Networking Principles and layered architecture

NETWORK AND COMMUNICATION

By – Mr. A. Swaminathan, VIT Chennai

Theory_Class 1

Outline (Syllabus)

- Data Communications and Networking
- Communications Model
- Evolution of network
- Requirements
- Data Flow
- Applications
- Network Topology
- Line configuration
- Protocols and Standards
- Network Models (OSI, TCP/IP)

Text and Reference

Text Books

- Computer Networks: A Systems Approach, Larry Peterson and Bruce Davie, 5th Ed, The Morgan Kaufmann Series, Elsevier, 2011.
- Computer Networking: A Top-Down Approach Featuring the Internet, J.F.Kurose and K.W.Ross, 6th Ed., Pearson Education,2012.

Reference Books

- Data Communications and Networking, Behrouz A. Forouzan, McGraw Hill Education, 5th Ed., 2012
- TCP/IP Protocol Suite, Behrouz A. Forouzan,McGraw-Hill Education, 4 Ed., 2009
- Data and Computer Communications, William Stallings, Pearson Education,10th Ed,2013.

Overview

- Communication
- Network
- Evolution of Networks
- Data Communication
- Components of Data Communication
- Network Criteria

Communication?

Communication

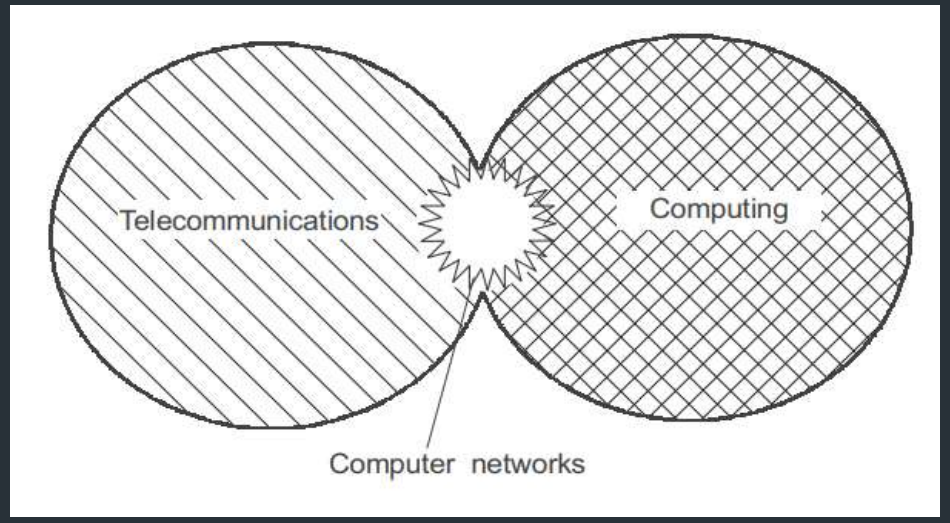
1. Sharing of information
2. Data?
3. Information?
4. Olden days
5. Modern

NETWORK?

- Batch processing - set of serial lines – Mainframe
- Telephone
- Cable
- Computer Networks
  - Interconnected things
  - Commonalities
  - Many data types
  - Support
  - Ever growing range of applications

Evolution of Networks

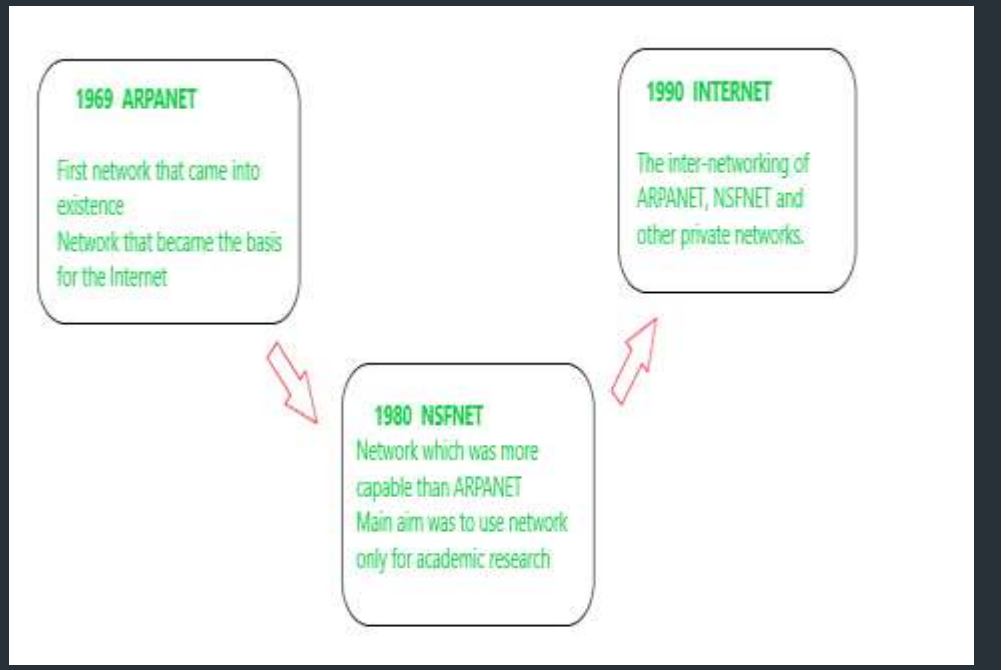
- Need?
- Batch Processing - 1950
- Advanced Research Agency Network (ARPANET) – 1969 US DoD
- National Science Federation Network (NSFNET) – 1980's
- Interspace



Source: Data Communications and Networking – Behrouz A. Forouzan

ARPANET + NSFNET + PRIVATE NETWORKS = INTERNET

Evolution of Networks (Cont.)



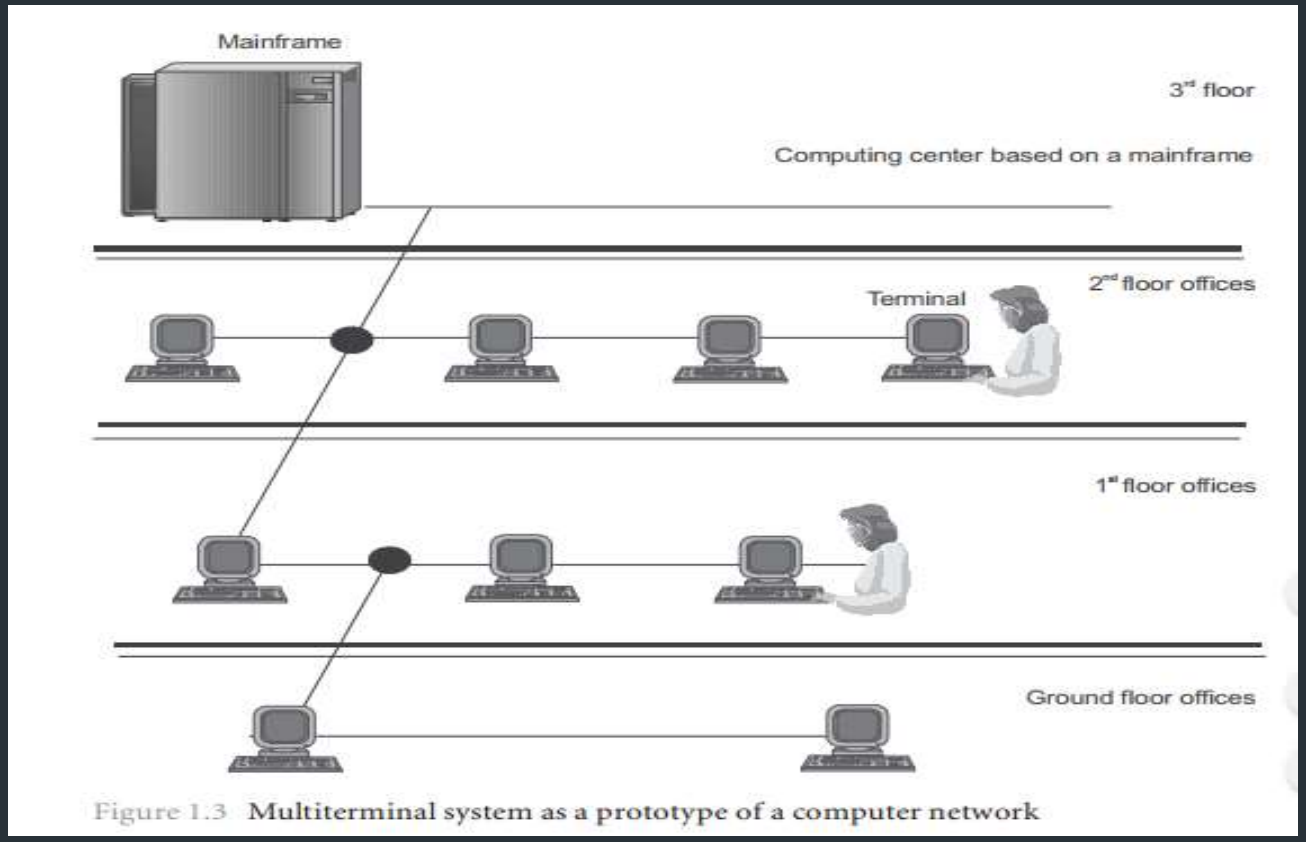


Figure 1.3 Multiterminal system as a prototype of a computer network

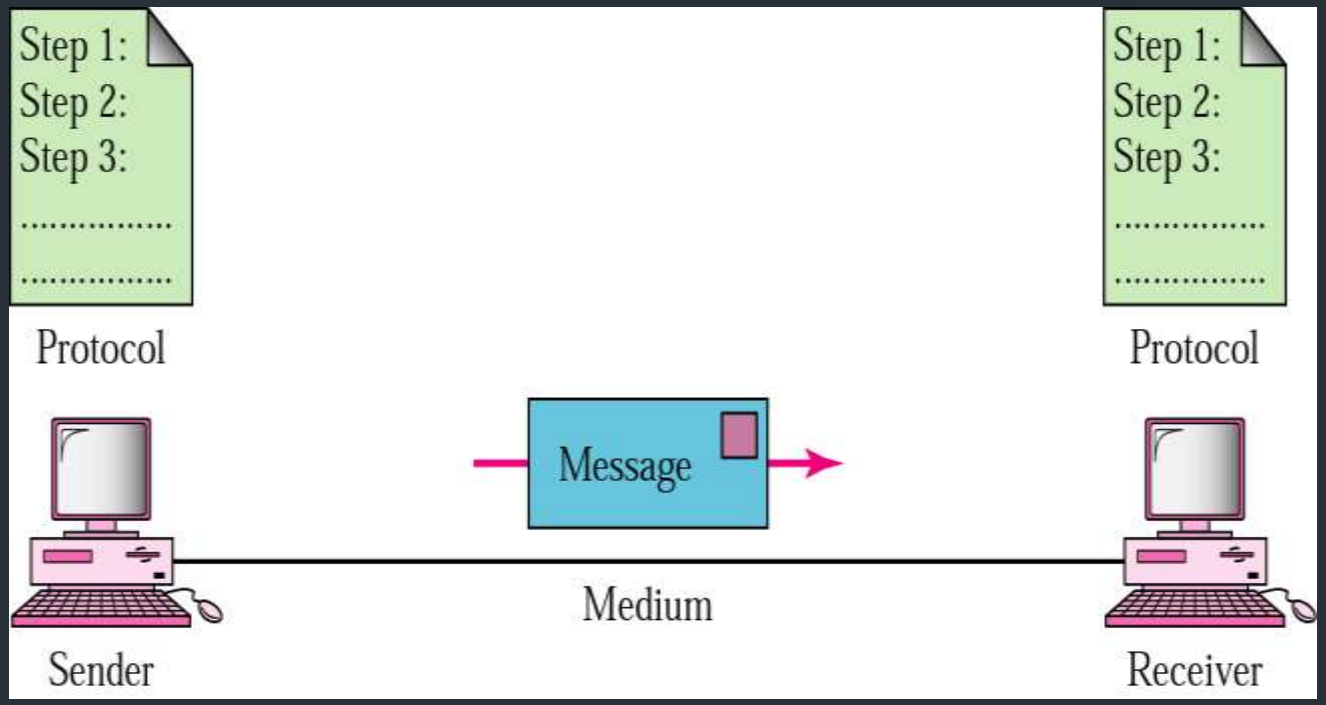
Source: Data Communications and Networking – Behrouz A. Forouzan

Data Communication

- Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.
- Characteristics
  - For effective data communication
    - Delivery
    - Accuracy
    - Timeless
- Aspects
  - Transmission Media
    - Wired
    - Wireless
  - Protocols

Components of Data Communication

- Message
- Sender
- Receiver
- Medium
- Protocol
- Realtime Components
  - Modem – Modulation and Demodulation
  - Multiplexer and Demultiplexer



Source: Data Communications and Networking – Behrouz A. Forouzan

Components of data communication

- Message : It is the data to be communicated. It consists of text, numbers, pictures, sound, or video or any combination of these.
- Sender : It is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera.
- Receiver : It is the device that receiver the message. It can be a computer, workstation, telephone, and television.
- Medium : Transmission medium is the physical path by which a message travels from sender to receiver. Example it consists of twisted pair wire, co axial cable, fiber optical, laser or radio waves.
- Protocol: It is a set of rules that govern data communication. Without a protocol two devices are connected but not communicated.

How to built a Network

- Requirements of applications
- Network Architecture
- Implementation
- Evaluation of performance

Network Criteria

- Performance
  - Depends on Network Elements
  - Measured in terms of Delay and Throughput
- Reliability
  - Failure rate of network components
  - Measured in terms of availability/robustness
- Security
  - Data protection against corruption/loss of data due to:
  - Errors
  - Malicious users

References

- Forouzan Behrouz, A. "Data Communication and networking." (2008).
- Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier, 2007.
- Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
- Web Links as mentioned in source

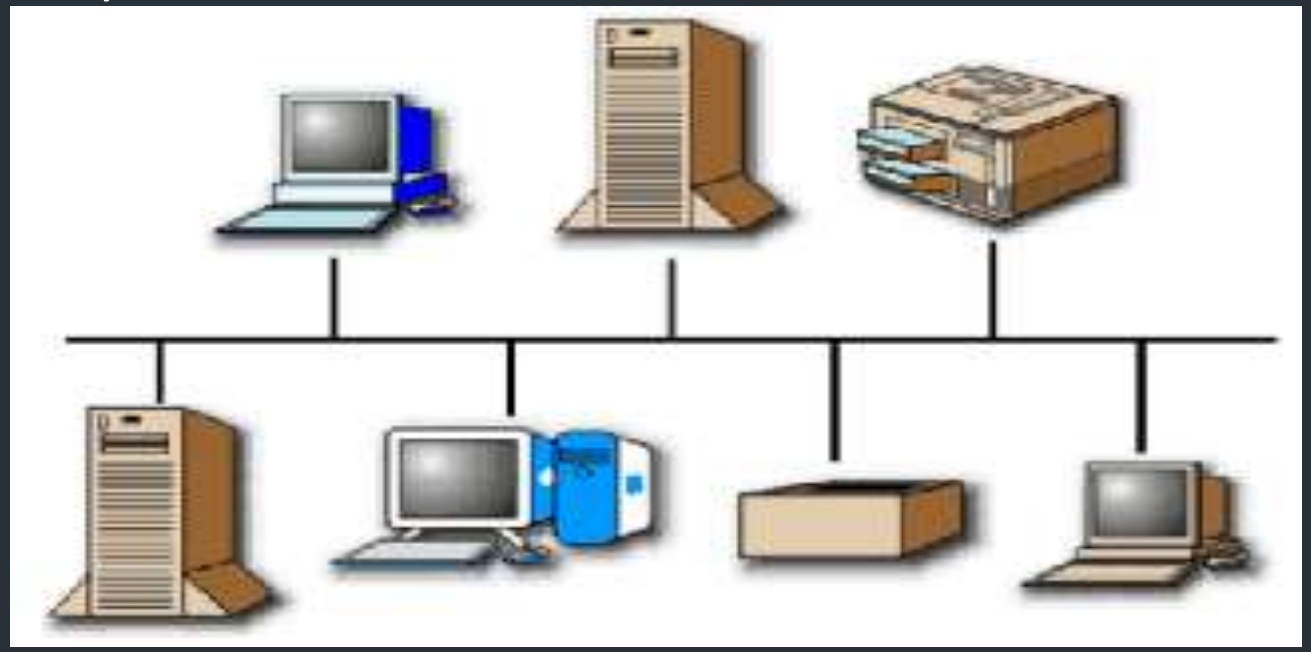
Theory_Class 2

Overview

- Network
- Hardware Components
- Data flow
- Internet
- Applications
- Benefits
- Issues

What is a Network?

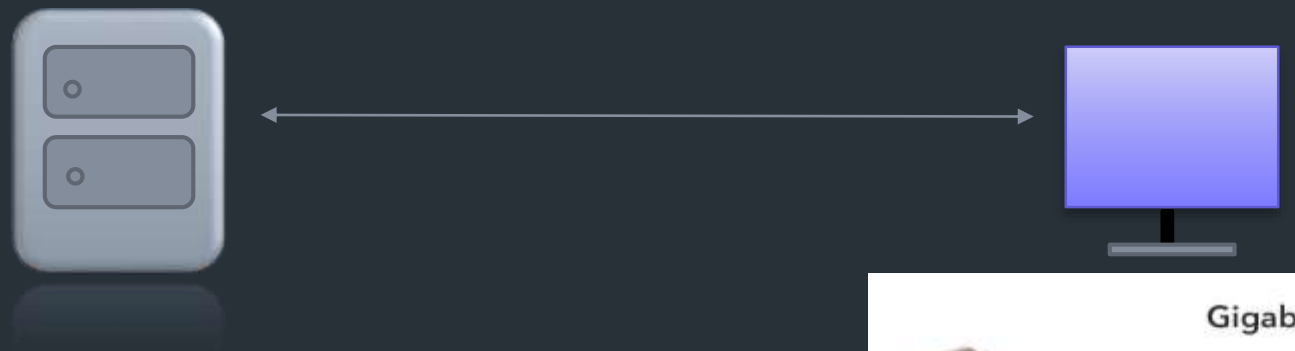
- A network is a set of devices (node) connected by media links.
- A computer network may be defined as an interconnected collection of autonomous computers.
- A network is a collection of computers, printers, routers, switches, and other devices that are able to communicate with each other over some transmission media.



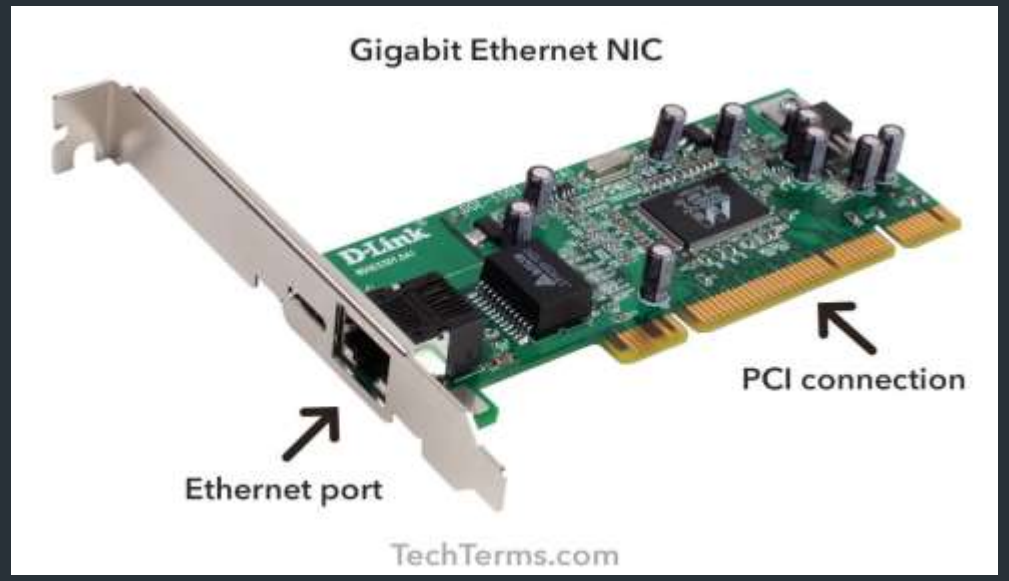
Source: Data Communications and Networking – Behrouz A. Forouzan

Hardware Components

1. Terminals (Computer, Mobile, Tablet, Printer, Server & Etc.)



2. NIC
   - Data -> electrical/light/radio
   - Types
     - Wired
     - Wireless



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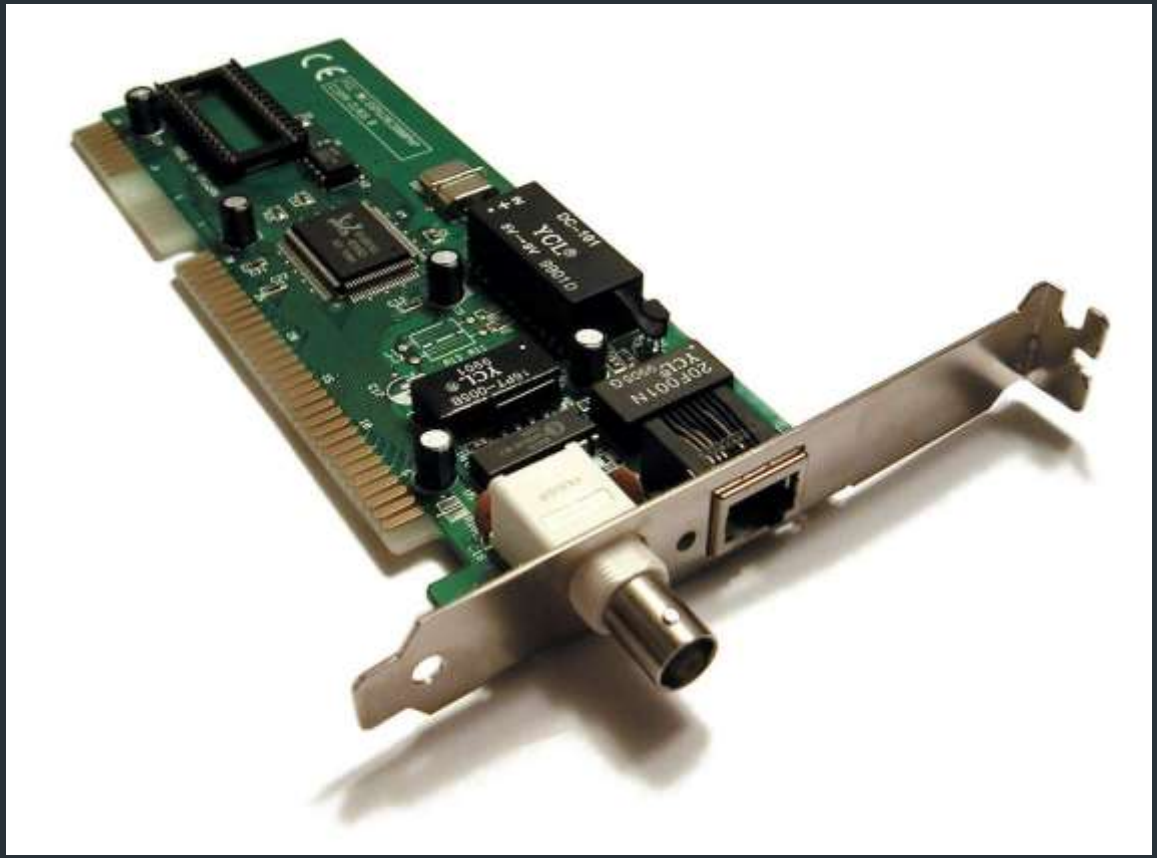
Hardware Components (Cont…)

2. NIC



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Hardware Components (Cont…)

3. LOS

4. NOS

Os – manages network devices

Ex. Cisco IOS, DellNOS

Hardware Components (Cont…)

5. HUB

Source: https://www.google.com/search?q=HUB&tbm=isch&ved=2ahUKEwjdpYSimdnqAhX_7TgGHdMqCDQQ2-cCegQIABAA&oq=HUB&gs_lcp=CgNpbWcQAzIHCAAQsQMQQzICCAAyAggAMgUIABCxAzIFCAAQsQMyBQgAELEDMgIIADIFCAAQsQMyBQgAELEDMgIIADoECCMQJzoECAAQQ1CpmAhYvJoIYMCeCGgAcAB4AIABxwGIAfsDkgEDMC4zmAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=gywUX53YPP_b4-EP09WgoAM&bih=608&biw=1366

Hardware Components (Cont…)

6. SWITCH

Source: https://www.google.com/search?q=SWITCH&tbm=isch&ved=2ahUKEwjx-LfjmdnqAhUw7TgGHfmWBzAQ2-cCegQIABAA&oq=SWITCH&gs_lcp=CgNpbWcQAzIECCMQJzIHCAAQsQMQQzIECAAQQzIECAAQQzIFCAAQsQMyBAgAEEMyBAgAEEMyBQgAELEDMgUIABCxAzIECAAQQ1COuQZYrMUGYPXHBmgAcAB4AIABvAGIAZEHkgEDMC42mAEAoAEBqgELZ3dzLXdpei1pbWfAAQE&sclient=img&ei=DS0UX7G-CbDa4-EP-a2egAM&bih=608&biw=1366

Hardware Components (Cont…)

7. BRIDGE

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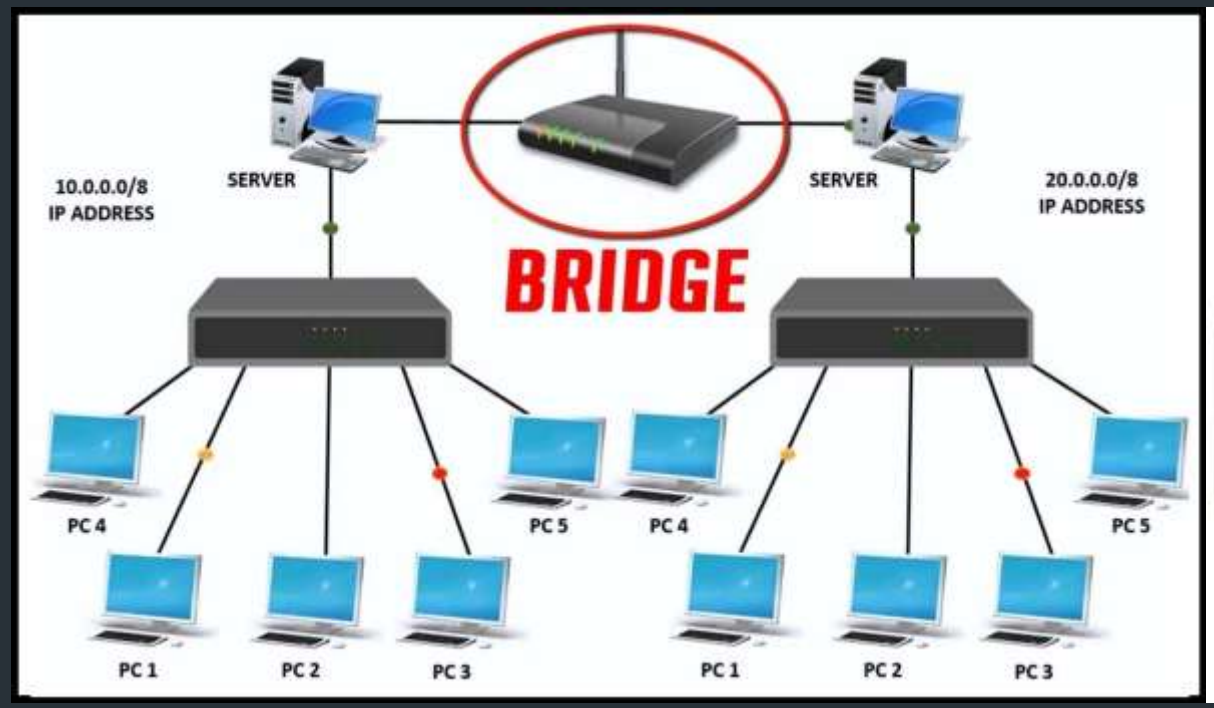
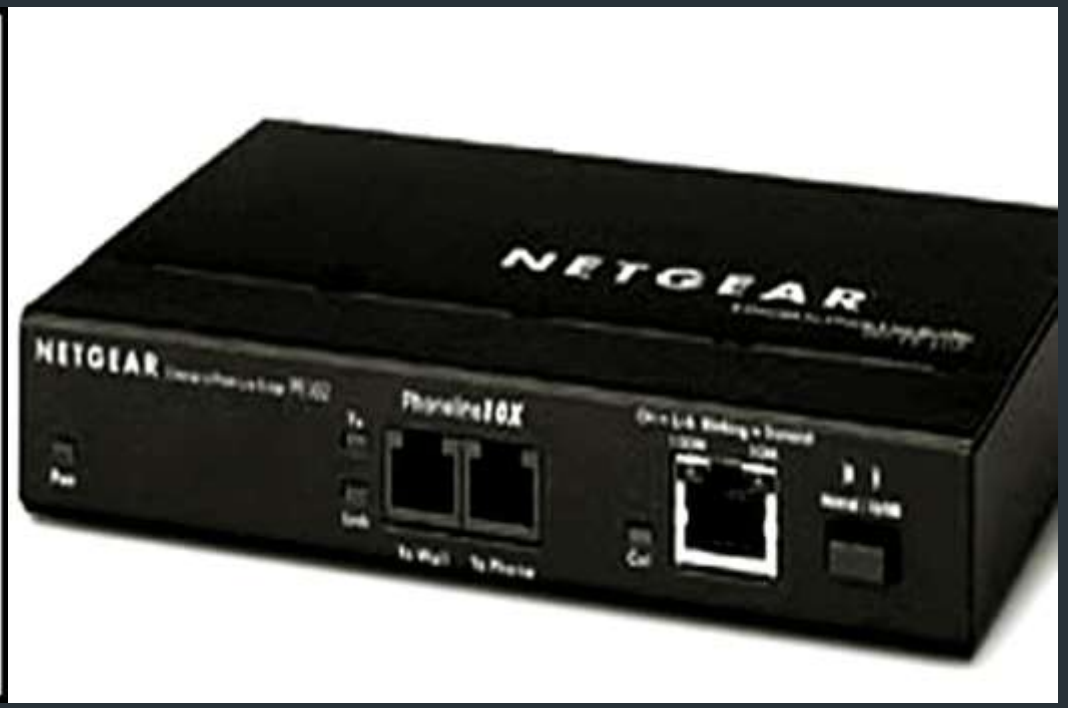
Hardware Components (Cont…)

7. BRIDGE





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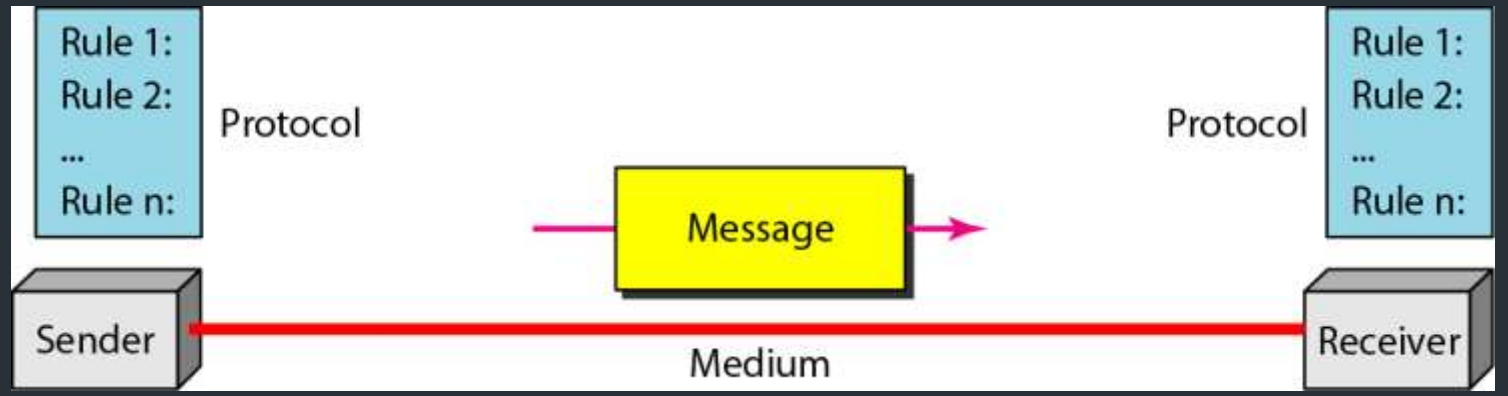
Hardware Components (Cont…)

8. ROUTER

Source: https://www.google.com/search?q=ROUTER&tbm=isch&ved=2ahUKEwjIjKHBmtnqAhWfwnMBHZXUB-YQ2-cCegQIABAA&oq=ROUTER&gs_lcp=CgNpbWcQAzIECCMQJzIECAAQQzIECAAQQzIECAAQQzIECAAQQzIECAAQQzIECAAQQzIECAAQQzICCAAyBAgAEEM6BQgAELEDUJfzAVji-gFg4_sBaABwAHgAgAGwAYgBlAaSAQMwLjWYAQCgAQGqAQtnd3Mtd2I6LWltZ8ABAQ&sclient=img&ei=0S0UX4jgN5-Fz7sPlamfsA4&bih=608&biw=1366

Directions of data flow

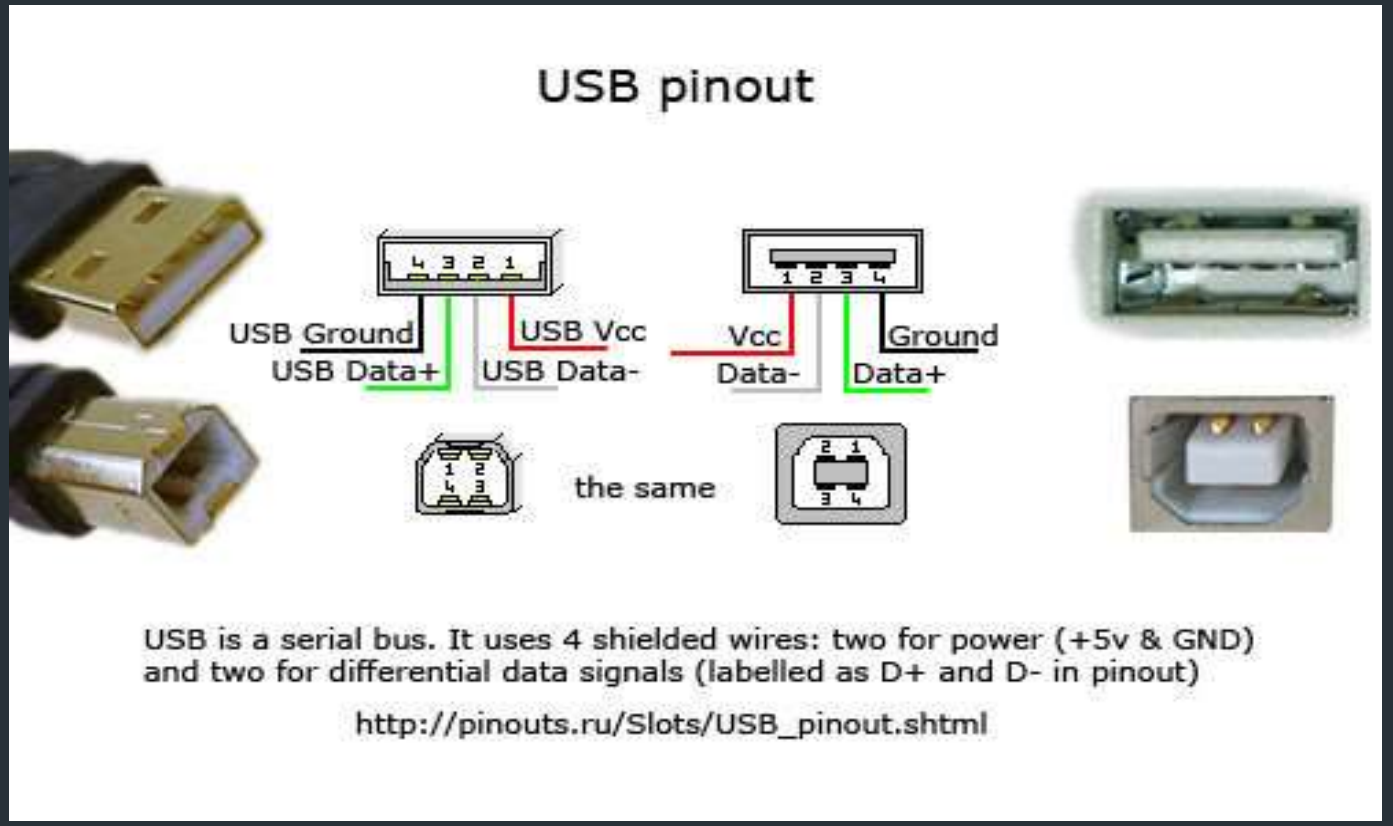
- Signal flow Direction



Source: Data Communications and Networking – Behrouz A. Forouzan

- Types
  - Simplex (Unidirectional) realtime ex
  - Duplex (Bi-directional). real time ex
    - Half duplex – 2 wire. real time ex
    - Full Duplex – 4 wire. real time ex
    - Full/Full Duplex. real time ex

USB



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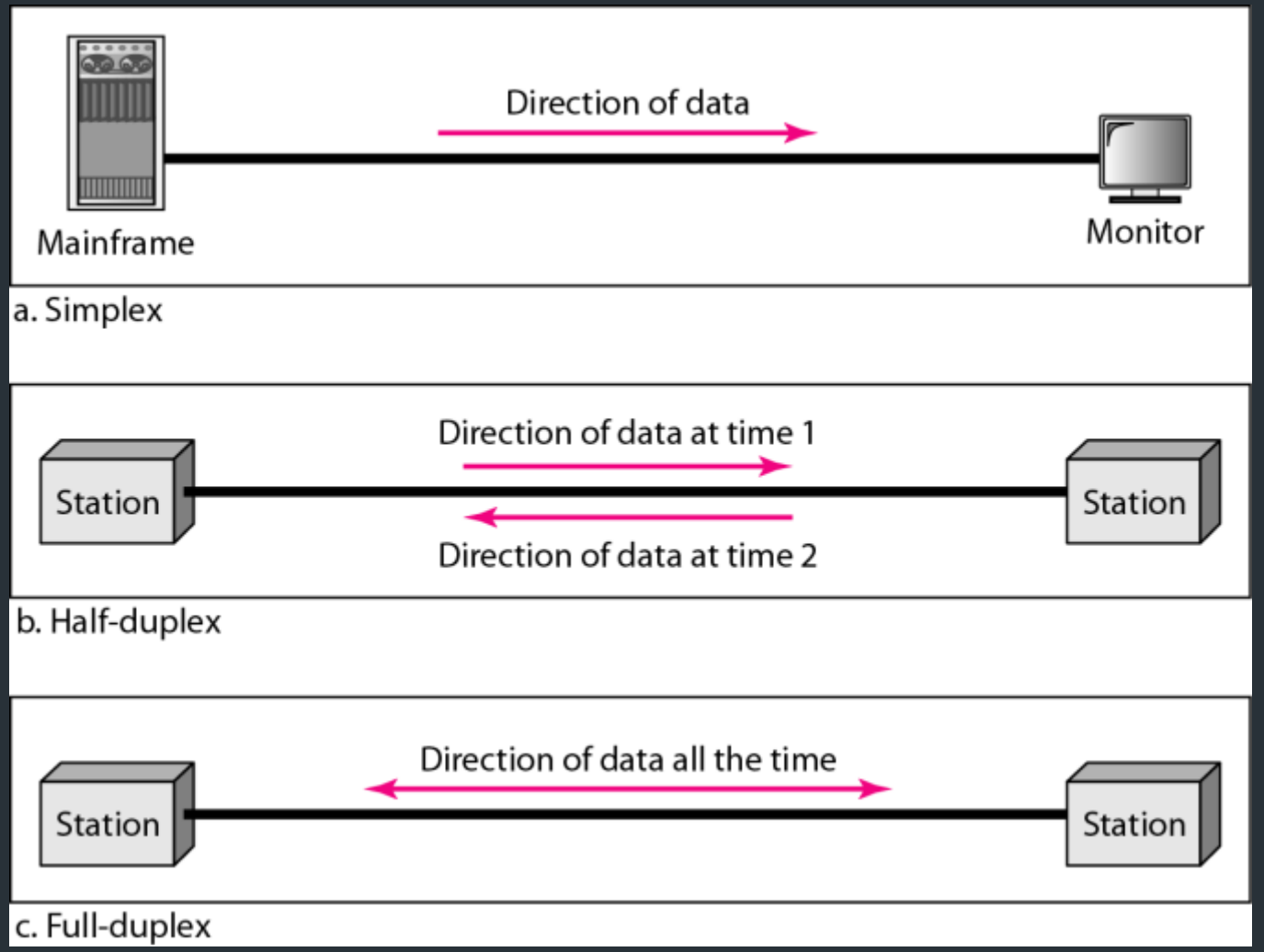
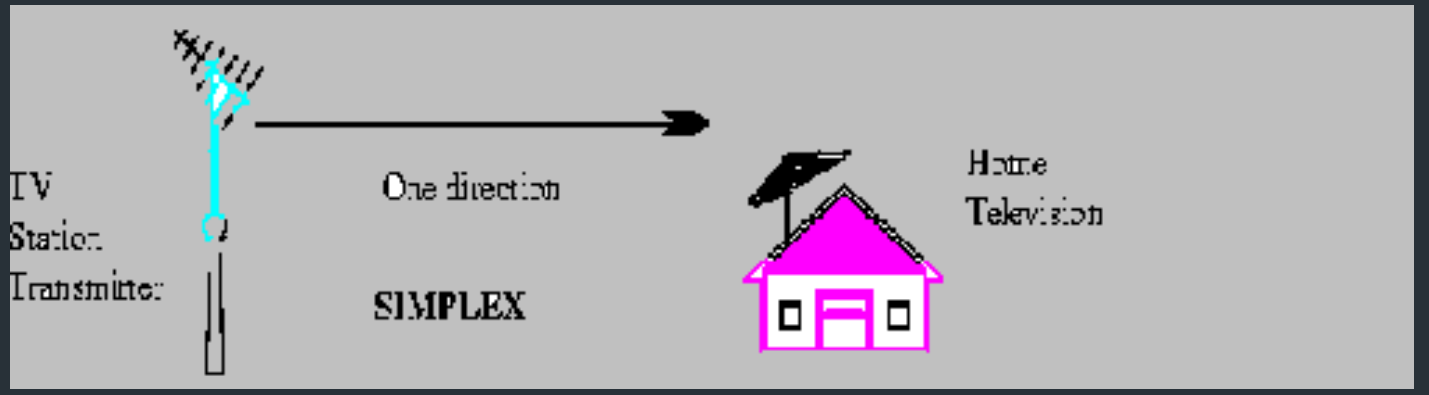
Directions of data flow (Cont.)



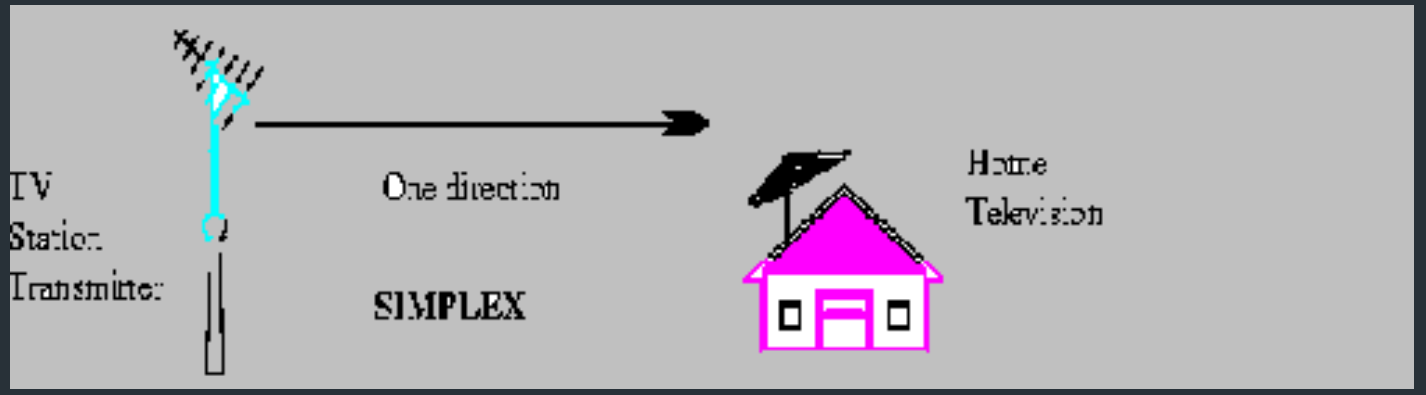
Source: Data Communications and Networking – Behrouz A. Forouzan

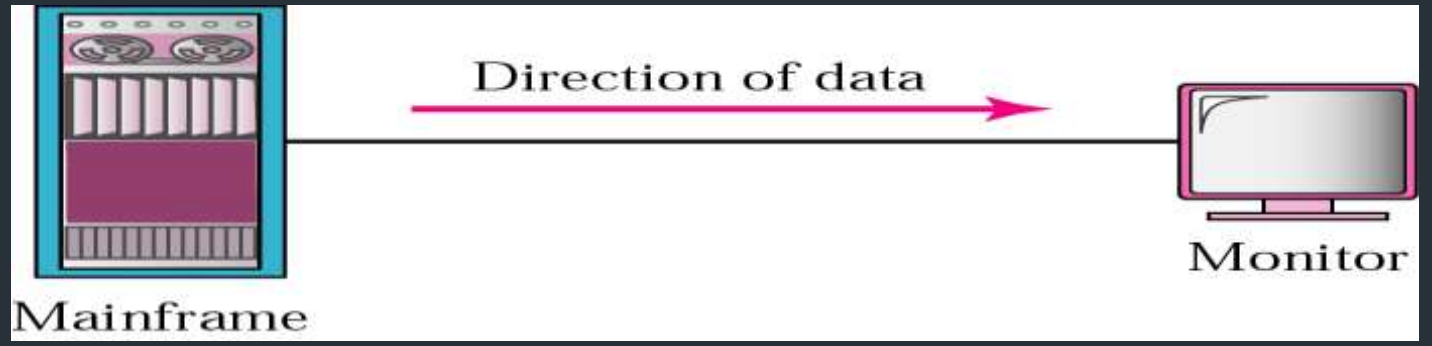
Simplex



Source: Data Communications and Networking – Behrouz A. Forouzan

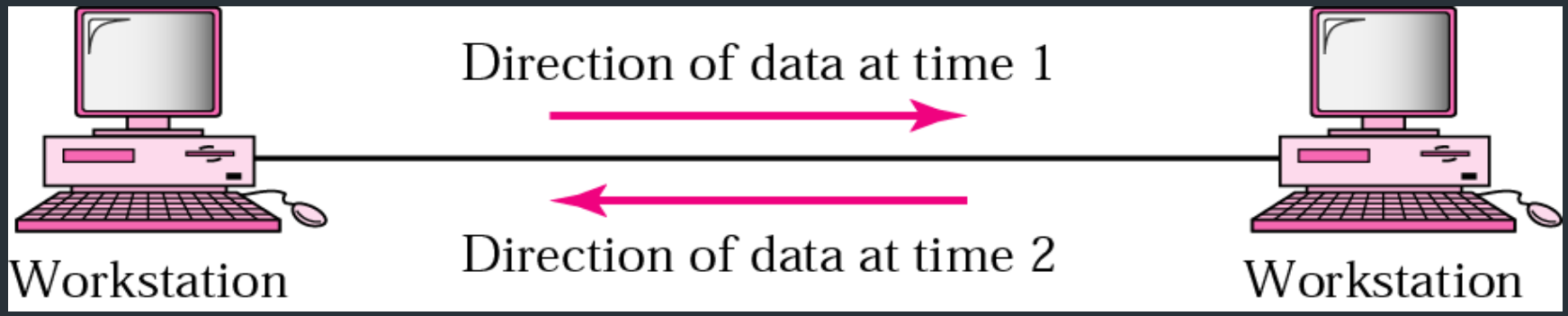
Half Duplex





Source: Data Communications and Networking – Behrouz A. Forouzan

Full Duplex



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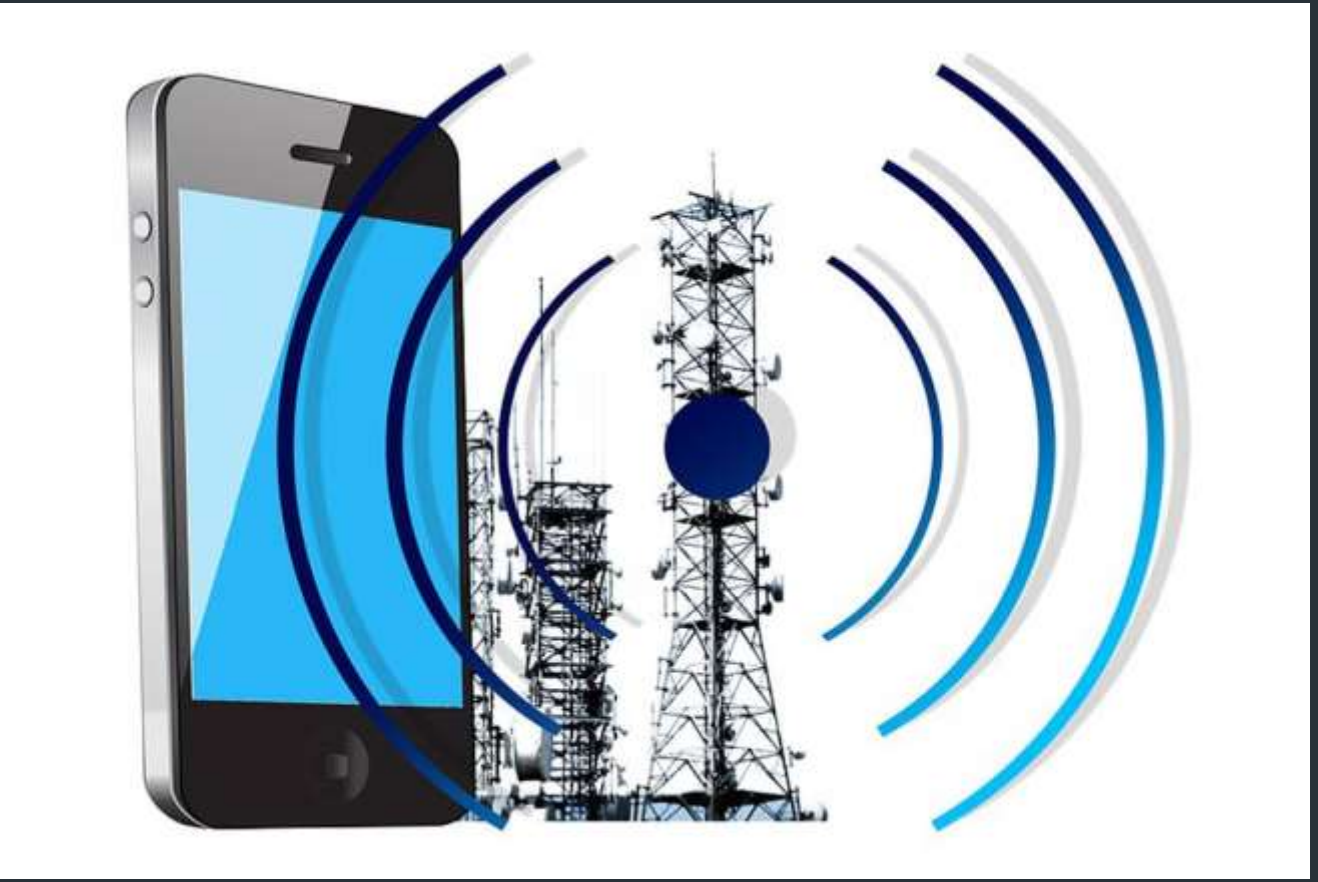
Full/Full Duplex



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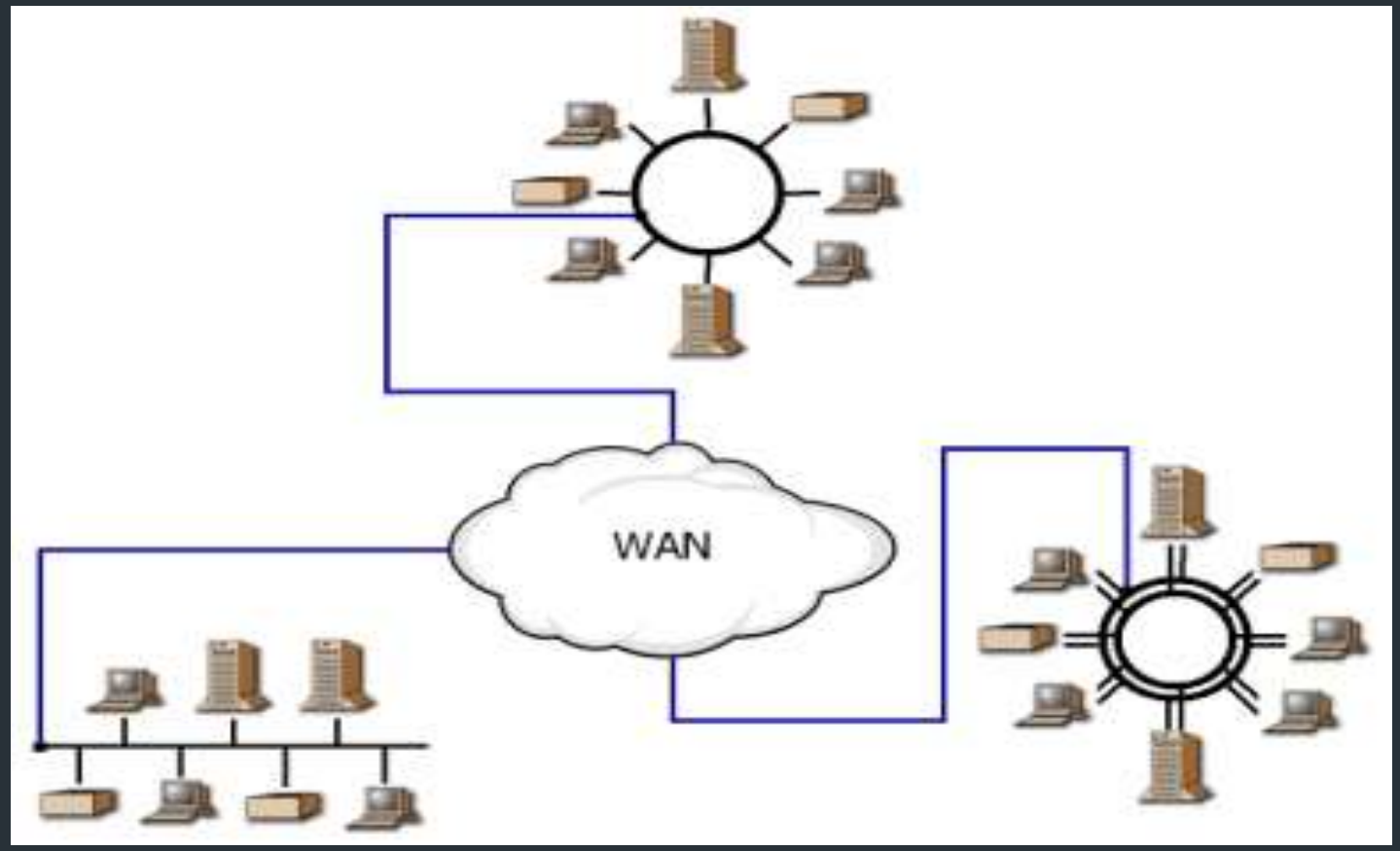
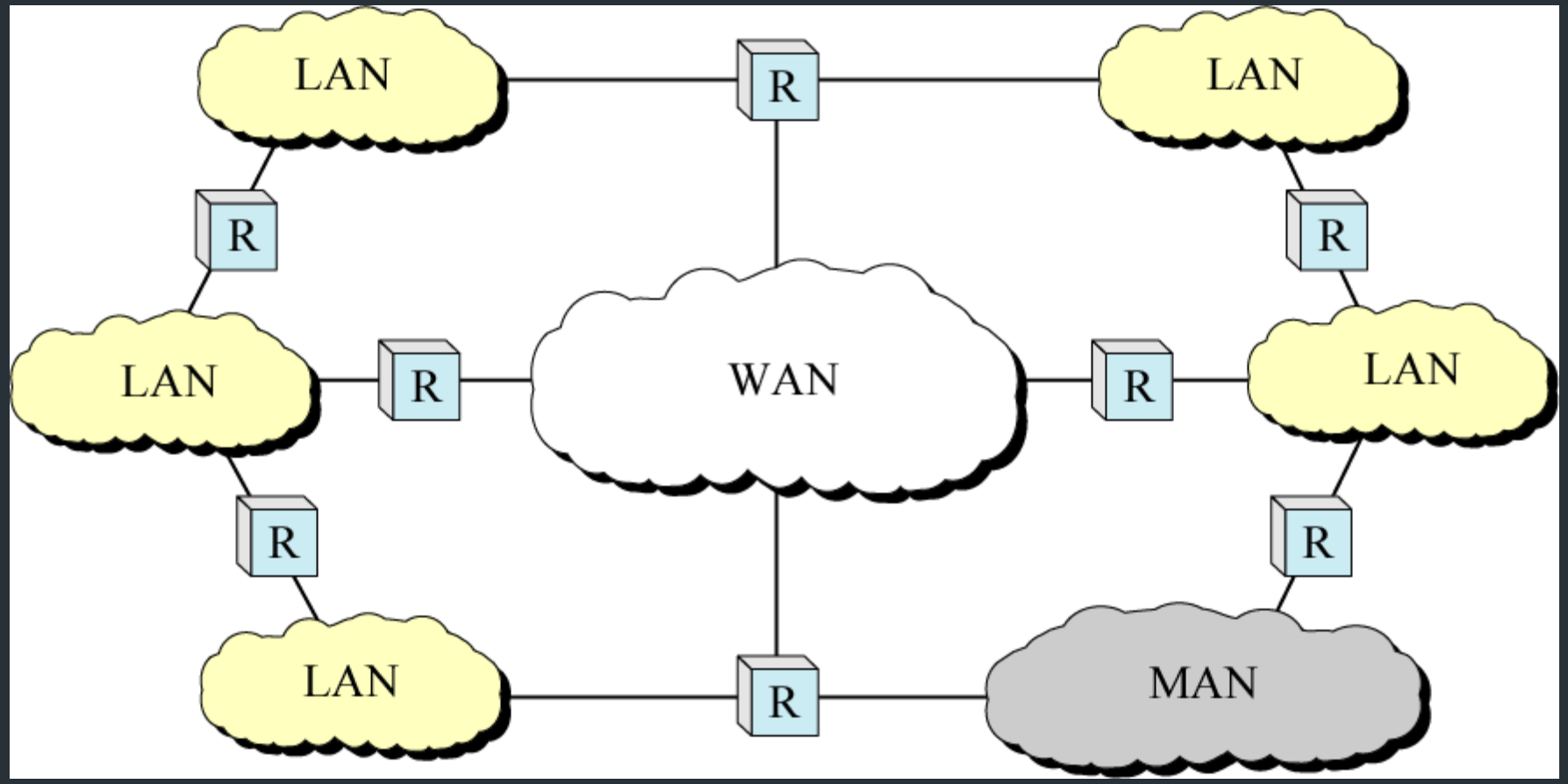
What is an Internetwork?

- An **Internetwork** is a collection of independent remote networks, LANs and WANs, and their connecting devices.
- They function together as one large network sharing connectivity resources.



Source: Data Communications and Networking – Behrouz A. Forouzan

Internet (Internetworking)



Source: Data Communications and Networking – Behrouz A. Forouzan

Applications

- Electronic data Interchange. (E-Com.)
- Teleconferencing
- Cellular Telephone
- Cable TV
- On-line Marketing , Sales, ticket reservations (boats, hotels, theaters)
- Financial Services. (E- Cash)
- Manufacturing
- Information ServicesEmail
- Web-enabled audio/video conferencing services
- Online movies and gaming
- Data transfer/file-sharing, often through File Transfer Protocol (FTP)
- Instant messaging
- Internet forums
- Social networking
- Online shopping
- Financial services

Benefits

- Sharing
- Access
- Reduced cost
- Improved security
- Increased speed

Issues

- Installation cost
- Administration
- Server failure
- Cable/Media Faults

References

- Forouzan Behrouz, A. "Data Communication and networking." (2008).
- Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier, 2007.
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- Web Links as mentioned in source

Theory_Class 3

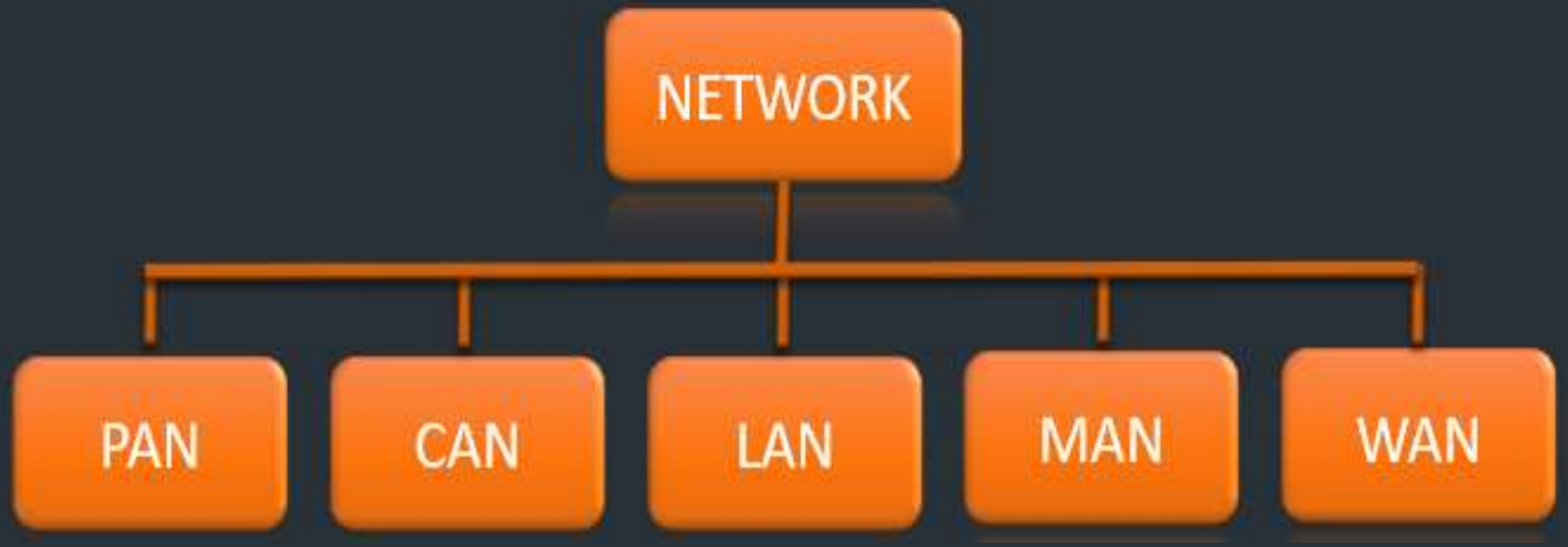
Categories of Network

NETWORK AND COMMUNICATION

Overview

- Classification of Networks
- Networks Classification by their component role
- Types of Servers
- Client Server
- Peer to peer
- Advantages and disadvantages

CLASSIFICATION OF AREA BY THEIR GEOGRAPHY



CAN

- A **Controller Area Network** (**CAN bus**) is a robust vehicle bus standard designed to allow microcontrollers and devices to communicate with each other's applications without a host computer.

- It is a message-based protocol, designed originally for multiplex electrical wiring within automobiles to save on copper, but can also be used in many other contexts.

- For each device the data in a frame is transmitted sequentially but in such a way that if more than one device transmits at the same time the highest priority device is able to continue while the others back off.

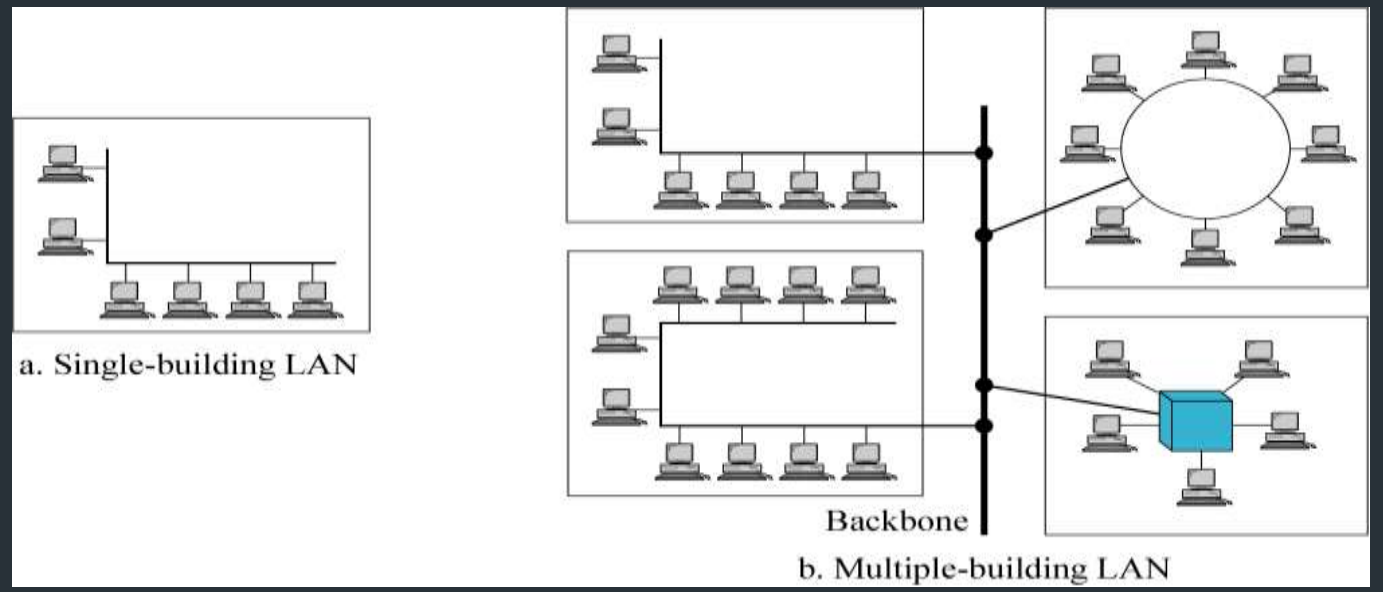
- Frames are received by all devices, including by the transmitting device.

LAN

- The network can be categorized based on its size, its ownership, the distance it covers, and its physical architecture.
- Interprocessor Distance:
- LAN :

10m – Room,

100m - Building and 1km or 2 km – upto Campus.



Source: Data Communications and Networking – Behrouz A. Forouzan

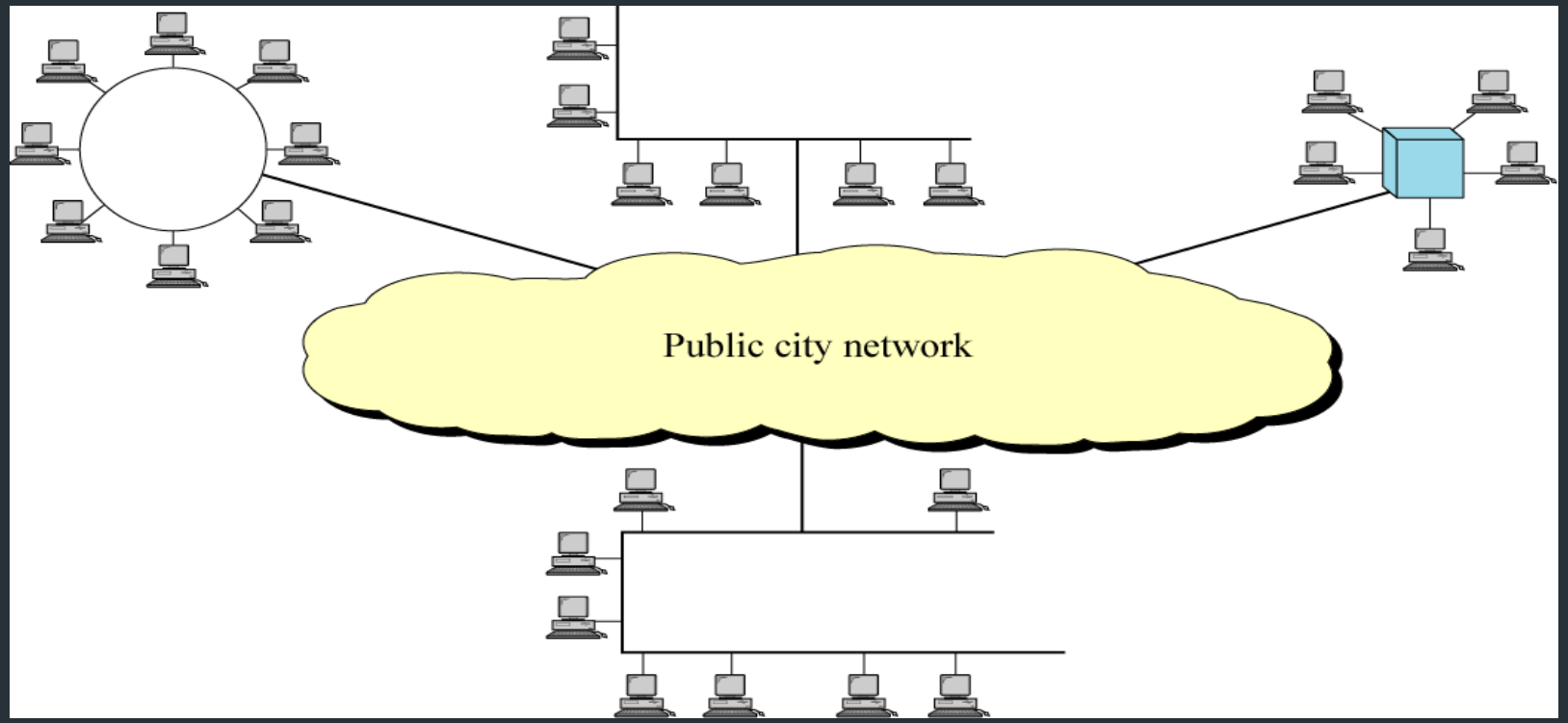
LAN (Cont.)

- It covers a small geographical area with in a building or up to a few kilometers outside
- They are widely used to connect PC with in a office.
- LAN has distinguished from other networks by three characters.
  - size
  - their transmission technology
  - their Topology
- LAN run at speeds of 10 Mbps to 100 Mbps. or (100/1000Mbps)
- Different Topologies will be used for LAN Connectivity.
  - Bus / RING
- IEEE 802.3 known as Ethernet is an typical example for LAN

LAN - Advantages

- LAN provides a cost-effective multi-user computer environment
- A LAN is suited to any type of application.
- Any number of users can be accommodated.
- It is flexible and growth-oriented.
- Today speeds are normally 100 or 1000 Mbps.
- It provide data integrity.

MAN



10km or 20 km – upto City level.

Source: Data Communications and Networking – Behrouz A. Forouzan

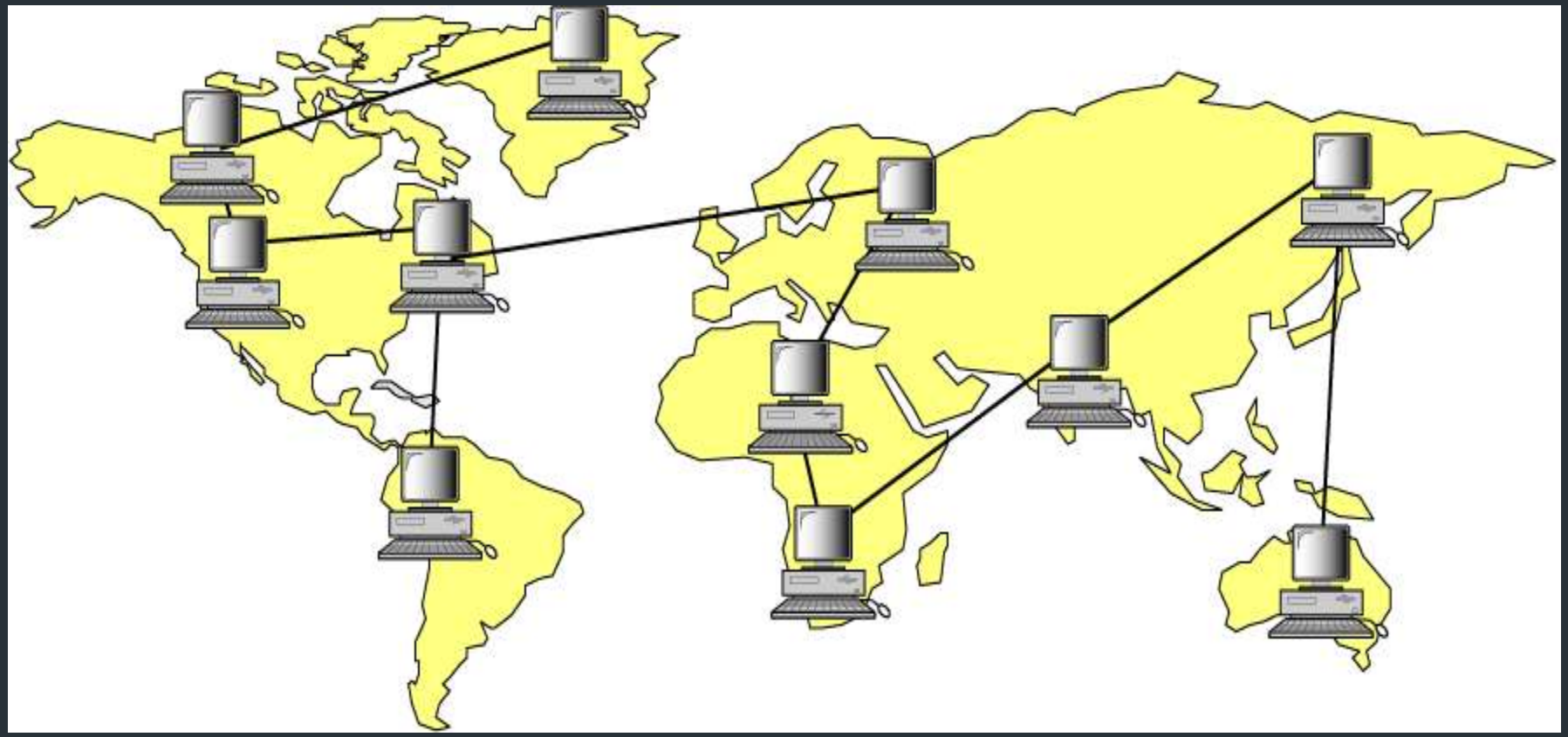
MAN (Cont.)

- MAN is a bigger network covers a group of nearby offices in a city .up to 10 – 20 kilometers range.
- MAN supports both voice and data. The typical example is Local Cable Network..
- LAN has distinguished from other networks by two characters.
  - standard that is adopted by them.
  - DQDB (Distributed Queue Dual Bus) – 802.6
- MAN run at speeds of 150 Mbps.
- Typical Topology will be used for MAN Connectivity.
  - BUS
- IEEE 802.6 known as Ethernet is an typical example for LAN.
- It may be a single network such as a cable TV network or it may be a means of connecting a number of LANs into a large network so that resources may be shared LAN-to-LAN as well as device-to-device.

MAN (Cont.)

- MAN provides the transfer rates from 34 to 150 Mbps.
- MAN is designed with two unidirectional buses.
- Each Bus is independent of the other in the transfer of traffic.
- The topology can be designed as an open bus or closed bus
- configuration.
- It can be support both data and voice.
- The high speed links between LANs within a MAN are made
- possible by fiber-optic connection.

WAN



100km – upto Country level , 1000km – upto continent and 10,000km – upto Planet level.(The Internet).

Source: Data Communications and Networking – Behrouz A. Forouzan

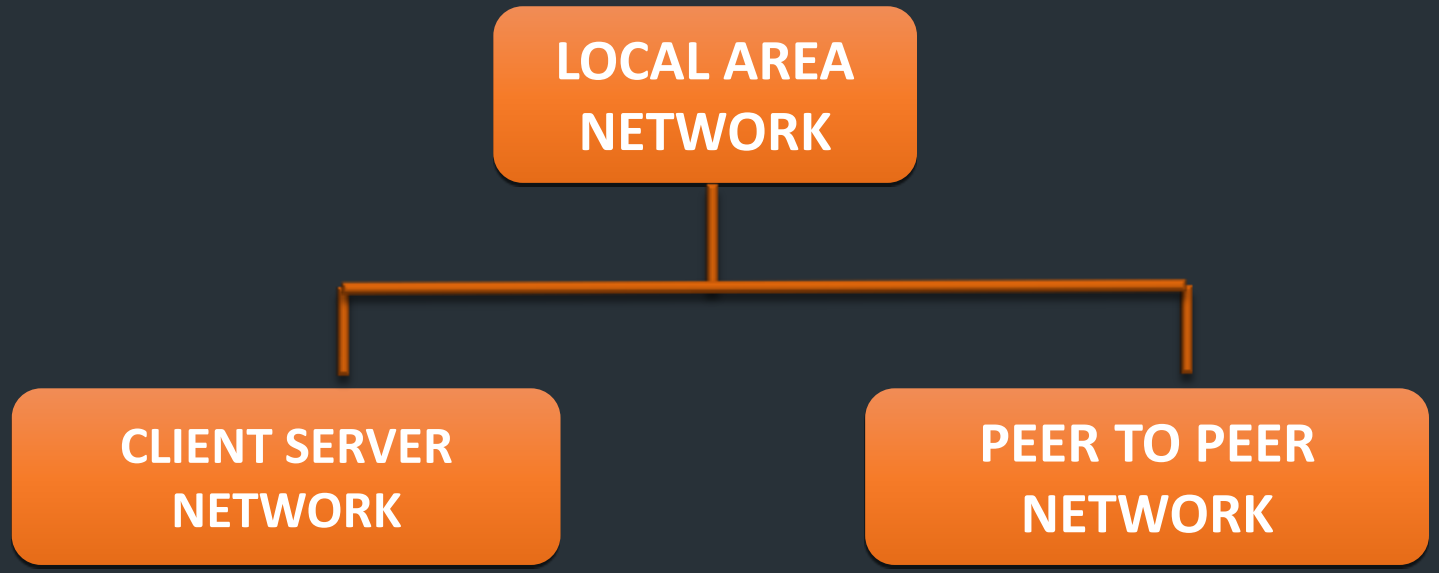
WAN (Cont.)

- WAN covers a large geographical area , country or continent.
- Hosts / Subnet
- The job of the Subnet is to carry the messages from host to host. subnet is an area in which the actual communication takes place.
- Subnet Consists of Two Distinct Components.
  - Transmission Lines
  - Switching Elements (Specialized Systems)
- Packet Switched Nodes / Router
- Inside the Subnet routers have a connectivity among themselves.
- Store and Forward Concept
- All the Topologies are applicable
- Works at 100 Mbps to 1000 Mbps.

Summary

Inter-processor distance	Square Meter	PAN
1 m	Room	LAN
10 m	Building	
100 m	Campus	
1 km	City	MAN
100 kms	Country	WAN
1000 kms	Continent	
10000 kms	World	INTERNET

NETWORK CLASSIFICATION BY THEIR COMPONENT ROLE



PEER TO PEER NETWORK

- In peer to peer network each computer is responsible for making its own resources available to other computers on the network.
- Each computer is responsible for setting up and maintaining its own security for these resources.
- Each computer is responsible for accessing the required network resources from peer to peer relationships.
- This network is useful for a small network containing less than 10 computers on a single LAN.
- Each computer can function as both client and server and do not have a central control system.
- There are no servers in peer network. Peer networks are amplified into home group.

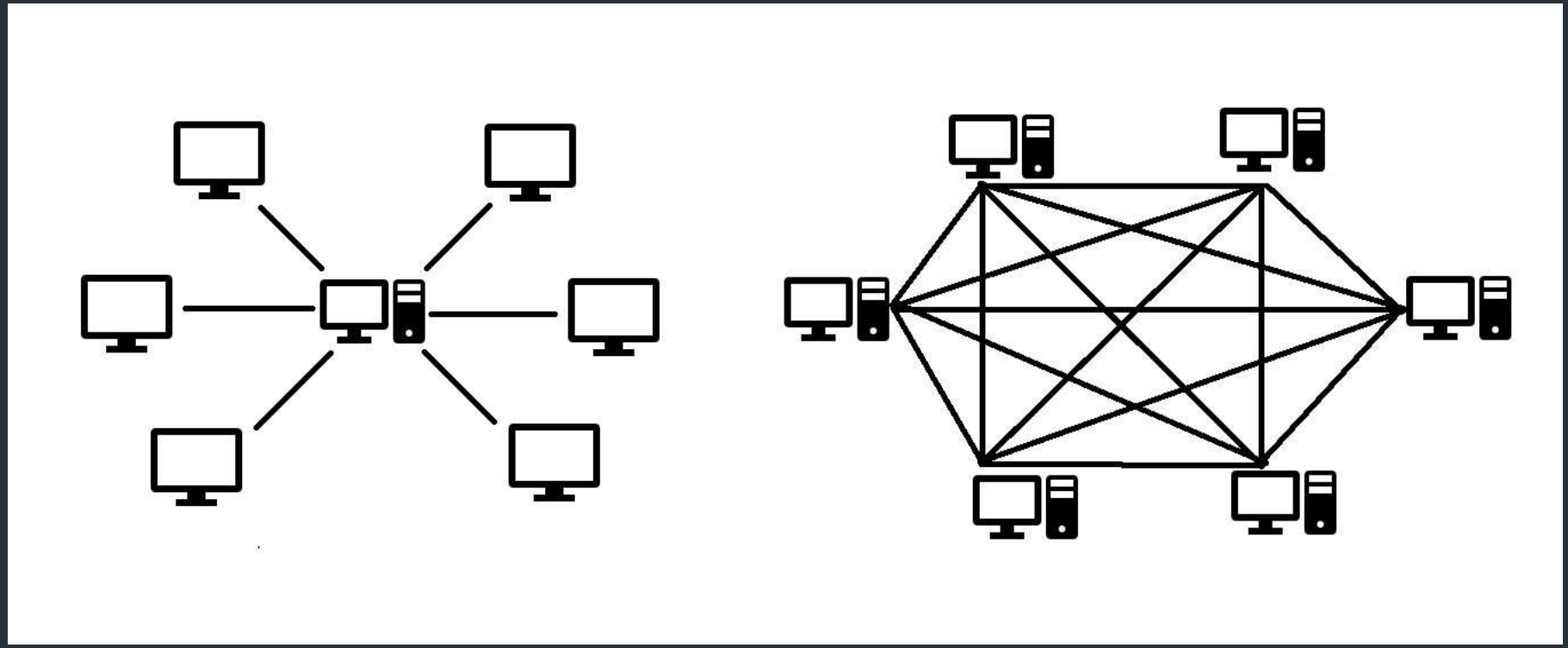
Advantages

- Use less expensive computer hardware
- Easy to administer
- No NOS required
- More built in redundancy
- Easy setup & lowcost

Disadvantages

- Not very secure
- No central point of storage of file archiving
- Additional load on computer because of resource sharing
- Hard to maintain version control

Point to point Peer to peer



CLIENT/SERVER NETWORK

- In client-server network relationship, certain computers act as server and other act as clients.
- Server: A server is simply a computer, that available the network resources and provides service to others computers when they request it.
- Client: A client is the computer running program that requests the service from a server.
- Local area network (LAN) is based on client server network relationship.
- A client-server network is one in which all available network resources such as files, directories, applications and shares devices, are centrally manages and hosted and then are accessed by client.
- Client-servers network are defined by the presence of servers on a network that provide security and administration of the network.

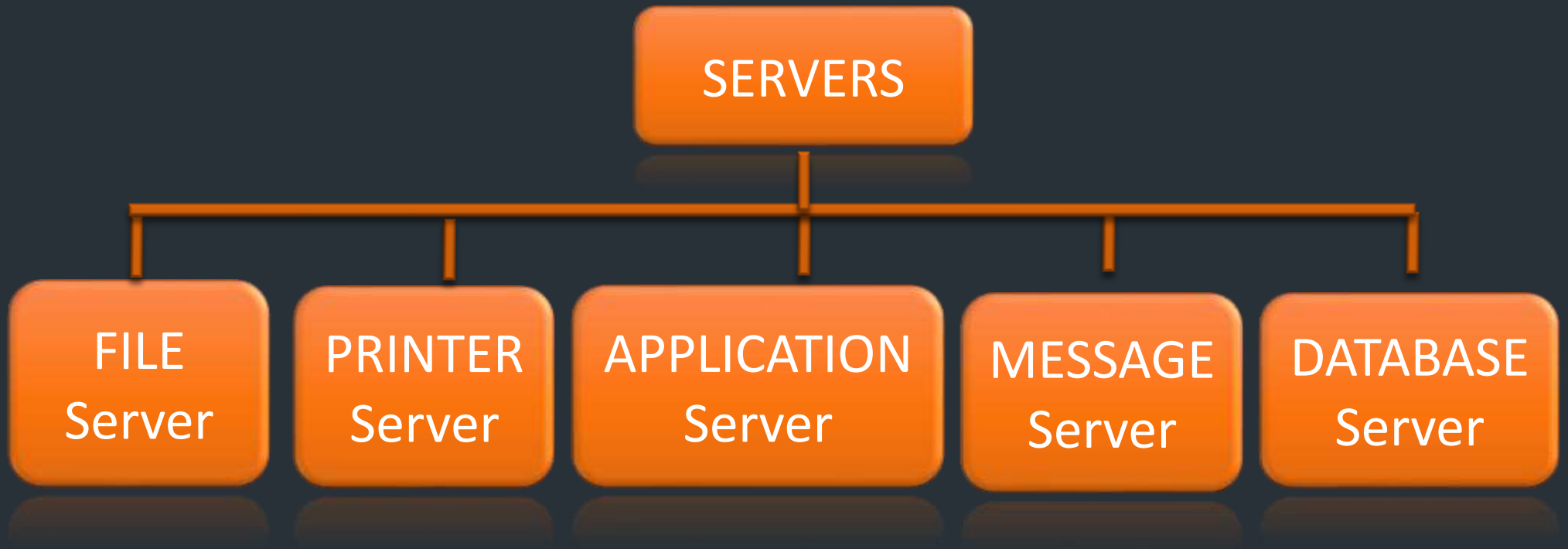
Advantages

- Very Secure
- Better Performance
- Centralized backup
- Very reliable

Disadvantages

- Requires professional administration
- More hardware intensive
- More software intensive
- Expensive dedicated software

Types of Servers



Types of Servers

- **File server:** provides services for storing, retrieving and moving data. User can read/write/exchange/manage files with help of file servers
- **Printer server:** used for controlling and managing printing on the network. It also offers the fax service to the network users.
- **Application server:** helps to share expensive software and additional computing power by the computers in a network.
- **Message server:** used to co-ordinate the interaction between users, documents and applications. Data - audio, video, binary, text or graphics
- **Database server:** It is a type of application server. It allows the uses to access the centralized strong database.

References

- Forouzan Behrouz, A. "Data Communication and networking." (2008).
- Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier, 2007.
- Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
- Web Links as mentioned in source

Theory_Class 4

Topology of Network

NETWORK AND COMMUNICATION

Theory_Class_4

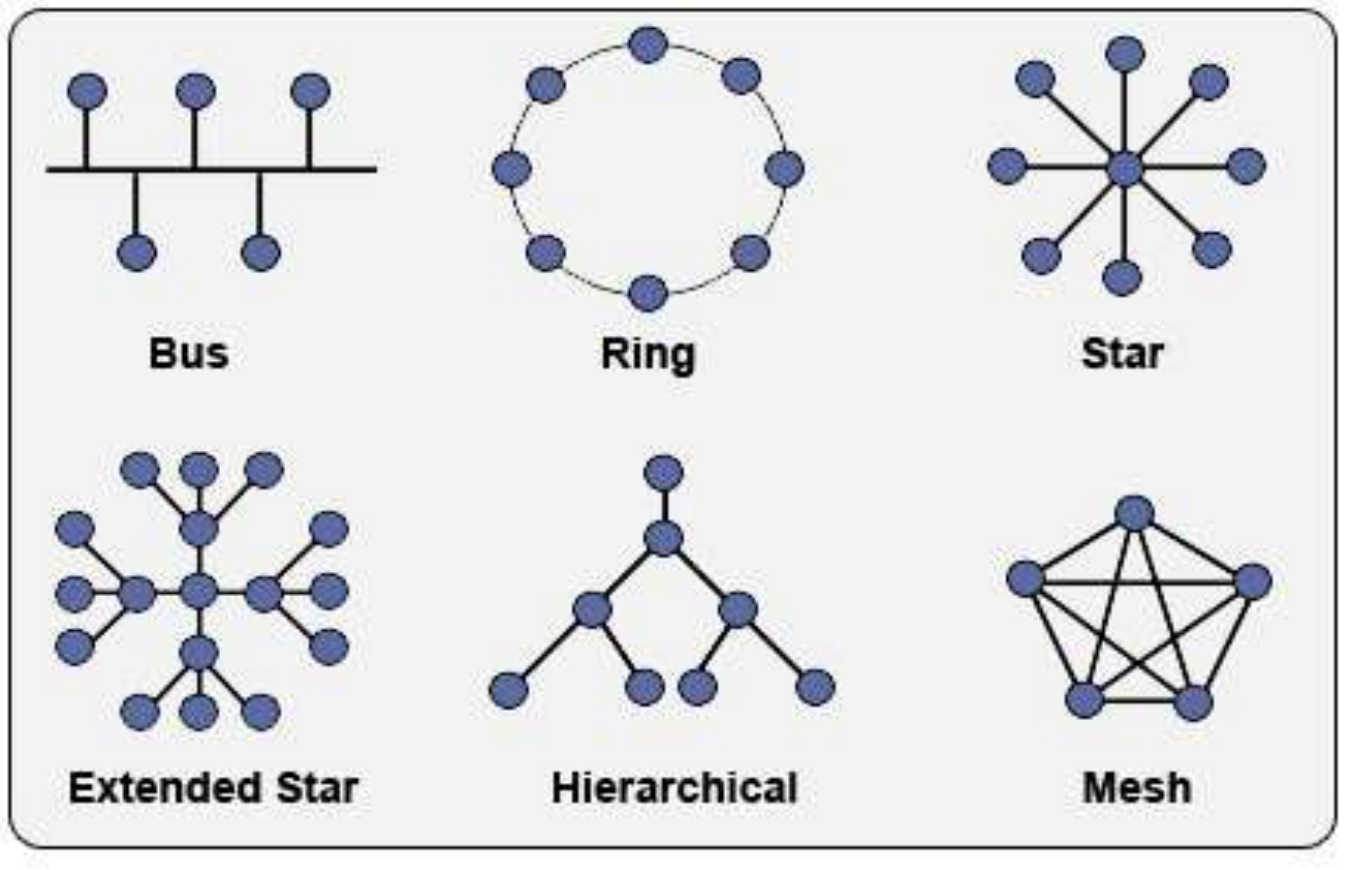
Overview

- Classification of Topology
  - Mesh
  - Star
  - Bus
  - Ring
  - Tree and Hybrid
- Applications
- Advantages
- Disadvantages
- Summary

Topology

- Topology refers to the layout of connected devices on a network.
- Here, some logical layout of topology.
  - Mesh
  - Star
  - Bus
  - Ring
  - Tree and Hybrid

Network Topology



Source:
https://www.google.com/search?hl=enIN&sxsrf=ALeKk03hwSjhvAGFuCwu3Gmel3tRpjsSkg:1595176161478&q=all+network+topology&tbm=isch&source=iu&ictx=1&tbs=simg:CAESogIJRJqfBVDDur8algILELCMpwgaYgpgCAMSKJgIugiXCJwIuQidA8gIvgisE7MIxTe2NOwhwz25NLE0xje0NMQ9kikaMNE9mVz8rfs1n_1a4lUORSA3TesM10zer56CVseWEaahVIujQ6pCxtu0kGYJdyxMxmSAEDAsQjq7CBoKCggIARIEOsyTGwwLEJ3twQkajgEKGgoHZGlhZ3JhbdqliPYDCwoJL20vMDJ2MG0yChgKBmNpcmNsZdqliPYDCgoIL20vMDF2a2wKFwoFc2xvcGXapYj2AwoKCC9tLzA3OGhtChkKB3BhdHRlcm7apYj2AwoKCC9tLzBod2t5CiIKDm1ham9yZWxsZSBibHVl2qWI9gMMCgovbS8wNGduazdtDA&fir=rRhA_ktkiUIuwM%252Cbb_Uw8h_IgBSAM%252C_&vet=1&usg=AI4kQH1y9ILNXZ6pUwe3a1V23JIzl5GQ&sa=X&ved=2ahUKEwiP5tWj3tnqAhVxzzgGHebOD2wQ9QEwAnoECAsQBA&biw=1366&bih=608#imgrc=rRhA_ktkiUIuwM

Mesh Topology

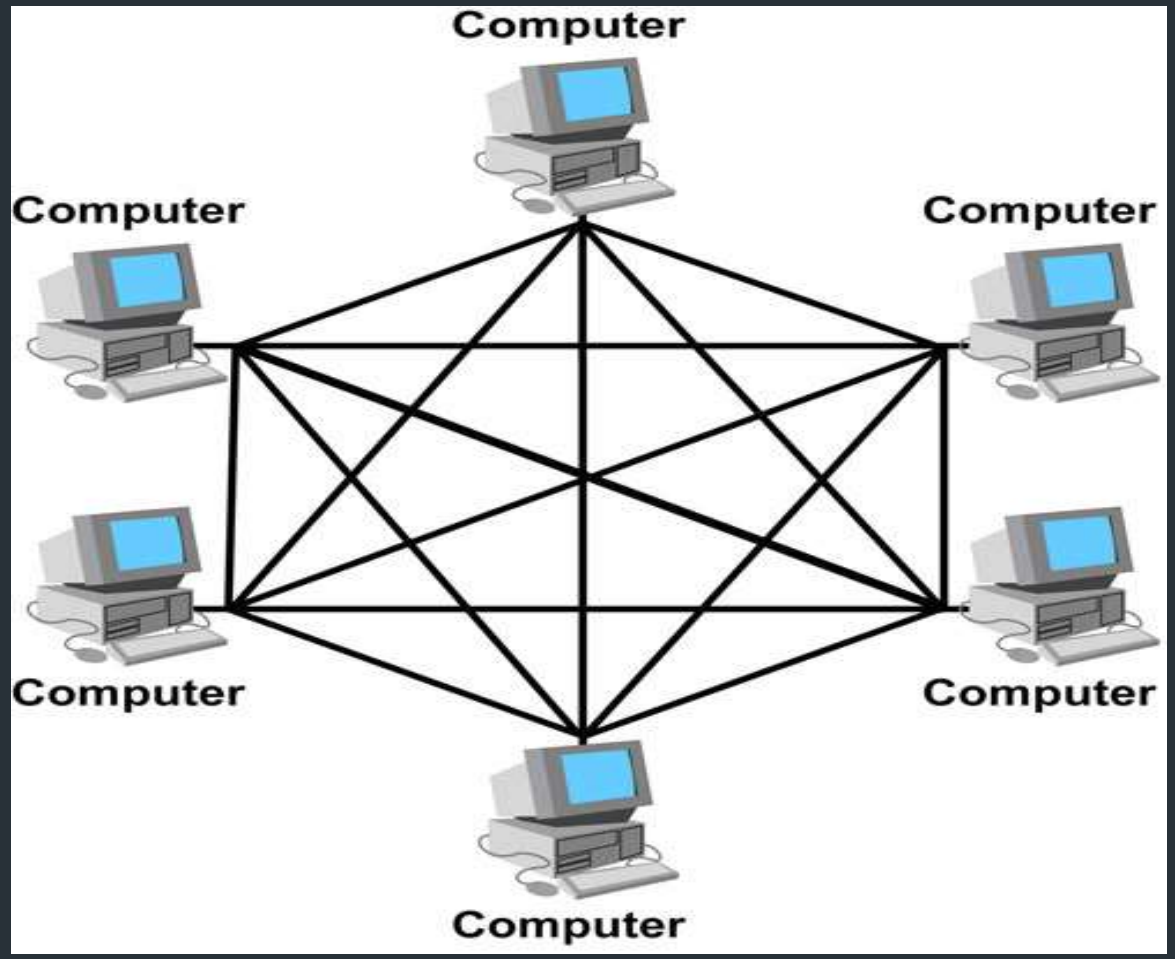
- Here every device has a point to point link to every other device.
- Node 1 node must be connected with n-1 nodes.
- A fully connected mesh can have n(n-1)/2 physical channels to link n devices.
- It must have n-1 I/O ports.

Mesh Topology

Advantages:

- They use dedicated links so each link can only carry its own data load. So traffic problem can be avoided.
- It is robust. If any one link get damaged it cannot affect others.
- It gives privacy and security.(Message travels along a dedicated link)
- Fault identification and fault isolation are easy.

Mesh Topology



Source:
https://www.google.com/search?q=mesh+topology&sxsrf=ALeKk03tS3SjffYF361a9BsWdZnYDwUjUQ:1595176294804&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjCo5_j3tnqAhWTzjgGHUP5Cc0Q_AUoAXoECBQQAw&biw=1366&bih=608#imgrc=UTWzqKYn8kW3_M

Mesh Topology

- Applications:

1. Telephone Regional office.
2. WAN.(Wide Area Network).

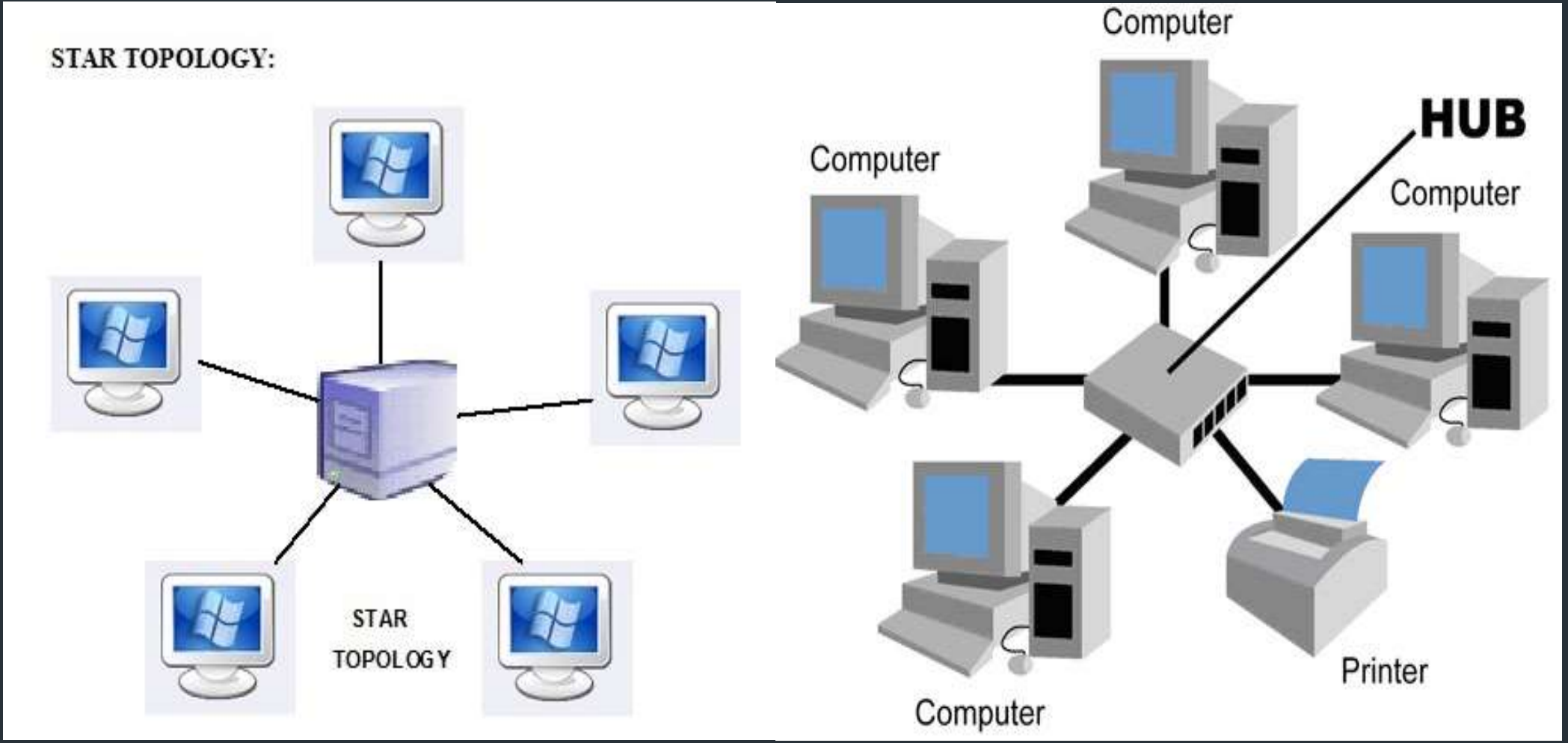
- Disadvantages:

1. The amount of cabling and the number of I/O ports required are very large. Since every device is connected to each devices through dedicated links.
2. The sheer bulk of wiring is larger then the available space.
3. Hardware required to connected each device is highly expensive.

Star Topology

- Here each device has a dedicated point-to-point link to the central controller called "Hub"(Act as a Exchange).
- There is no direct traffic between devices.
- The transmission are occurred only through the central "hub".
- When device 1 wants to send data to device 2; First sends the data to hub. Which then relays the data to the other connected device.

Star Topology



Source: https://www.google.com/search?q=star+topology&sxsrf=ALeKk00lpbi8-NUJDztVFnYPKMcO6UtIdg:1595176323873&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjizY3x3tnqAhXDxzgGHY_yC3MQ_AUoAXoECBAIGA&biw=1366&bih=608#imgrc=nKaweyBG6ovnEM

Star Topology

Advantages:

1. Less expensive than mesh since each device is connected only to the hub.
2. Installation and configuration are easy.
3. Less cabling is needed than mesh.
4. Robustness.(if one link fails, only that links is affected. All other links remain active)
5. Easy for fault identification & to remove parts.
6. No distruptions to the network when connecting(or) removing devices.

Star Topology

Applications:

Star topology used in Local Area Networks(LANs).

High speed LAN often uses STAR.

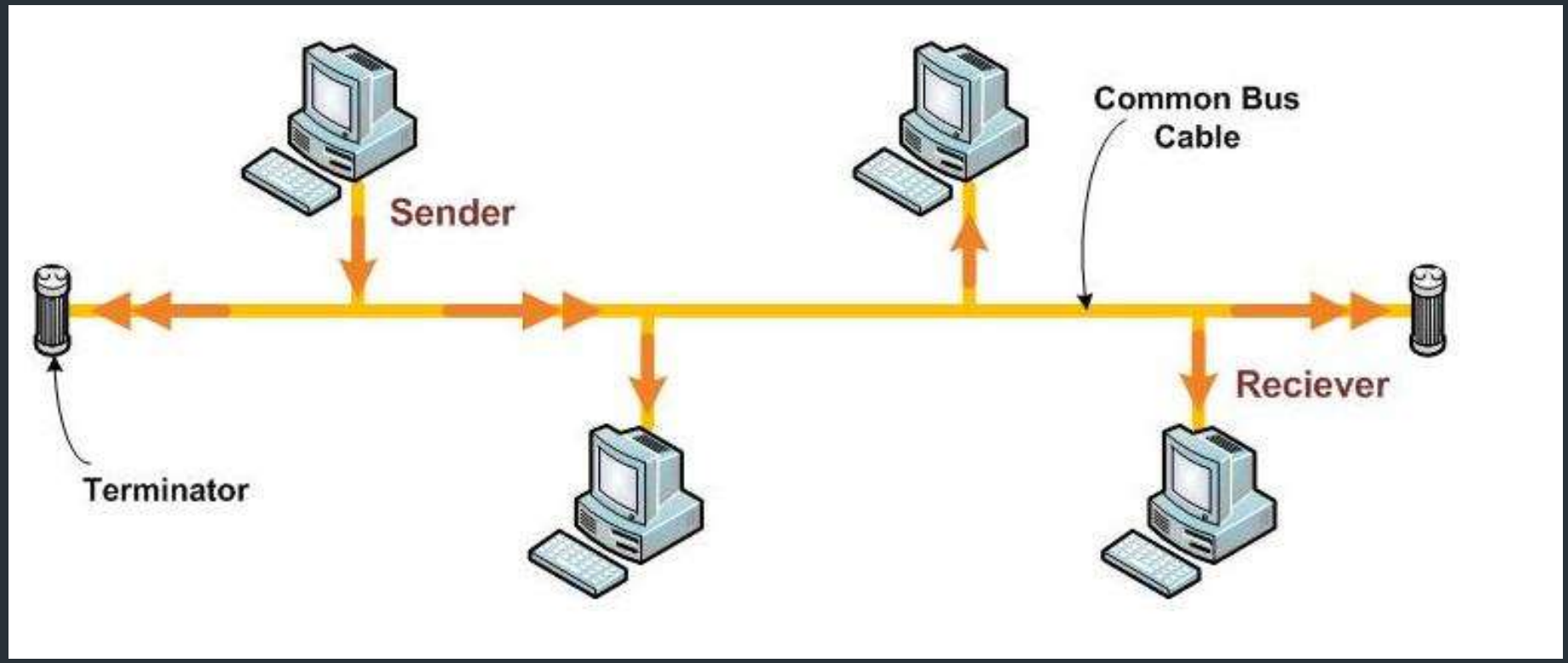
Disadvantages:

1. Even it requires less cabling than mesh, when compared with other topologies it is still large.(Ring or bus).
2. Dependency(whole n/w dependent on one single point(hub). When it goes down the whole system is dead.

Bus Topology

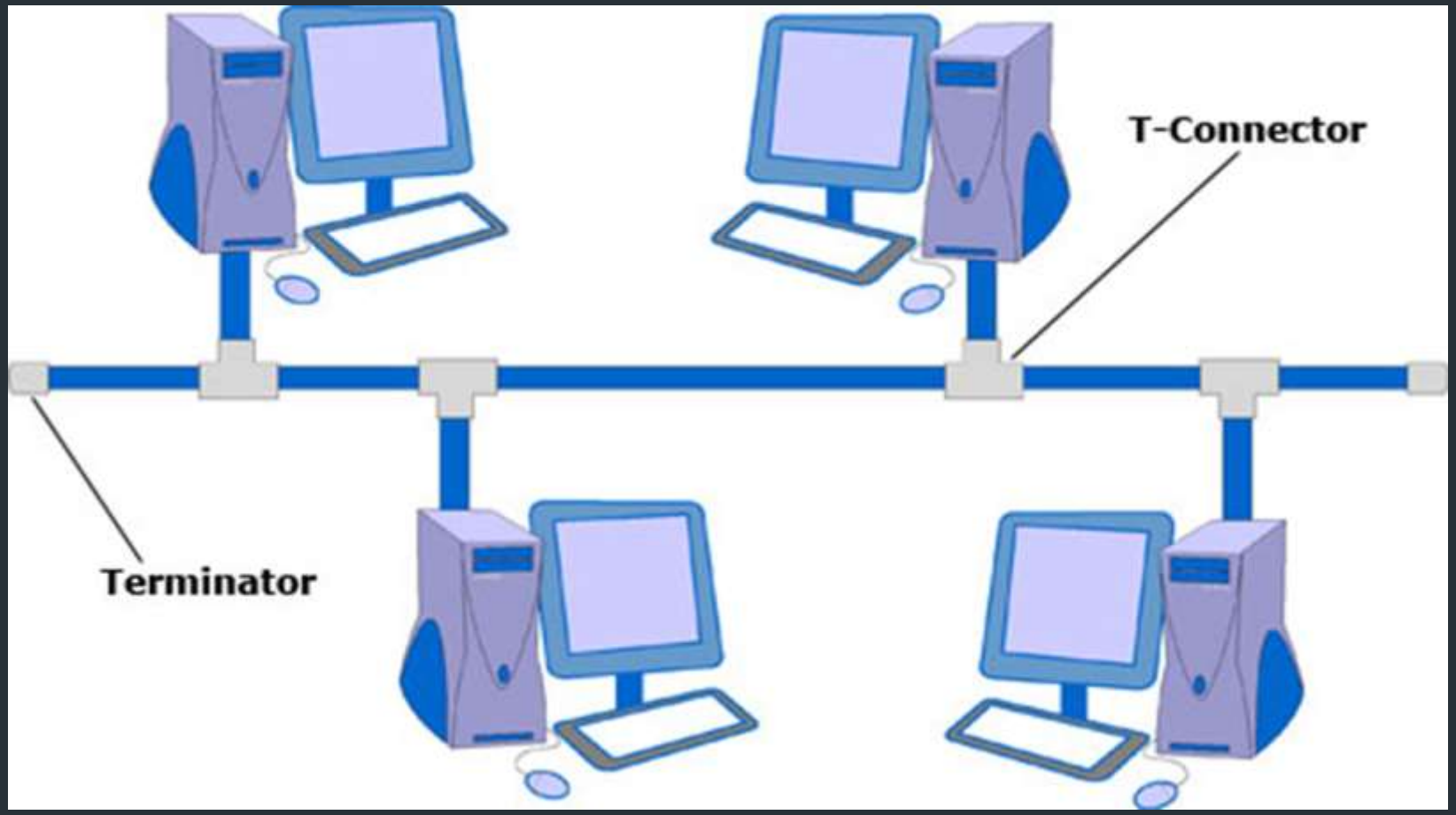
1. A bus topology is multipoint.
2. Here one long cable act as a backbone to link all the devices are connected to the backbone by drop lines and taps.
3. Drop line- is the connection b/w the devices and the cable.
4. Tap- is the splitter that cut the main link.
5. This allows only one device to transmit at a time.

Bus Topology



Source: https://www.google.com/search?hl=en-IN&sxsrf=ALeKk02WSDDVqZ5yHC-lYehhD07m2Wsbfw:1595176583211&q=bus+topology+data+flow&tbm=isch&source=iu&ictx=1&tbs=simg:CAEStgIJbPotd5utQ28aqgILELCMpwgaYgpgCAMSKJcIlQiYCJoIiAPbHa4UoAqcCJkIxj2UJ7k0rijDPbE-ujSoPqc0rz4aMNGlvWs1m8CoH0RN60H9UrXRUpFrQ6nN1tmk0q-q9uVBLyCP9LM7IHd19HGTWkJfGSAEDAsQjq7-CBoKCggIARIEiwQ-9gwLEJ3twQkaogEKGgoHZGlhZ3JhbdqliPYDCwoJL20vMDJ2MG0yCiQKEGNvbXB1dGVyIG5ldHdvcmvapYj2AwwKCi9tLzAyNXN6dHMKHwoMaWxsdXN0cmF0aW9u2qWI9gMLCgkvbS8wMWtyOGYKHgoMbW9iaWxlIHBob25l2qWI9gMKCggvbS8wNTBrOAodCgtlbGVjdHJvbmljc9qliPYDCgoIL20vMDJtcnAM&fir=b3Na9_iCymIGZM%252C4iEJtee8OuE3yM%252C_&vet=1&usg=AI4_-kSyF8T8cZdoISZdpEIvCb5yN4slJQ&sa=X&ved=2ahUKEwi9r-Ls39nqAhWzH7cAHShEDAIQ9QEwAnoECAgQBA&biw=1366&bih=608#imgrc=b3Na9_iCymIGZM

Bus Topology



Source: http://myeducationmeee.blogspot.com/2016/03/network-topology.html

Bus Topology

- A device want to communicate with other device on the n/ws sends a broadcast message onto the wire
- All other devices can see the message but only the intended devices accepts and process the message.

Advantages:

1. Most computer motherboard
2. Ease of installation
3. Less cabling

Bus Topology

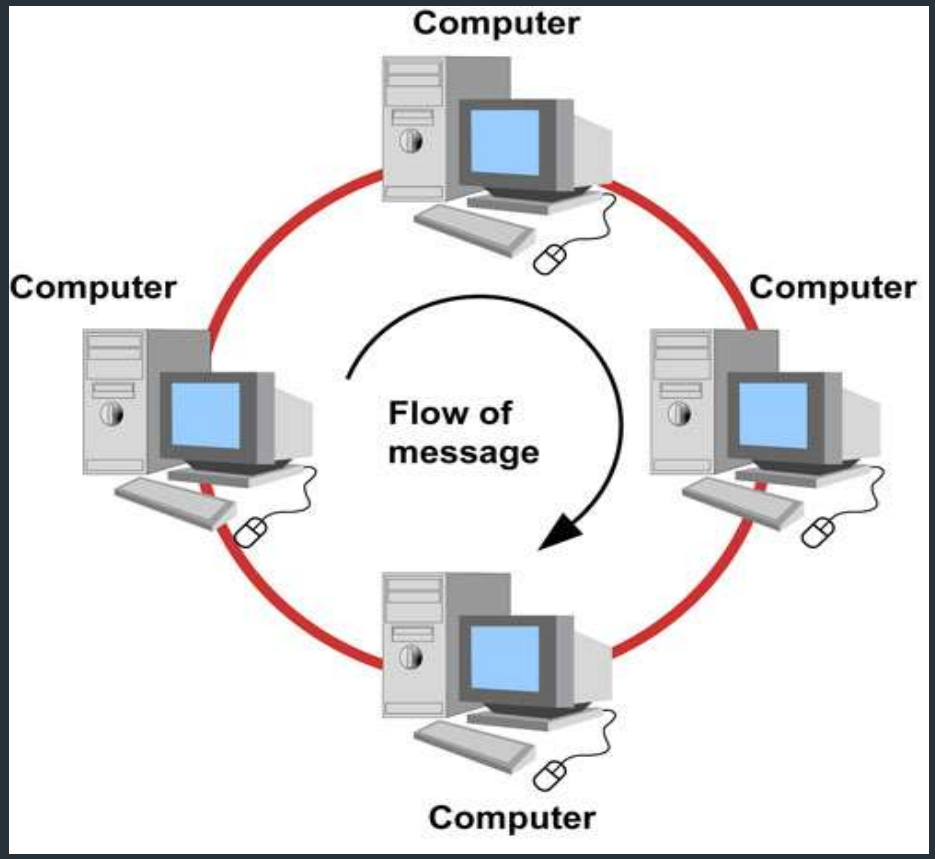
Disadvantages:

1. Difficult reconfiguration and fault isolation.
2. Difficult to add new devices.
3. Signal reflection at top can degradation in quality.
4. If any fault in backbone can stops all transmission.

Ring Topology

1. Here each device has a dedicated connection with two devices on either side.
2. The signal is passed in one direction from device to device until it reaches the destination and each device have repeater.
3. When one device received signals instead of intended another device, its repeater then regenerates the data and passes them along.
4. To add or delete a device requires changing only two connections.

Ring Topology



Source: https://everythingaboutcomputernetworks.weebly.com/ring-topology.html

Ring Topology

Advantages:

1. Easy to install.
2. Easy to reconfigure.
3. Fault identification is easy.

Disadvantages:

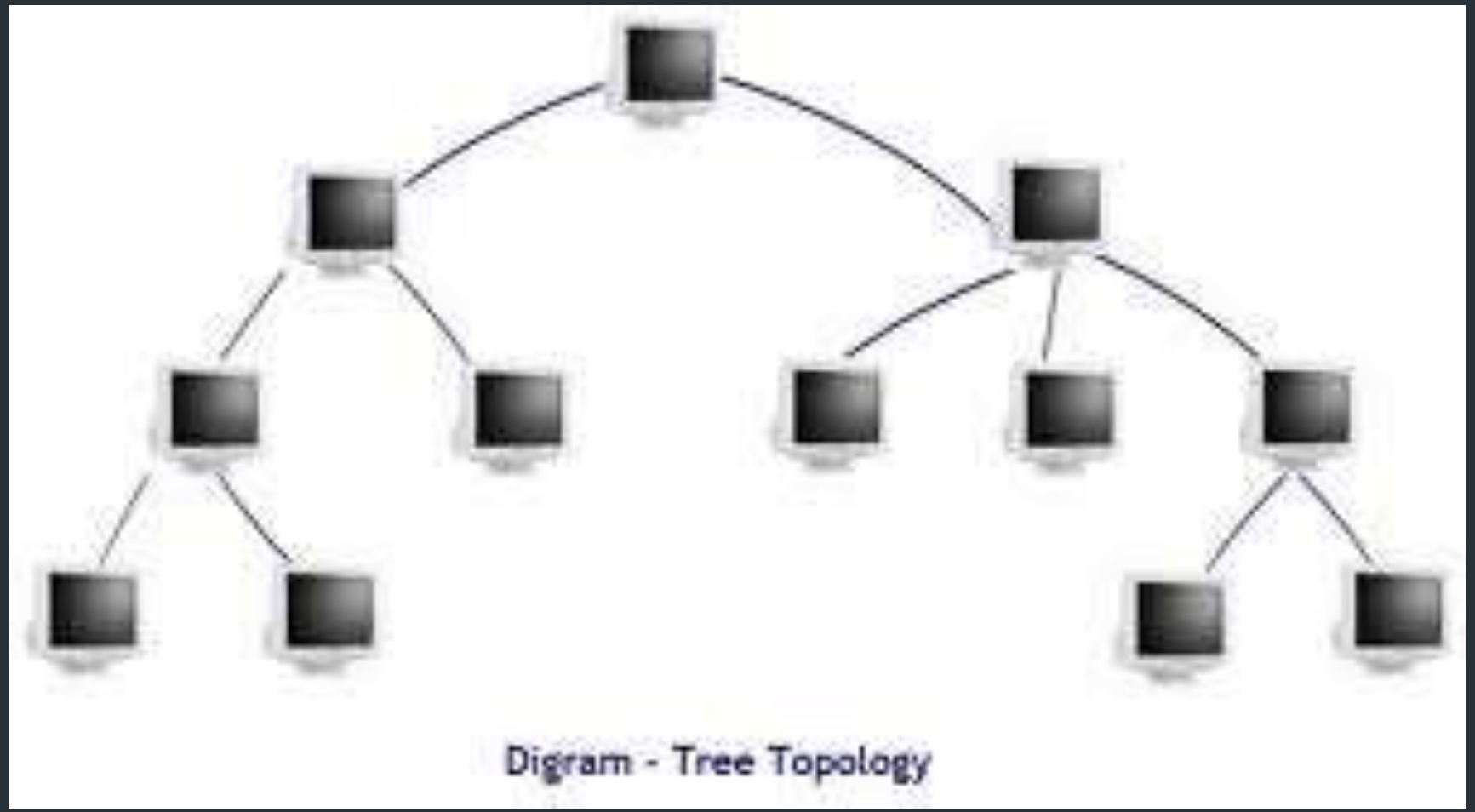
1. Unidirectional traffic.
2. Break in a single ring can break entire network.

- Ring topologies are found in some office buildings or school campuses.
- Today high speed LANs made this topology less popular.

Tree Topology

- Alternatively referred to as a star bus topology.
- Tree topology is one of the most common network setups that is similar to a bus topology and a star topology.
- A tree topology connects multiple star networks to other star networks. Below is a visual example of a simple computer setup on a network using the star topology.

Tree Topology

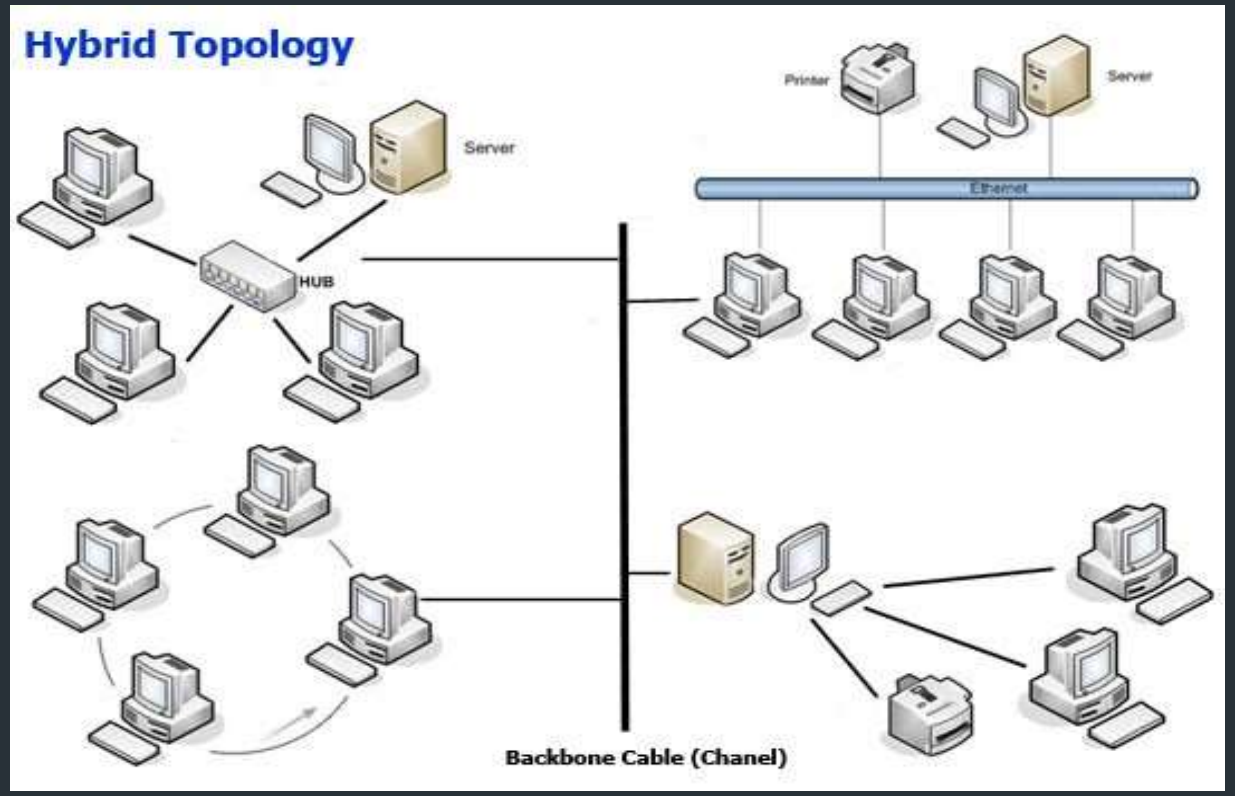


Digram - Tree Topology

Source: http://solutions24h.com/types-of-network-topologies/

Hybrid Topology

A network which contain all type of physical structure and connected under a single backbone channel



Source: https://slideplayer.com/slide/13319741/

Things to consider while selecting the Topology

- No. of ports
- No. of cables
- Reliability
- Cost
- Security

Summary

- Cost - Bus n/w may be the least expensive way to install a n/w.
- Length - of cable needed- the linear bus n/w uses shorter lengths of cable.
- Future growth - with star topology, expending a n/w is easily done by adding another devices.
- Cable type - most common used cable in commercial organization is twisted pair. Which often used with star topologies.
- Full mesh topology is theoretically the best since every device is connected to every other device.(thus maximizing speed and security. however, it quite expensive to install)
- Next best would be tree topology, which is basically a connection of star.

References

- Forouzan Behrouz, A. "Data Communication and networking." (2008).
- Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier, 2007.
- Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
- Web Links as mentioned in source

Theory_Class 5

Overview

- Protocols
- Popular Protocols
- Standards
- List of Standard Organizations
- OSI Model
- TCP/IP Protocol

PROTOCOLS & STANDARDS

DATA COMMUNICATION AND NETWORKING

Protocols

Network Protocols

Set of rules that governs/used for communication. The key elements are given below.

1. **Syntax:** structure/format of the data. Meaning the order in which the data is present.
2. **Semantics:** The meaning of each section of bits.
3. **Timing:** Refers to two characteristics: - When data should be sent and how fast they can be sent.

How it works?

- Network protocols take large-scale processes and break them down into small, specific tasks or functions.
- Each layer is assigned a functions
- This occurs at every level of the network and each function must cooperate at each level to complete the larger task at hand.

List of Network protocols

- Communication
- Network management
- Security

Communication Protocol

- Communication Protocol is a system of rules that allow two or more entities of a communications system to transmit information via any kind of variation of a physical quantity.

Network Management Protocol: SNMP

- An Internet Standard protocol for collecting and organizing information about managed devices on IP networks
- modifying that information to change device behavior.
- Devices that typically support SNMP include cable modems, routers, switches, servers, workstations, printers, and more.

Network security protocols

- Ensures the security and integrity of data in transit over a network connection.
- Network security protocols define the processes and methodology to secure network data from any illegitimate attempt to review or extract the contents of data.

Popular Protocols

- **ISDN** - **Integrated Services Digital Network**. Communication protocol offered by phone companies which allows phone networks to carry voice, video, and data.
- **CDMA** - **Code Division Multiple Access**.
  X.25 - ITU's standard that defines how connections between terminal equipment and computers are maintained.
- TCP/IP (Transmission Control Protocol/Internet Protocol) suite
- ARP (Address Resolution Protocol)
- DNS (Domain Name System)
- FTP (File Transfer Protocol)
- HTTP (Hyper Text Transfer Protocol)
- HTTPS (Hypertext Transfer Protocol Secure)
- ICMP (Internet Control Message Protocol)
- IGMP (Internet Group Management Protocol)
- IMAP4 (Internet Message Access Protocol version 4)

Standards

- Standard provides a model for development that makes it possible for a product to work regardless of the individual manufacturer
- **Dejure** – haven't approved by organized body, but adopted as standards through wide spread use ASCII USB
- **Defacto** - Proprietary and Non proprietary
  - Proprietary – invented by commercial organizations; close off communications
  - Non proprietary-developed by groups or committees; open standards QWERTY
- International Standard Organization **(ISO)**
- International Telecommunications Union- Telecommunications Standard Sector **(ITU-T)**
- American National Standards Institute **(ANSI)**
- The Institute of Electricals and Electronic Engineering **(IEEE)**
- The Electronic Industries Association **(EIA)**

List of Standard Organizations

- **International Standard Organization (ISO)**. Responsible for a wide range of standards including networking standards.
- **CCITT - Consultative Committee for International Telegraph and Telephone**. Responsible for development of Communication standards.
- **International Telecommunications Union-Telecommunications Standards Sector (ITU-T)** - develops worldwide standards for telecommunication technologies.
- **American National Standard Institute (ANSI)**
- **Institute of International Electrical and Electronics Engineers (IEEE)**
- **Electronic Industries Association (EIA)**
- Telecommunications Industry Association **(TIA)** and other leading telecommunication companies worked cooperatively to create **ANSI/TIA/EIA-568-A** standard for commercial buildings.

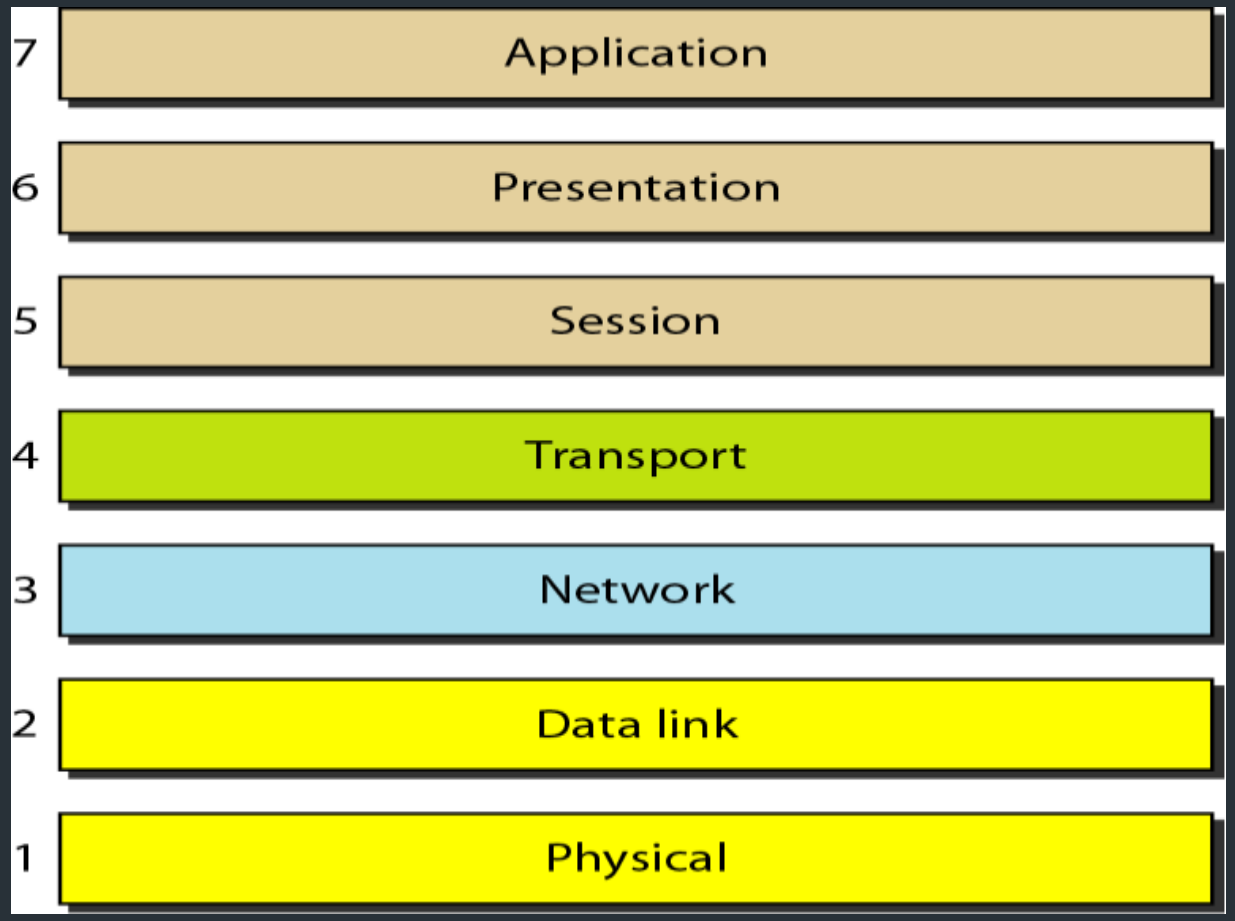
OSI MODEL

DATA COMMUNICATION AND NETWORKING

The OSI model

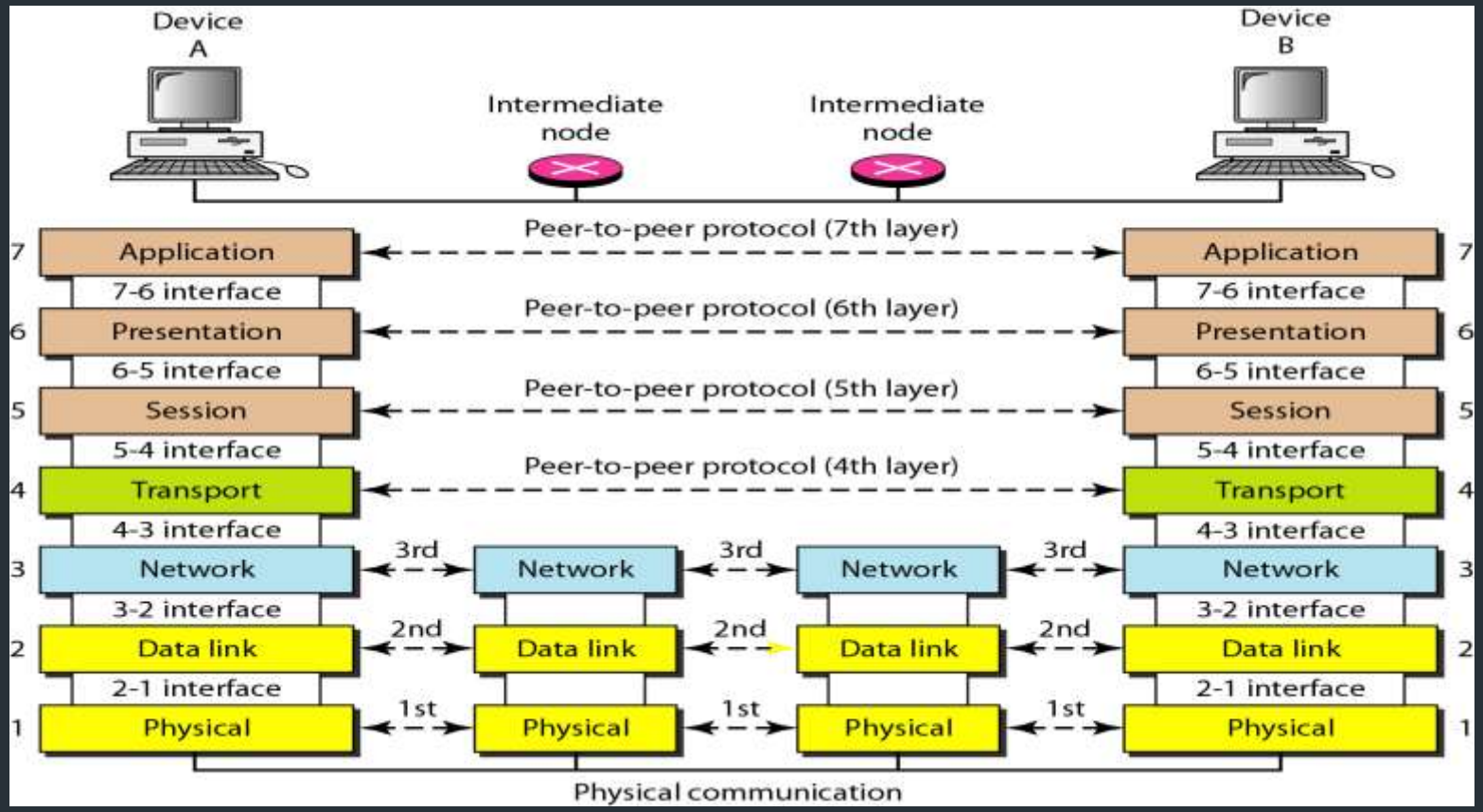
- **ISO** is the organization. **OSI** is the model.
- **International Standards Organization (ISO)** is a multinational body dedicated to worldwide agreement on international standards - Established in **1947**.
- An ISO standard that covers all aspects of network communications is **the Open Systems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

Seven layers of the OSI model



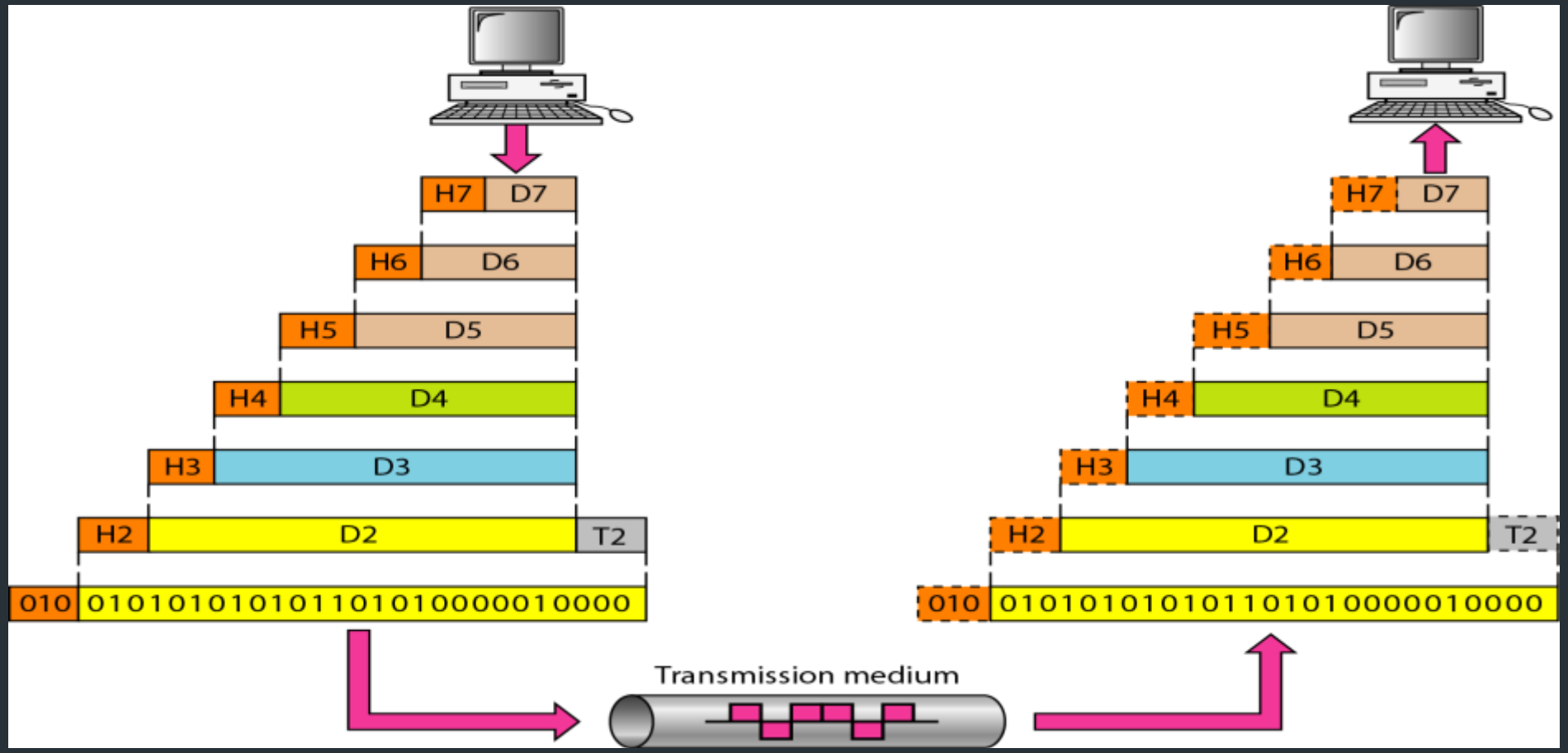
Source: Data Communications and Networking – Behrouz A. Forouzan

The interaction between layers in the OSI model



Source: Data Communications and Networking – Behrouz A. Forouzan

An exchange using the OSI model

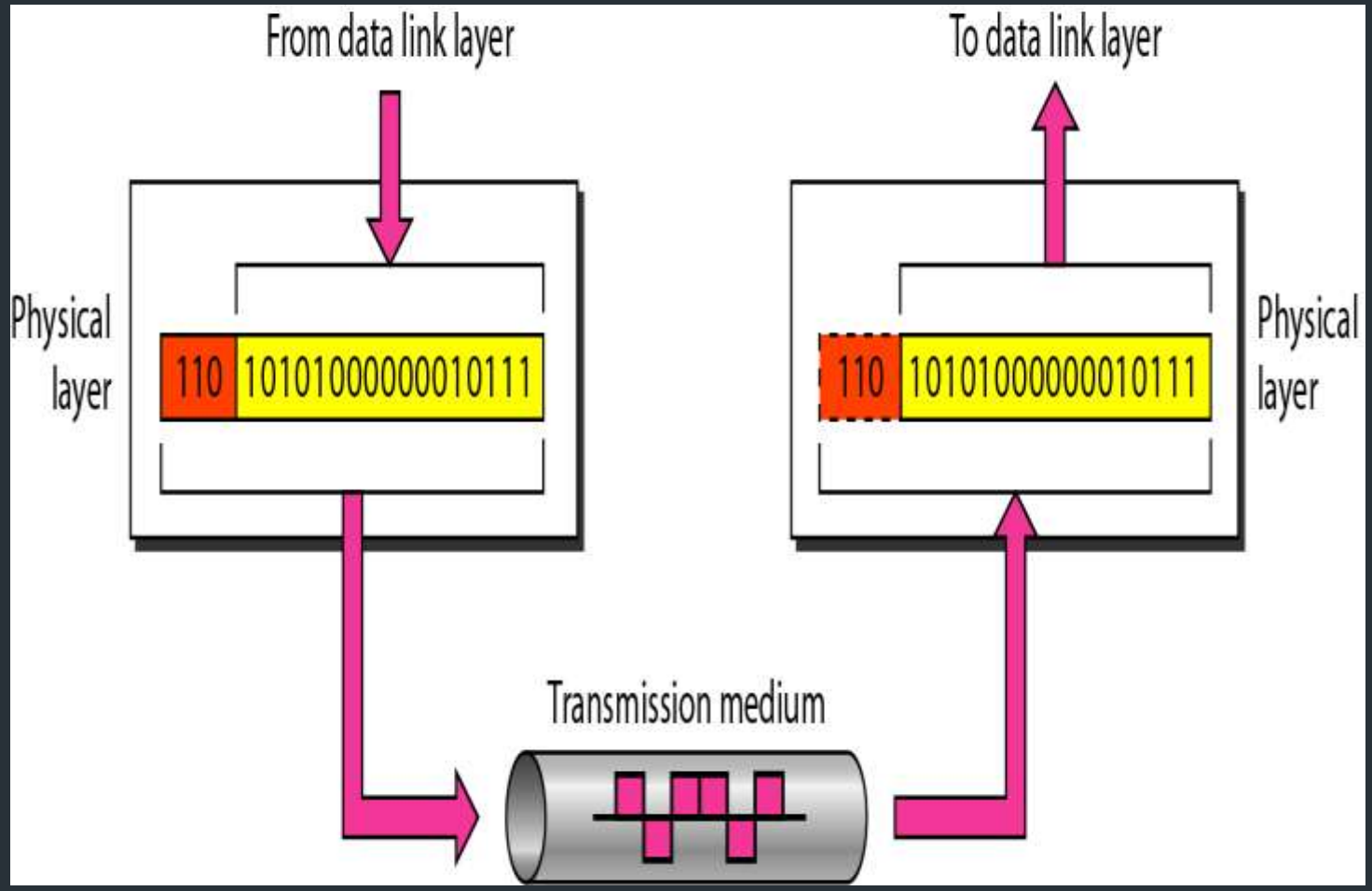


Source: Data Communications and Networking – Behrouz A. Forouzan

Physical layer

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

- Physical charac, i/f and media
- Representation of bits
- Data rate
- Bits Sync.
- Line config.
- Physical topology
- Transmission mode

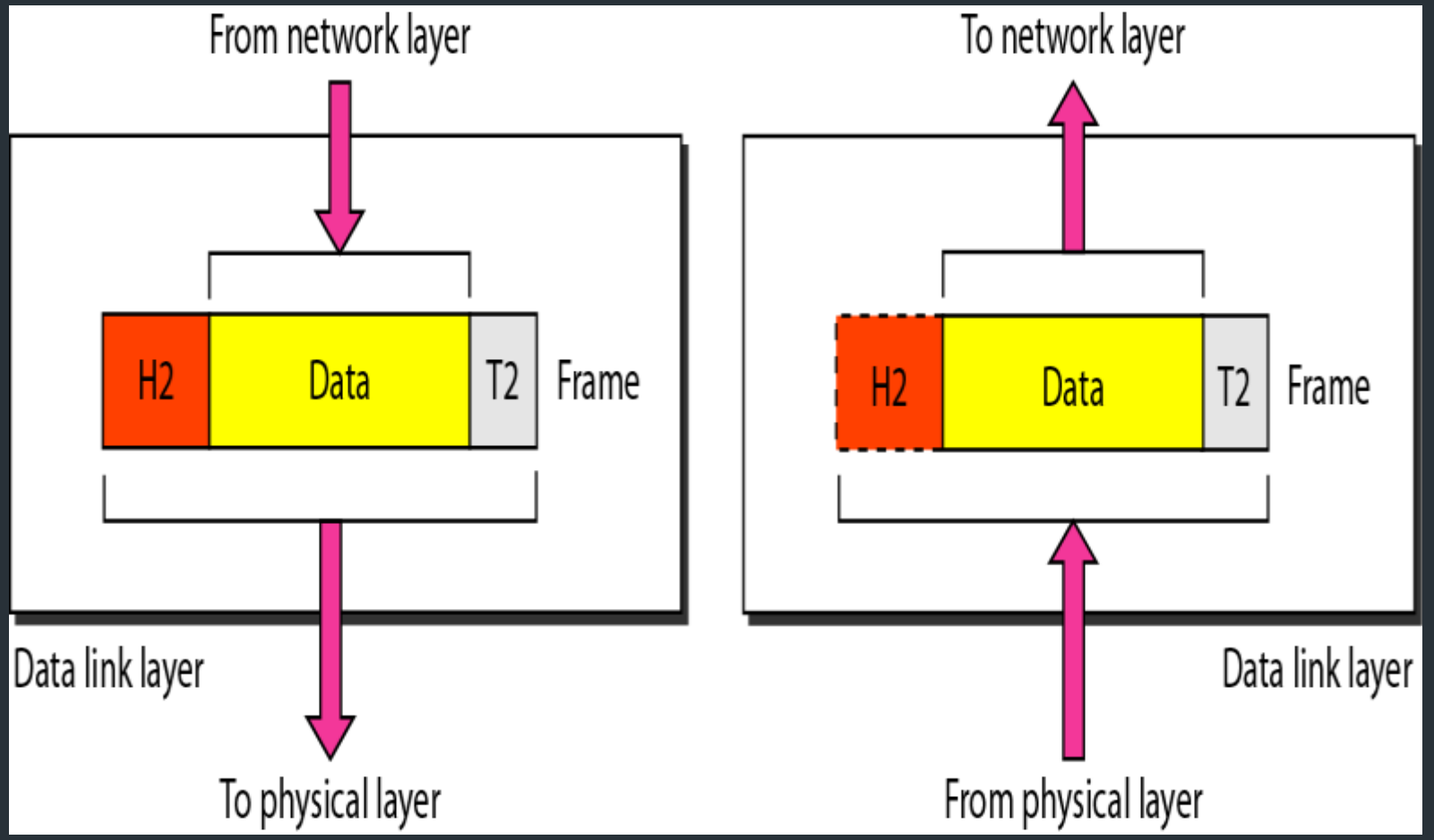


Source: Data Communications and Networking – Behrouz A. Forouzan

Data link layer (Cont....)

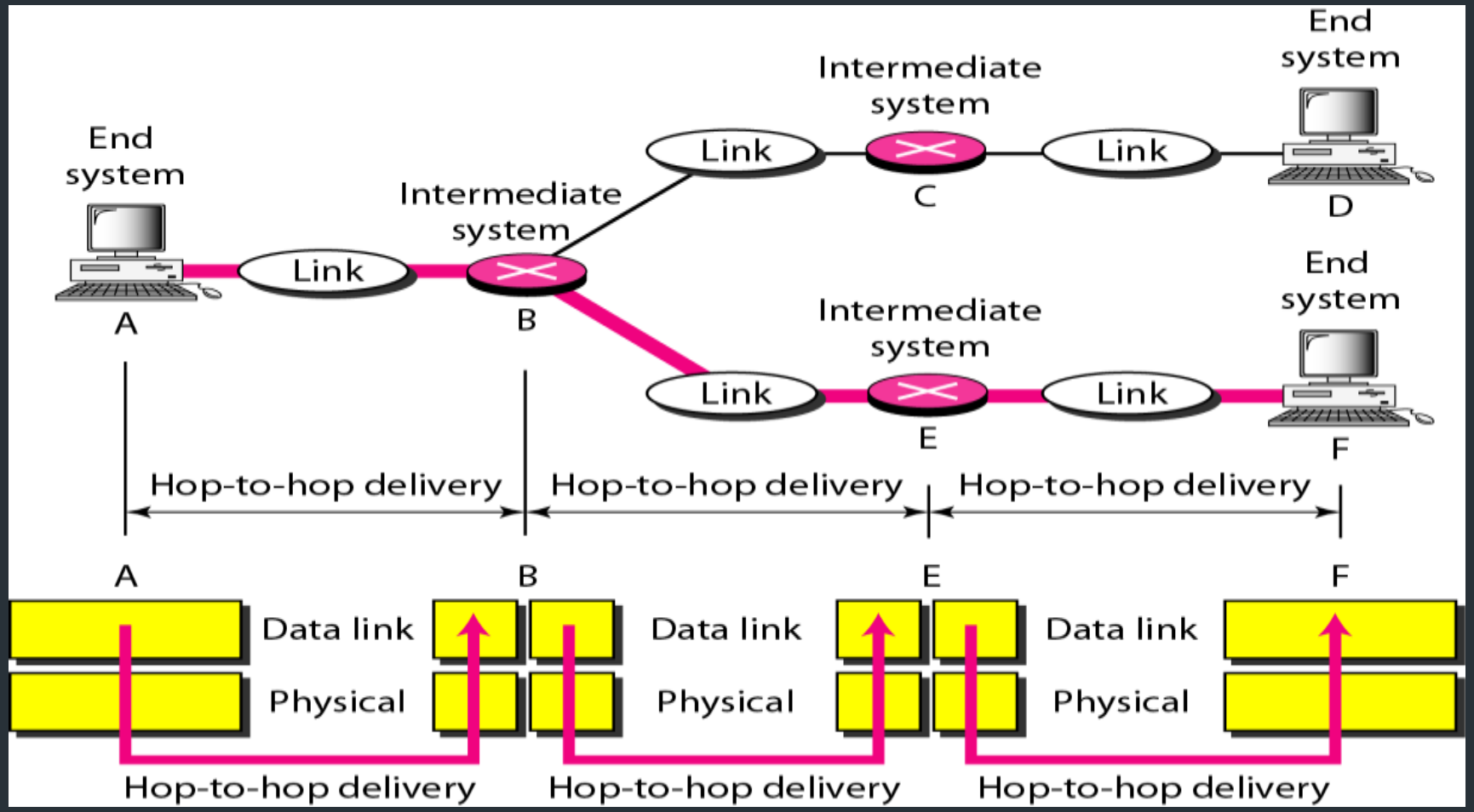
The data link layer is responsible for moving frames from one hop (node) to the next.

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



Source: Data Communications and Networking – Behrouz A. Forouzan

Hop-to-hop delivery

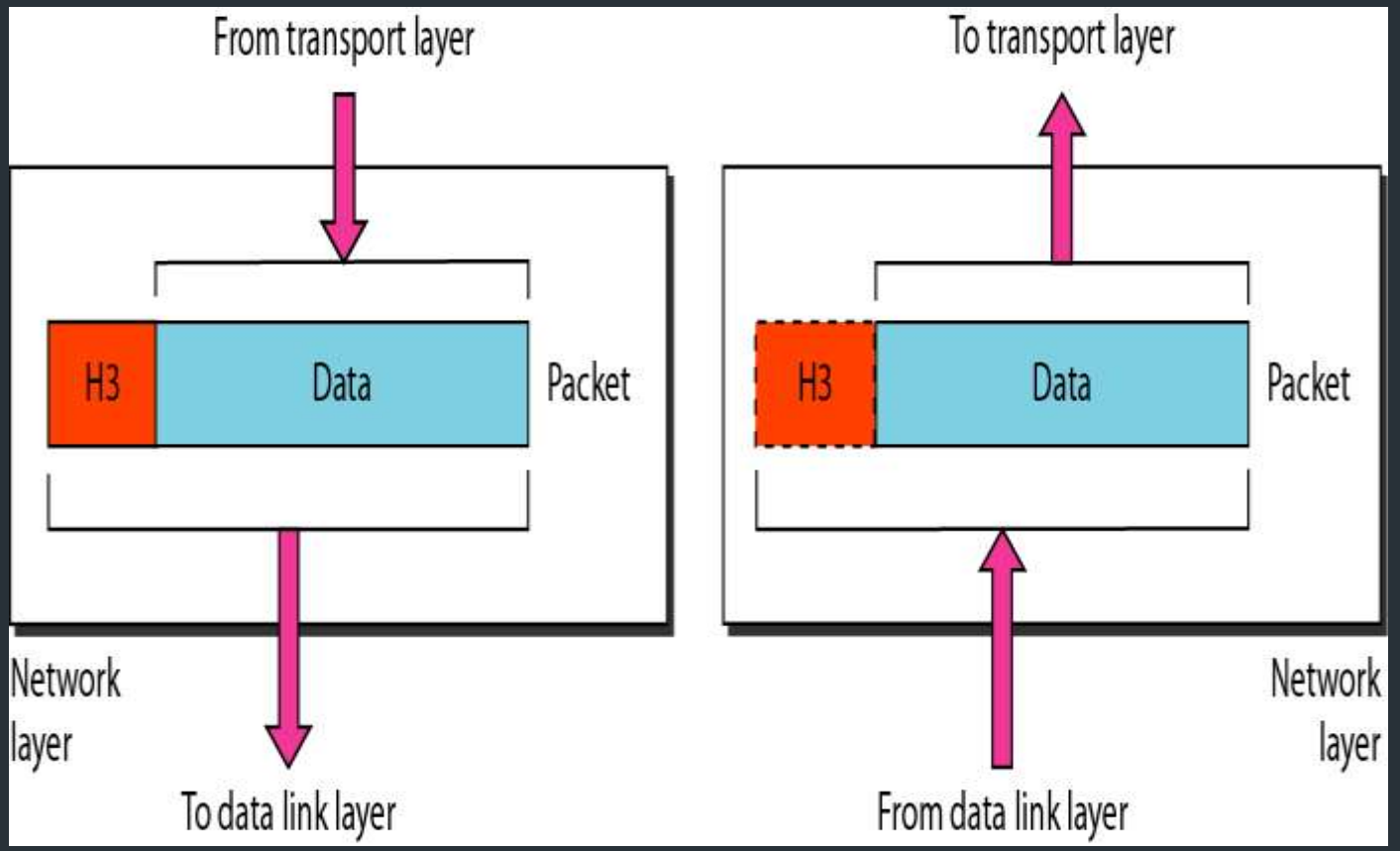


Source: Data Communications and Networking – Behrouz A. Forouzan

Network layer

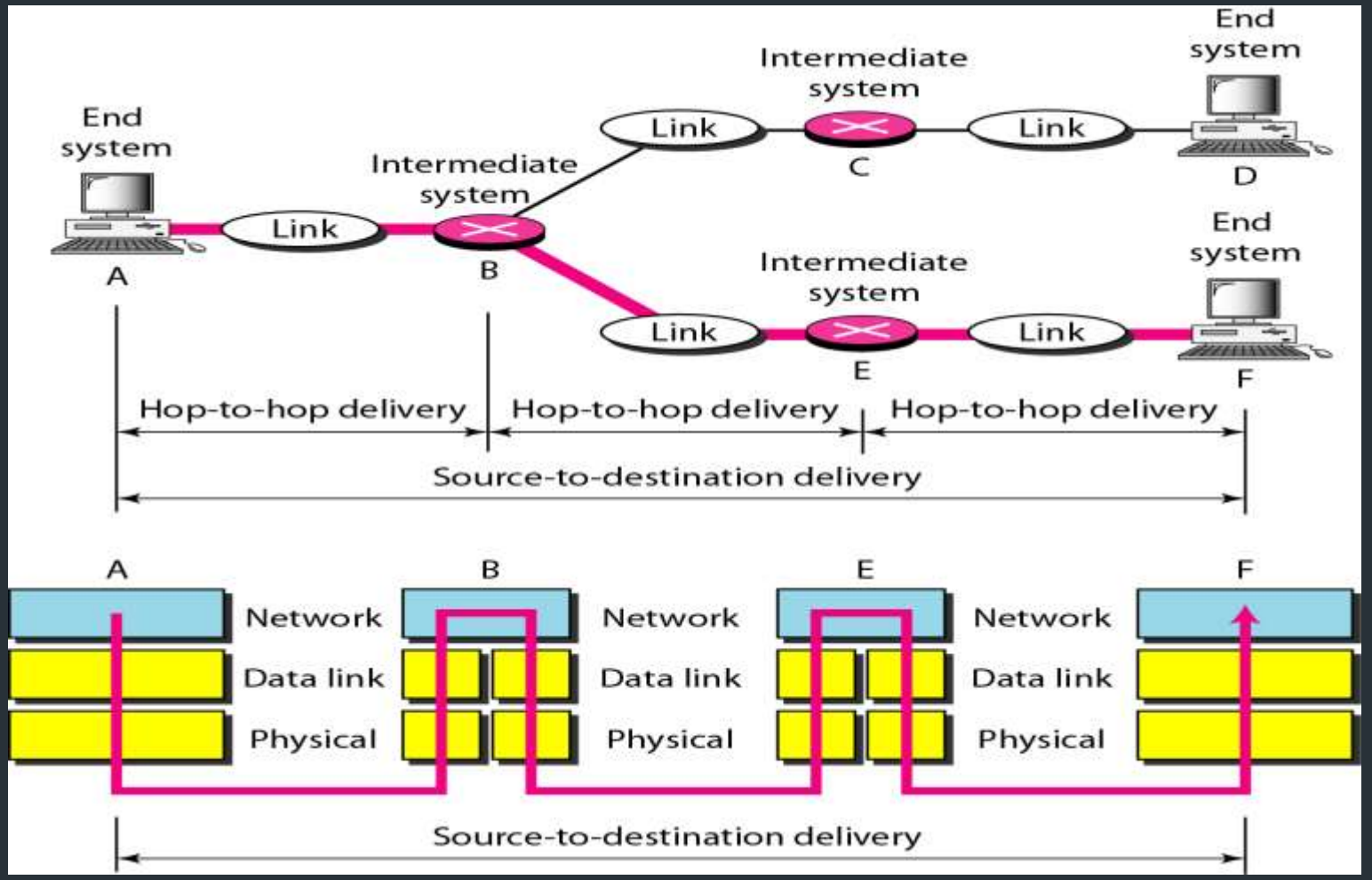
The network layer is responsible for the delivery of individual packets from the source host to the destination host.

- Source -> Destination
- Logical Addressing
- Routing



Source: Data Communications and Networking – Behrouz A. Forouzan

Source to destination delivery

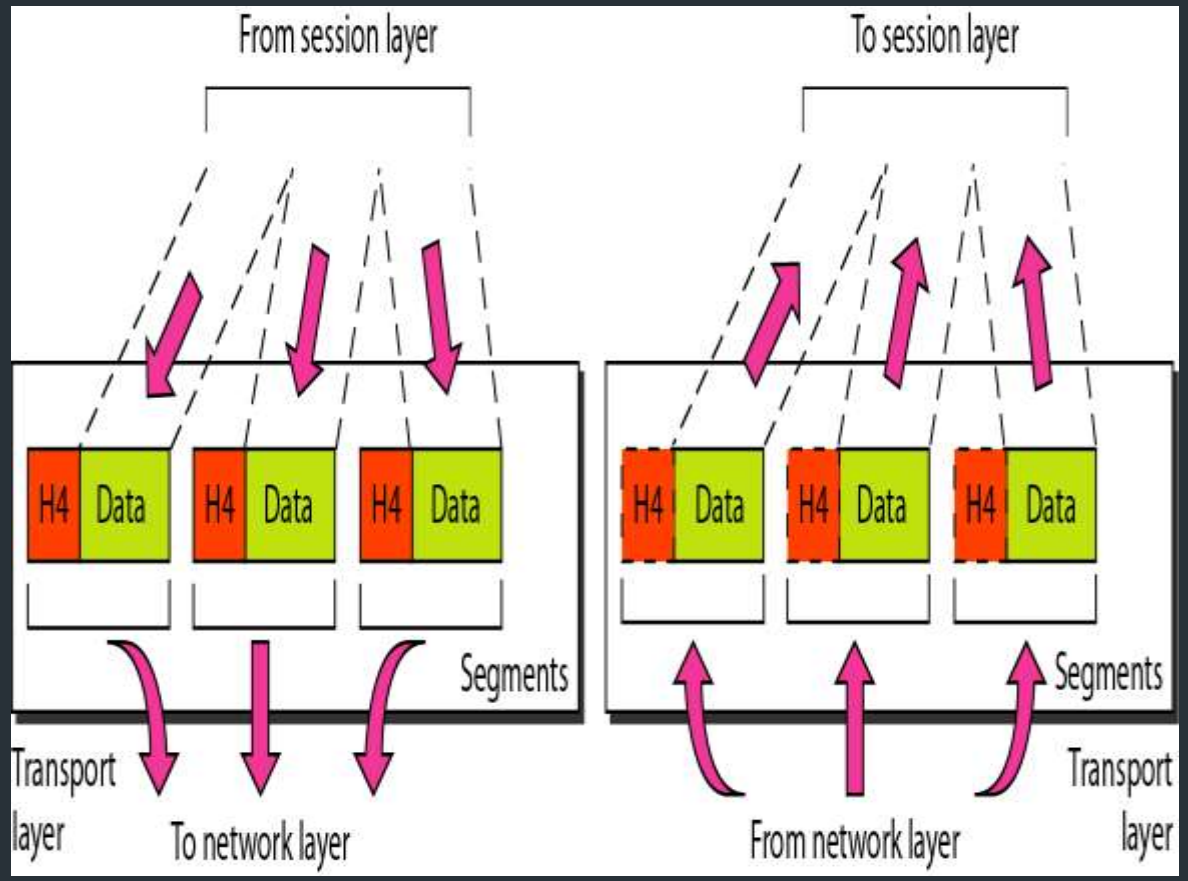


Source: Data Communications and Networking – Behrouz A. Forouzan

Transport layer

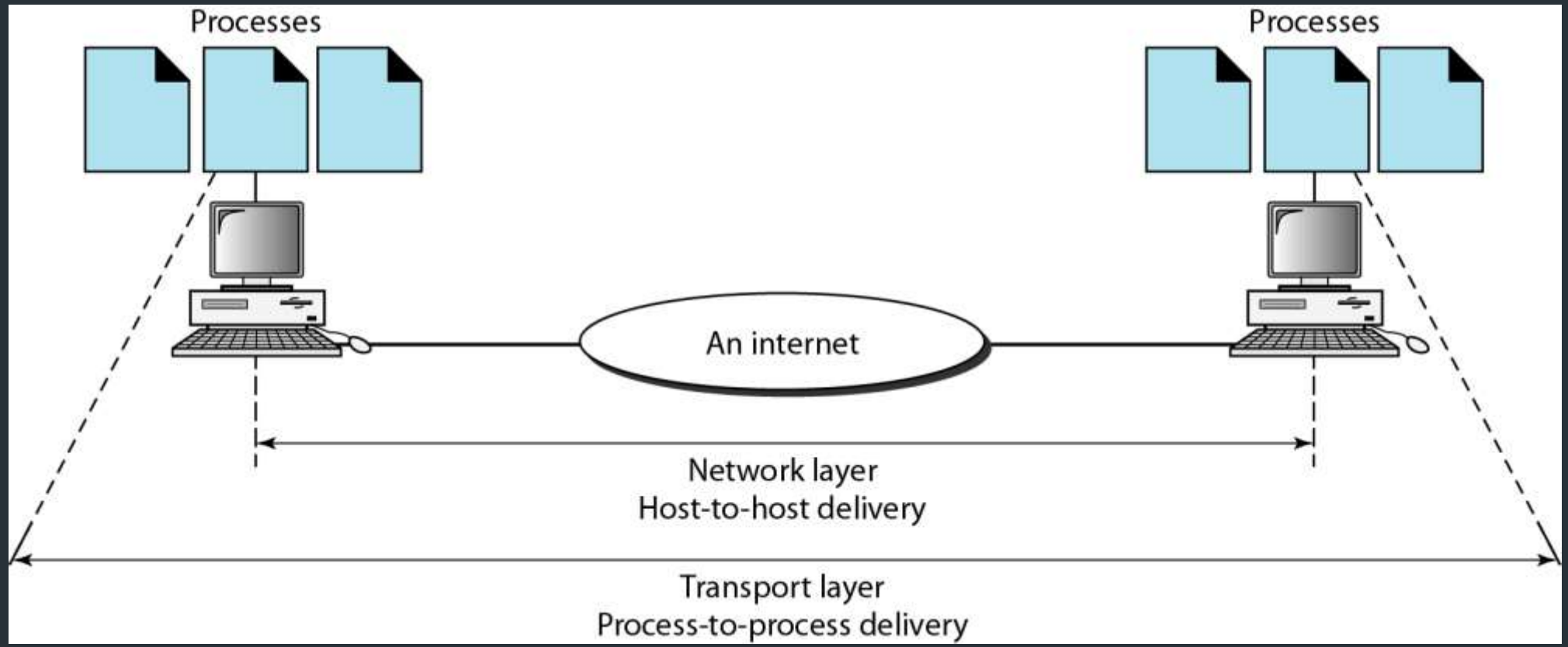
The transport layer is responsible for the delivery
of a message from one process to another.

- Source to destination
- Service point addressing
- Segmentation and reassembly
- Connection control
- Flow control
- Error Control



Source: Data Communications and Networking – Behrouz A. Forouzan

Reliable process-to-process delivery of a message

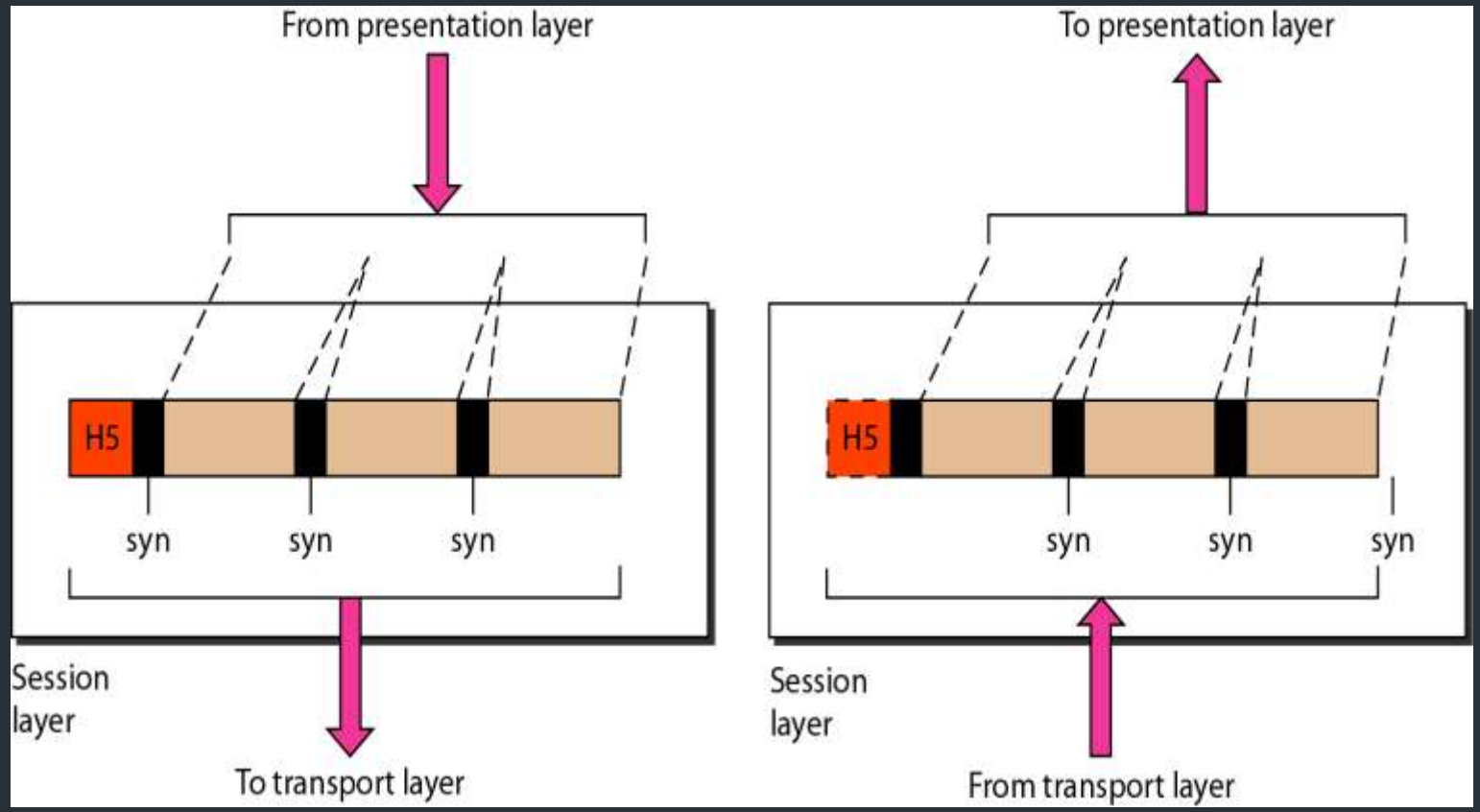


Source: Data Communications and Networking – Behrouz A. Forouzan

Session layer

The session layer is responsible for dialog control and synchronization.

- Dialogue control
- Synchronization

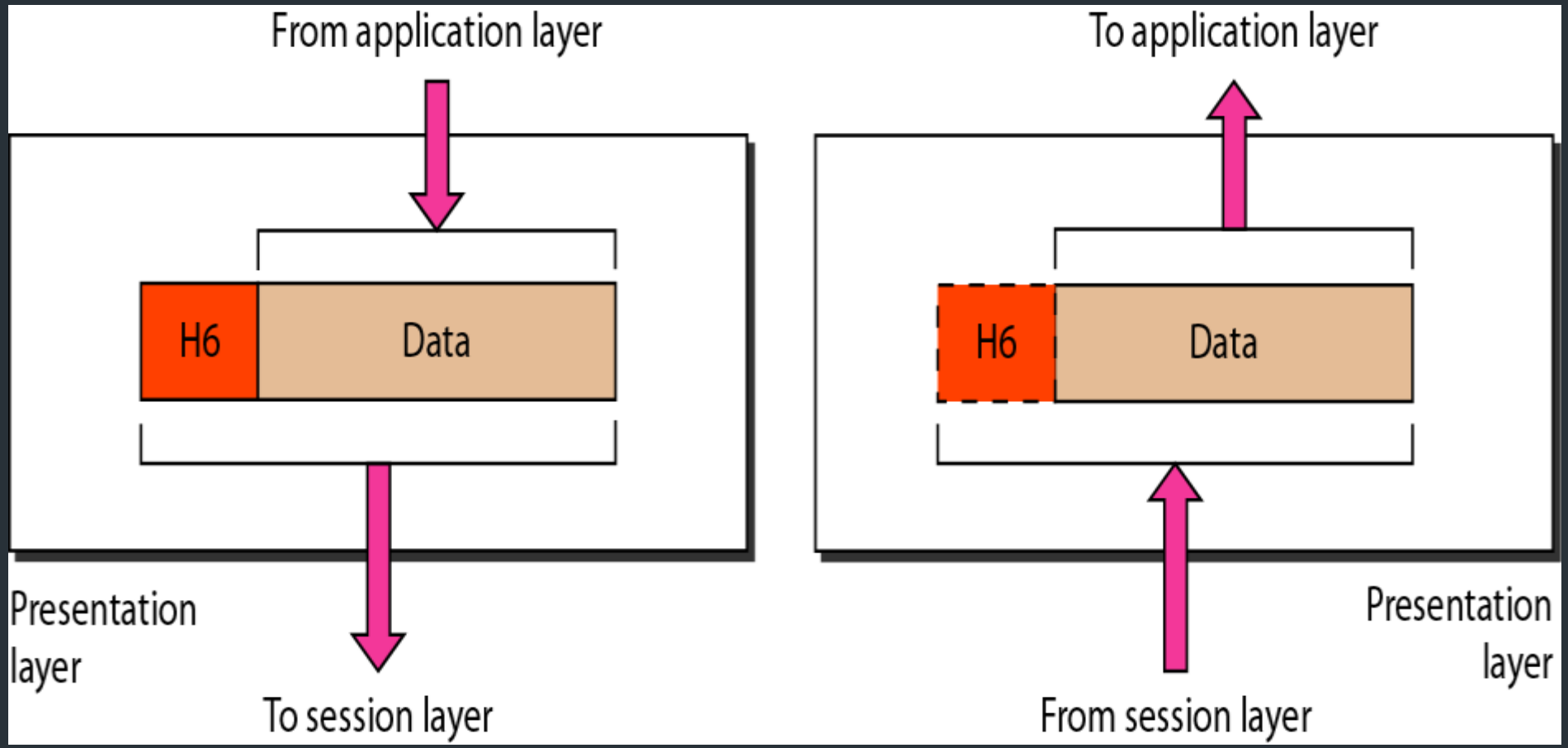


Source: Data Communications and Networking – Behrouz A. Forouzan

Presentation layer

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

- Translation
- Encryption
- Compression

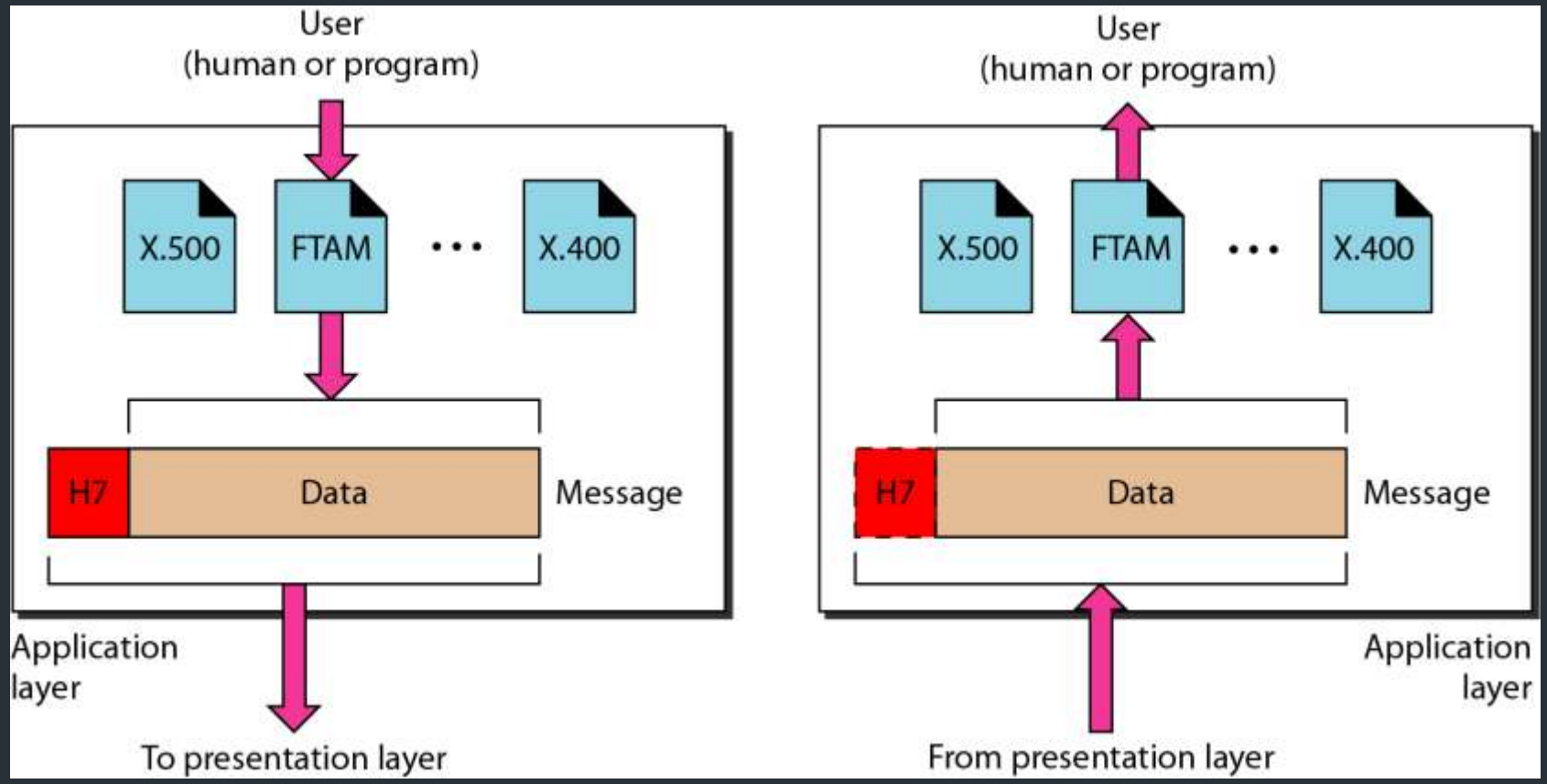


Source: Data Communications and Networking – Behrouz A. Forouzan

Application layer

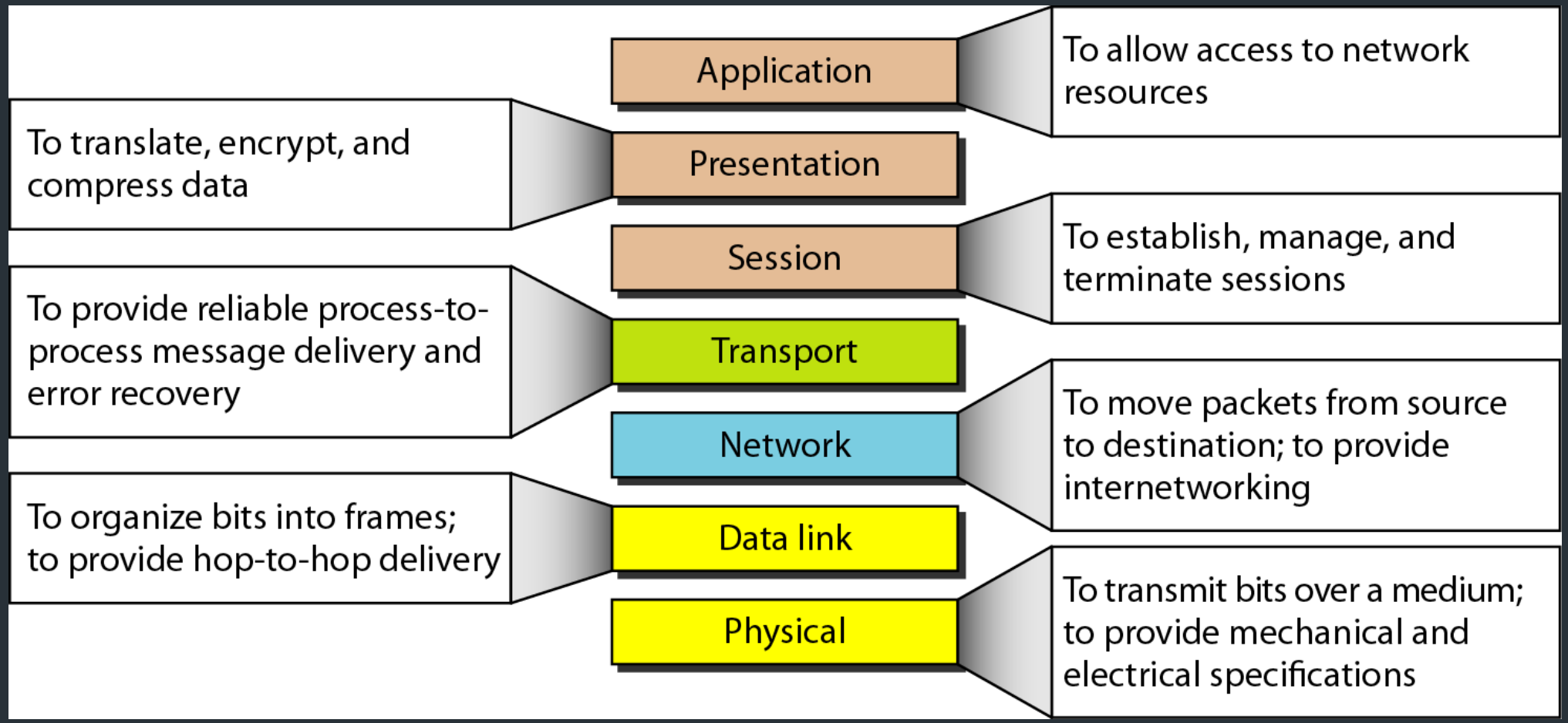
The application layer is responsible for providing services to the user.

- Network Virtual terminal
- FTAM (File Transfer Access and Management)
- Mail services
- Directory services



Source: Data Communications and Networking – Behrouz A. Forouzan

Summary of layers



Source: Data Communications and Networking – Behrouz A. Forouzan

TCP/IP PROTOCOL

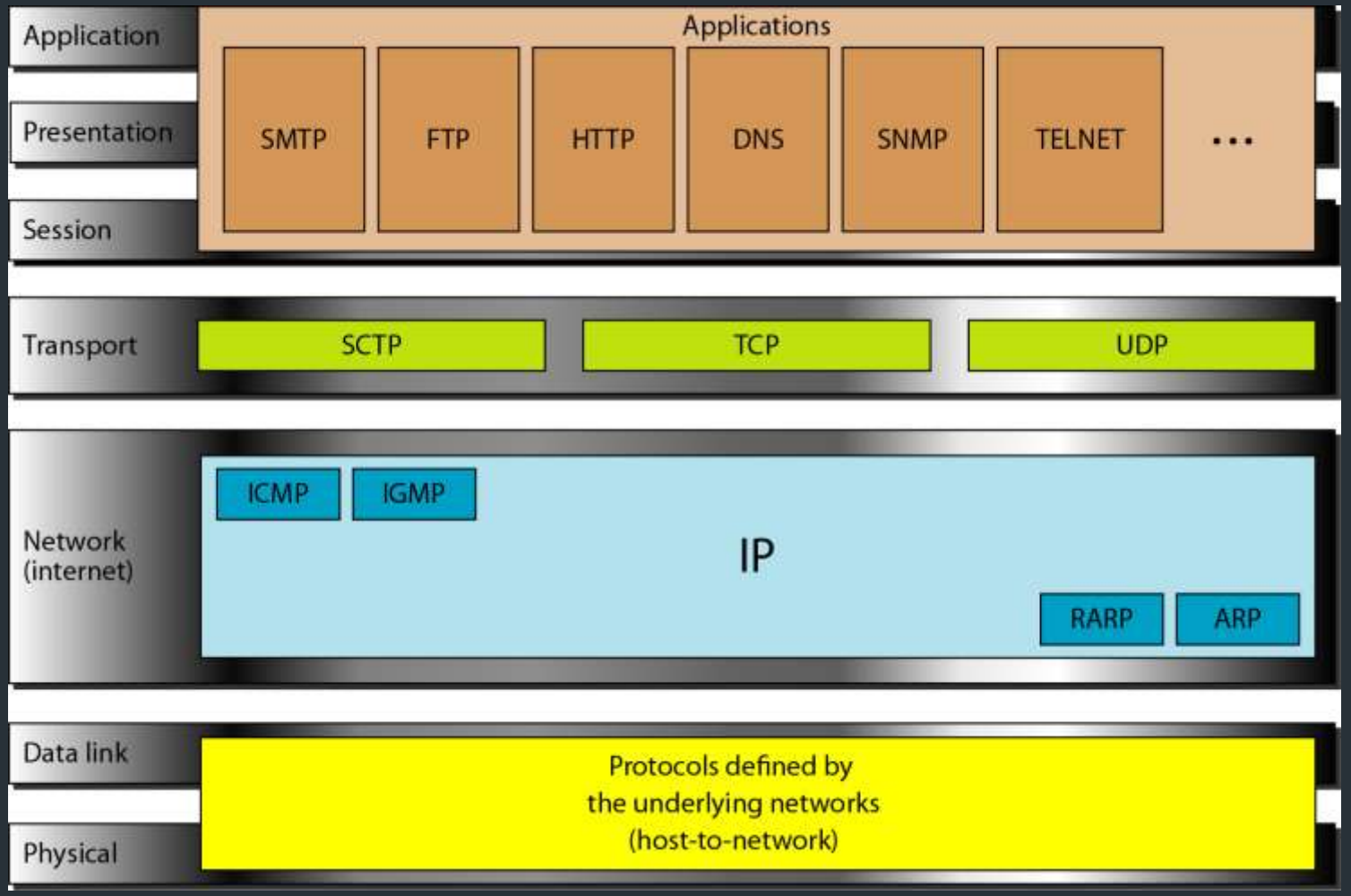
DATA COMMUNICATION AND NETWORKING

TCP/IP PROTOCOL SUITE

- The 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 Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Application Layer

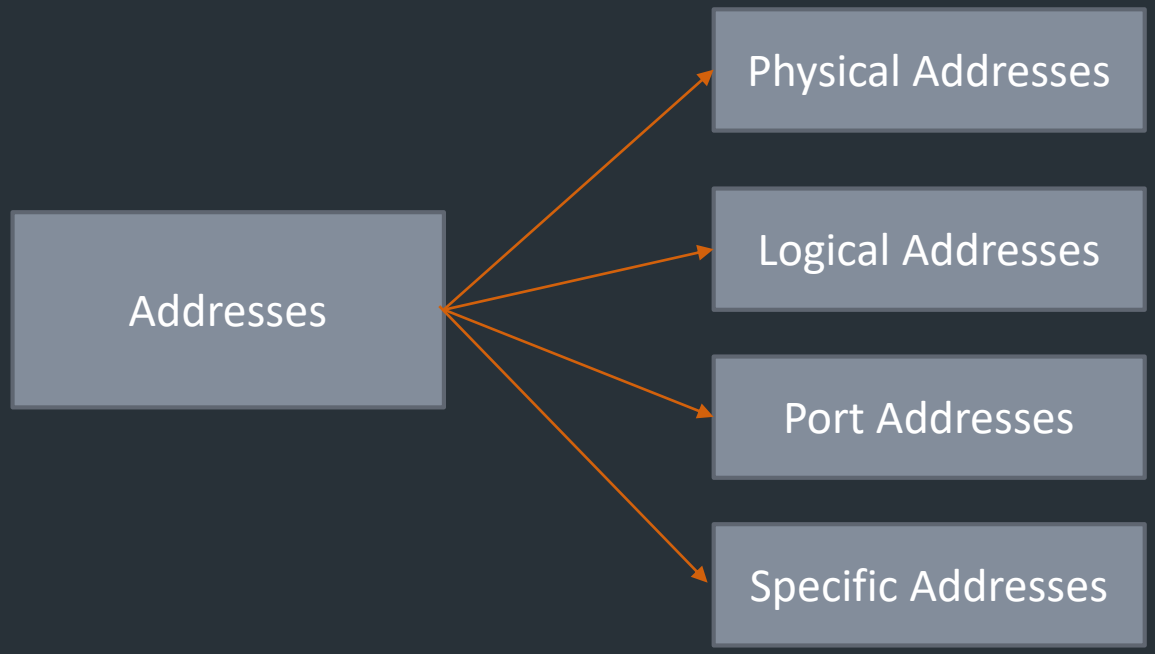
TCP/IP and OSI model



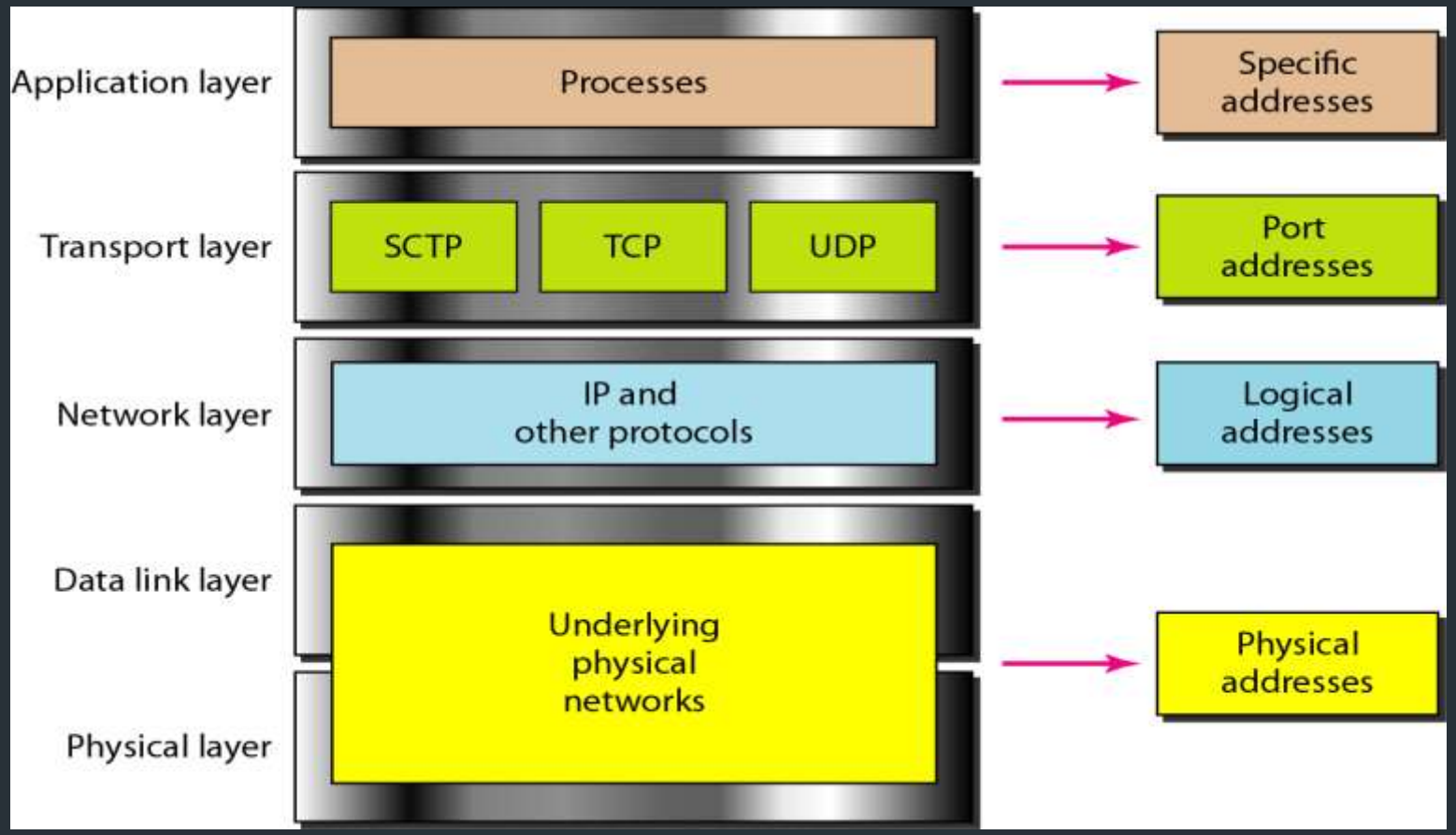
Source: Data Communications and Networking – Behrouz A. Forouzan

Addressing

Four levels of addresses are used in an internet employing the TCP/IP protocols



Relationship of layers and address TCP/IP



Source: Data Communications and Networking – Behrouz A. Forouzan

MAC address or Physical address

Most local-area networks use a 48-bit (6-byte) **physical address** written as 12 hexadecimal digits; every byte (2 hexadecimal digits) is separated by a colon, as shown below:

07:01:02:01:2C:4B

A 6-byte (12 hexadecimal digits) physical address

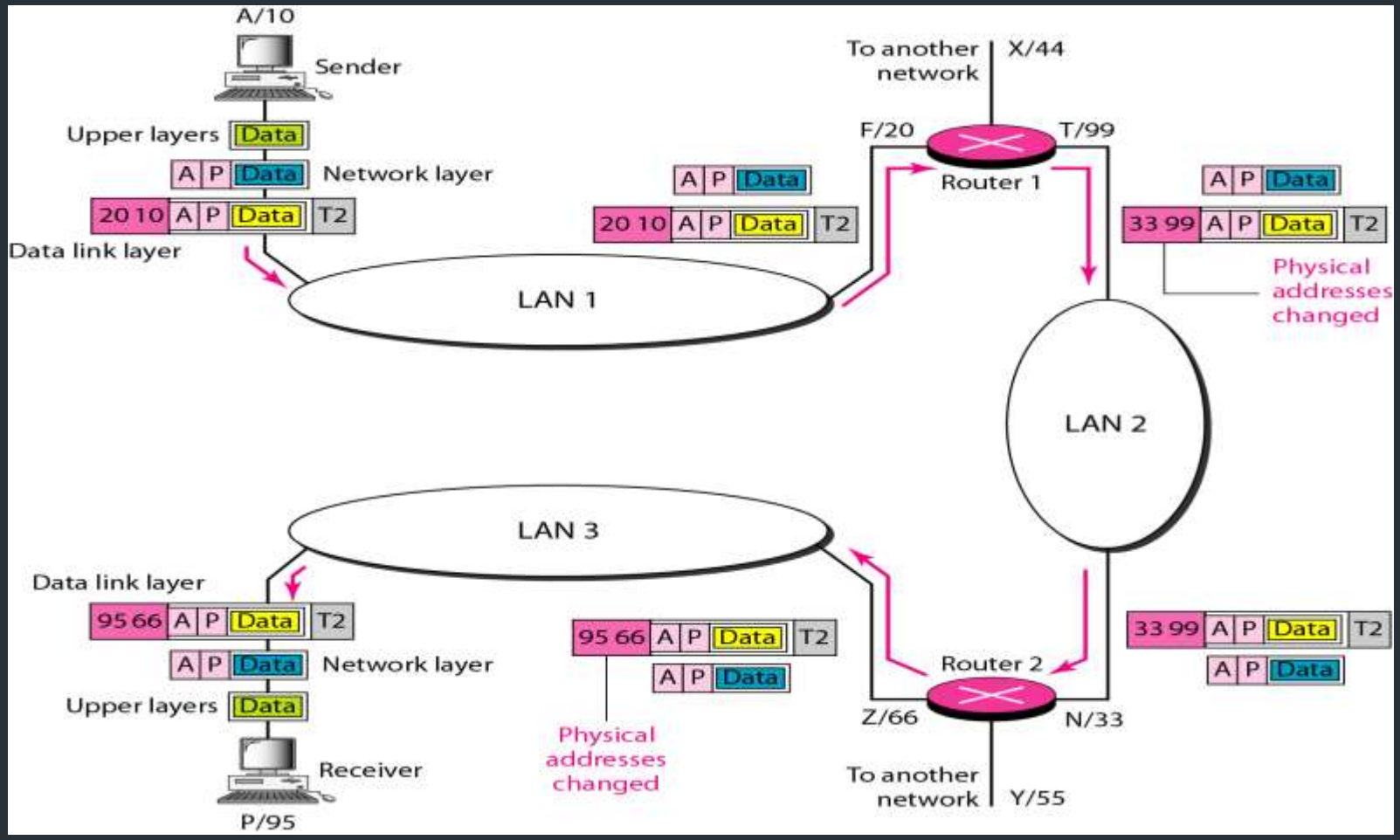
Source: Data Communications and Networking – Behrouz A. Forouzan

IP Address

The physical addresses will change from hop to hop, but the logical addresses usually remain the same.

A logical address is a 32-bit(IPv4) or 128-bit(IPv6).

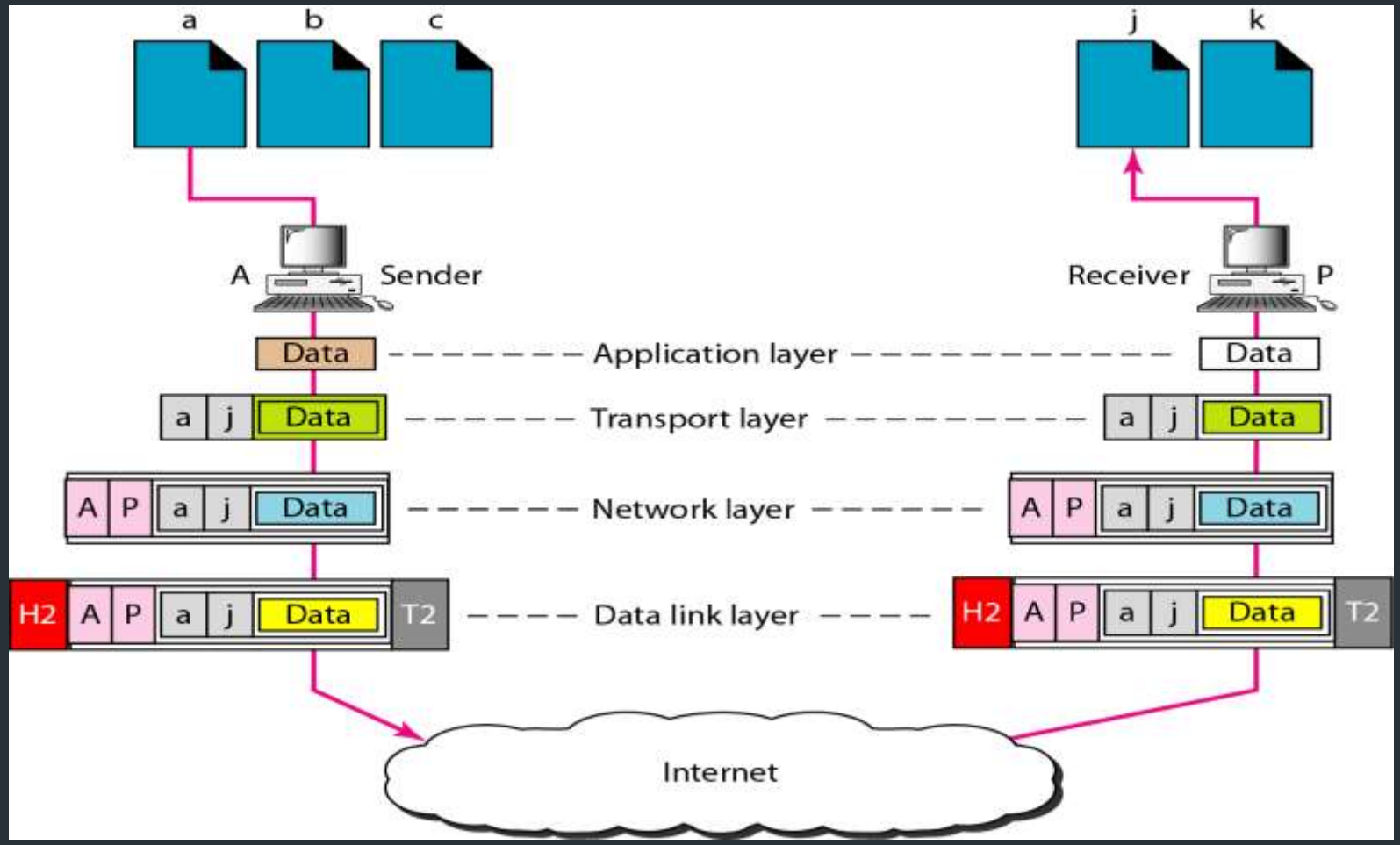
Examples
IPv4: 192.168.2.33
IPv6:
2dbe:ab67:237f:50cd:83fd
:ab34:92bd:66ca



Source: Data Communications and Networking – Behrouz A. Forouzan

Port address

A port address is a 16-bit address represented by one decimal number.
Ex.753
A 16-bit port address represented as single number.



Source: Data Communications and Networking – Behrouz A. Forouzan

References

- Forouzan Behrouz, A. "Data Communication and networking." (2008).
- Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier, 2007.
- Stallings, William. *Data and computer communications*. Pearson Education India, 2007.
- Web Links as mentioned in source

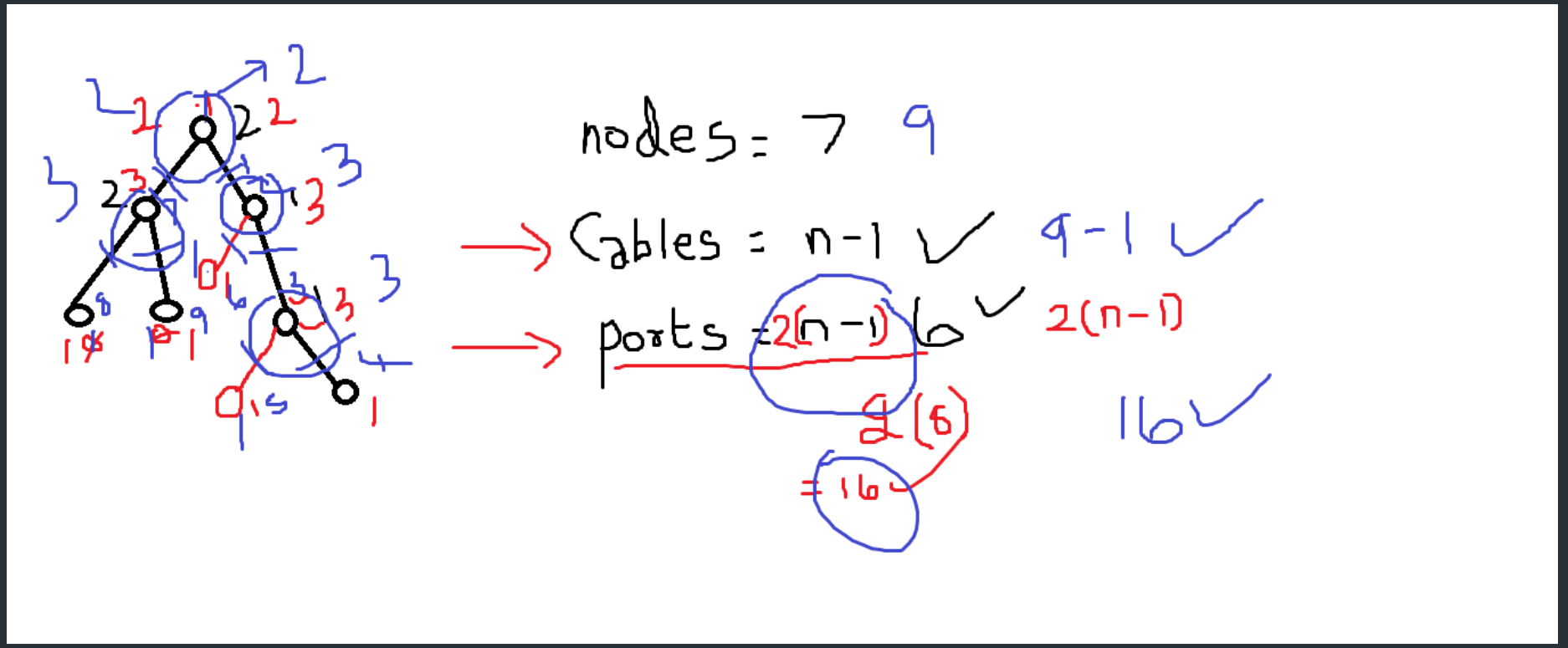
Theory_Class 6

Networking Principles and layered architecture

NETWORK AND COMMUNICATION

Theory_Class_6 – DOUBTS CLEARING SESSION

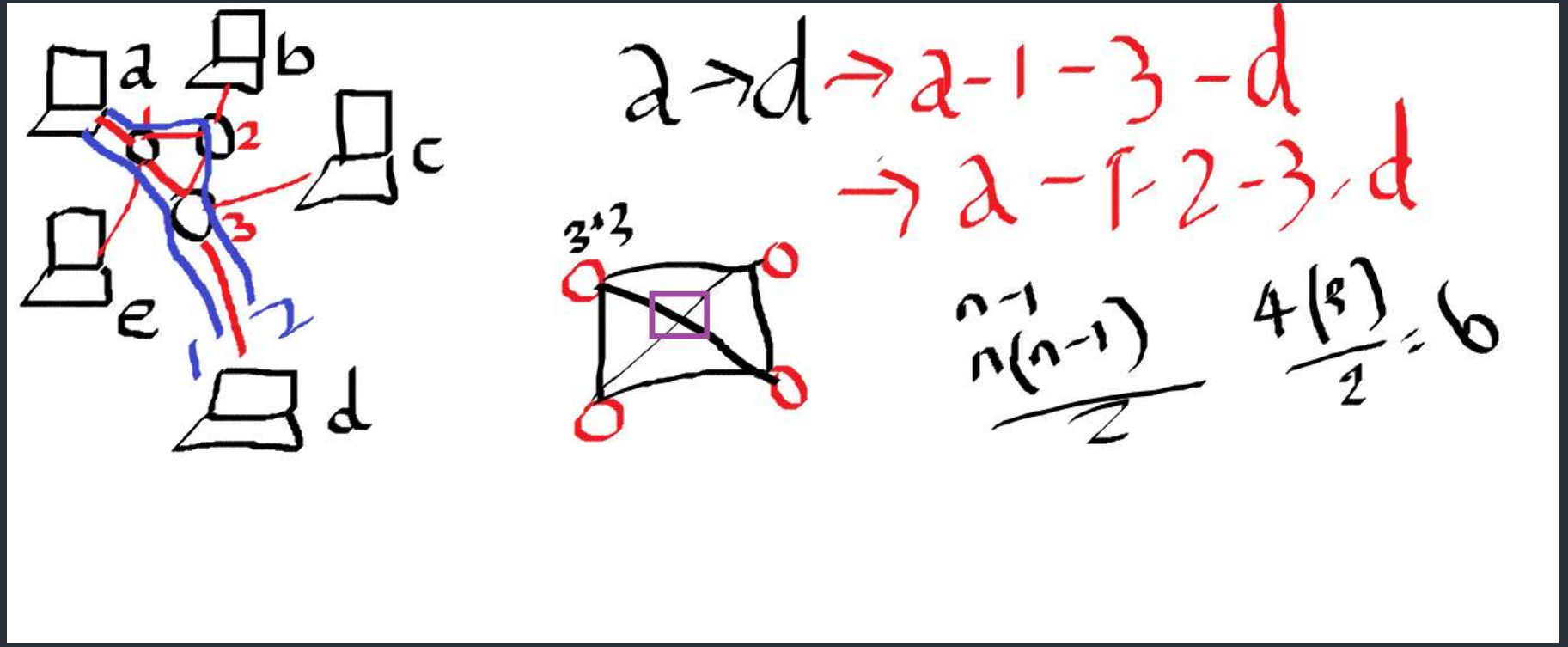
Cables and ports calculation for tree - M Abishek –



The ip address always go up to 255? Why sir? – Naveen Gupta

- Ex. 192.168.1.10. It is an example for IP address. IP address contains four parts here in which three parts belongs to Network id and the last part belong to host id. Each part composed of 8 digit (octal) number. i.e. For this Ex. 192.168.1.10. the corresponding bit are (11000000.10101000.00000001.00001010). If you put 1 for all digits 128+64+32+16+8+4+2+1=255. So, it ranges from 0 to 255. For more information i will clear about this in tomorrow's class session. So that everyone can come to know.

Doubts Clearing Session



Thank You

Queries?