Data Communication

#4 OSI Layer

Susmini I. Lestariningati, M.T

The Needs for Standards

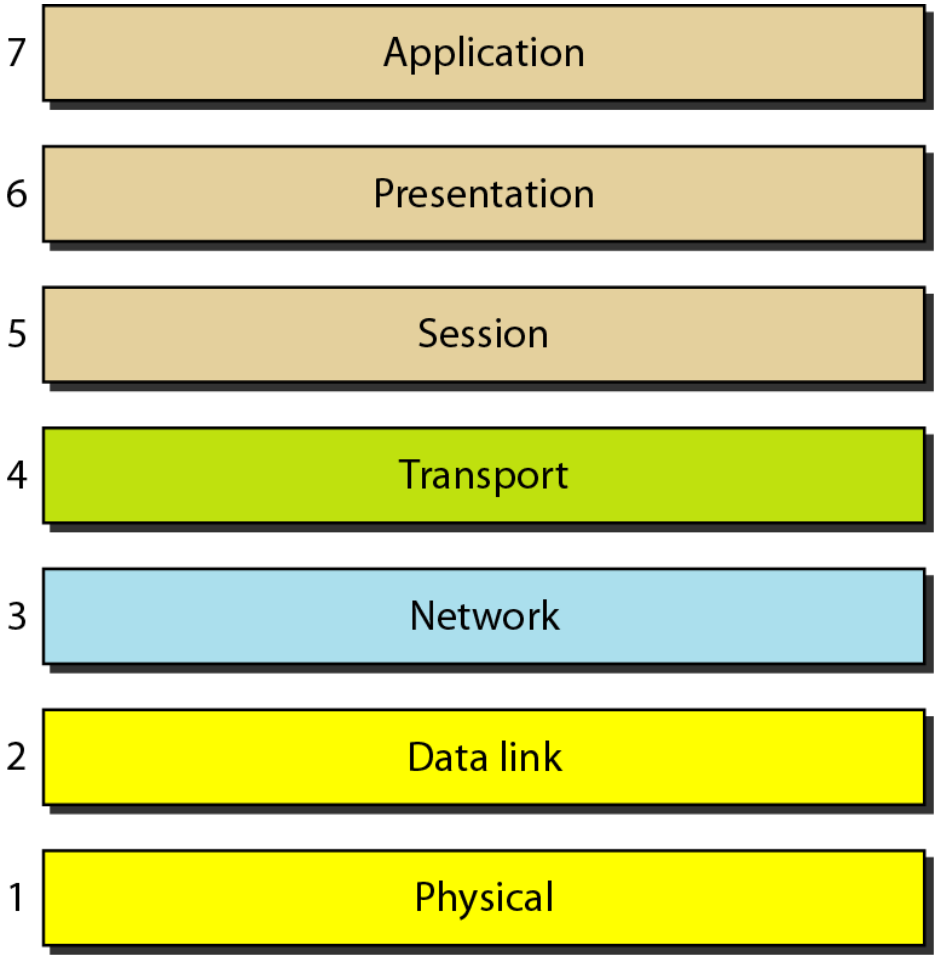
- Over the past couple of decades many of the networks that were built used different hardware and software implementations, as a result they were incompatible and it became difficult for networks using different specifications to communicate with each other
- to address the problem of networks being incompatible and unable to communicate with each other, the International Organization for Standardization (ISO) researched various network schemes.
- the ISO recognised there was a need to create a **Network Model** that would help vendors create interoperable network implementations.

What is ISO?

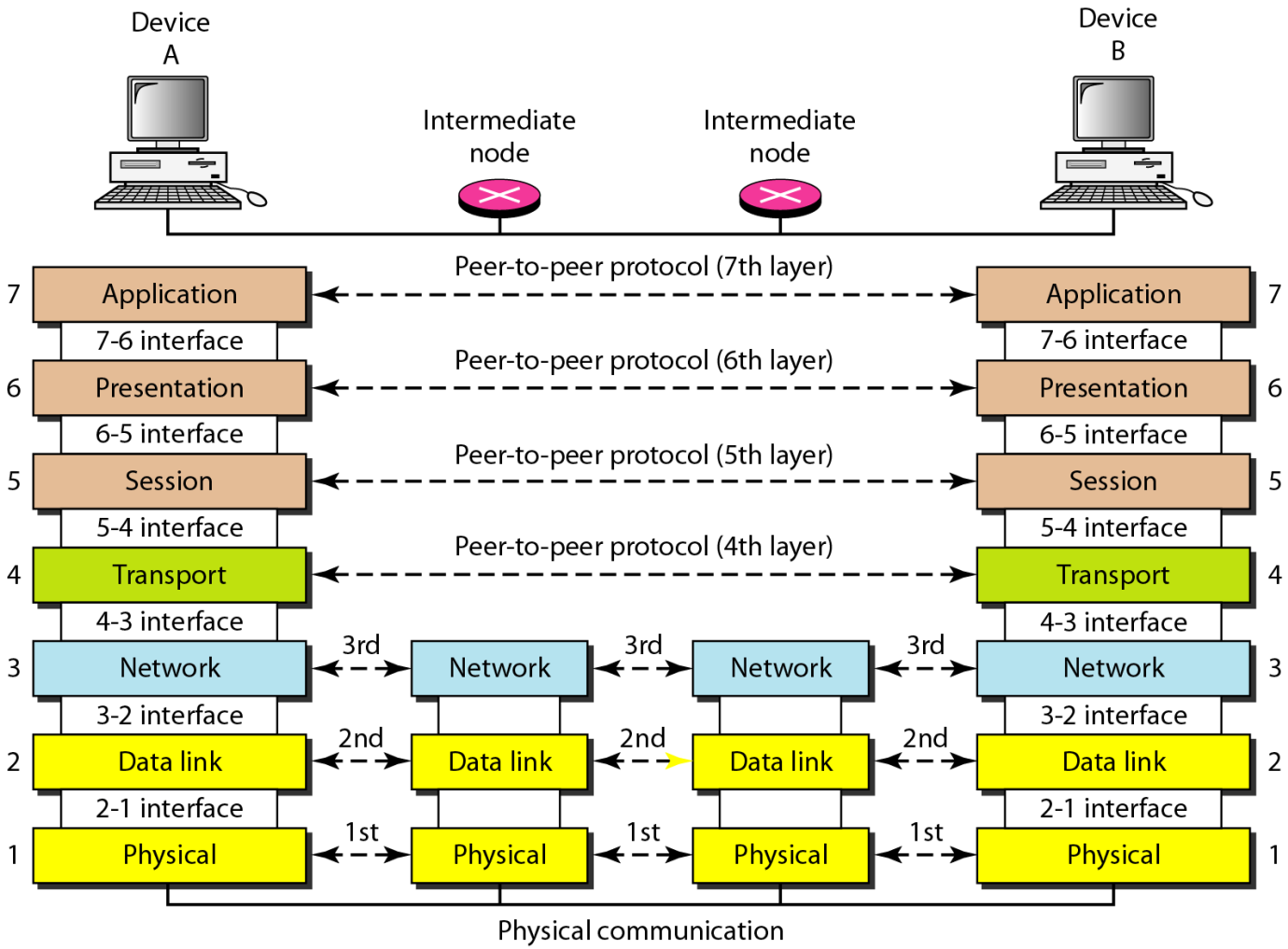
- The International Organisation for Standardisation (ISO) is an International standards organisation responsible for a wide range of standards, including many that are relevant to networking.
- In 1984 in order to aid network interconnection without necessarily requiring complete redesign, the Open Systems Interconnection (OSI) reference model was approved as an international standard for communications architecture.

The OSI Reference Model

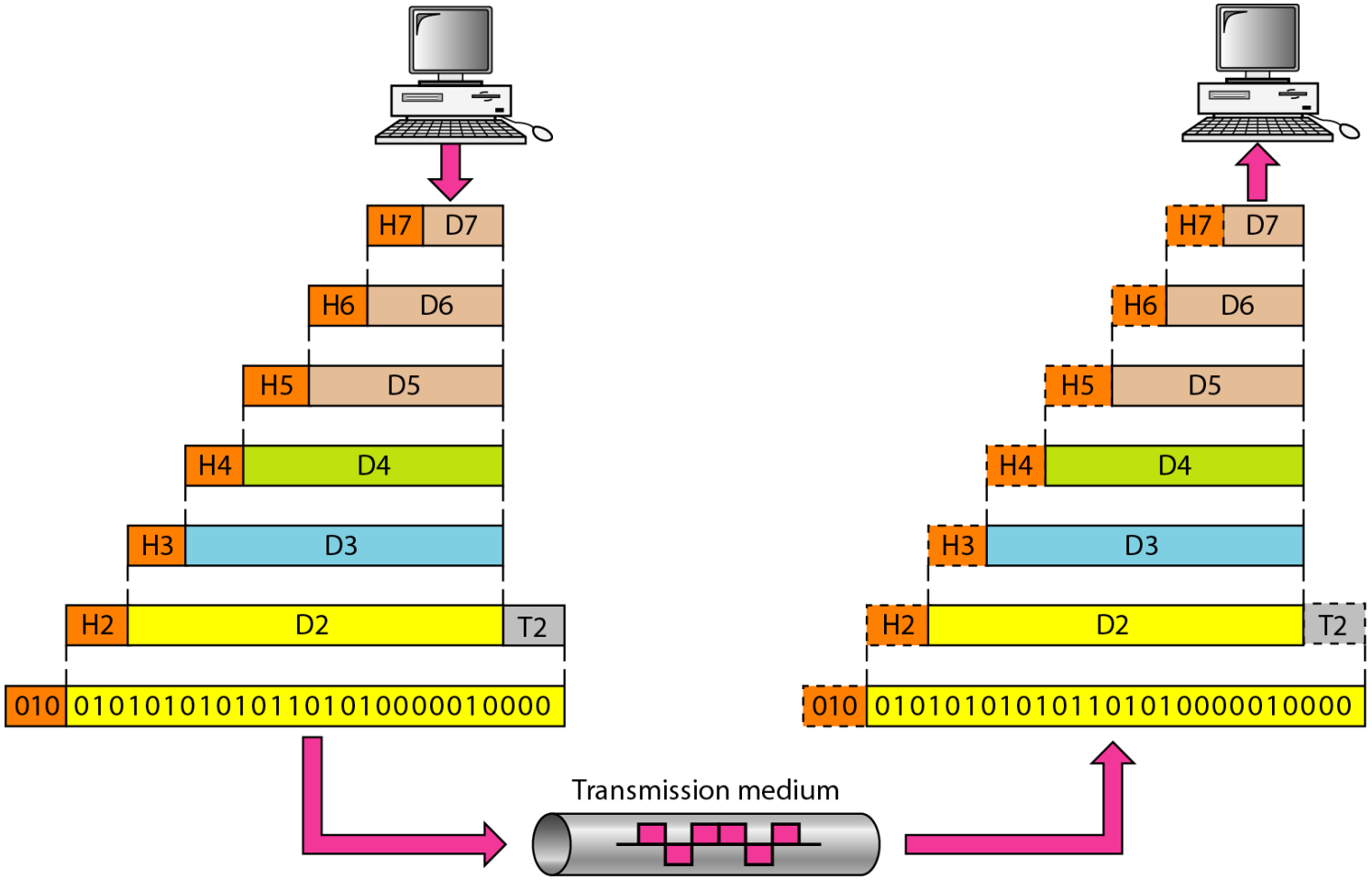
- The OSI Reference Model is composed of seven layers, each specifying particular network functions.
- The process of breaking up the functions or tasks of networking into layers reduces complexity.
- Each layer provides a service to the layer above it in the protocol specification.
- Each layer communicates with the same layer's software or hardware on other computers.
- The lower 4 layers (transport, network, data link and physical —Layers 4, 3, 2, and 1) are concerned with the flow of data from end to end through the network.
- The upper four layers of the OSI model (application, presentation and session—Layers 7, 6 and 5) are orientated more toward services to the applications.
- Data is Encapsulated with the necessary protocol information as it moves down the layers before network transit.



The interaction between layers in the OSI model

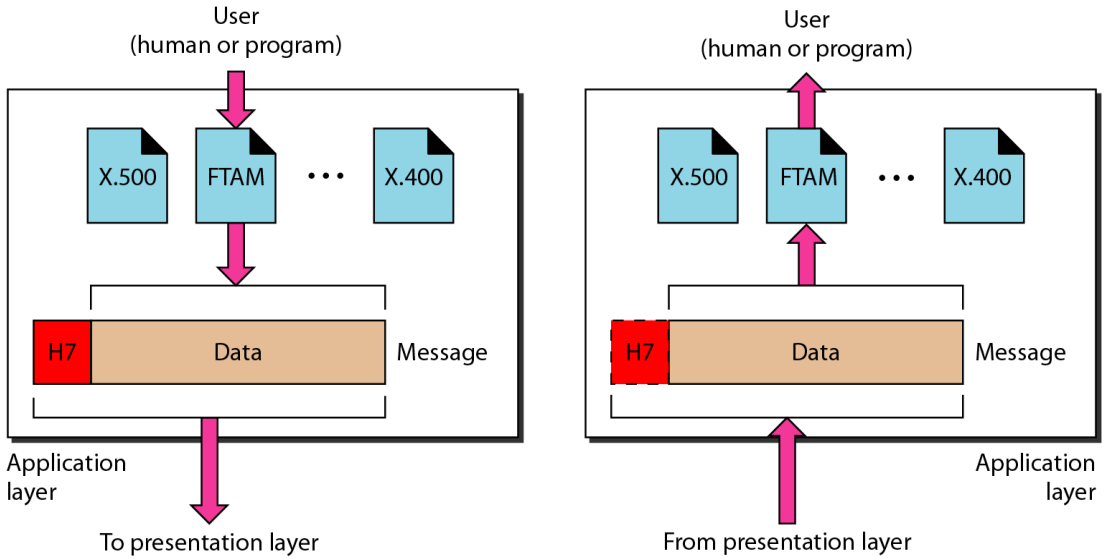


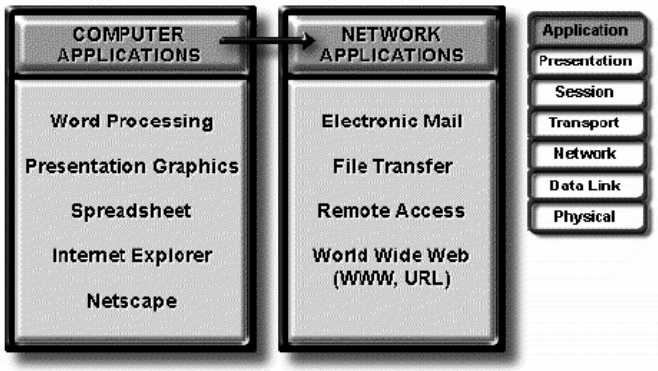
An Exchange using the OSI layer



Application Layer

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

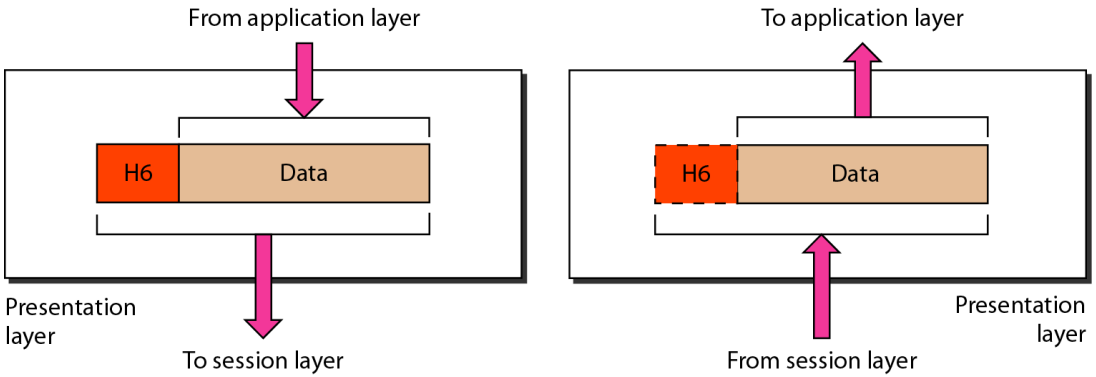


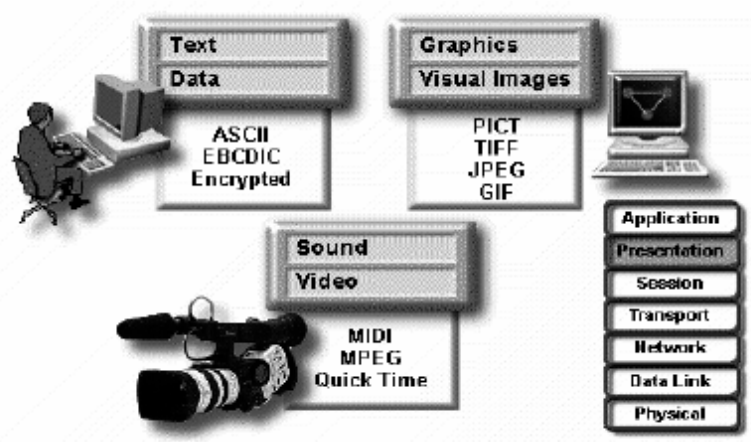


- The application layer is the OSI layer that is closest to the user.
- It provides network services to the user's applications.
- It differs from the other layers in that it does not provide services to any other OSI layer, but rather, only to applications outside the OSI model.
- Examples of such applications are spreadsheet programs, word processing programs, and bank terminal programs.
- The application layer establishes the availability of intended communication partners, synchronizes and establishes agreement on procedures for error recovery and control of data integrity.

Presentation Layer

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



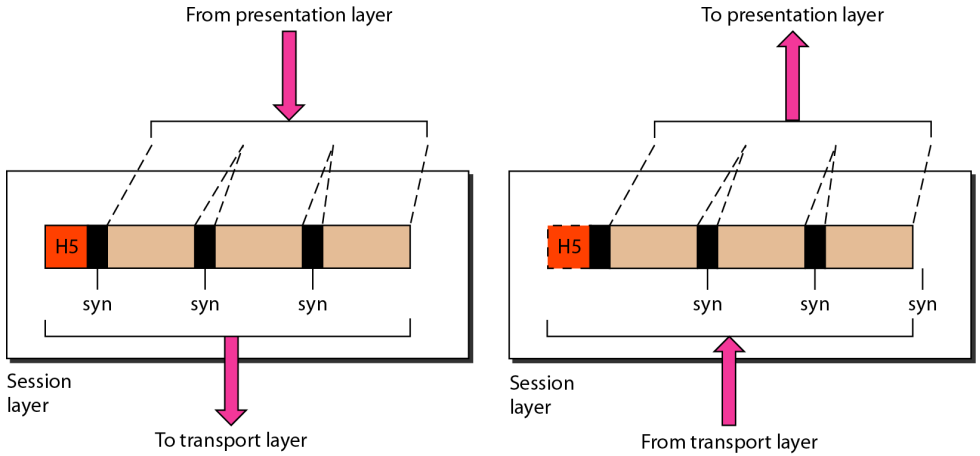


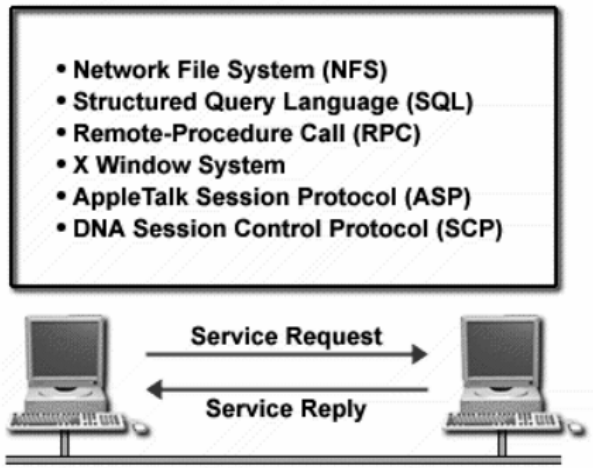
- The presentation layer ensures that the information that the application layer of one system sends out is readable by the application layer of another system.
- If necessary, the presentation layer translates between multiple data formats by using a common format.
- Provides encryption and compression of data.
- Examples :

  JPEG, MPEG, ASCII, EBCDIC, HTML.

Session Layer

- The session layer is responsible for dialog control and synchronization.

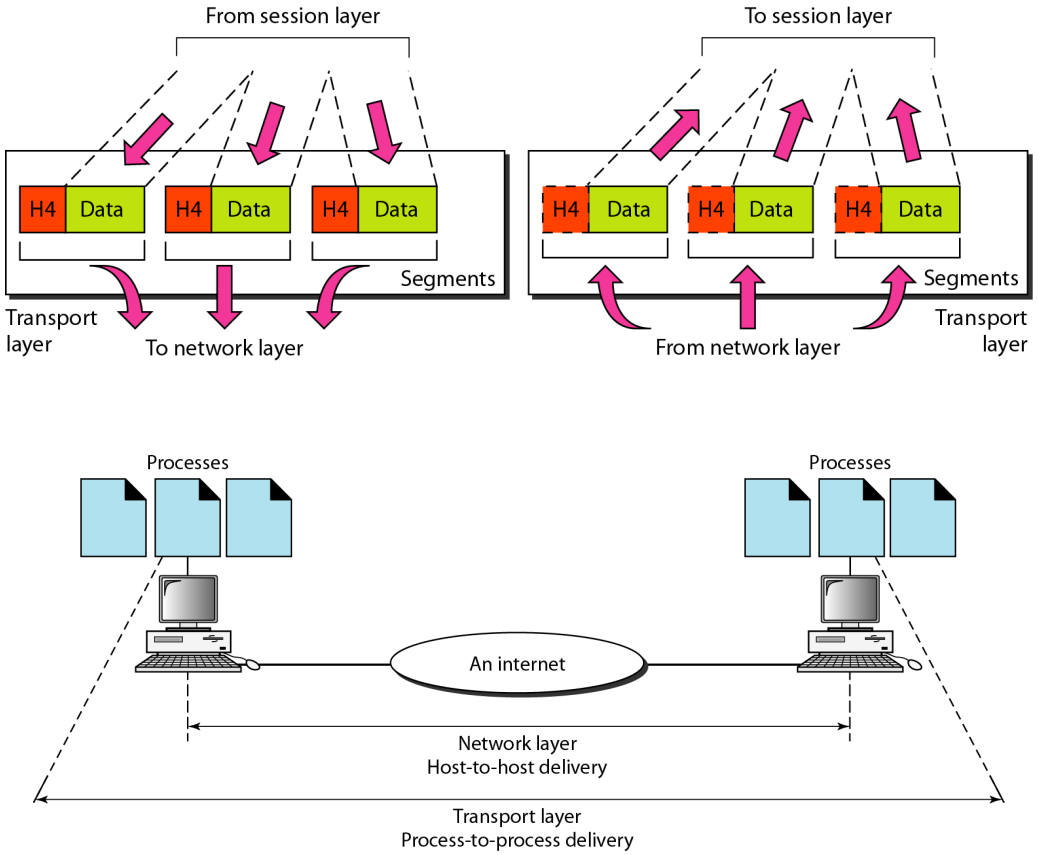




- The session layer defines how to start, control and end conversations (called sessions) between applications.
- This includes the control and management of multiple bi-directional messages using dialogue control.
- It also synchronizes dialogue between two hosts' presentation layers and manages their data exchange.
- The session layer offers provisions for efficient data transfer.
- Examples :- SQL, ASP (AppleTalk Session Protocol).

Transport Layer

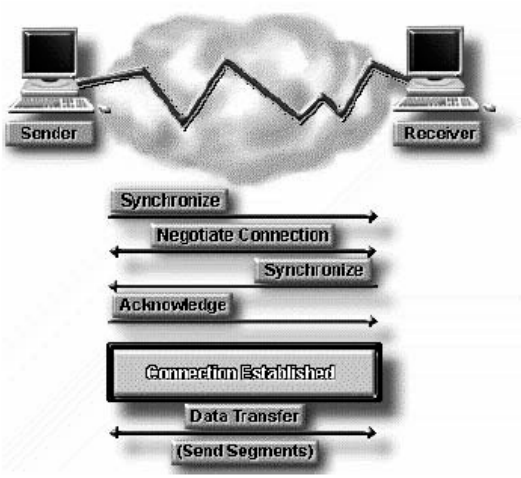
- The transport layer is responsible for the delivery of a message from one process to another.



- The transport layer regulates information flow to ensure end-to-end connectivity between host applications reliably and accurately.
- The transport layer segments data from the sending host's system and reassembles the data into a data stream on the receiving host's system.
- The boundary between the transport layer and the session layer can be thought of as the boundary between application protocols and data-flow protocols. Whereas the application, presentation, and session layers are concerned with application issues, the lower four layers are concerned with data transport issues.
- Layer 4 protocols include TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).

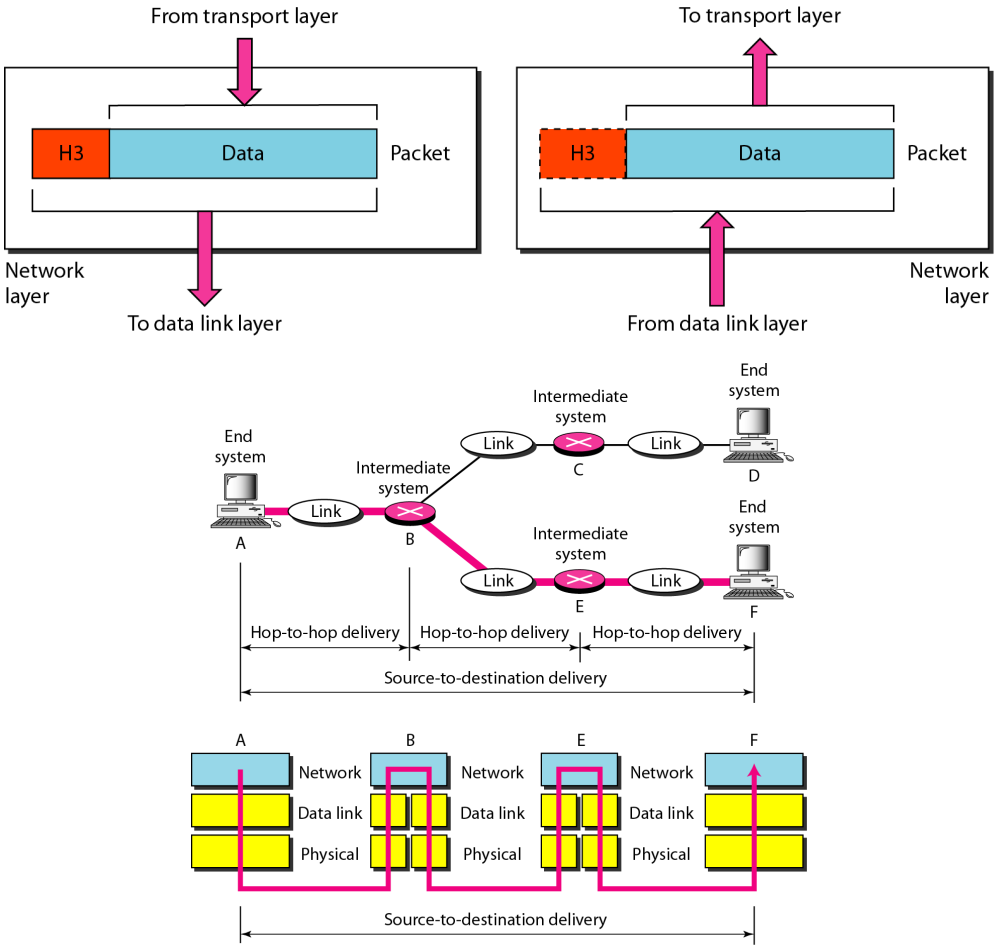
Transmission Control Protocol (TCP)

TCP	UDP
Reliability When a file or message send it will get delivered unless connections fails. If connection lost, the server will request the lost part. There is no corruption while transferring a message.	*Reliability* When you a send a data or message, you don't know if it'll get there, it could get lost on the way. There may be corruption while transferring a message.
Ordered connection, one after the other, you know the first message will get there first. You don't have to worry about data arriving in the wrong order.	*Ordered* don't know what order they'll arrive in i.e. **ordered**
Heavyweight TCP "stream" arrive in the wrong order, resend requests have to be sent, and all the out of sequence parts have to be put back together, so requires a bit of work to piece together.	*Lightweight* tracking connections, etc. It's just fire and forget! This means it's a lot quicker, and the network card / OS have to do very little work to translate the data back from the packets.
Streaming nothing distinguishing where one packet ends and another begins. There may be multiple packets per read call.	*Datagrams* and are guaranteed to be whole if they arrive. One packet per one read call.
Examples 80), e-mail (SMTP TCP port 25 Postfix MTA), File Transfer Protocol (FTP port 21) and Secure Shell (OpenSSH port 22) etc.	*Examples* UDP port 53), streaming media applications such as IPTV or movies, Voice over IP (VoIP), Trivial File Transfer Protocol (TFTP) and online multiplayer games etc



Network Layer

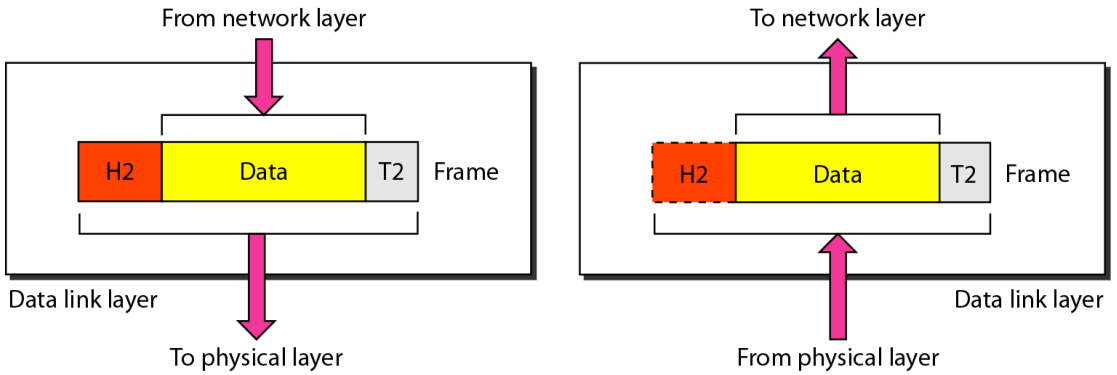
- The network layer is responsible for the delivery of individual packets from the source host to the destination host.

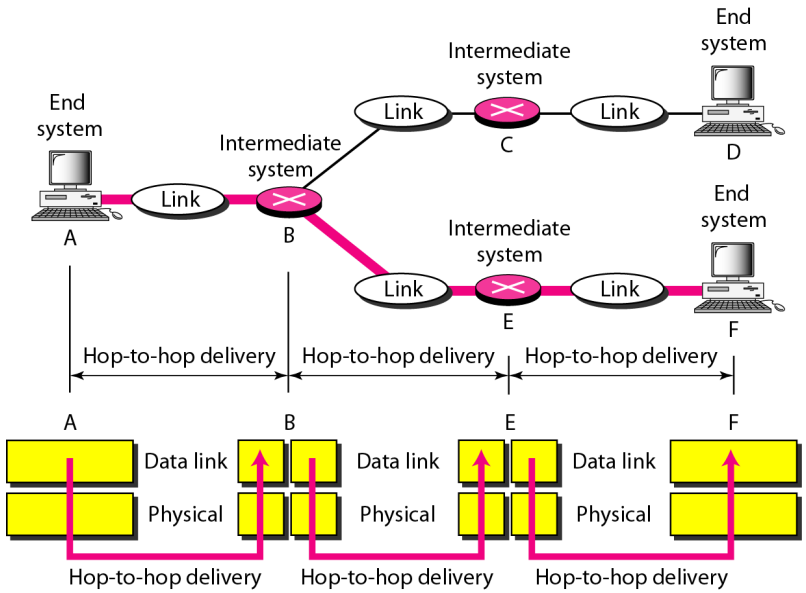


- Defines end-to-end delivery of packets.
- Defines logical addressing so that any endpoint can be identified.
- Defines how routing works and how routes are learned so that the packets can be delivered.
- The network layer also defines how to fragment a packet into smaller packets to accommodate different media.
- Routers operate at Layer 3.
- Examples :- IP, IPX, AppleTalk.

Data Link Layer

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

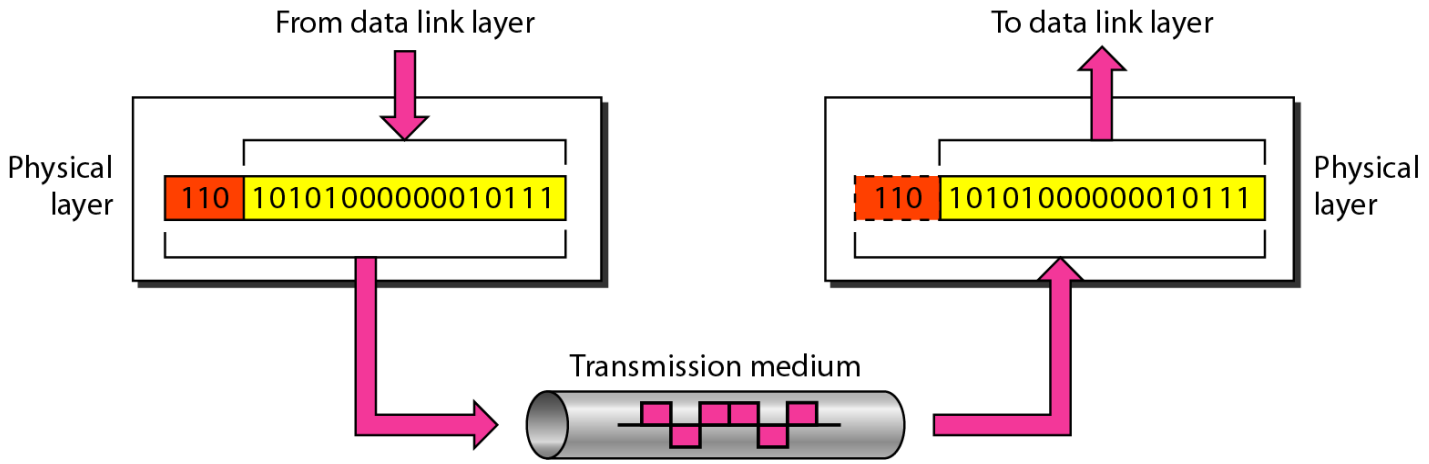




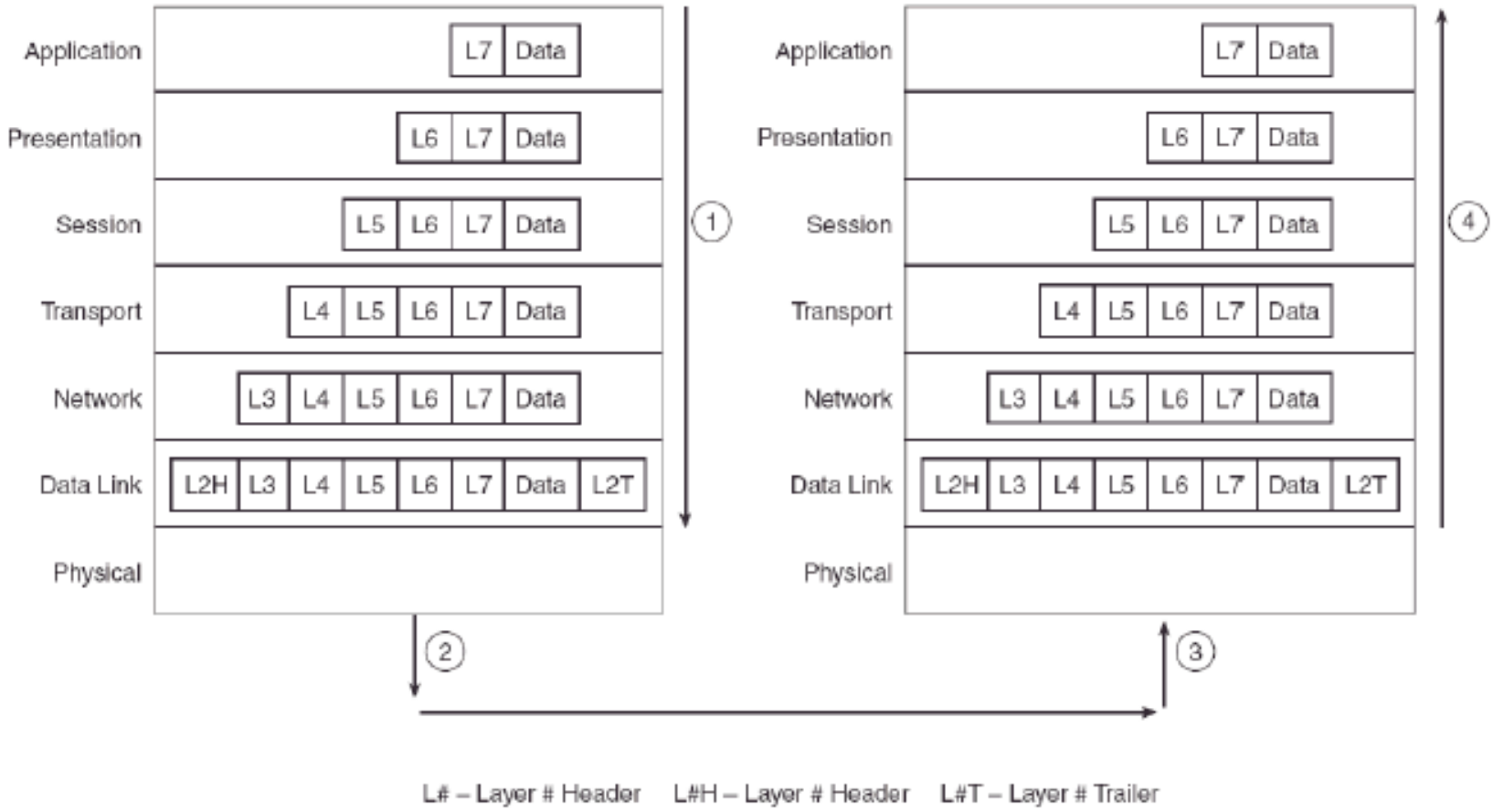
- The data link layer provides access to the networking media and physical transmission across the media and this enables the data to locate its intended destination on a network.
- The data link layer provides reliable transit of data across a physical link by using the Media Access Control (MAC) addresses.
- The data link layer uses the MAC address to define a hardware or data link address in order for multiple stations to share the same medium and still uniquely identify each other.
- Concerned with network topology, network access, error notification, ordered delivery of frames, and flow control.
- Examples :- Ethernet, Frame Relay, FDDI.

Physical Layer

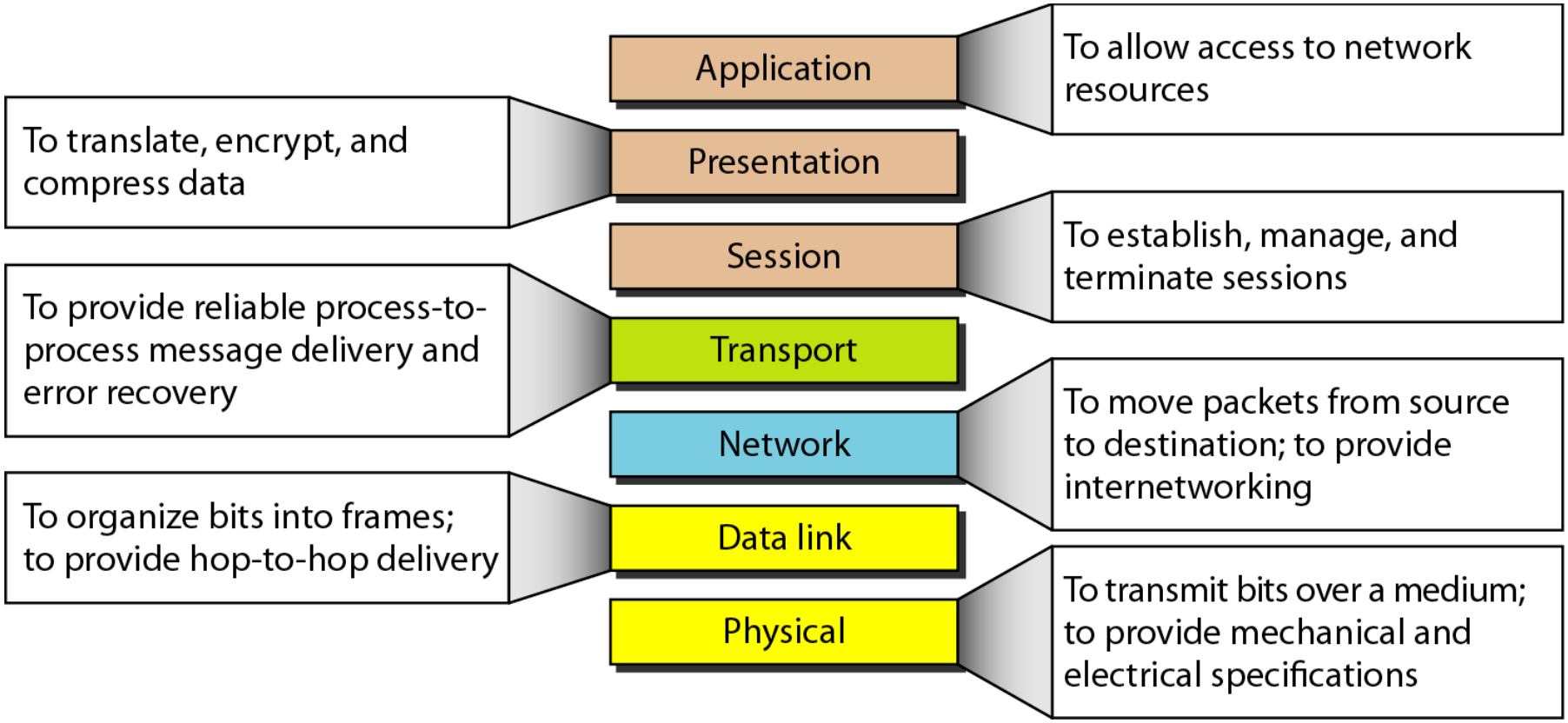
- The physical layer is responsible for movements of individual bits from one hop (node) to the next.



- The physical layer deals with the physical characteristics of the transmission medium.
- It defines the electrical, mechanical, procedural, and functional specifications for activating, maintaining, and deactivating the physical link between end systems.
- Such characteristics as voltage levels, timing of voltage changes, physical data rates, maximum transmission distances, physical connectors, and other similar attributes are defined by physical layer specifications.
- Examples :- EIA/TIA-232, RJ45, NRZ.


Application
Presentation
Session
Transport
Network
Data Link
Physical
L7 Data
L6 L7 Data
L5 L6 L7 Data
L4 L5 L6 L7 Data
L3 L4 L5 L6 L7 Data
L2H L3 L4 L5 L6 L7 Data L2T
1
2
3
4
L# – Layer # Header
L#H – Layer # Header
L#T – Layer # Trailer

Summary of Layers



Summary

- There was no standard for networks in the early days and as a result it was difficult for networks to communicate with each other.
- The International Organisation for Standardisation (ISO) recognised this. and researched various network schemes, and in 1984 introduced the Open Systems Interconnection (OSI) reference model.
- The OSI reference model has standards which ensure vendors greater compatibility and interoperability between various types of network technologies.
- The OSI reference model organizes network functions into seven numbered layers.
- Each layer provides a service to the layer above it in the protocol specification and communicates with the same layer's software or hardware on other computers.
- Layers 1-4 are concerned with the flow of data from end to end through the network and Layers 5-7 are concerned with services to the applications.