Data Communication Network
DAY – 3

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Protocol

Protocol and Standards

- ***Protocols define the format and order of messages sent and received among network entities, and actions taken on message transmission and receipt.***
- A protocol defines what, how, when it communicated.
- **The key elements of a protocol :**
  - **syntax :** structure and format of the information data
  - **Semantics:** meaning of each section of bits. an route identify the route to be taken or the final destination of the message
  - **Timing:** when data should be sent and how fast it should be sent

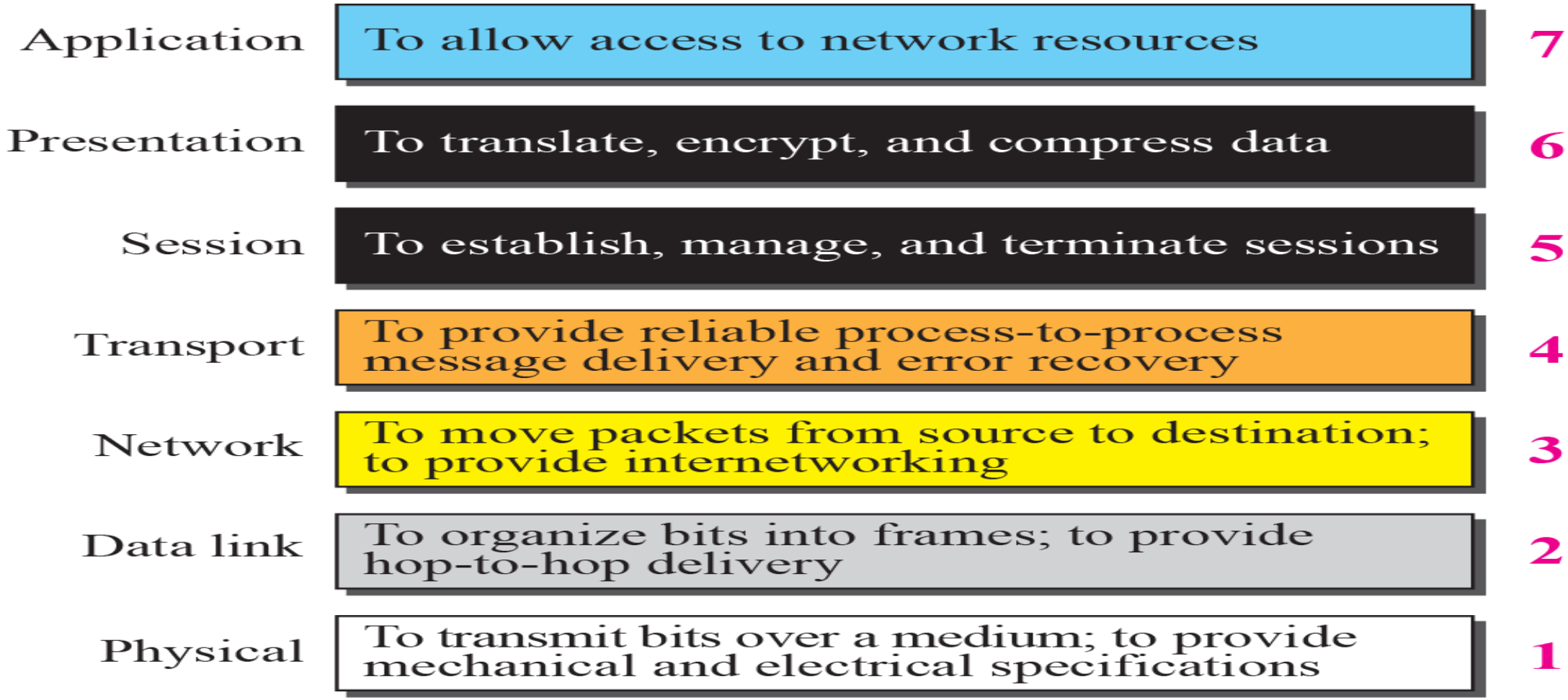
Standards

- Standards are developed by cooperation among standards creation committees, forums, and government regulatory agencies.
- Standards Creation Committees
  1. International Standards Organization (ISO)
  2. International Telecommunications Union (ITU)
  3. American National Standards Institute (ANSI)
  4. Institute of Electrical and Electronics Engineers (IEEE)

OSI Model & Layers

- Established in 1947, **the International Standards Organization (ISO)** is a multinational body dedicated to worldwide agreement on international standards.
- We can not see standard but we can represent them.
- An ISO standard that covers all aspects of network communications is the **Open Systems Interconnection (OSI)** model.
- OSI model is now considered the primary Architectural model for inter-computer communications.
- **Term "open" denotes the ability to connect any two systems which conform to the reference model and associated standards.**

OSI Layers


Application
To allow access to network resources
7
Presentation
To translate, encrypt, and compress data
6
Session
To establish, manage, and terminate sessions
5
Transport
To provide reliable process-to-process message delivery and error recovery
4
Network
To move packets from source to destination; to provide internetworking
3
Data link
To organize bits into frames; to provide hop-to-hop delivery
2
Physical
To transmit bits over a medium; to provide mechanical and electrical specifications
1

Application Layer

- Interacts with application programs and is the highest level of OSI model.
- contains management functions to support distributed applications.
- enables the user, whether human or software, to access the network
- Examples : browser , applications such as file transfer, electronic mail, remote login etc.
- Protocols
  - http [80]: hyper text transfer protocol
  - https [443]: secure hyper text transfer protocol
  - ftp [20/21]: file transfer protocol
  - Smtp (25) : simple mail transfer protocol
  - Pop3 (110) : post office protocol
  - telnet(23) : used to connect to the remote machine
  - ssh [22]: secure shell
  - dns (53) : domain name service (used to get the IP address from the domain name)

Presentation Layer

Translation

- **On sender side : translates from ASCII to EBDIC (Extended Binary Coded Decimal Interchange Code)**
- **On receiver side: translates from EBDIC to ASCII**

Encryption/Decryption

- **Plain Text to Cipher Text**
- **Algorithms : RSA, SHA**

Compression / Decompression

- **Sender Side : Compression**
- **Receiver Side : Decompression**

Data Representation [Content-type] (Used to Decide Common File Formats)

- For text (plain: text/plain , html: text/html , json: application/json , xml: text/xml)
- For image (bmp: image/bmp , png: image/png, jpg: image/jpg , jpeg: image/jpeg)
- For audio & Video (wave: audio/wav, mp3: audio/mp3, mp4: video/mp4, fllv: video/flv

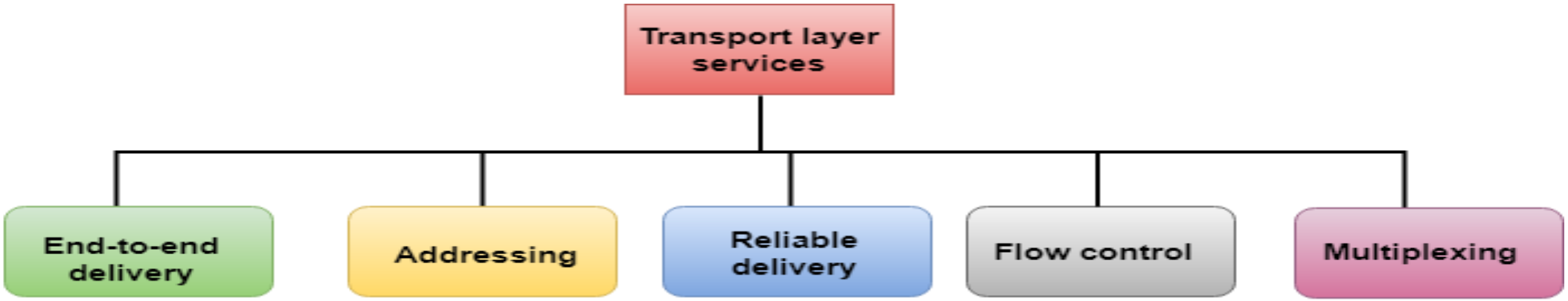
Session Layer

- **To start/manage/terminate the session.**
  - how to start, control and end conversations (called sessions) between applications.
  - log-on or password validation is also handled by this layer.
- **The session layer is the network *dialog controller.***
  - mechanism for controlling the dialogue between the two end systems and synchronization.
  - Allows the communication between two processes to take place in either half duplex (one way at a time) or full-duplex (two ways at a time) mode.
- **Synchronization**
  - Session layer can also provide check-pointing mechanism such that if a failure of some sort occurs between checkpoints, all data can be retransmitted from the last checkpoint.
  - It establishes, maintains, and synchronizes the interaction among communicating systems.
- **Protocols**
  - SIP: session initiation protocol
  - NetBIOS : Network Basic Input Output Service
  - RPC: Remote Procedure Call

Transport Layer

- Most Important Layer of OSI
- Responsible **for process-to-process/ End to End delivery** of the entire message.
- Provide a reliable mechanism for the **exchange of data between two processes** in different computers.
- Segment
  - smaller part of session PDU
  - every segment contains sequence number
  - every segment contains checksum for error checking
  - Segment contains:
    - **data** (from the session layer PDU)
    - **sequence number** : used for re-assembling the segments on the receiver machine
    - **checksum :** used to check if the data is not damaged

Responsibilities of Transport Layer



End –to-End delivery

- The transport layer transmits the entire message to the destination

Addressing

- The transport layer provides the user address which is specified as a station or port.

Reliable delivery

- provides reliability services by retransmitting the lost and damaged packets
- Error control, sequence control, loss control, duplicate control.

Error Control

- performs the checking for the errors end-to-end to ensure that the packet has arrived correctly.

Flow Control

- Flow control is used to prevent the sender from overwhelming the receiver.
- If the receiver is overloaded with too much data, then the receiver discards the packets & ask for retransmission of packets.

Multiplexing

- uses the multiplexing to improve transmission efficiency.

Transport Layer Protocol

TCP

- Transmission Control Protocol (Reliable)
- connection oriented protocol
  - connection will kept alive till the data transfer in progress
- flow control, error checking and sequencing
- slower than UDP
- E.g. Email (no data loss)

UDP

- User Datagram Protocol (Unreliable)
- Connection Less Protocol
- does not provide error checking/ flow control
- Faster than TCP because no ACK only sending of data packets
- E.g: Online Games, Streaming

Network Layer

- The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links).
- It determines the route from the source to the destination and also manages the traffic problems such as switching, routing and controls the congestion of data packets.
- Segment Contains :
  - data
  - source IP address
  - destination IP address
- **Network Layer Responsibilities:**
  - Logical Addressing : The network layer translates the logical addresses into physical addresses
  - Routing : sending the data across the network
  - Internetworking : provides the logical connection between different types of networks
  - Fragmentation : breaking the packets into the smallest individual data units that travel through different networks.
- **Protocols :**
  - IP : internet protocol
  - IPx : internetwork packet exchange
  - ICMP : Internet Control Messaging Protocol
  - NAT : Network Address Translation
  - ARP : Address Resolution Protocol
  - PPP: Point to Point Protocol
- **Device** : Router

Data Link Layer

- Data link layer attempts to provide reliable communication over the physical layer interface.
- **DATA LINK Layer Responsibilities :**
  - **Framing:**
    - Breaks the outgoing data into frames and reassemble the received frames.
    - every frame contains (Source MAC address and Destination MAC address)
  - **Physical Addressing:**
    - uses MAC address to identify every NIC uniquely
  - **Flow Control:**
    - A flow control mechanism to avoid a fast transmitter from running a slow receiver by buffering the extra bit is provided by flow control. This prevents traffic jam at the receiver side.
  - **Error Control:**
    - Error control is achieved by adding a trailer at the end of the frame. Duplication of frames are also prevented by using this mechanism. Data Link Layers adds mechanism to prevent duplication of frames.
  - **Access Control:**
    - Protocols of this layer determine which of the devices has control over the link at any given time, when two or more devices are connected to the same link.
- **Protocols**
  - ARP(Address Resolution Protocol) : getting physical address from logical address
  - RARP: Reverse Address Resolution Protocol
- **Device :** Switch

Physical Layer

- Provides physical interface for transmission of information.
- Covers all - mechanical, electrical, functional and procedural - aspects for physical communication. Characteristics like voltage levels, timing of voltage changes, physical data rates, etc.
- send data in the form of 1's and 0's.
- senders and receivers clock must be synchronized.
- **Transmission mode:**
  - Defines direction of transmission simplex, half duplex and full duplex
- **Devices:**
  - NIC , Cables , hubs , repeaters , connectors

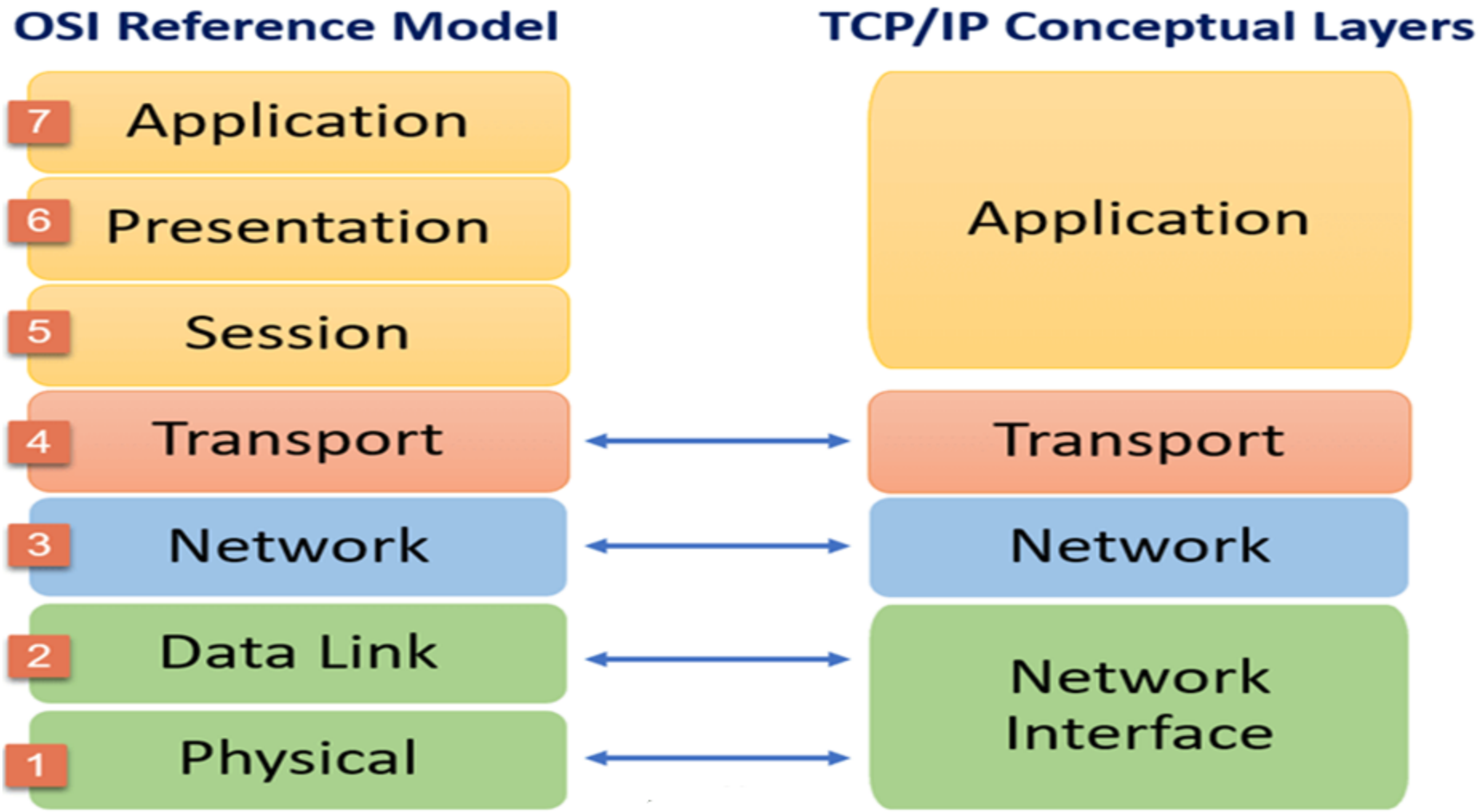
7 Layers of OSI Model

Application (PDU : Data)	• End user Layer • HTTP, FTP, IRC, SSH, DNS
Presentation (PDU : Data)	• Syntax Layer • SSL, SSH, IMAP, FTP, MPEG, JPEG
Session (PDU : Data)	• Synch and Send to port • API's, Sockets
Transport (PDU : Segment)	• End to end Connections • TCP , UDP
Network (PDU : Packet)	• Packets • IP, ICMP, IPSec, IGMP
Data Link (PDU : Frame)	• Frames • Ethernet, PPP. Switch, Bridge
Physical (PDU : Bits)	• Physical Structure • Coax, Fiber, Wireless, Hubs, Repeaters

OSI and TCP/IP Model

- OSI model is a generic model that is based upon functionalities of each layer. TCP/IP model is a protocol-oriented standard.
- OSI model distinguishes the three concepts, namely, services, interfaces, and protocols. TCP/IP does not have a clear distinction between these three.
- OSI model gives guidelines on how communication needs to be done, while TCP/IP protocols layout standards on which the Internet was developed. So, TCP/IP is a more practical model.
- In OSI, the model was developed first and then the protocols in each layer were developed. In the TCP/IP suite, the protocols were developed first and then the model was developed.
- The OSI has seven layers while the TCP/IP has four layers.

OSI and TCP/IP Model



Thank You