

Computer Networks: Reference Model



By,

Mr. Kumar Pudashine, (MEng, AIT, Bangkok)

CISA, CISM, CRISC, CNDA, CDCP, COBIT 5, CCNP (Enterprise), JNCIA, CEH v9, ITIL, ISO 27001:2013, AcitivIdentity Certified

Senior Section Chief, Network and Security

Agricultural Development Bank,

Kathmandu

Protocols : What It is ?

2

- A Protocol is a set of rules that governs Data Communications.
- For Communication to occur, the entities must agree on a Protocol.
- The Key Elements of a Protocol are
 - Syntax => Refers to Structure or Format of Data.
 - Semantics => Refers to Meaning of Each Data.
 - Timing => When Data Should be Sent and How Fast ?

“French Scientist Cannot Communicate With Japanese Scientist
Without Any Protocol”

Standards : What It is ?

3

- Creates Open and Competitive Market for Manufacturers.
- Provides guidelines to Manufactures for Interoperability.
- Data Communication Standards Fall into Two Categories
 - *De facto*
 - *De jure*
- *De facto* Standards have not been approved by an Organization.
- Standards through Wide Spread Use are *De facto* Standards.
- *De jure* Standards have been legalized by an Organization.

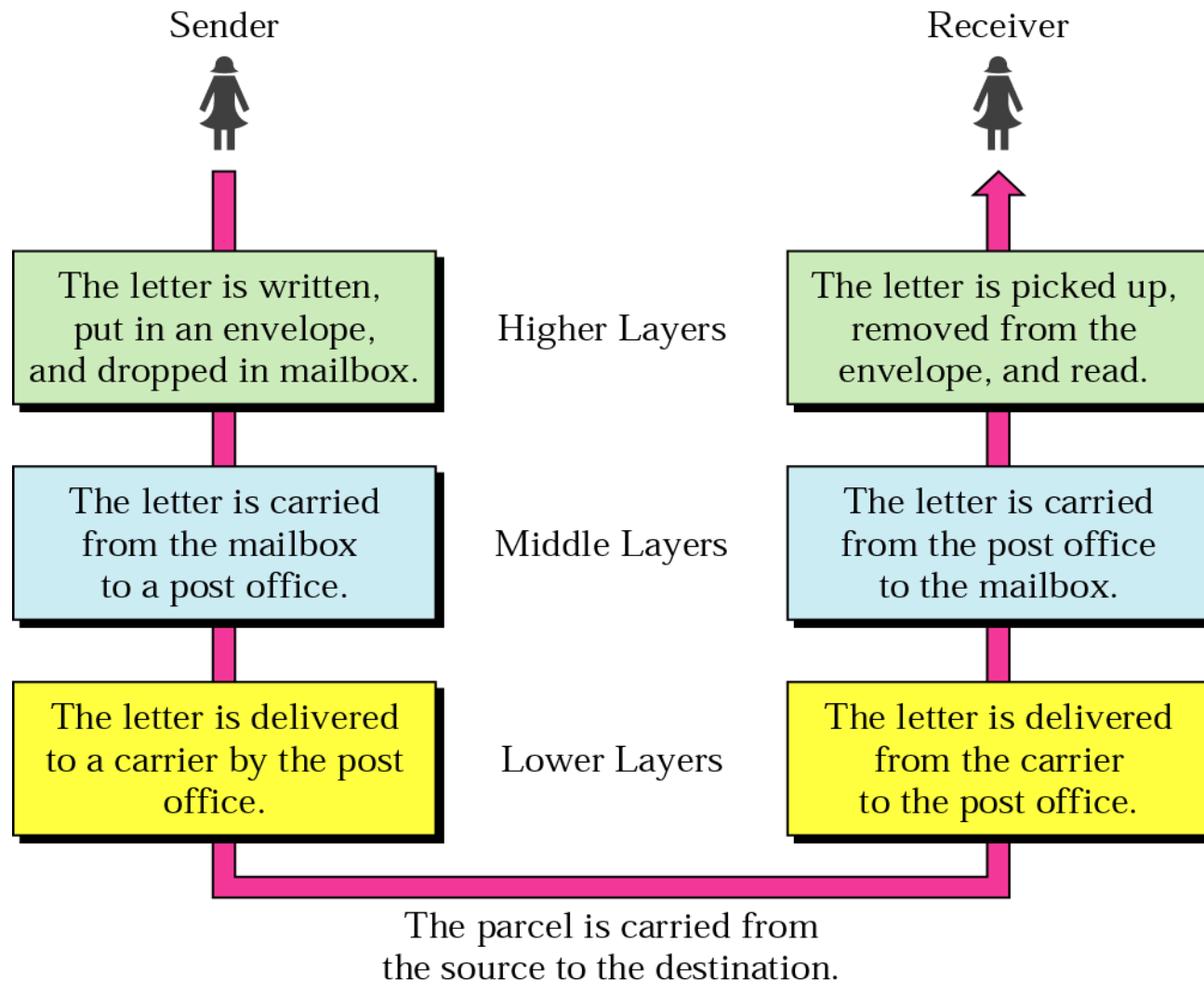
Standard Organization

4

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

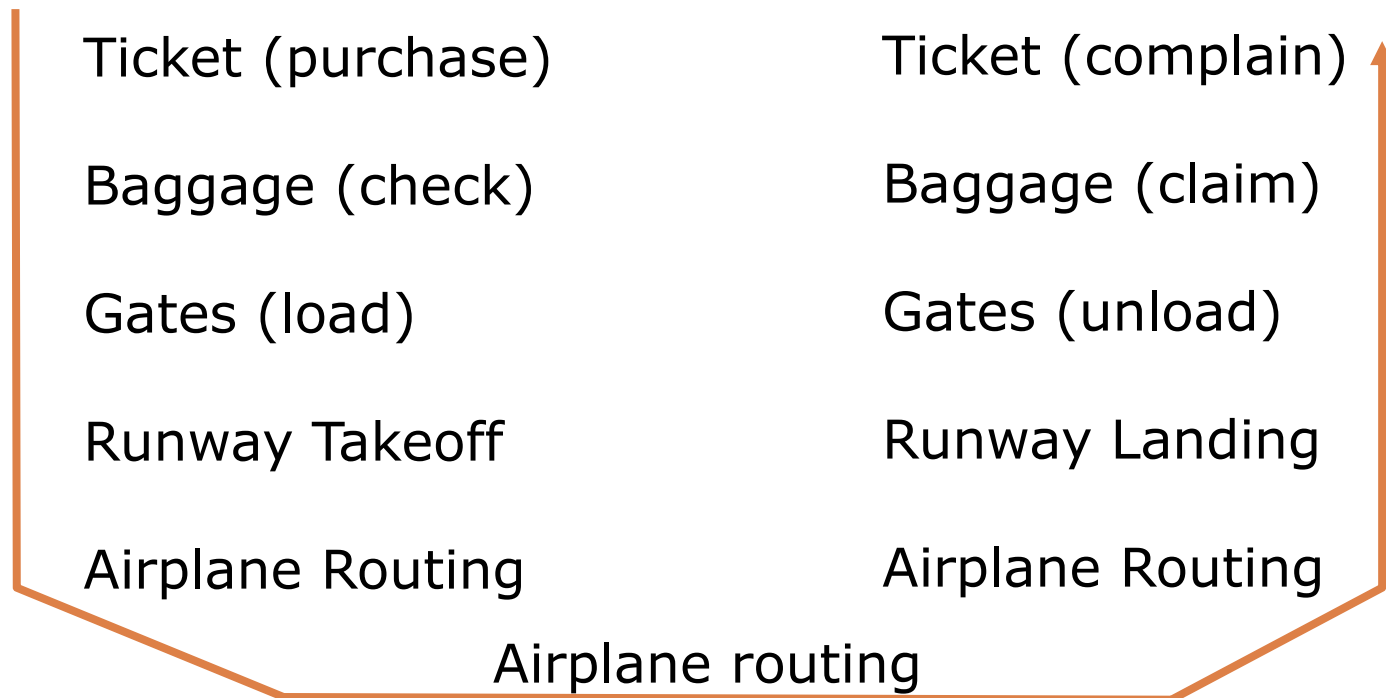
Protocol Analogy: Sending a Letter

5



Protocol Analogy: Organization of Air Travel

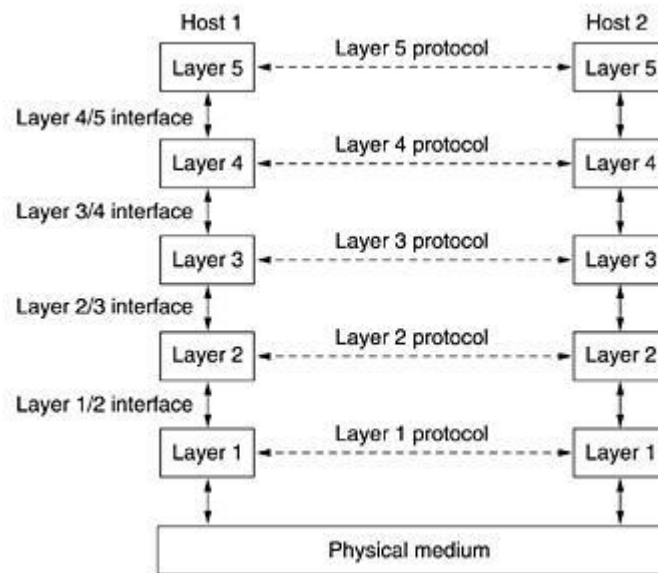
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Network Software : Protocol Hierarchies

7

- Stack of Layers => Protocol Stack OR Protocol Suite.
- Each Layer Provides Service to Layer Above It.



- No Direct Data Transfers from layer n on one Machine to Other.
- Through Physical Medium actual Communication Occurs.

Network Software : Design Issues of Layers

8

- Addressing
- Segmentation and Reassembly
- Encapsulation
- Connection Control
 - Connection Oriented Service
 - Connectionless Service
- Flow Control
- Error Control
- Multiplexing and Demultiplexing
- Routing

Network Software : Relationships of Services to Protocols

9

- Service is a set of Primitives (Operations) that a Layer Provides.
- *Layer K* Provides Service to *Layer K+1*.
- *Layer K* is the Service Provider.
- *Layer K+1* is the Service Taker.
- A Service is a Type of Abstract Data Type in OOP.
- ADT Defines Operations but Not How They are Implemented.

Why Layering ??

10

- To Separate Specific Functions in Each Layer.
- Each Layer Should Define a Unique Function.
- To make their Implementation Transparent to Other Components.
- Allows Independent Design and Testing of Each Components.
- Modularization Eases Maintenance and Updating of System.

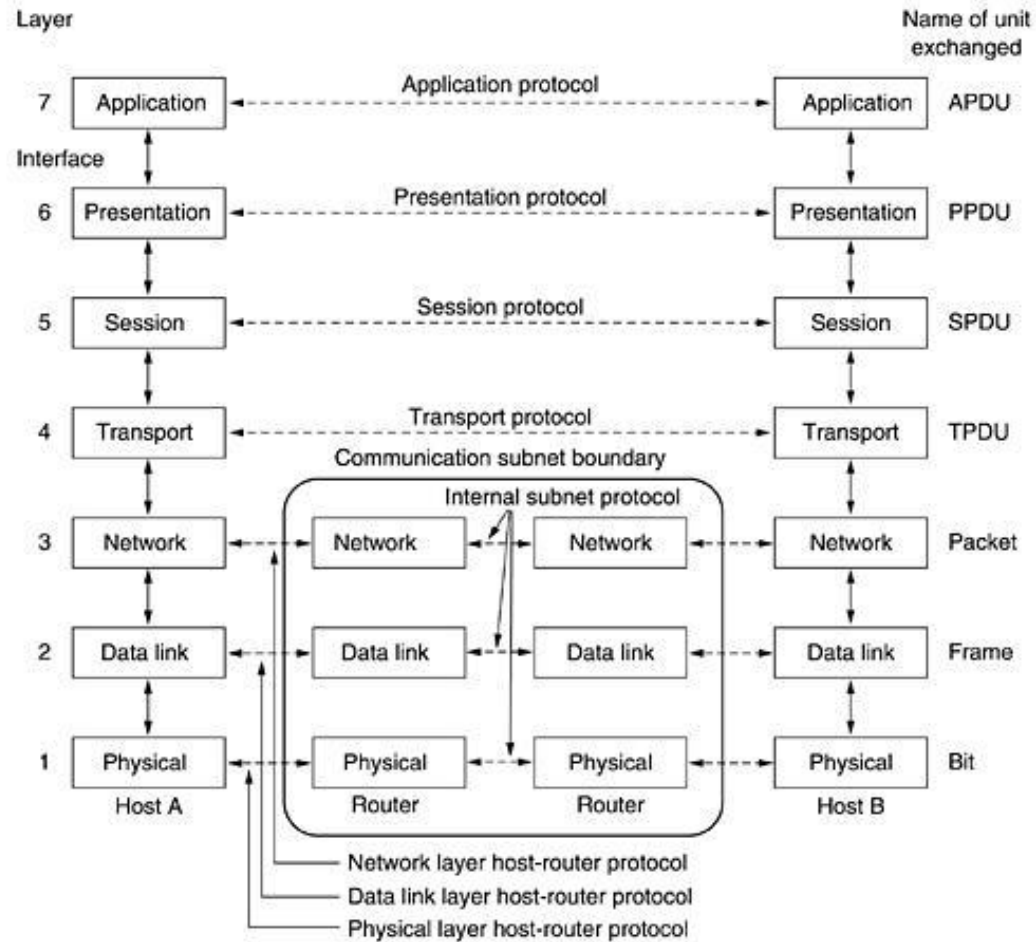
OSI Model

11

- ❑ Open System Interconnection
- ❑ Developed by International Organization for Standardization.
- ❑ It Consists of Seven Layers.
- ❑ Considered as a Reference Model.
- ❑ A Theoretical System Delivered Too Late.

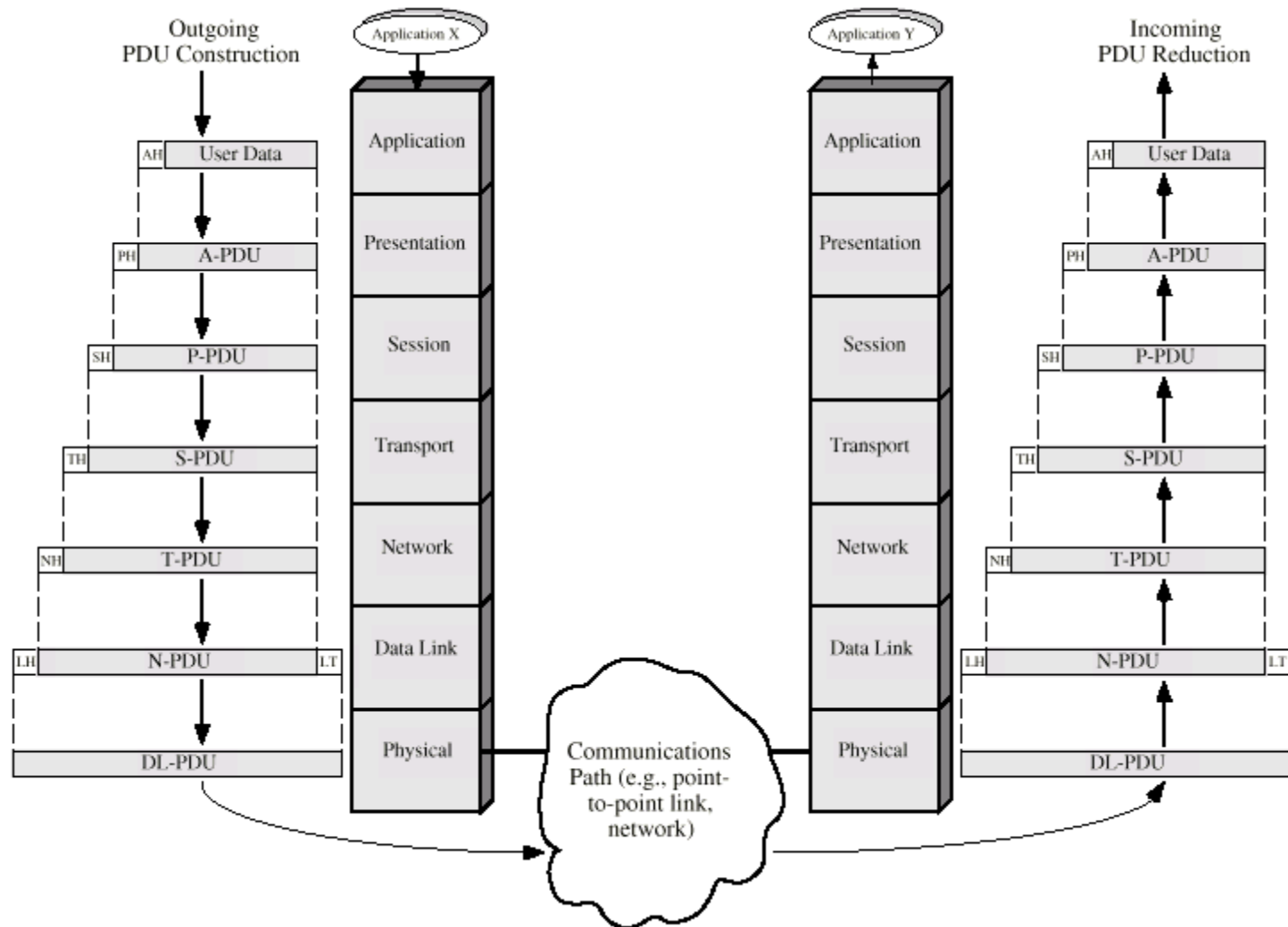
The OSI Reference Model

12



The OSI Environment

13



OSI Layers : Functions

14

Physical Layer

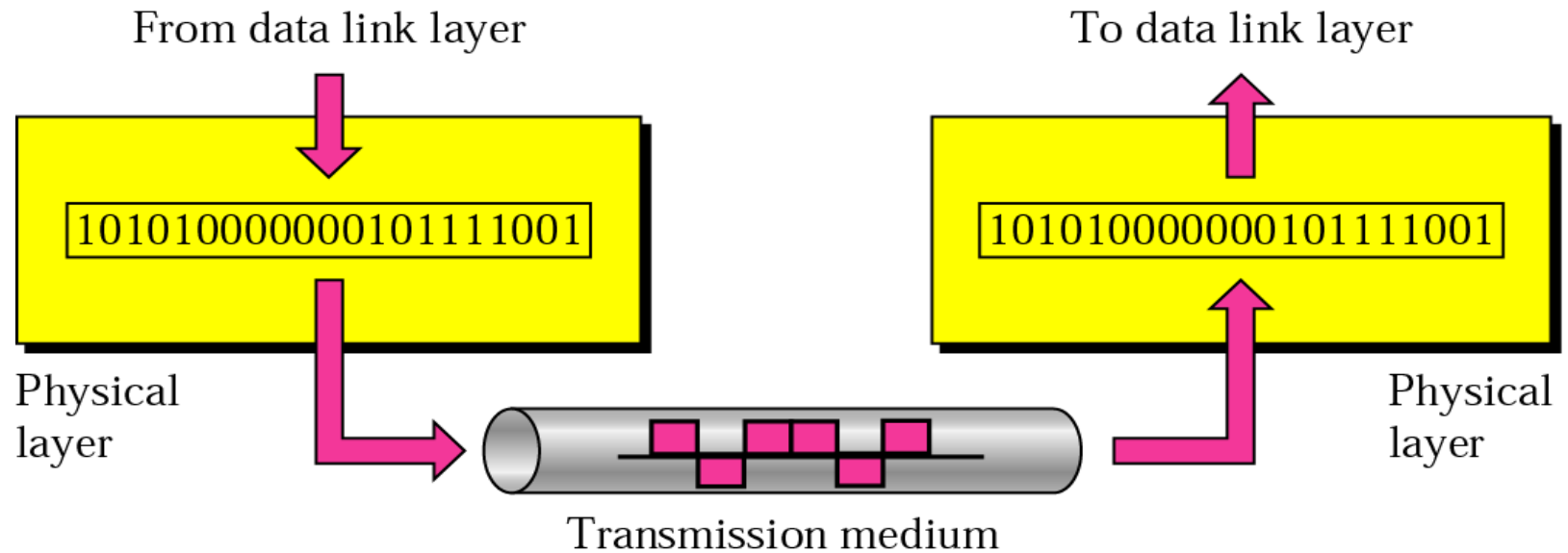
- ❑ Responsible for Transmitting Individual Bits.
- ❑ Deals with Physical Characteristics of Interfaces and Medias.
[Electrical and Mechanical]

Data Link Layer

- ❑ Enables Node to Node Communication.
- ❑ Responsible for Transmitting Frames From One Node to Next.
- ❑ Framing
- ❑ Physical Addressing
- ❑ Error Control
- ❑ Access Control [E.g CSMA/CD]

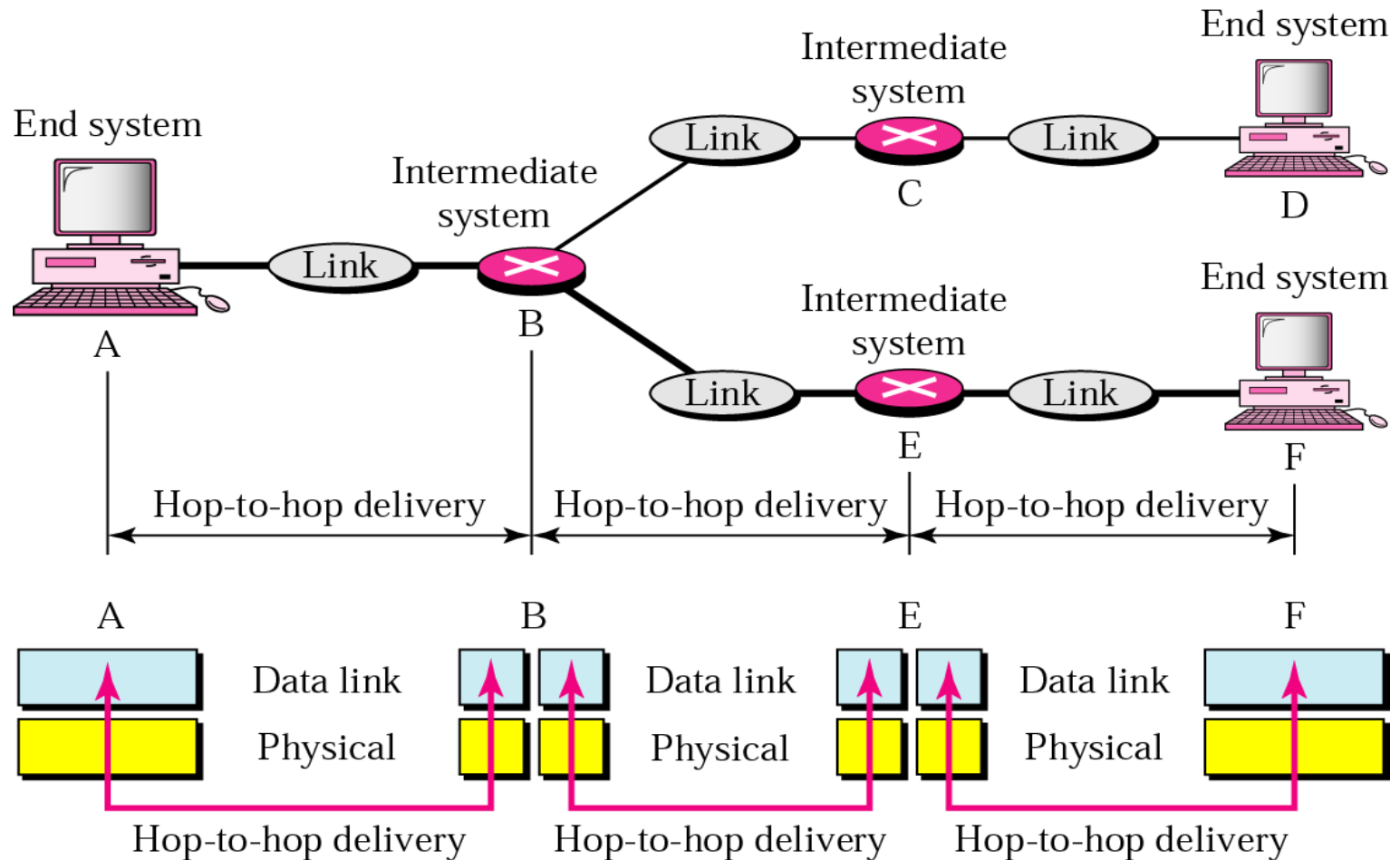
OSI Layers : Physical Layer

15



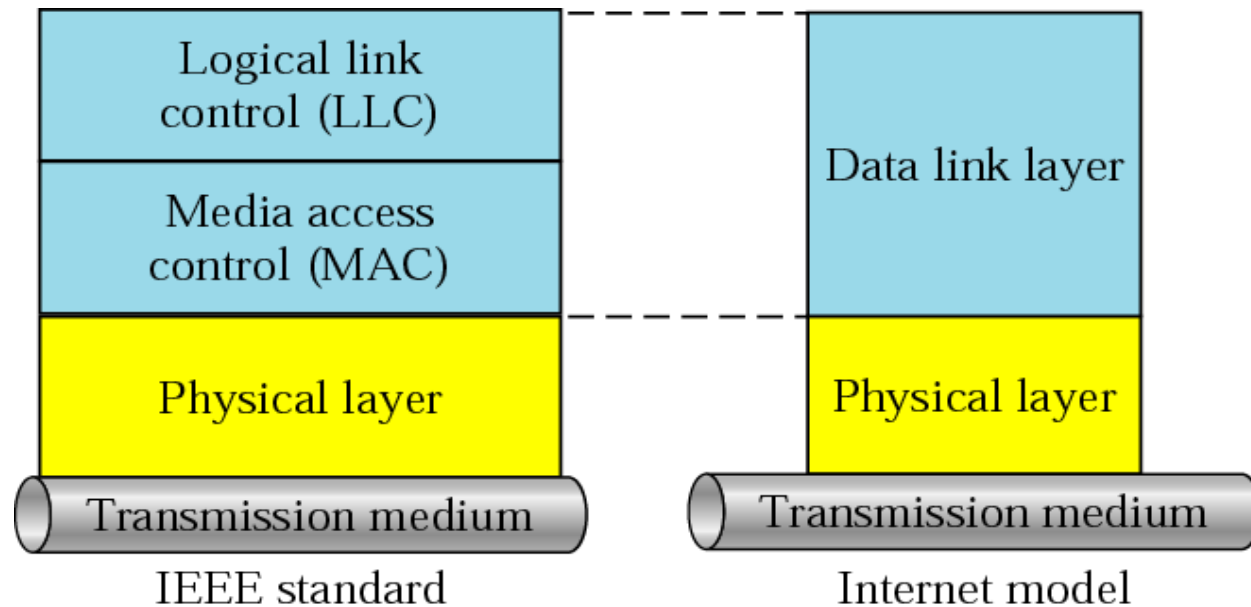
Data Link Layer : Node to Node Delivery

16



Data Link Sub Layers : LLC and MAC

17



OSI Layers : Functions

18

Network Layer

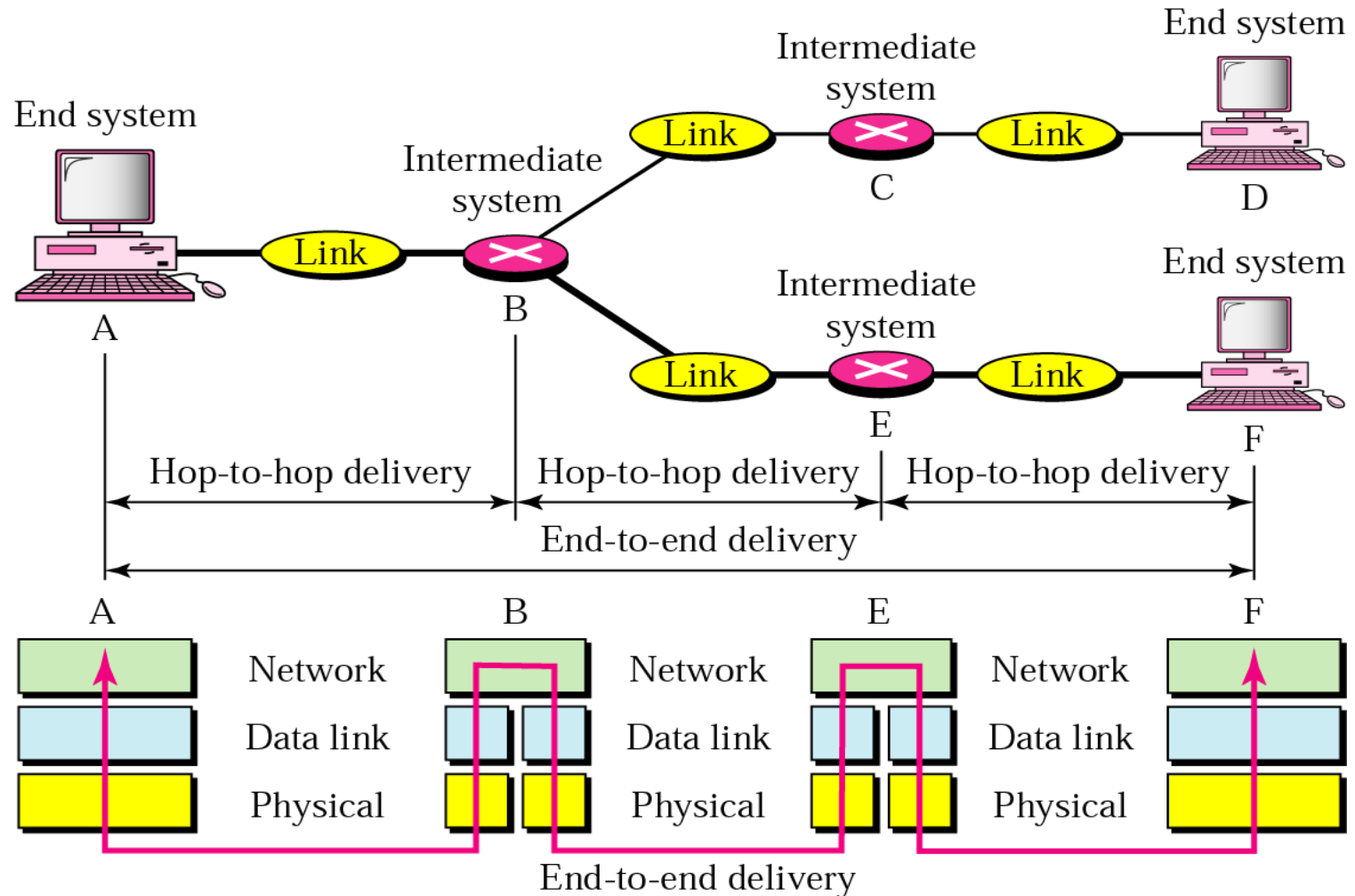
- ❑ Enables Host to Host Communication
- ❑ Responsible for Delivery of Packets
- ❑ Logical Addressing
- ❑ Routing

Transport Layer

- ❑ Enables Process to Process Communication.
- ❑ Port Addressing
- ❑ Segmentation and Reassembly.
- ❑ Connection Control
- ❑ Flow Control
- ❑ Error Control

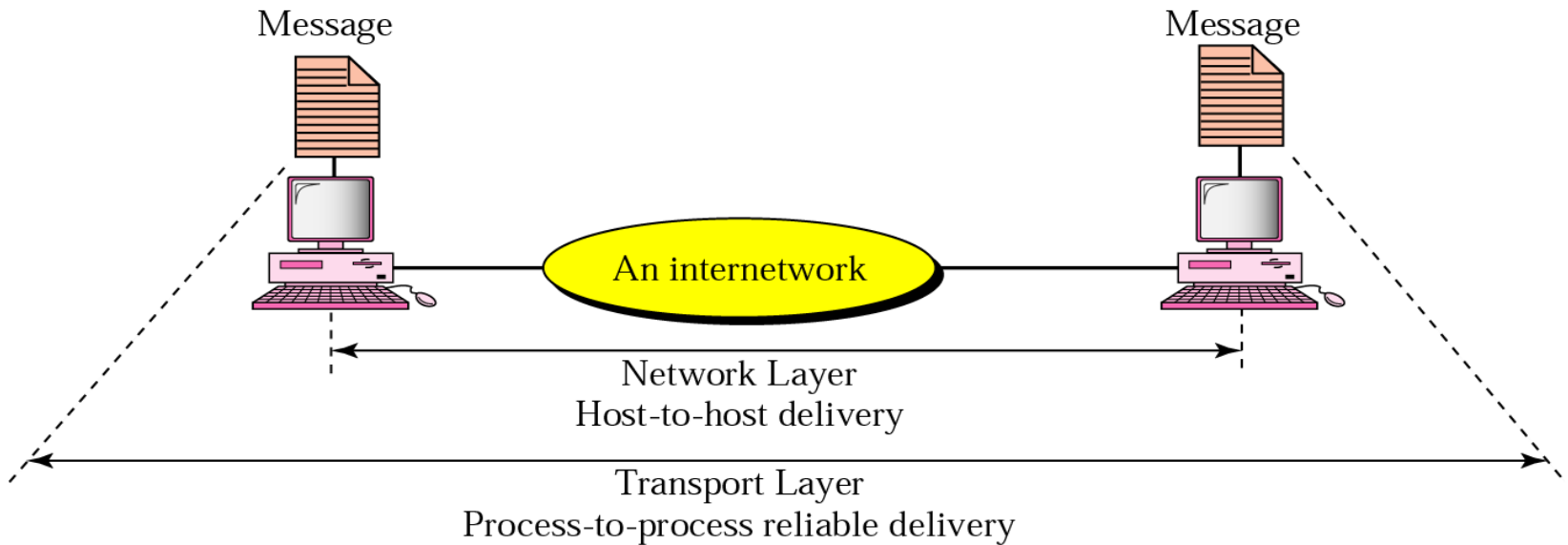
Network Layer : End to End Delivery

19



Transport Layer : Process to Process Delivery

20



OSI Layers : Functions

21

Session Layer

- ❑ Control of Dialogues Between Applications.
- ❑ Whose Turn is To Transmit ??
- ❑ Dialogue Discipline => Half Duplex/ Full Duplex

Presentation Layer

- ❑ Data Formats and Coding.
- ❑ Data Compression
- ❑ Encryption

Application Layer

- ❑ Responsible for Providing Service to End Users.
- ❑ Mail Transfer Service.
- ❑ File Transfer Service.

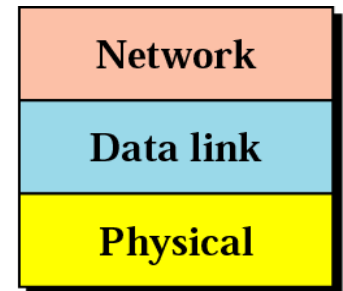
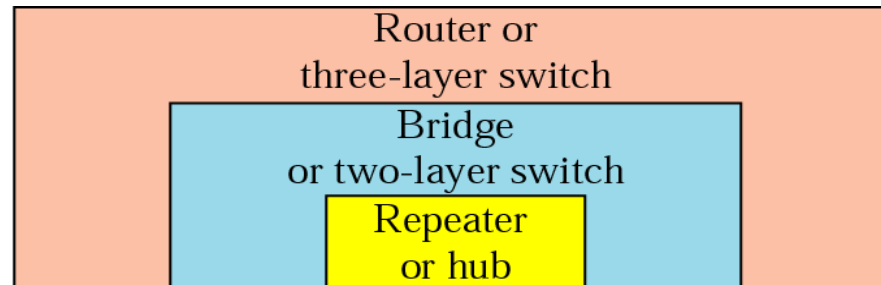
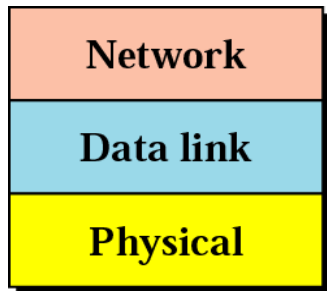
OSI Model Compared to TCP/IP

22

OSI model	TCP/IP			
Application	Telnet	FTP	DHCP	TFTP
Presentation	HTTP	SMTP	DNS	SNMP
Session	Application layer			
Transport	TCP			UDP
	Transport layer			
Network	ICMP			ARP
	IP			
	Internet layer			
Data Link	Network interface layer			
Physical				

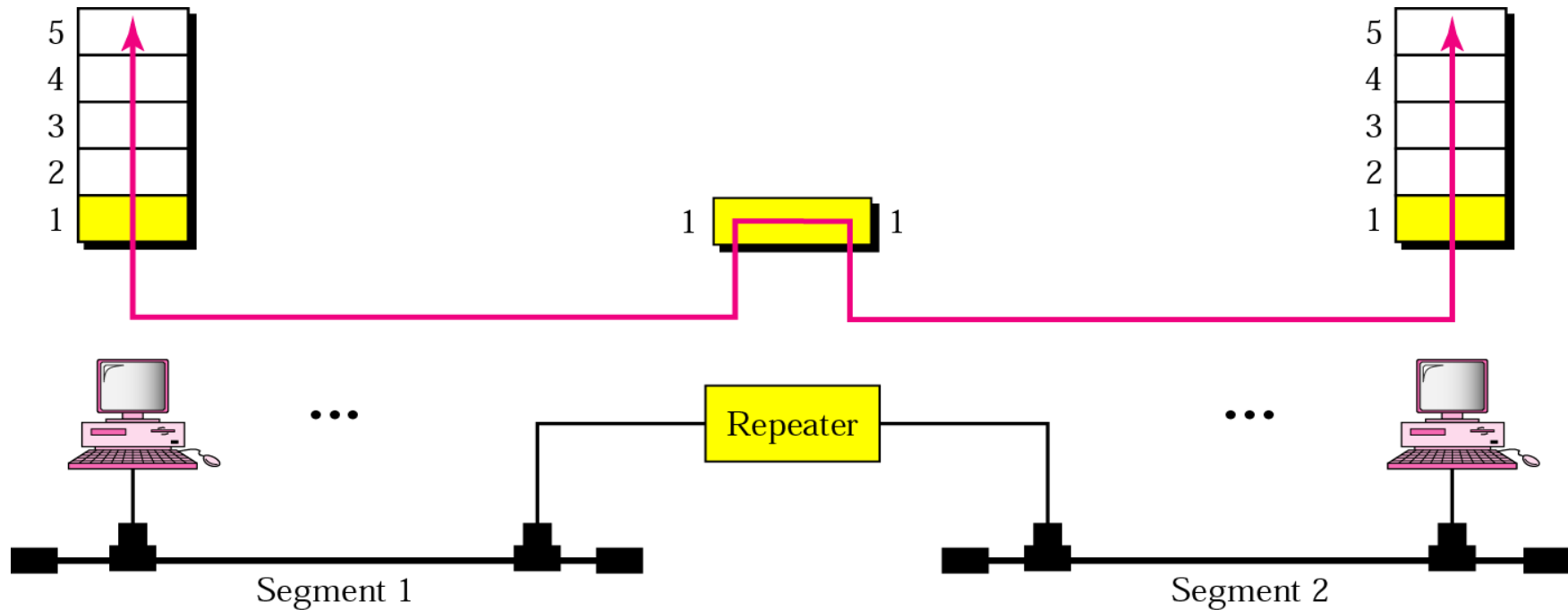
Networking Hardware : Hub and Repeaters

23



Physical Layer Devices : Repeaters

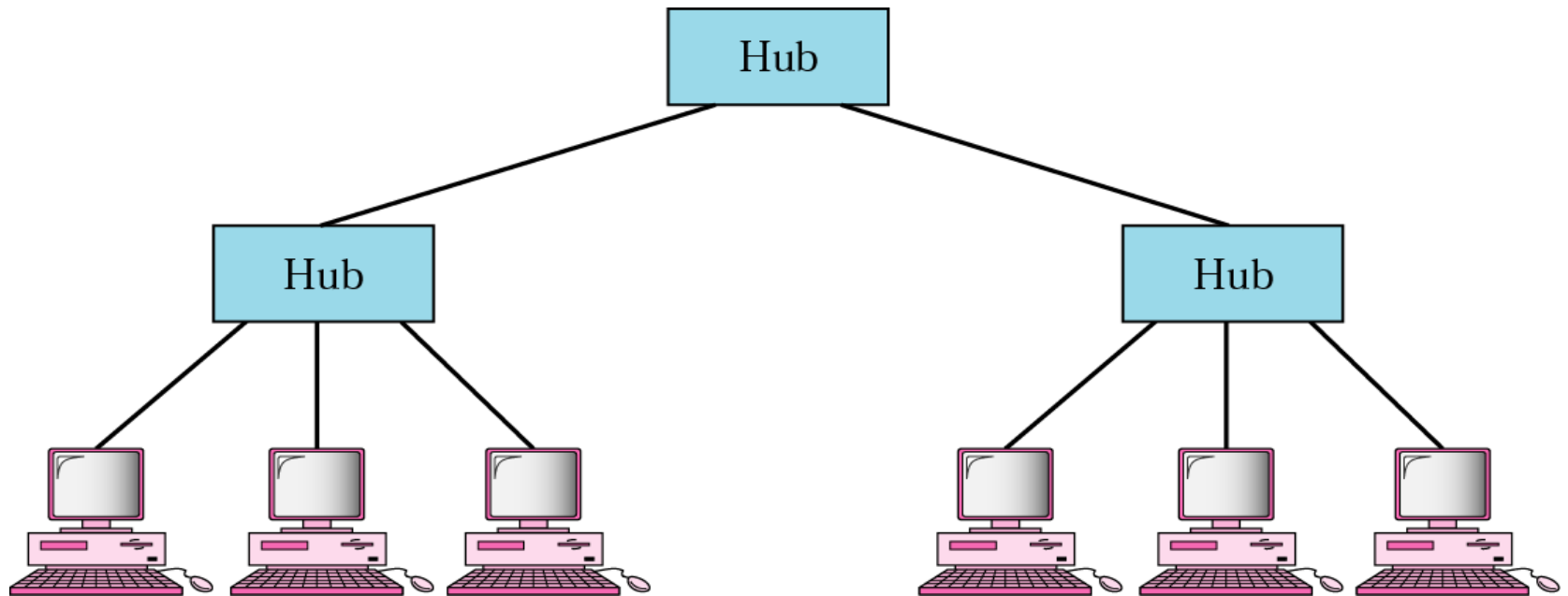
24



- ☐ Repeater Forwards Each Frame.
- ☐ It has No Filtering Capability
- ☐ Repeater is a Regenerator NOT an Amplifier.

Physical Layer Devices : Hubs

25

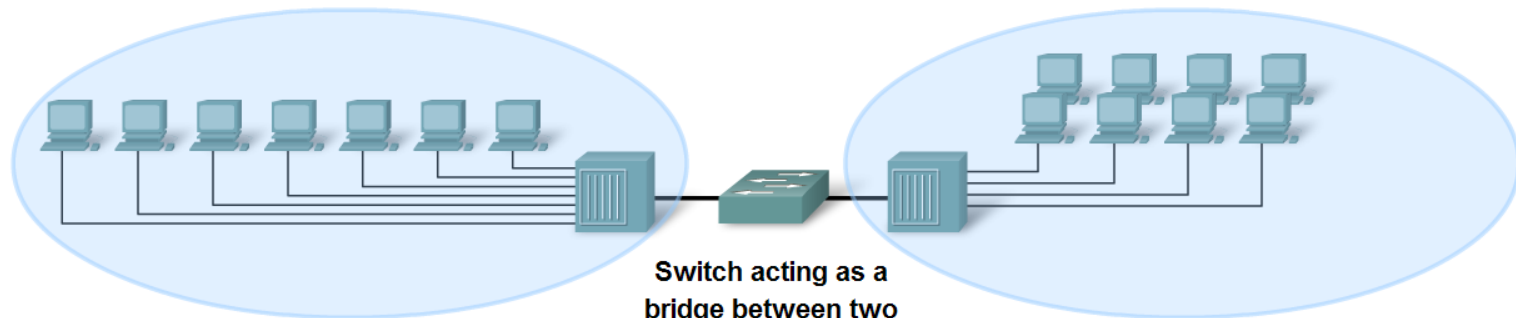


- ❑ Physical Topology => Star
- ❑ Logical Topology => Bus
- ❑ Extends Collision Domain.

Link Layer Devices : Switch

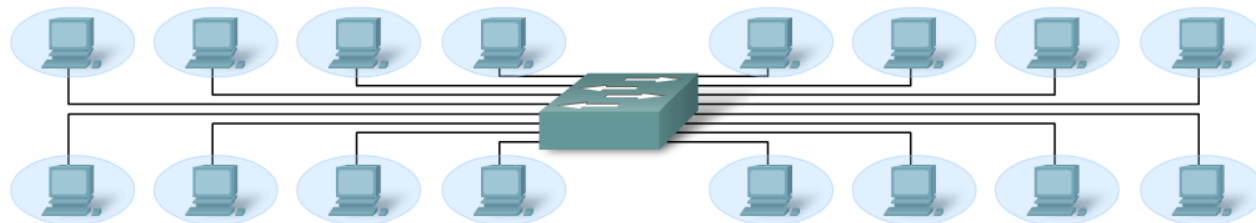
26

Switch Uses



Switch acting as a bridge between two shared-media hubs

Two collision domains—one for each shared media LAN.



Switch at the center of a LAN

Each computer has its own collision domain.

Thank You