IT301: Data Communication & Computer Network(DCCN)

Class: B. Tech (CS) Sec A
Semester : V
Teacher: Dr. Amritanjali

Course Objectives

This course enables the students to:

- Study the components of the data communication model and communications architecture.
- Understand the differences and similarities between the OSI model and the TCP model.
- Understand the fundamentals of the theory of signalling.
- Understand the basic principles of signal encoding techniques, error-detection, and error-correction techniques.
- Understand the characteristics of analog signaling and digital signaling and the strengths and weaknesses of each method.

Course Outcomes

After the completion of this course, students will be able to:

- Identify the elements of a communication network.
- Illustrate different data communications and networking standards.
- Design and implement a simple LAN and a WAN that meet a specific set of criteria.
- Identify the new trends and technologies, their potential applications.
- Examine the social impact of the networking technology particularly on issues related to security and privacy.

Syllabus

Module I

- **Data Communications and Networking**: Overview A Communications Model, Data Communications, Data Communication Networking, The Need for Protocol Architecture, A Simple Protocol Architecture, OSI, The TCP/IP Protocol Architecture, Data TransmissionConcepts and Terminology, Analog and Digital Data Transmission, Transmission Impairments, Channel Capacity. (8L)

Module II

- **Transmission Media and Signal Encoding Techniques:** Guided Transmission Media, Wireless Transmission, Wireless Propagation, Line-of-Sight Transmission.Digital Data Digital Signals, Digital Data Analog Signals, Analog Data Digital Signals, Analog Data Analog Signals. (8L)

Module III

- **Digital Data Communication Techniques and Data Link Control:** Asynchronous and Synchronous Transmission, Types of Errors, Error Detection, Error Correction, Line Configurations, Interfacing, Flow Control, Error Control, High-Level Data Link Control (HDLC). (8L)

Module IV

- Multiplexing, Circuit Switching and Packet Switching Multiplexing Frequency Division Multiplexing, Synchronous Time Division Multiplexing, Statistical Time Division Multiplexing, Switching Networks, Circuit-Switching Networks, Circuit-Switching Concepts, Control Signaling, Soft switch Architecture, Packet-Switching Principles, X.25, and Frame Relay. (8L)

Module V

- Asynchronous Transfer Model Protocol Architecture, ATM Logical Connections, ATM Cells, Transmission of ATM Cells, ATM Service Categories, ATM Adaptation Layer. Routing in Switched Networks Routing in Circuit-Switching Networks, Routing in Packet-Switching Networks, Least-Cost Algorithms. (8L)

Text Book: Stallings W., Data and Computer Communications, 10th Edn., Pearson Education, PHI, New Delhi, 2014.(T1)

Reference Book: Forouzan B. A., Data Communications and Networking, 5thEdn. TMH, New Delhi, 2017.(R1)

Data Communication

- Exchange of data between two devices
- Requires communication medium for data transmission

Communication System

A communication system consist of hardware and software to manage data communication

- Message
- Sender
- Receiver
- Transmission Medium
- Protocols

Communication System
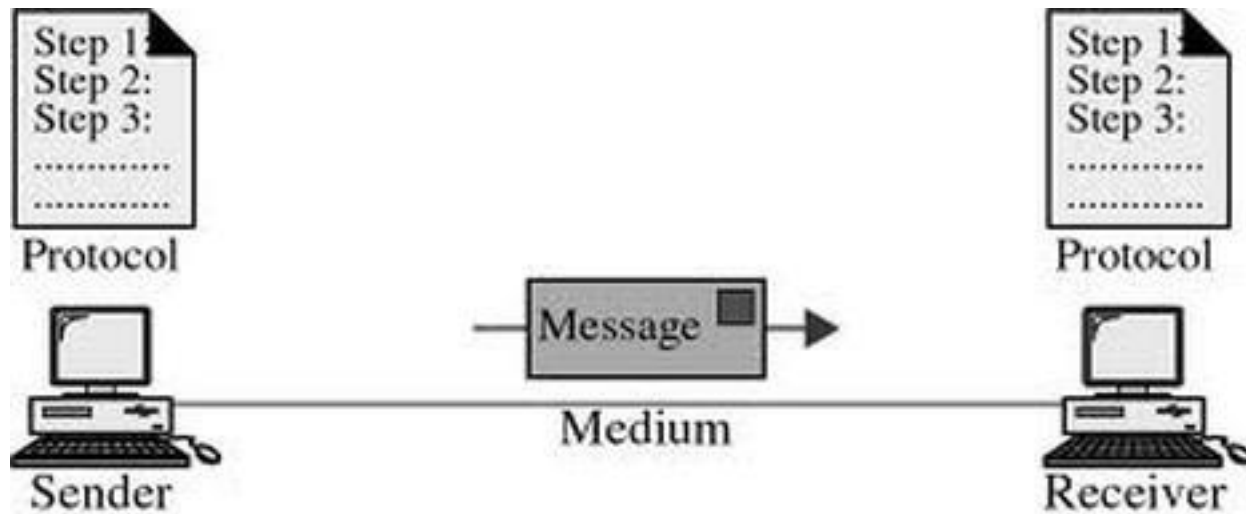
Effectiveness

Source: xconnect.net
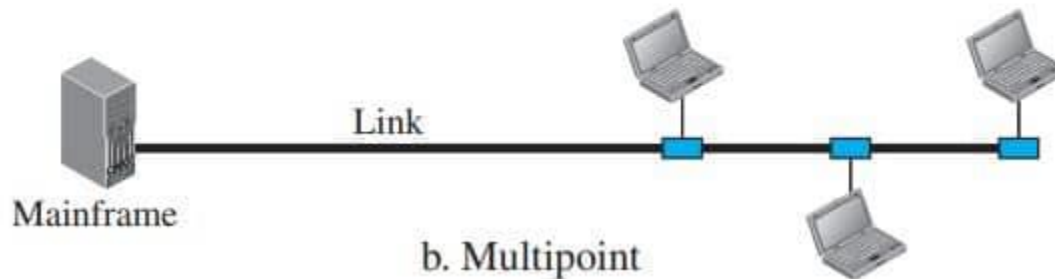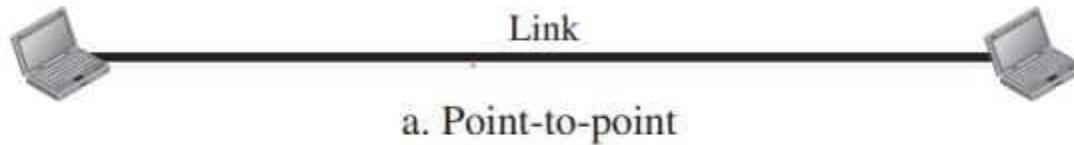

Source: blogspot.com
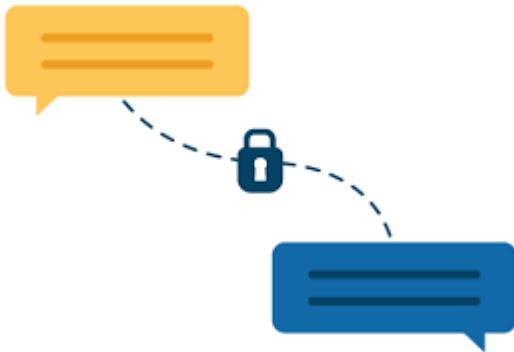
Source: qliqsoft.com

Effective Communication

- Delivery

- Accuracy

- Timeliness

- Jitter

Types of Connections

Types of connections: point-to-point and multipoint

Link

a. Point-to-point

Link

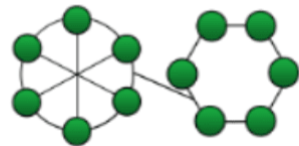Mainframe

b. Multipoint

Transmission Modes

(a) simplex
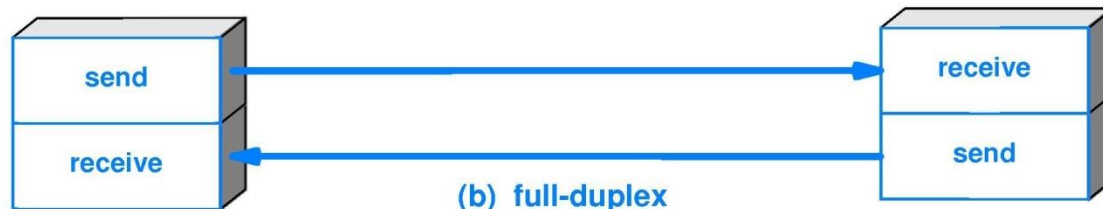
(b) full-duplex

(c) half-duplex

Source: blackbox.co.uk

Topologies
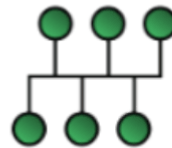
BUS Topology

RING Topology

HYBRID Topology

TREE Topology
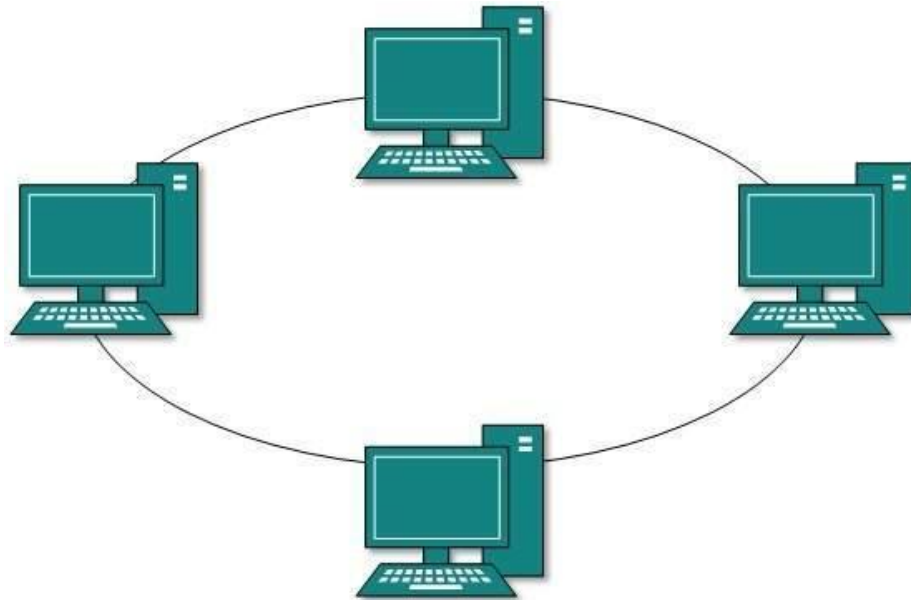
MESH Topology

STAR Topology

Source: EdupointBD

Terminator

Data Flow

Bus Topology

Star Topology
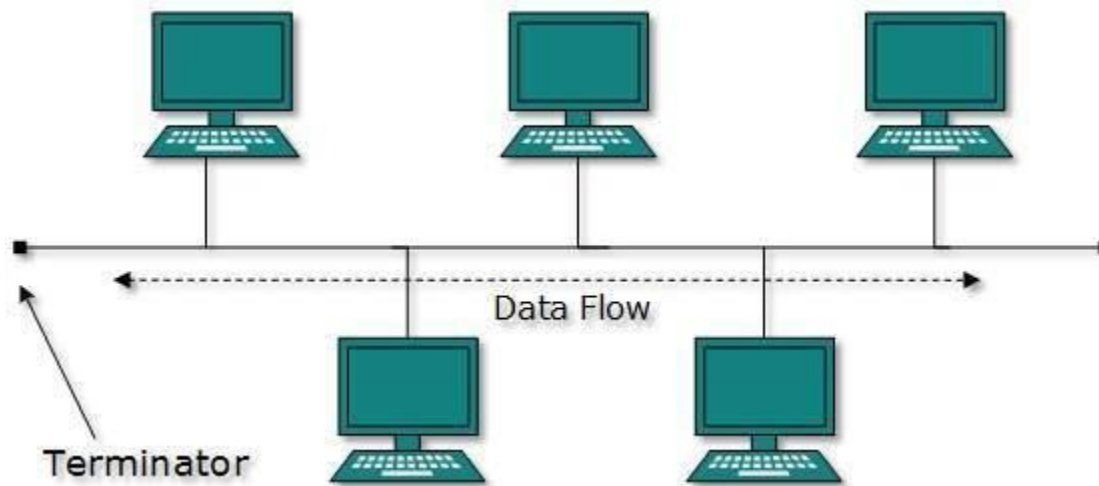
Ring Topology

Source: wordpress.com

Mesh Topology

Core Layer

Distribution Layer

Access Layer

Tree Topology
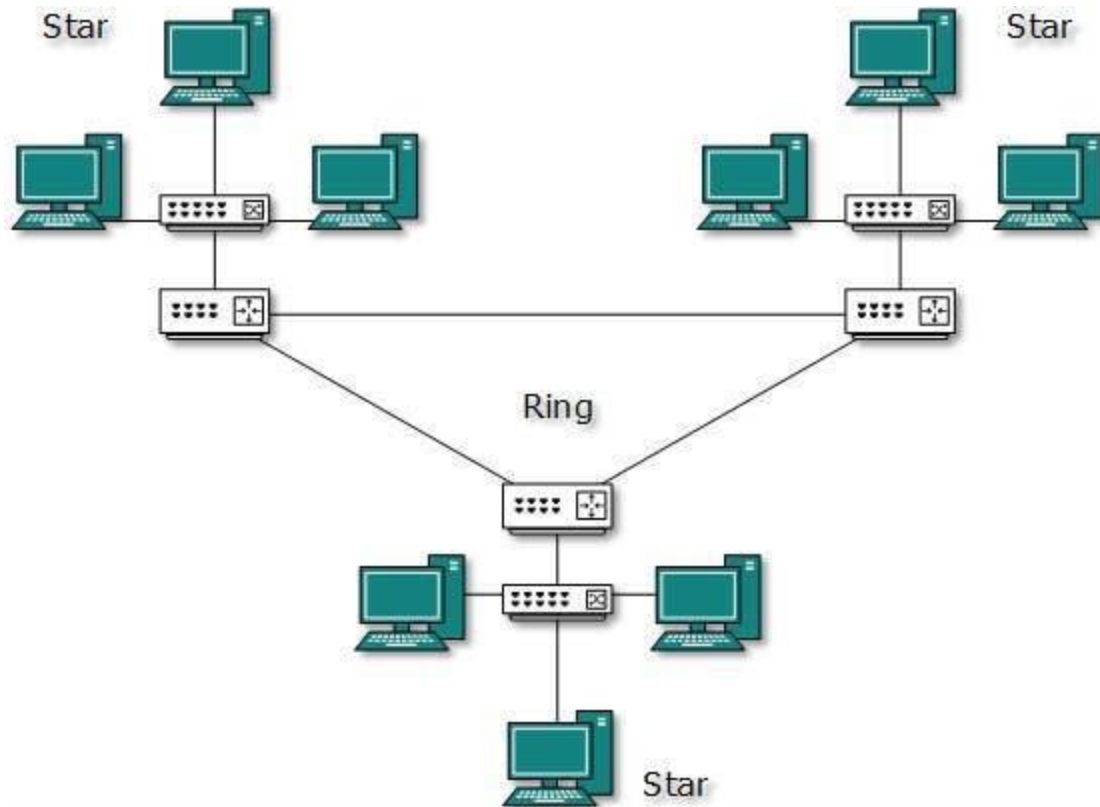
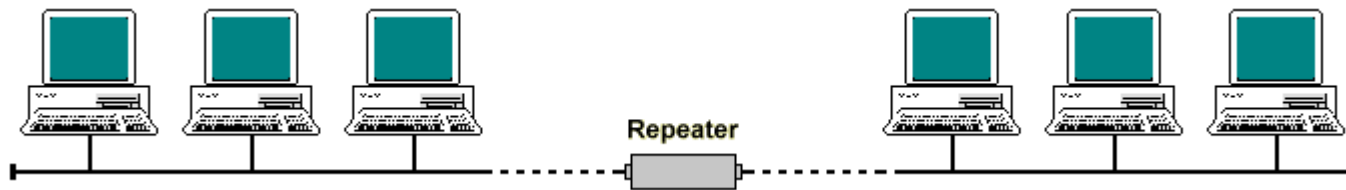**Hybrid Topology**

Interconnecting Devices

Repeaters

- Regenerates Signal
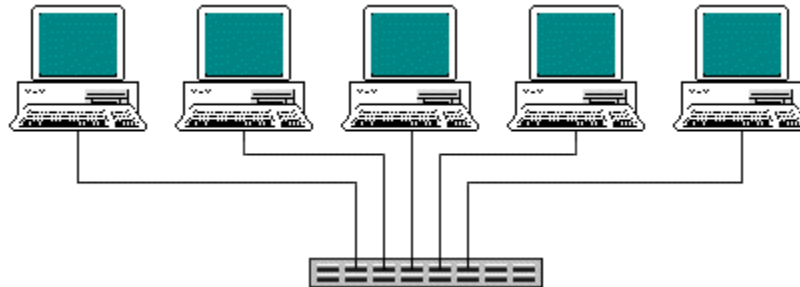- Used for extending network length

Source: technologyuk.net

Hubs

- Actives hubs regenerate signals while passive hubs only relay the signal on all ports

Source: technologyuk.net

Bridges

	Bridge 1	Bridge 2
A	1	1
B	1	1
C	2	1
D	2	2
E	2	2

Source: technologyuk.net
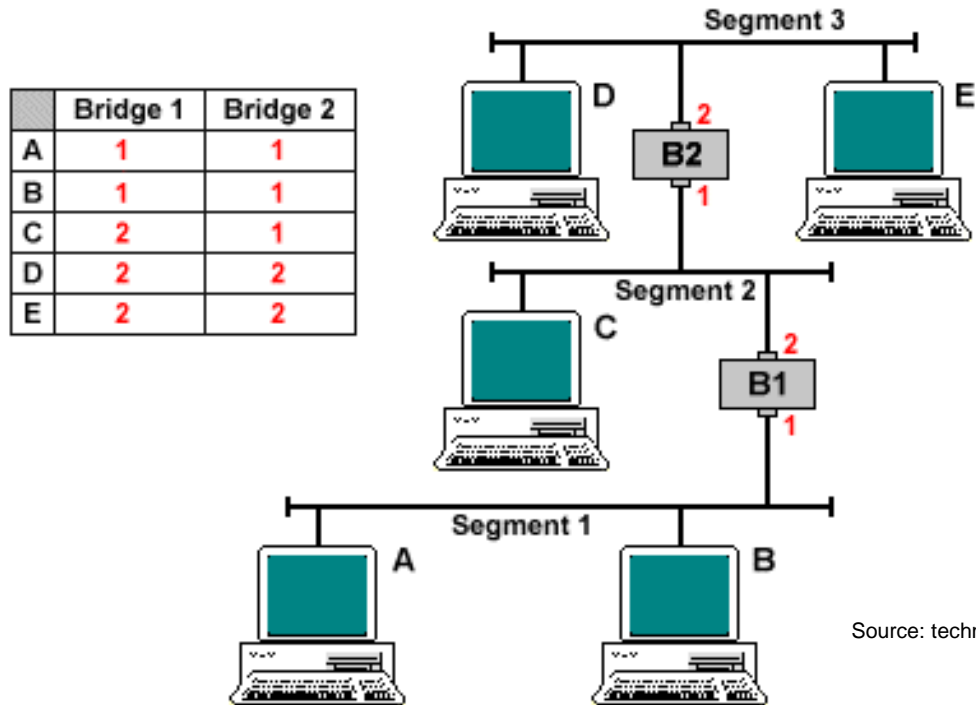
- Connect two or more network segments of same type

Switches

Workstations

File/print server

Workgroup switch
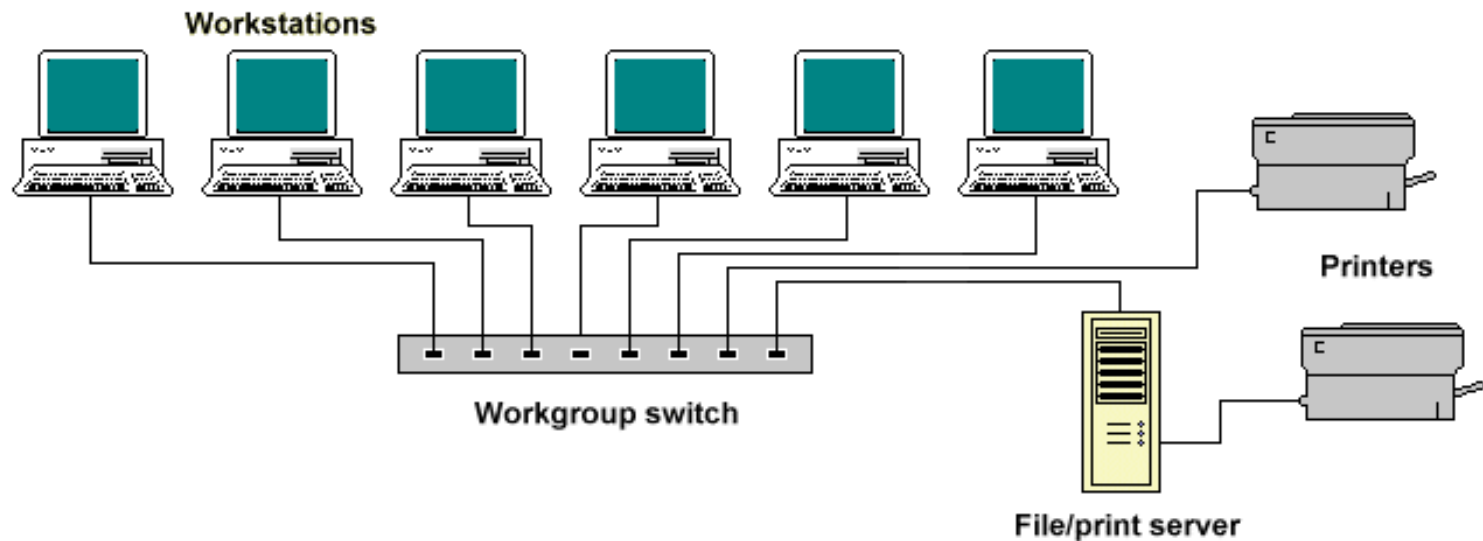
Printers

Source: technologyuk.net

- Connect multiple devices or network segments

Routers
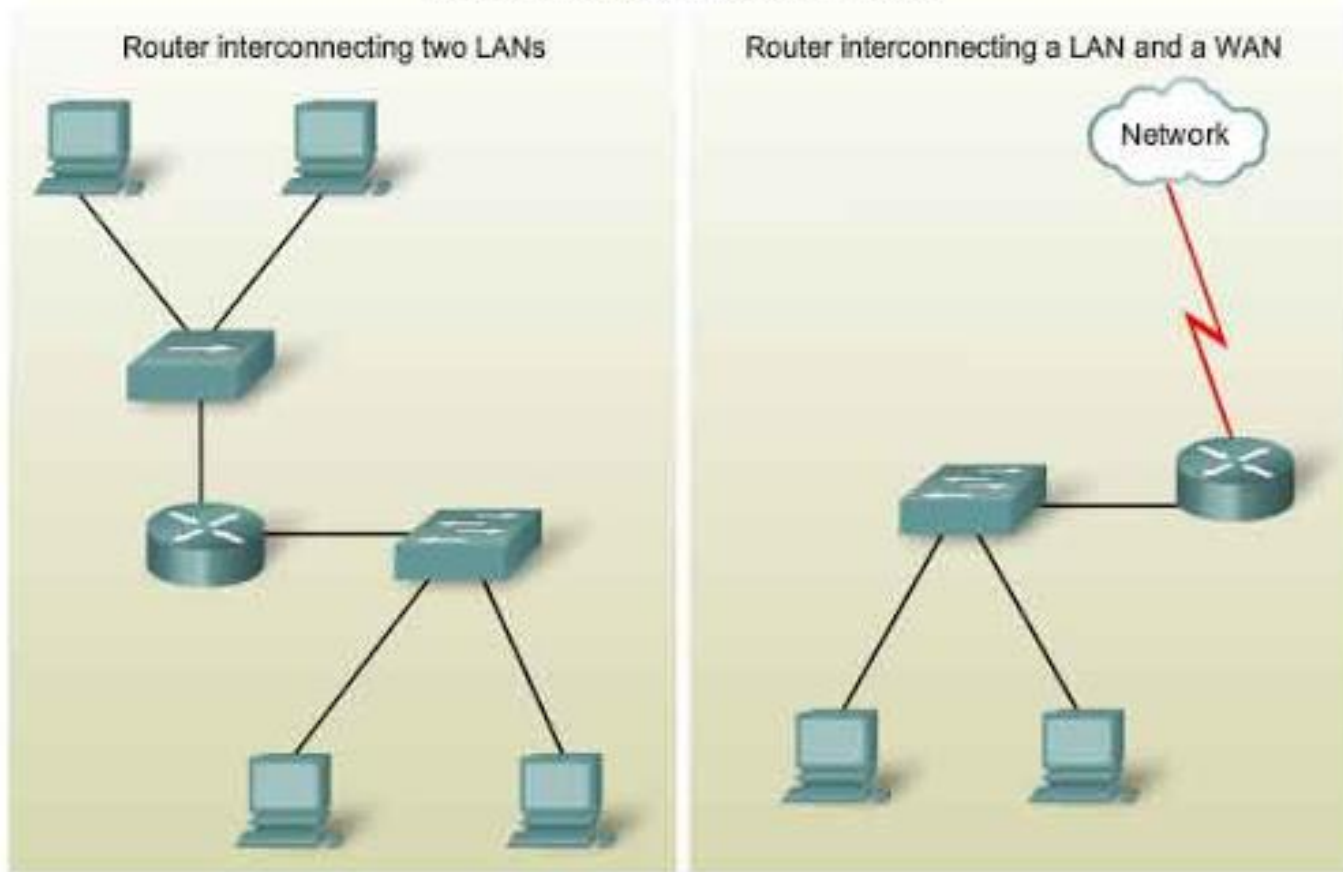
Image Source: hightek.net

Internetwork

Client Side

Computer

Computer

Switch

Router

Bunch of Routers

Server

example.com

Router

Server Side
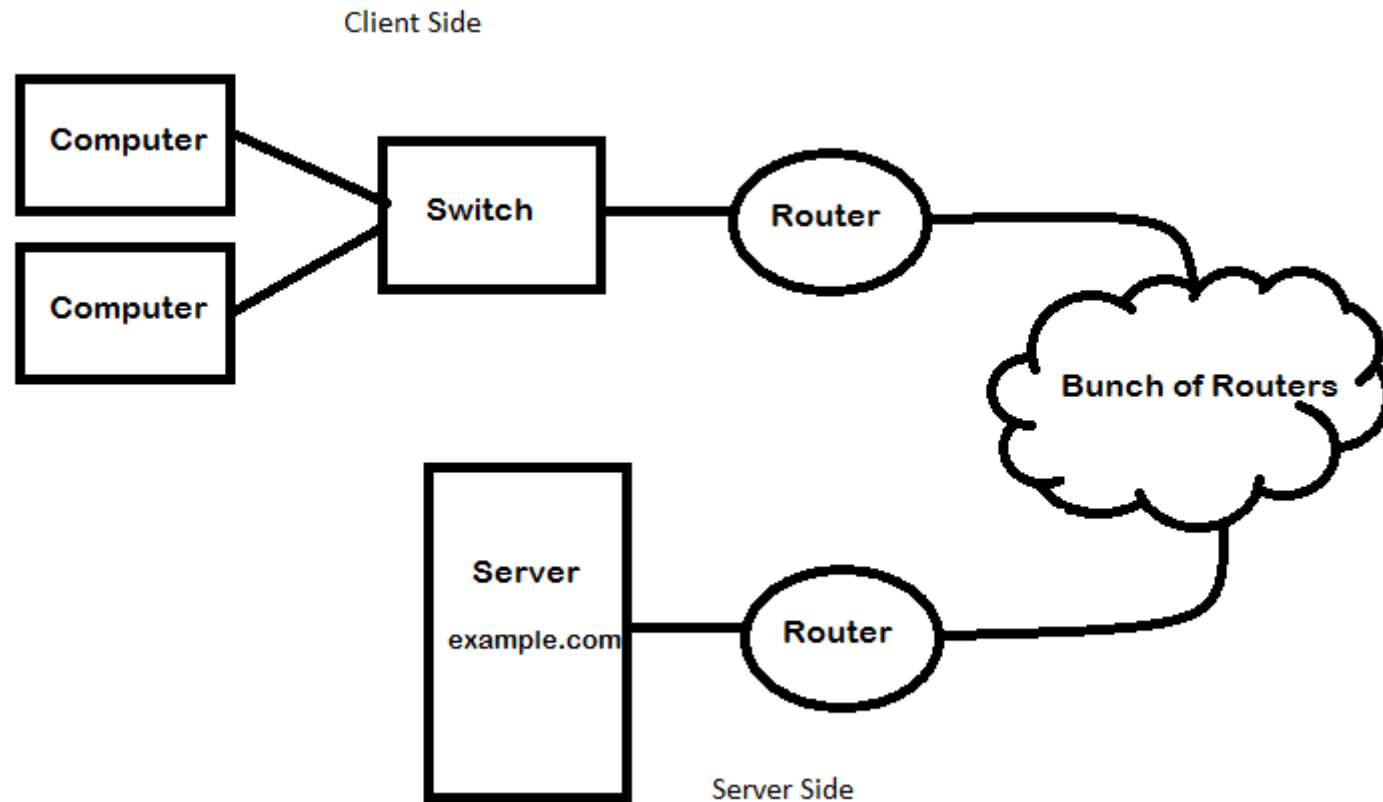
Communication Models

- Layered approach is used to define a communication model

- Protocol architecture defines the layers of the communication model

- Each layer performs a subset of functions required for communication

- In each layer, protocols define rules for sending and receiving data blocks

- The data block is referred as protocol data unit

Layering
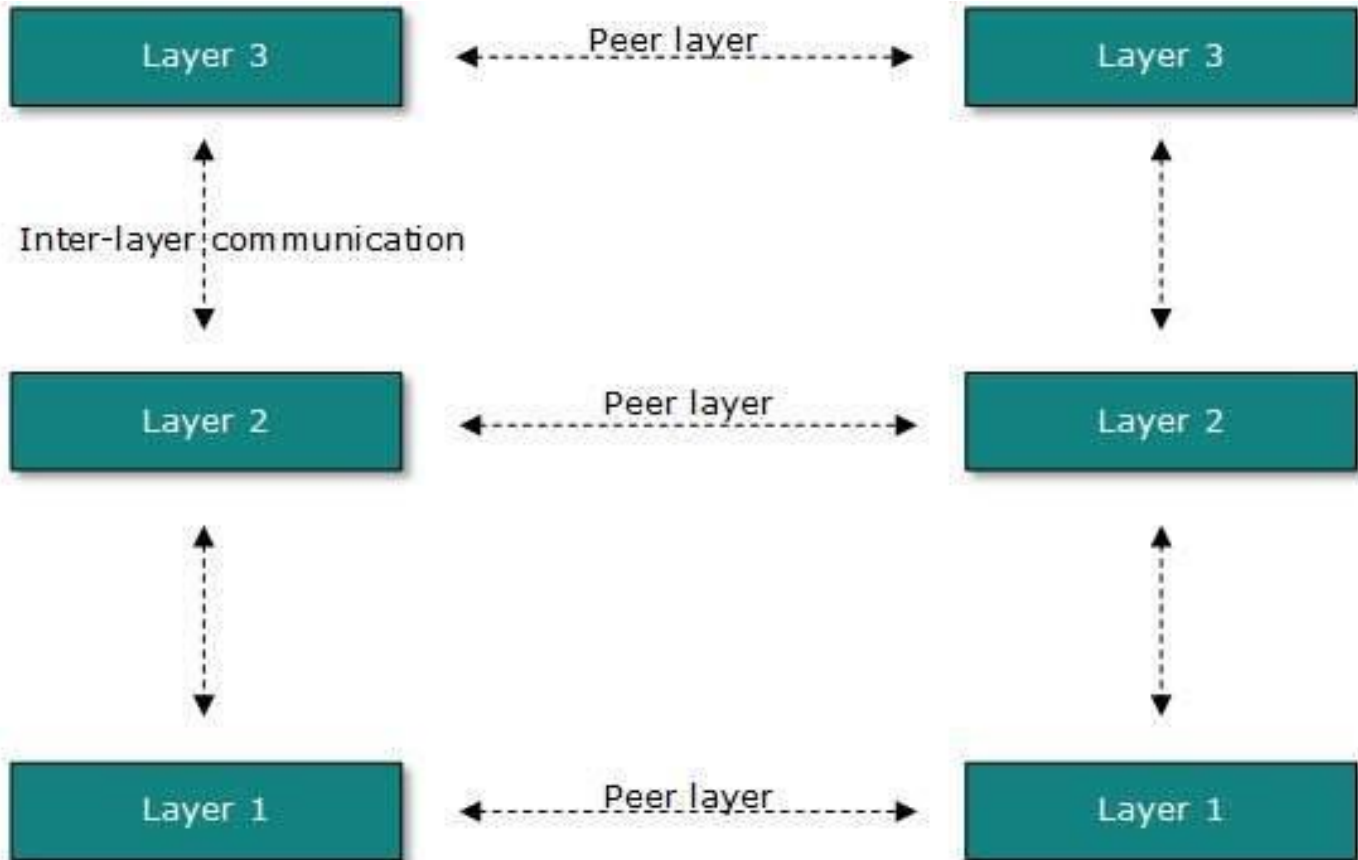
Layered Architecture

- Each layer can be designed separately
- They make calls to the services provided by
- the layer below it
- Each layer defines
  - Functions of the layer
  - Protocol for communication with the peer layer
  - Services provided by the layer to the higher layer

Data Encapsulation
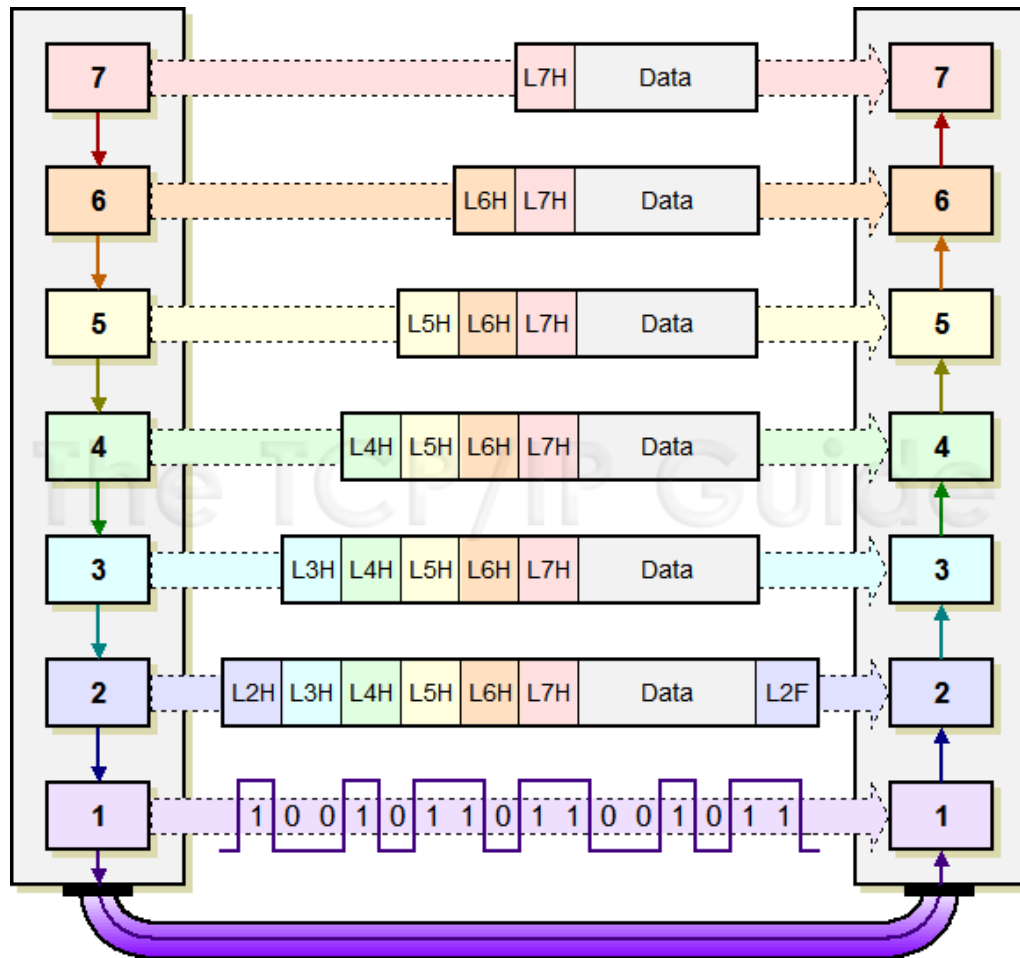
OSI Model

- OSI- Open System Interconnection
- Specifies standards for different systems to communicate with each other
- Divides the communication functionalities into separate layers
- 7 layers have been defined in this model

OSI Model Layers

7	Application Layer	Human-computer interaction layer, where applications can access the network services
6	Presentation Layer	Ensures that data is in a usable format and is where data encryption occurs
5	Session Layer	Maintains connections and is responsible for controlling ports and sessions
4	Transport Layer	Transmits data using transmission protocols
3	Network Layer	Decides which physical path the data will take
2	Data Link Layer	Defines the format of data on the network
1	Physical Layer	Transmits raw bit stream over the physical medium

Image Source: imperva.com

Layers Functionalities

- **Application Layer**
  - Provides interface to the user applications for sending and receiving messages

- **Presentation Layer**
  - Sender side: Takes data from the application layer and prepares it in a format suitable for transmission
  - Receiver side: Delivers data to the application in a form required by the application
  - Deals with data encoding, encryption, compression etc.

Layers Functionalities

- **Session Layer**
  - Creates and manage sessions between sending and receiving applications
  - Uses checkpoints for recovering sessions, in case of connection interrruption

- **Transport Layer**
  - Sender side: Divides the data into segments of suitable size
  - Receiver side: Reassembles the segments in correct order
  - Deals with flow control and error control

Layers Functionalities

- **Network Layer**
  - Encapsulates segments into packets, divide segments if required
  - Routes packets to the destination through best path

- **Data Link Layer**
  - Sender side: Encapsulates packets into frames to send it to next hop device
  - Receiver side: Recreates the frame from the received bits, check for errors
  - Deals with flow control and error control

- Physical Layer
  - Responsible for transmission of bits of the frames through signals