# NETWORKING STANDARDS: OSI MODEL

# OSI MODEL

# Introduction

- Networks are complicated structures with many interrelated parts. To better understand how the various parts fit together, it is useful to have a network model. A network model is like a generic car. Every car has wheels, a steering, an engine, headlights, and breaks. Similar to a car, every network has a physical layer, a data link layer, and a network layer, and so on.
- One car can be automatic and another can be manual; one car may have engine in front and another can have engine in back. Like wise on network may implement the physical or data link layer differently than another, but they both are networks, and they both have layers in one form or another.

# OSI Reference Model

- OSI (Open System Interconnection) is the most widely accepted model for understanding the network communication. It was developed by ISO (International Standards Organization) in **1977**.
- ISO is a multinational body dedicated to worldwide agreement on international standards.
- It covers all aspects of network communications in OSI reference model.
- *An open system is a set of protocols that allows any two different systems to communicate regardless of the underlying architecture*. Vendor-specific protocol close off communication between unrelated systems.

# Purpose of OSI Model

- The purpose of OSI model is *to open communication between different system without requiring changes to the logic of the underlying hardware and software*.
- The OSI is *not a protocol*; *it is model for understanding and designing a network architecture that is flexible, robust and open for communication with other systems*.

# Layered Architecture of OSI

- The OSI model has seven layers. Number of layers in any model is derived on *following principles*.
  - A layer should be created where a different level of abstraction is needed.
  - Each layer should perform a well define function.
  - The function of each layer should be chosen with an eye towards defining internationally standardized protocol
  - The layer boundaries should be chosen to minimize the information flow across the interface.
  - The number of layers should be large enough that distinct function need not be thrown together in the same layer out of necessity, and small enough that the architecture does not become unwieldy

# Layered Network Architecture

- **Advantages:**
- Provide modular approach for any network architecture
- A new layer can be introduced any time (if required) without interfering other layers.
- A layer can be removed easily if it’s functions become obsolete.
- Modification to a particular layer can be done without interfering other layers.

**Disadvantage:**

Increases the address overhead in data packet as it travels from bottom layer to the top layer.

# OSI Layers

| | |
|---|---|
| 7 | Application Layer |
| 6 | Presentation Layer |
| 5 | Session Layer |
| 4 | Transport Layer |
| 3 | Network Layer |
| 2 | Data Link Layer |
| 1 | Physical Layer |

- The 7 layers of the OSI model can be split into 2 halves, those which provides *interconnection* services and those which provide *internetworking* services. Each layer within the model provides a set of services to the layer above and enhances the service provided by the layer below.

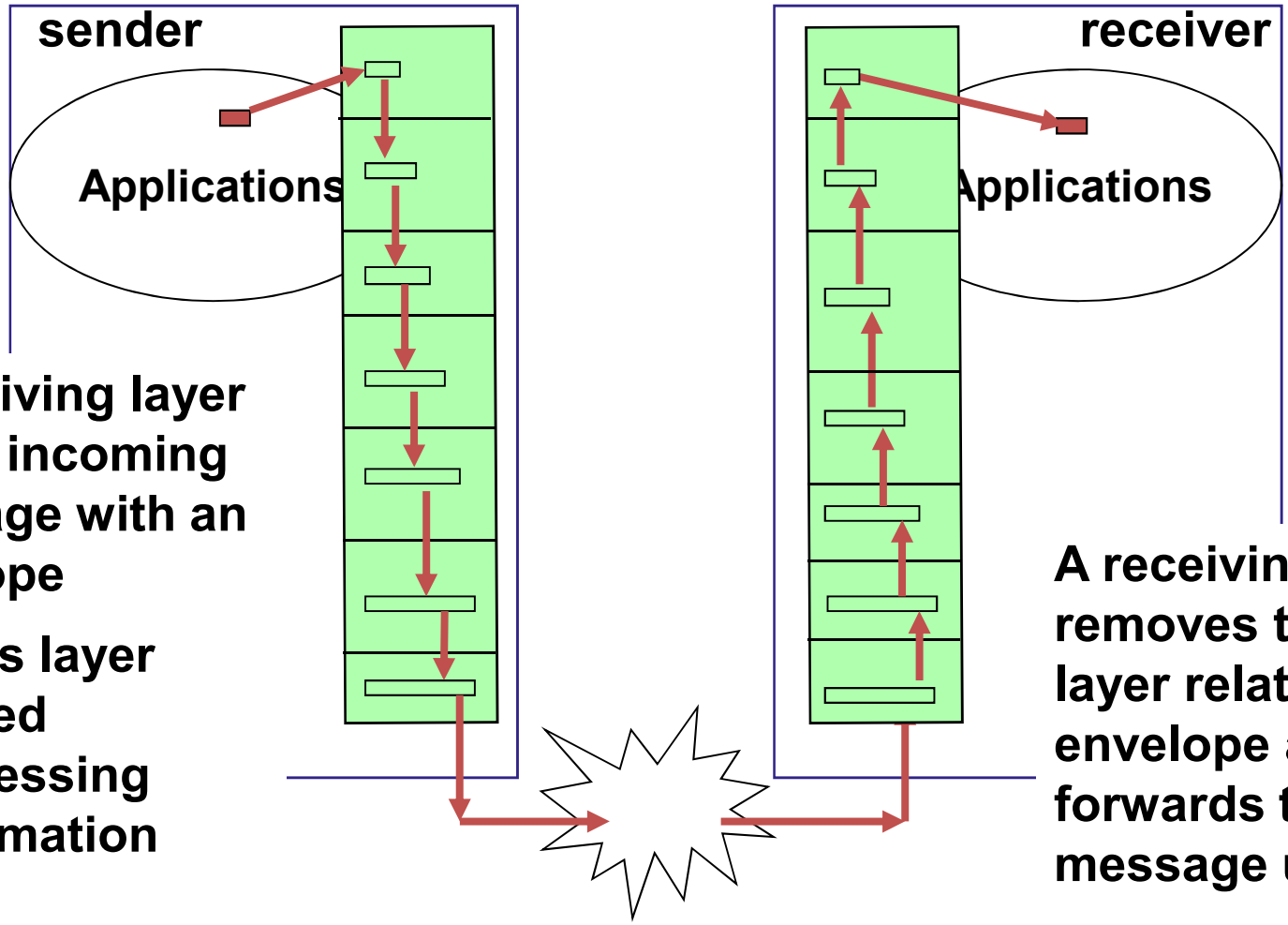
# OSI Layers

- **The Interconnection Layers**
- Interconnection group of standards makes up the bottom 4 layers of the OSI model, which are known as the *physical, data link, network and transport layers.*
- The *physical layer* defines the functional, procedural and physical interfaces of communication links between equipment. For example, plug specifications, and pin allocations.
- The *data link* layer adds error-checking information and formats data for physical transmission.
- The *network layer* provides routing and multiplexing services.
- The *transport layer* includes error detection and correction as well as multiplexing. Its basic function is to enhance the quality provided by the network layer below, if this is necessary.

# OSI Layers

- **The Internetworking Layers**
- The internetworking group includes the top 3 layers of the OSI model and basically provides the support services for the user applications. They are known as the *session, presentation, and application* layers.
- The *session layer* provides the organization, synchronization and timing of the exchange of the data between end systems.
- The *presentation layer* is concerned with now the information to be exchanged. This includes resolving character set differences, such as ASCII to EBCDIC, providing text compression and encryption/decryption services.
- The *application layer* provides support for the user applications, which wish to exchange information. (i.e. file transfer)

# Message Transmission Using Layers




A receiving layer wraps incoming message with an envelope

- Adds layer related addressing information

A receiving layer removes the layer related envelope and forwards the message up

# Function Each Layer

**1. Physical Layer (layer 1)**

- The physical layer co-ordinates the functions required to transmit a bit streams over a physical medium. It deals with the mechanical and electrical specifications of the primary connections, such as cables and connectors.

It also handles:

- **Line configuration:** how can two or more devices be linked physically? Are transmission lines to be shared or limited to use between two devices?
- **Data transmission mode:** Is the transmission mode simplex or duplex?
- **Topology:** How are the networking devices arranged?
- **Bit synchronization:** deals with synchronization between sender and receiver

# Function Each Layer cont...d

## 2. Data Link Layer (Layer 2)

- The main purpose of the data link layer is to deliver data units (group of bits) from one station to the next station (node-to-node) without error. It accepts packets from the network layer and packages the information into data units called **frames** to be presented to the physical layer for transmission. The data link layer adds header (contains sender's and receiver's address) and trailer (contains control information, such as routing, segmentation, CRC etc) to the data being sent.

# Function Each Layer cont...d

**Data Link Layer cont...d**

Data link layer is responsible for following:

- **Node to node delivery:** the data link layer is responsible for node to node delivery.
- **Addressing:** Adds header and trailer to the data packet.
- **Flow control:** It regulates the amount of data that can be transmitted at one time.
- **Error handling:** Data link layer protocols provide for data recovery, usually by having the entire frame retransmitted.

# Function Each Layer cont...d

**3. Network Layer (Layer 3)**

- The network layer is responsible for the source to destination delivery of packet across multiple network links. Whereas the data link layer oversees station to station (node to node) delivery. The network layer ensures that each packet gets from its point of origin to its destination successfully and efficiently. For this purpose the network layer provides two reliable services ***switching and routing***.
- **Switching** refers to temporary connection between physical links, resulting in longer links for network transmission; i.e. long distance telephone services.
- **Routing** means selecting the best path for sending a packet from one point to another when more than one path is available. In this case, each packet may take a different route to the destination. Where the packets are collected and resembled into their original order.

# Function Each Layer cont...d

## 3. Network Layer (Layer 3) cont...d

Network layer is responsible for following:

- **Source to destination delivery:** moving the packet from its point of origin to its intended destination across multiple network links.
- **Routing:** Deciding which of the multiple paths a packet should take. Routing considerations include speed and cost.
- **Multiplexing:** using a single physical line to carry data between many devices at the same time.

# Function Each Layer cont...d

**4. Transport Layer (layer 4)**

- The transport layer is responsible for source to destination (end to end) delivery of the entire message. Whereas the network layer oversees end to end delivery of individual packets, it does not recognize any relationship between those packets.

Transport layer is responsible for following:

- **End to end message delivery:** conforms the transmission and arrival of all packets of a message at the destination point.
- **Segmentation and reassembling:** The transport layer Header contains **sequence**, or **segmentation** number. These numbers enable the transport layer to reassemble the message correctly at the destination and to identify and replace packet lost in transmission.

# Function Each Layer cont...d

**5. Session Layer (Layer 5)**

- The session layer is the network *dialog controller.* It establishes, maintains, and synchronizes the link between communicating devices. It also ensures that each session close appropriately rather than shutting down abruptly and leaving the user hanging.

Session layer is responsible for following:

- **Session management:** Dividing a session into subsessions by the introduction of checkpoint ad separating *long messages* into shorter units, called dialog units appropriate for transmission.
- **Synchronization:** Deciding in what order to pass the dialog units to the transport layer, and where in the transmission to require conformation from the receiver.
- **Dialog control:** Deciding who sends, and when.
- **Graceful close:** Ensuring that the exchange has been completed appropriately before the session close.

# Function Each Layer cont...d

## 6. Presentation Layer (Layer 6)

- The presentation layer ensures interoperability among communicating devices. It is responsible for code conversion (e.g. from ASCII to EBCDIC and vice versa), if required.
- The presentation layer is also responsible for the encryption and decryption of data for security purposes. It also handles the compression and expansion of data when necessary for transmission efficiency.

# Function Each Layer cont...d

## 6. Presentation Layer (Layer 6) cont...d

Presentation layer is responsible for following:

- **Translation:** changing the format of message (e.g. from ASCII to EBCDIC and vice versa).
- **Encryption/Decryption:** handles encryption and decryption of data for security purposes.
- **Compression:** It also handles the compression and expansion of data when necessary for transmission efficiency.
- **Security:** validates passwords and log-in codes.

# Function Each Layer cont...d

**7. Application Layer (Layer 7)**

- The application layer enables the user, whether human or software, to access the network. *It provides user interface and support for services such as electronic mail, remote file access and transfer*.

Presentation layer is responsible for following:

- **Mail services:** provides the basis for electronic mail forwarding and storage.
- **Directory services:** Provides distributed database sources and access for global information about various object and services.
- **File access, transfer, and management:** Allows a user at a remote computer to access files in another host (to make changes or read data); to retrieve files from a remote computer for use in the local computer.