# Notes

# Computer Networks

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## Introduction

- The term telecommunication means communication at a distance.
- The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.
- Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.

## Components of data communication

- Message: info (data) to be communicated
- Sender: device that sends the data message
- Receiver: device that receives the message
- Medium: transmission medium (physical path) by which a message travels from the transmitter to the receiver
- Protocol: set of rules that governs data communications

## Data Representation

- Text
  In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s). Different sets of bit patterns have

been designed to represent text symbols. Each set is called a code, and the process of representing symbols is called coding.

- Numbers
  Numbers are also represented by bit patterns. However, a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematical operations. Appendix B discusses several different numbering systems.
- Images
  Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot.
- Audio
  Audio refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continuous, not discrete. Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal.
- Video
  Video refers to the recording or broadcasting of a picture or movie. Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion.

<u>Data Flow</u>

- Simplex In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive.
- Half-Duplex In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.

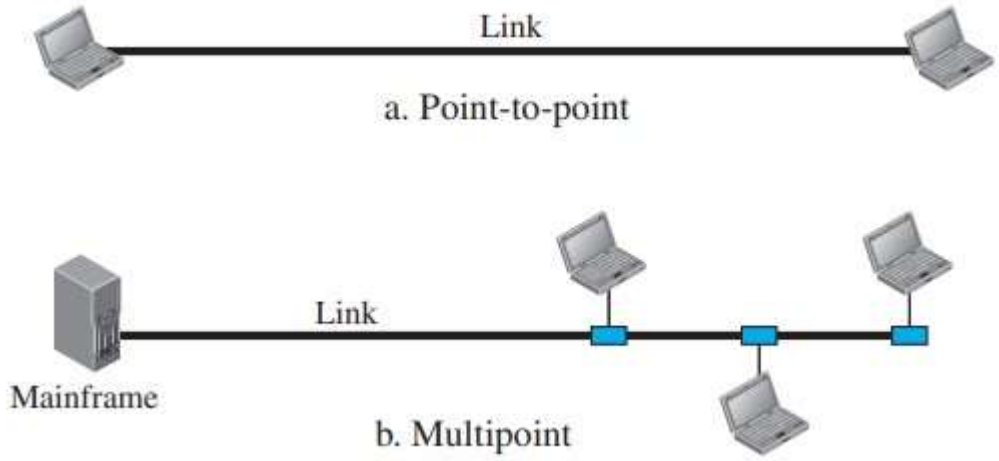
- Full-Duplex In full-duplex mode (also called duplex), both stations can transmit and receive simultaneously.

## Network Criteria

- Performance
  Can be measured in many ways
  - ✦ transit time: amount of time required for a message to travel from one device to another
  - ✦ response time: time elapsed between an inquiry and a response
  - ✦ Number of users
  - ✦ Type of transmission medium
  - ✦ Hardware capabilities and software efficiency
- Reliability
  A measure of frequency of failure and the time needed to recover, network robustness
- Security
  Protecting of data from unauthorized user

## Physical Structures

Types of connections: point-to-point and multipoint.

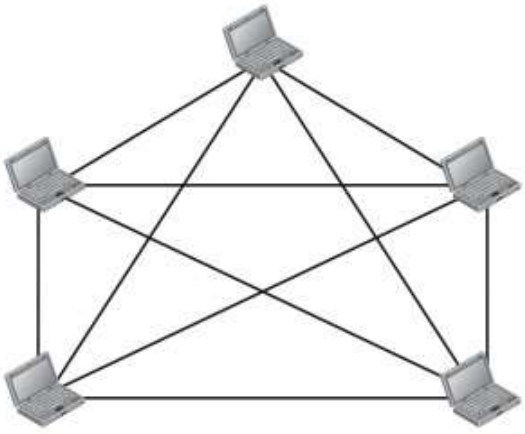



## Physical Topology

Physical topology refers to the way in which a network is laid out physically. Network topology is the geometric representation of the relationship of all the links and linking devices (nodes).

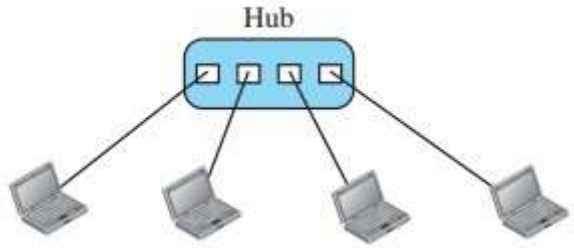
- Mesh Topology

In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.



- Star Topology

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub. The devices are not directly linked to one another.

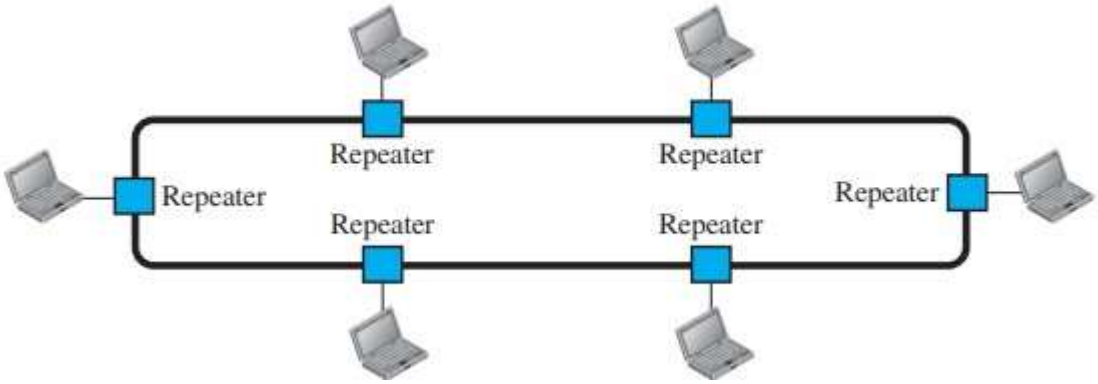



- Bus Topology

The preceding examples all describe point-to-point connections. A bus topology, on the other hand, is multipoint. One long cable acts as a backbone to link all the devices in a network.


- Ring Topology

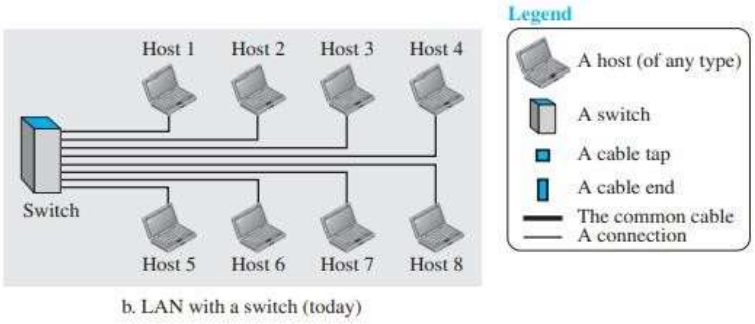
In a ring topology, each device has a dedicated point-to-point connection with only the two devices on either side of it. A signal is passed along the ring in one direction, from device to device, until it reaches its destination.




Categories of networks

- Local Area Networks (LANs) ○ Usually privately owned and links the devices in a single office, building or campus

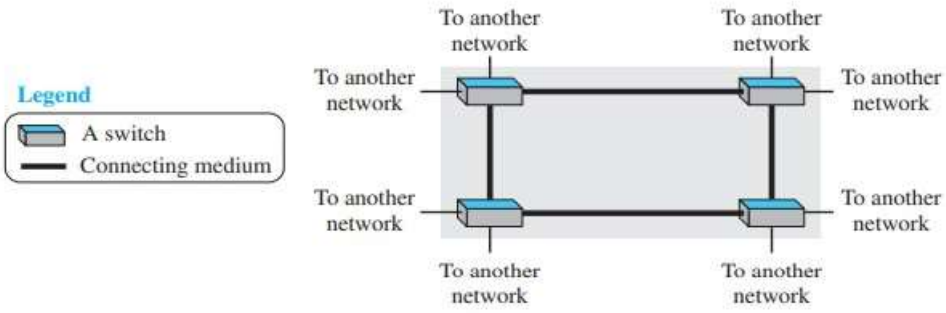
○ Most common LAN topologies are bus, ring and star ○ Speeds of 100Mbps-1Gbps



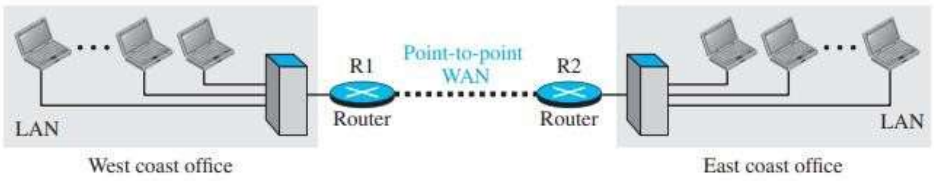

b. LAN with a switch (today)

- Metropolitan Area Networks (MANs) ○ Designed to extend over a city ○ May be owned by a large private organization or a service provider (telephone company)

- Wide Area Networks (WANs)
  - ○ Provide long-distance transmission of data, voice, image and video info over large geographical areas that may comprise a country or a continent




- Internetworks ○ When two or more networks are connected they become an internetwork or internet




## NETWORK MODELS

A network uses a combination of hardware and software to send data from one location to another

—Hardware consists of the physical equipment that carries signals from one point of the network to another

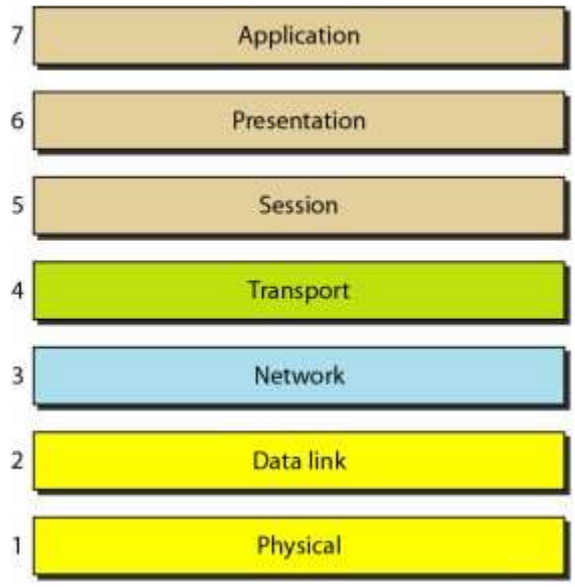
—The task of sending a piece of information from one point in the world to another can be broken into several tasks, each performed by a separate software package

- Each piece of software uses the services of another software package to do its job.
- At the lowest layer, a signal is sent from the source to the destination computer.

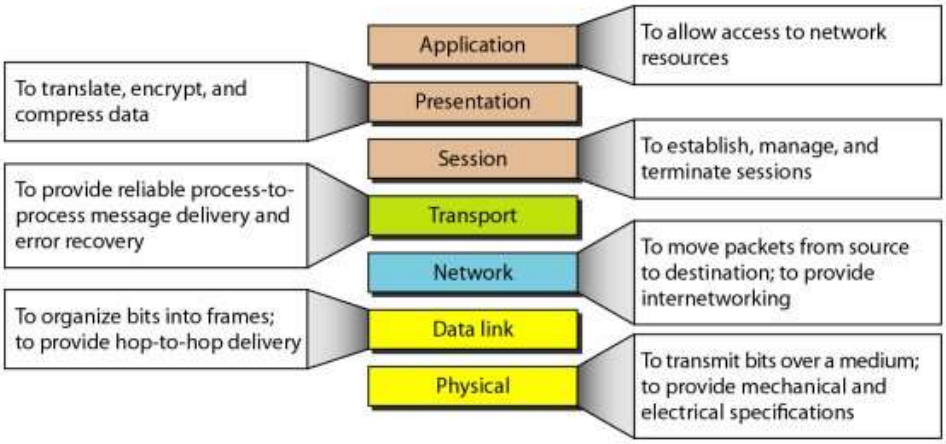
## THE OSI MODEL

Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model. It was first introduced in the late 1970s.

## Seven layers of the OSI model

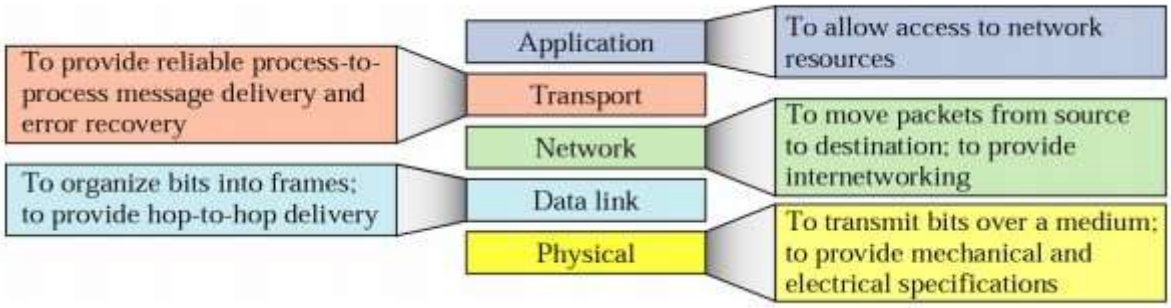



## Summary of layers




## TCP/IP PROTOCOL SUITE

The layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application.




## Difference Between TCP/IP and OSI model

| **OSI Model** | **TCP/IP Model** |
|---|---|

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| It is developed by ISO (International Standard Organization) | It is developed by ARPANET (Advanced Research Project Agency Network). |
| OSI model provides a clear distinction between interfaces, services, and protocols. | TCP/IP doesn't have any clear distinguishing points between services, interfaces, and protocols. |
| OSI refers to Open Systems Interconnection. | TCP refers to Transmission Control Protocol. |
| OSI uses the network layer to define routing standards and protocols. | TCP/IP uses only the Internet layer. |
| OSI follows a vertical approach. | TCP/IP follows a horizontal approach. |
| OSI layers have seven layers. | TCP/IP has four layers. |
| In the OSI model, the transport layer is only connectionoriented. | A layer of the TCP/IP model is both connection-oriented and connectionless. |
| In the OSI model, the data link layer and physical are separate layers. | In TCP, physical and data link are both combined as a single host-to-network layer. |
| Session and presentation layers are a part of the OSI model. | There is no session and presentation layer in the TCP model. |
| It is defined after the advent of the Internet. | It is defined before the advent of the internet. |

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| The minimum size of the OSI header is 5 bytes. | The minimum header size is 20 bytes |