e6fsplm

Chapter 1
Introduction to Computer network

Lecture 1

1-1 DATA COMMUNICATIONS

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 or wireless.

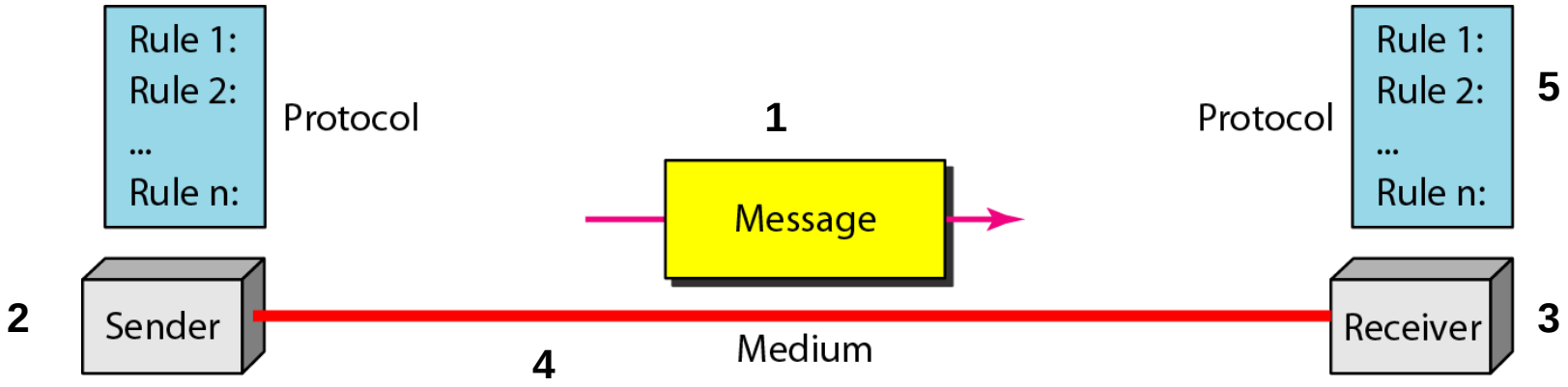
1. ***Delivery → Correct destination***
2. ***Accuracy → Accurate data***
3. ***Timelines → Real-time transmission***
4. ***Jitter → Uneven delay***

Topics discussed in this section:

Components
Data Representation
Data Flow

Components

Figure 1.1 ***Five components of data communication***

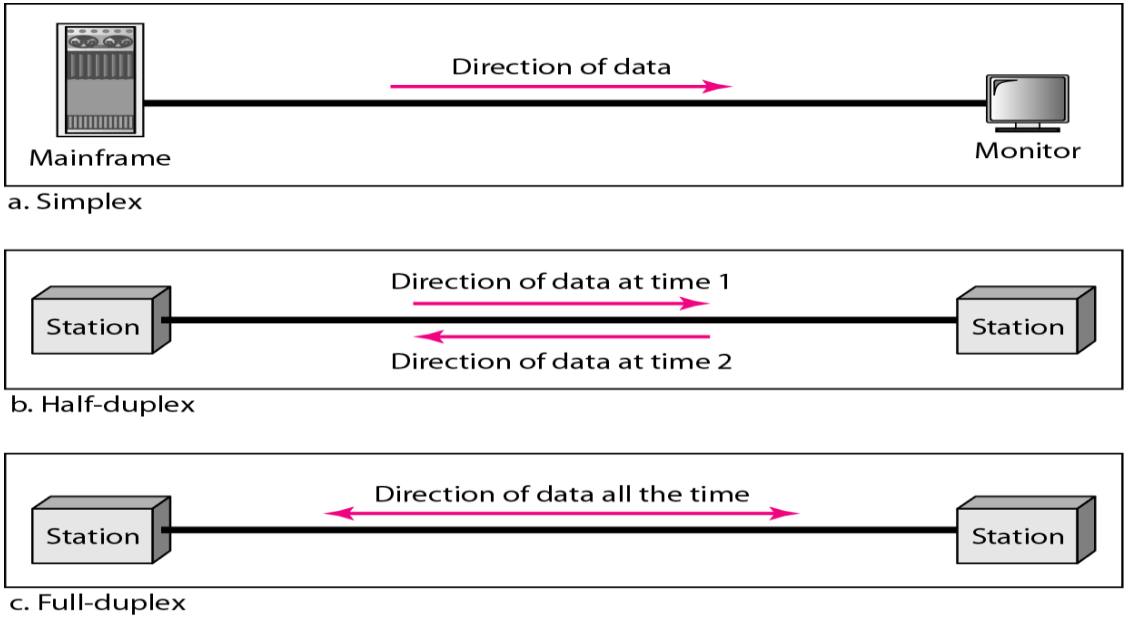


Data Representation

1. *Text*
2. *Numbers*
3. *Images*
4. *Audio*
5. *Video*

Data flow

- ***Simplex***
- ***Half-duplex***
- ***Full-duplex***



1-2 NETWORKS

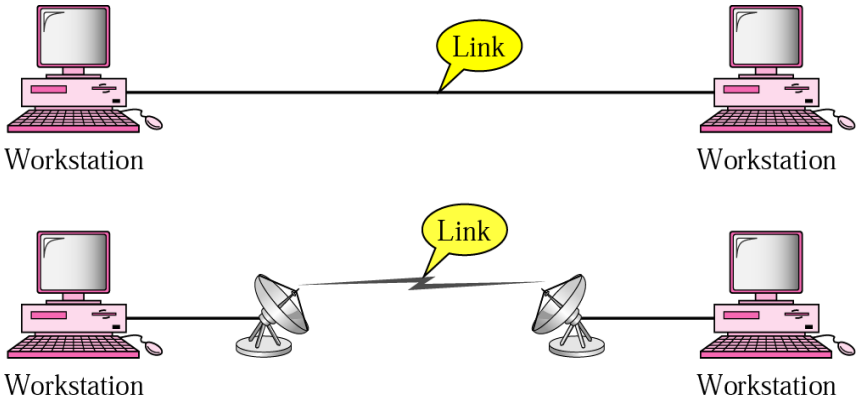
A network is a set of devices (nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

Topics discussed in this section:

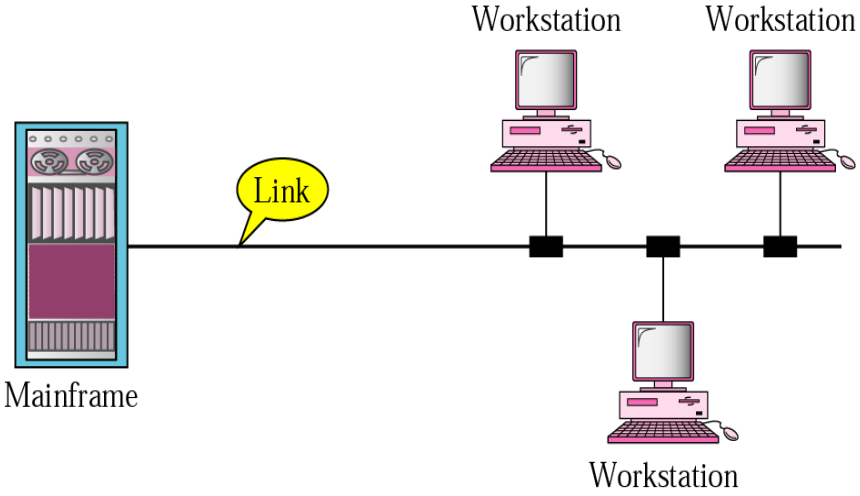
Distributed Processing
Network Criteria (performance, reliability, and security)
Physical Structures (type of connections and topologies)
Network Models
Categories of Networks (LAN, MAN and WAN)
Interconnection of Networks: Internet

Types of connections

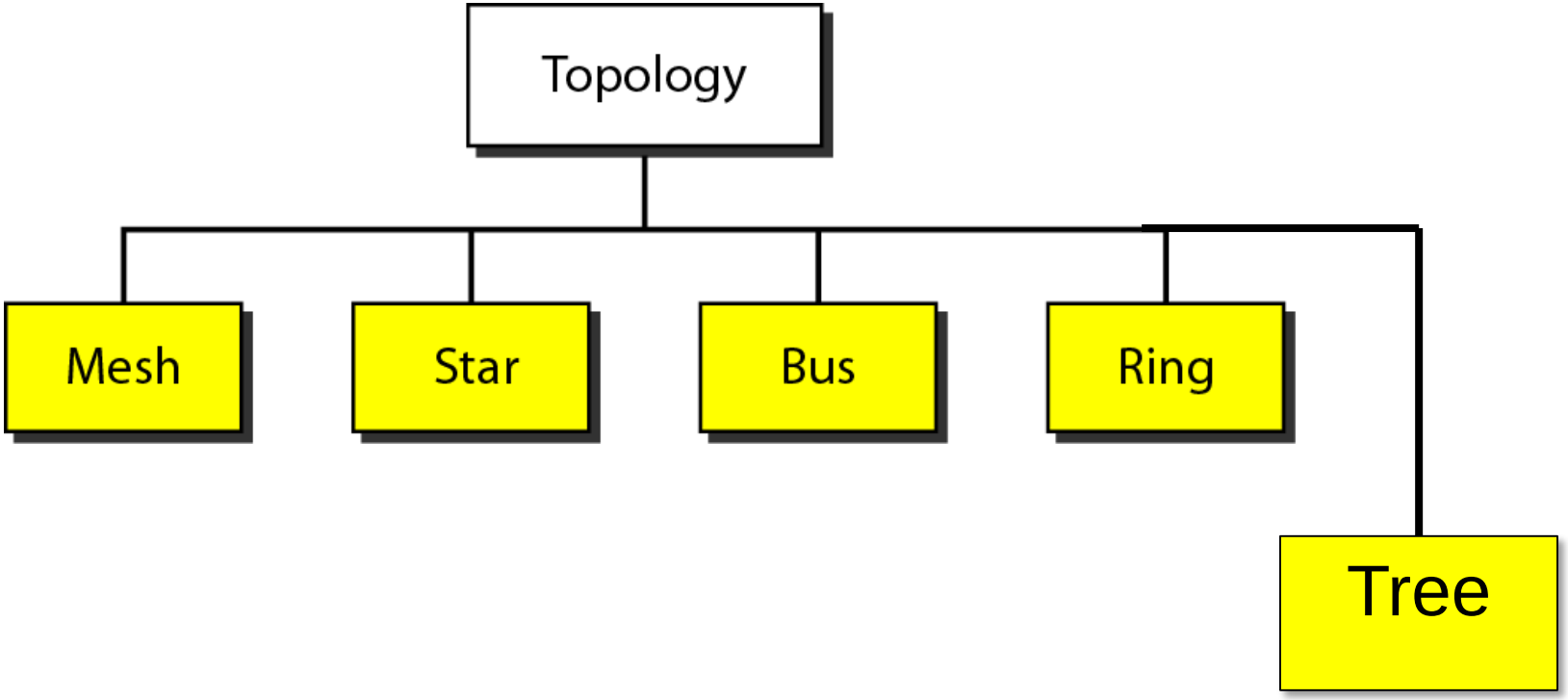
- Point to point
  - A dedicated link is provided between two devices



- Multipoint
  - More than two specific devices share a single link

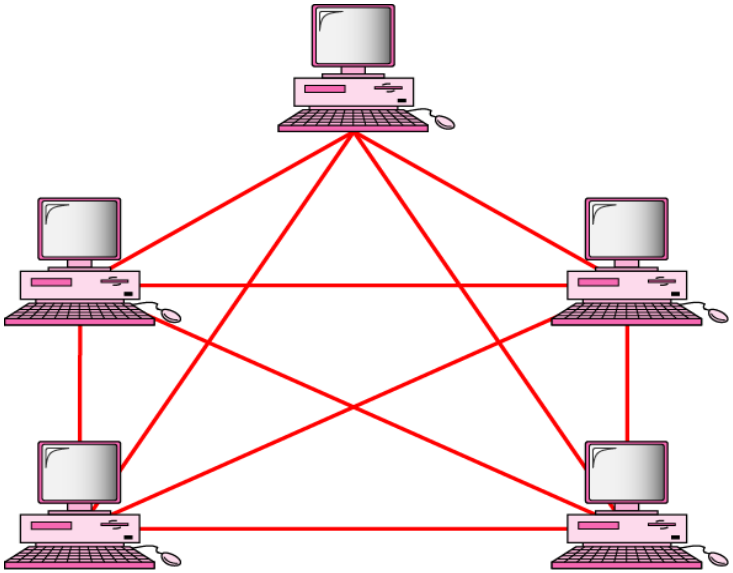


Physical Topology



MESH Topology

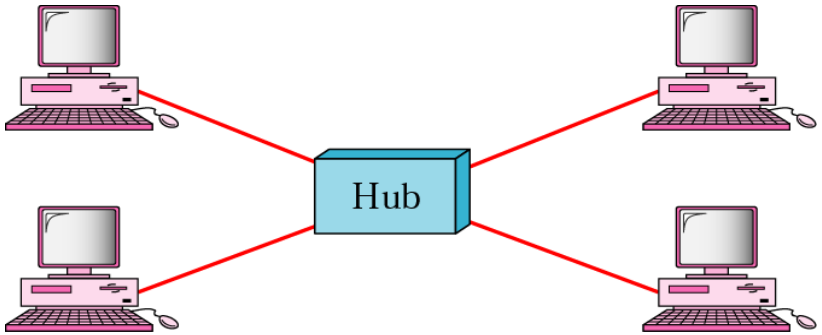
- Every device has a dedicated point-to-point link to every other devices
- Dedicated
  - Link carries traffic only between the two devices it connects
  - A fully connected mesh network has n(n-1)/2 physical channels to link n devices
  - Every device on the network must have n-1 input/output (I/O) ports
- Advantage
  - Less traffic, robust, secure, easy to maintain
- Disadvantage
  - Need more resource (cable and ports), expensive



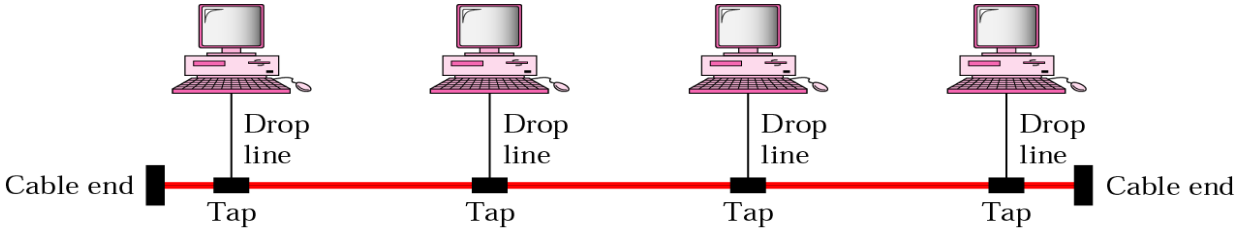
n(n-1)/2 physical duplex links

STAR Topology

- Each device has a dedicated point-to-point link only to a central controller, usually called a hub.
- No direct traffic and link between devices
- Advantages
  - Less expensive
  - Easy to install and reconfigure
  - Robustness
- Disadvantage
  - Single point of failure

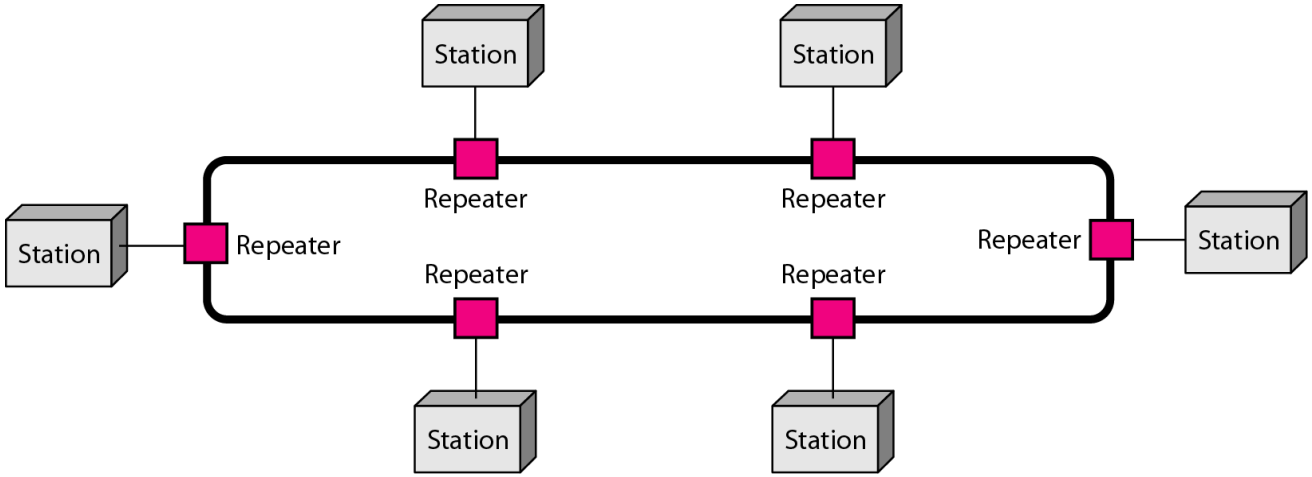


BUS Topology



- A multipoint topology
- All devices are linked through a *backbone* cable
- Nodes are connected to the bus cable by drop lines and taps.
  - Drop line
    - A connection running between the device and the main cable
  - Tap
    - A connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core
- Advantage:
  - Ease of installation
- **Disadvantages:**
    - Difficult reconnection and fault isolation
    - Broken or fault of the bus cable stops all transmission

RING Topology



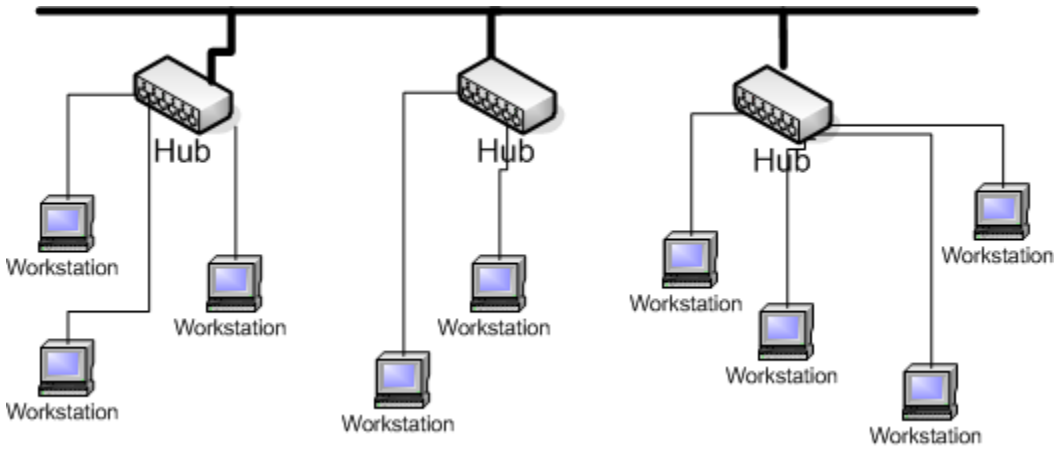
- Each device is dedicated point-to-point connection only with the two devices on either side of it
- A signal is passed along the ring in the direction, from device to device, until it reaches its destination
- Each device in the ring incorporates a repeater

- Advantages
  - Relatively easy to install and reconfigure
  - Fault isolation is simplified
- Disadvantage
  - Unidirectional traffic

Tree Topology

Tree topologies integrate multiple topologies together

Example: Tree topology integrates multiple star topologies together onto a bus



- Advantages:
  - Point-to-point wiring for individual segments.
  - Supported by several hardware and software venders.
- Disadvantages:
  - Overall length of each segment is limited by the type of cabling used.
  - If the backbone line breaks, the entire segment goes down.
  - More difficult to configure and wire than other topologies.

Categories of Networks

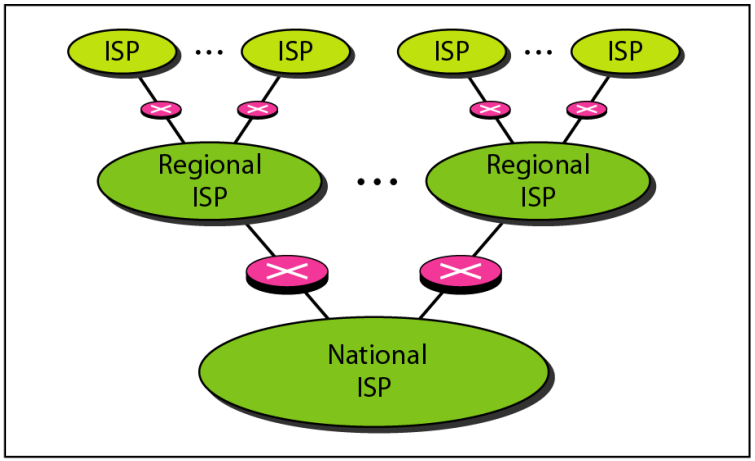
1. Local Area Network (LAN)
2. Wireless Local Area Network (WLAN)
3. Metropolitan Area Network (MAN)
4. Wide Area Network (WAN)
5. Personal Area Network (PAN)

1. Task Draw the PAN, LAN, WLAN, MAN,WAN architecture and Explain its features and implementation– Assignment -1

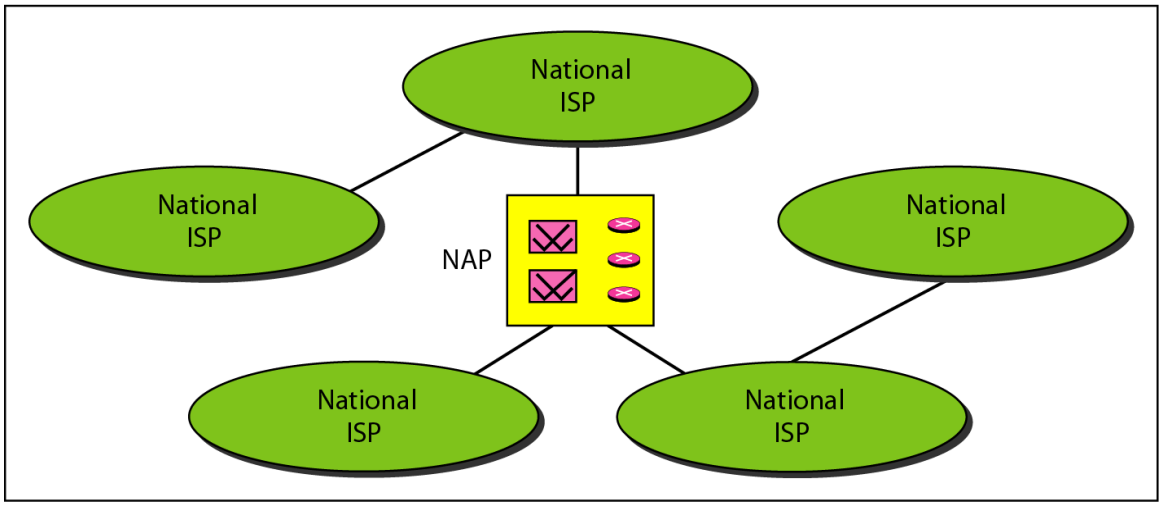
1-3 THE INTERNET

The Internet has changed many aspects of our daily lives. It has affected the way we do business as well as the way we spend our leisure time. The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

Hierarchical organization of the Internet



a. Structure of a national ISP



b. Interconnection of national ISPs

1-4 PROTOCOLS AND STANDARDS

***protocols* and *standards*.**

Protocol is synonymous with rule.
Standards are agreed-upon rules.

Topics discussed in this section:

Protocols
Standards
Standards Organizations
Internet Standards

PROTOCOLS AND STANDARDS

Protocols

- **Syntax → format of the data**
- **Semantics → meaning of each section**
- **Timing → when data should be sent and how fast.**

Standards

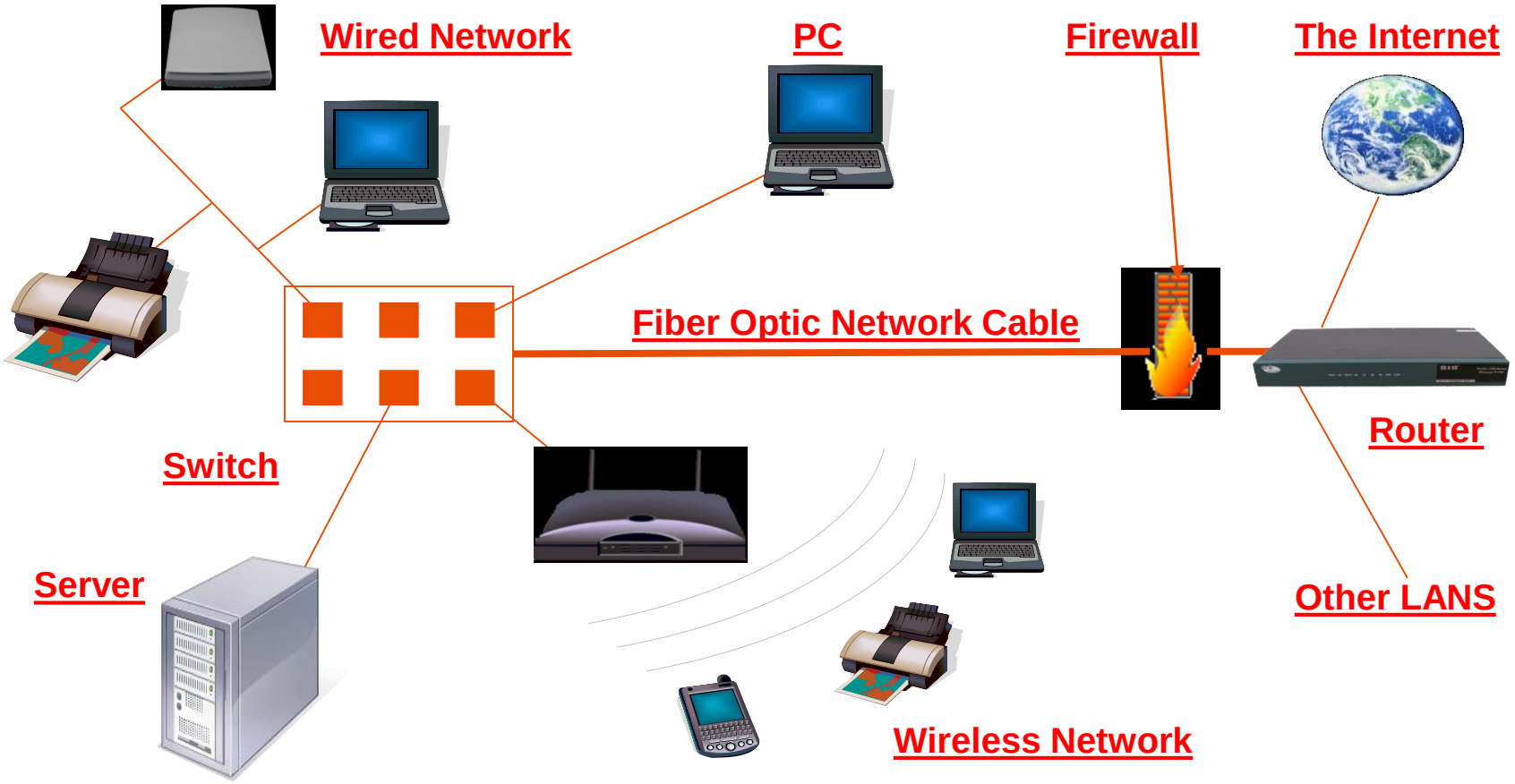
- **fact**
- **Law**

PROTOCOLS AND STANDARDS

Standards Organizations

- International Organization for Standardization (ISO)
- International Telecommunication Union - Telecommunication Standards (ITU-T)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Electronic Industries Association (EIA)

The Network Diagram



The Networking Devices

1. **NIC Card**
2. **Repeater**
3. **Hub**
4. **Switch**
5. **Bridge**
6. **Router**
7. **Gateway**
8. **Firewall**

Explain the above terms with its features and implementation and also draw their diagrams– Assignment -2

Network Media

The function of the media is to carry a flow of information through a LAN.

A. Wired Media:- A widely adopted *family* that uses copper and fiber media in local area network (LAN) technology are collectively known as Ethernet

1. **Copper Cable**
   a. **Coaxial Cables**
   b. **Shielded Twisted Pair(STP)**
   c. **Unshielded Twisted Pair**

2. **Fibre Optic Cable**

B. Wireless Media:- use the atmosphere, or space, as the medium.

Physical Media Comparison

	Twisted Pair	Coaxial	Fiber Optic	Wireless LAN
Bandwidth	Up to 1 Gbps	10–100 Mbps	Up to 10 Gbps or higher	Up to 54 Mbps
Distance	Up to 100 m	Up to 500 m	Up to 60 km	Up to 100 m
Price	Least expensive	Inexpensive	Most expensive	Moderate

Network Models

Lecture 2

OSI Model

1-5.1 THE OSI MODEL

Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards.

An ISO is the Open Systems Interconnection (OSI) model is the standard that covers all aspects of network communications from ISO. It was first introduced in the late 1970s.

Layered Architecture

Layers

Layer 7. Application

Layer 6. Presentation

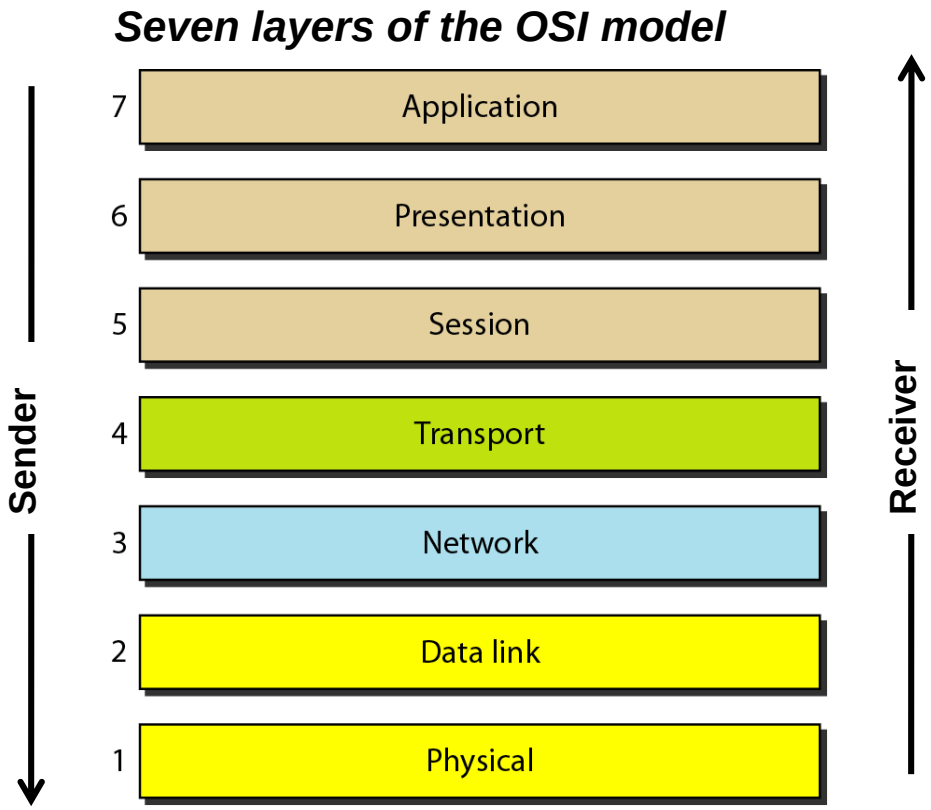
Layer 5. Session

Layer 4. Transport

Layer 3. Network

Layer 2. Data Link

Layer 1. Physical



Summary of layers

OSI Model			
	Data unit	**Layer**	**Function**
User support layers	Data	7. Application	Network process to application
		6. Presentation	Data representation and encryption
		5. Session	Inter-host communication
User⇔ Network	Segment	4. Transport	End-to-end connections and reliability
Network support layers	Packet	3. Network	Path determination and logical addressing
	Frame	2. Data Link	Physical addressing
	Bit	1. Physical	Media, signal and binary transmission

Sender ↓

↑ Receiver

Physical Layer

The physical layer is responsible for movements of individual bits from one hop (node) to the next.

- Function
  - Physical characteristics of interfaces and media
  - Representation of bits
  - Data rate
  - Synchronization of bits
  - Line configuration (point-to-point or multipoint)
  - Physical topology (mesh, star, ring or bus)
  - Transmission mode (simplex, half-duplex or duplex)

Data Link Layer

The data link layer is responsible for moving frames from one hop (node) to the next. Hope to hope delivery

- Function
  - Framing
  - Physical addressing
  - Flow control
  - Error control
  - Access control

Network Layer

The network layer is responsible for the delivery of individual packets from the source host to the destination host.

- Source-to-destination delivery
- Responsible from the delivery of packets from the original source to the final destination
- Functions
  - Logical addressing
  - routing

Transport Layer

The transport layer is responsible for the delivery of a message from one process to another.

- Process-to- process delivery
- Functions
  - Segmentation and reassemble
  - Connection control (Connection-oriented or connection-less)
  - Flow control
  - Error control

Session Layer

The session layer is responsible for dialog control and synchronization.

- **It establishes, maintains and synchronize the interaction between communicating system**
- **Function**
  - **Synchronization (checkpoints)**

Presentation Layer

The presentation layer is responsible for translation, compression, and encryption.

- **Concerned with the syntax and semantics of the information exchanged between two system**
- **Functions**
  - **Translation** (EBCDIC-coded text file → ASCII-coded file)
  - **Encryption and Decryption**
  - **Compression**

Application Layer

The application layer is responsible for providing services to the user.

- Functions
  - Remote log-in
  - File transfer and access
  - Mail services
  - Accessing the World Wide Web

Network Models

Lecture 3

TCP/IP Model

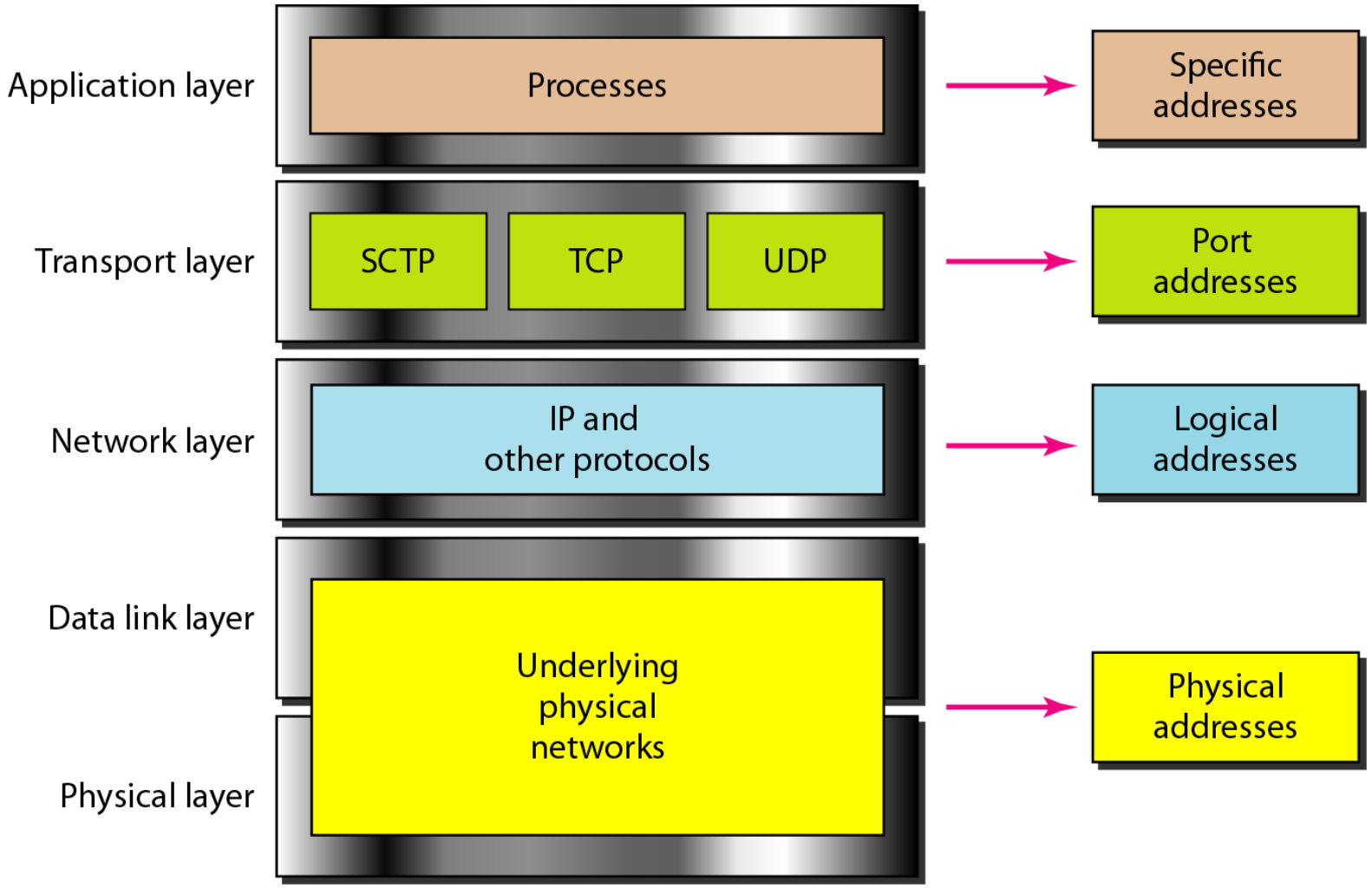
1-5.2 TCP/IP PROTOCOL SUITE

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.

Topics discussed in this section:

Physical and Data Link Layers
Network Layer
Transport Layer
Application Layer

Relationship of layers and addresses in TCP/IP



TCP/IP	OSI
Implementation of OSI model	Reference model
Model around which Internet is developed	This is a theoretical model
Has only 4 layers	Has 7 layers
Considered more reliable	Considered a reference tool
Protocols are not strictly defined	Stricter boundaries for the protocols
Horizontal approach	Vertical approach
Combines the session and presentation layer in the application layer	Has separate session and presentation layer
Protocols were developed first and then the model was developed	Model was developed before the development of protocols
Supports only connectionless communication in the network layer	Supports connectionless and connection-oriented communication in the network layer
Protocol dependent standard	Protocol independent standard

Here are some cons/ drawbacks of using OSI Model:

- Fitting of protocols is a tedious task.
- You can only use it as a reference model.
- It doesn’t define any specific protocol.
- In the OSI network layer model, some services are duplicated in many layers such as the transport and data link layers
- Layers can’t work in parallel as each layer need to wait to obtain data from the previous layer.

Here, are few drawbacks of using the TCP/IP model:

- TCP/IP is a complicated model to set up and manage.
- The shallow/overhead of TCP/IP is higher-than IPX (Internetwork Packet Exchange).
- In this, model the transport layer does not guarantee delivery of packets.
- Replacing protocol in TCP/IP is not easy.
- It has no clear separation from its services, interfaces, and protocols.