2. Presentation Layer	To provide the functions of translation, encryption and compression.
3. Session Layer	To establish, manage and terminate sessions
4. Transport Layer	To provide process to process delivery of message
5. Network Layer	To provide source to destination delivery of packets.
6. Datalink Layer	To provide hop to hop delivery of frames
7. Physical Layer	To transmit data over a bit stream from one hop to the next and provide electrical and mechanical specification.

Review Questions



Q1. OSI Stands for _____.

Q2. List the key components of a Protocol.

Q3. _____ and _____ are two categories of Standards.

Q4. Which of the following is true with respect to layered architecture?

a) Each layer is allowed to depend on the layer above it being present and correct

b) A layer may call other layers above and below it, as long as it uses them

c) All of the mentioned

d) None of the mentioned

Q5. What are the drawbacks for Layers?

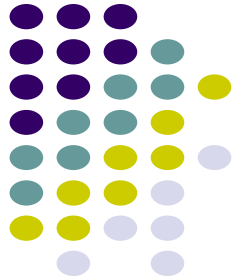
a) It is often necessary to pass data through many layers, which can slow performance significantly

b) Layers support information hiding

c) Multi-layered programs can be hard to debug because operations tend to be implemented through a series of calls across layers

d) None of the mentioned

Answers



- 1. Open System Interconnection.
- 2. Syntax, Semantic and Timing.
- 3. De facto Standard and De Jure Standard
- 4. *Option d: None of the above mentioned*
- 5. Multi-layered programs can be hard to debug because operations tend to be implemented through a series of calls across layers