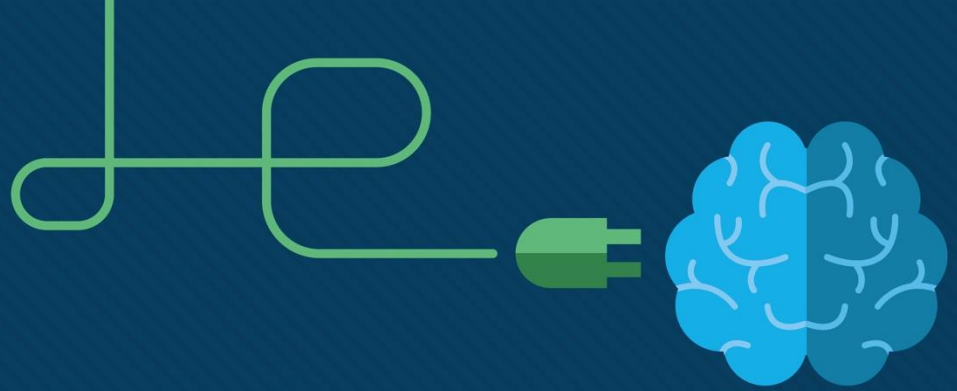


Module 2: Network Architecture

Introduction to Networks 7.0
(ITN)

Network Architecture

- **Network architecture** is the design of a computer network. It is a framework for the specification of a network's physical components and their functional organization and configuration, its operational principles and procedures, as well as communication protocols used.

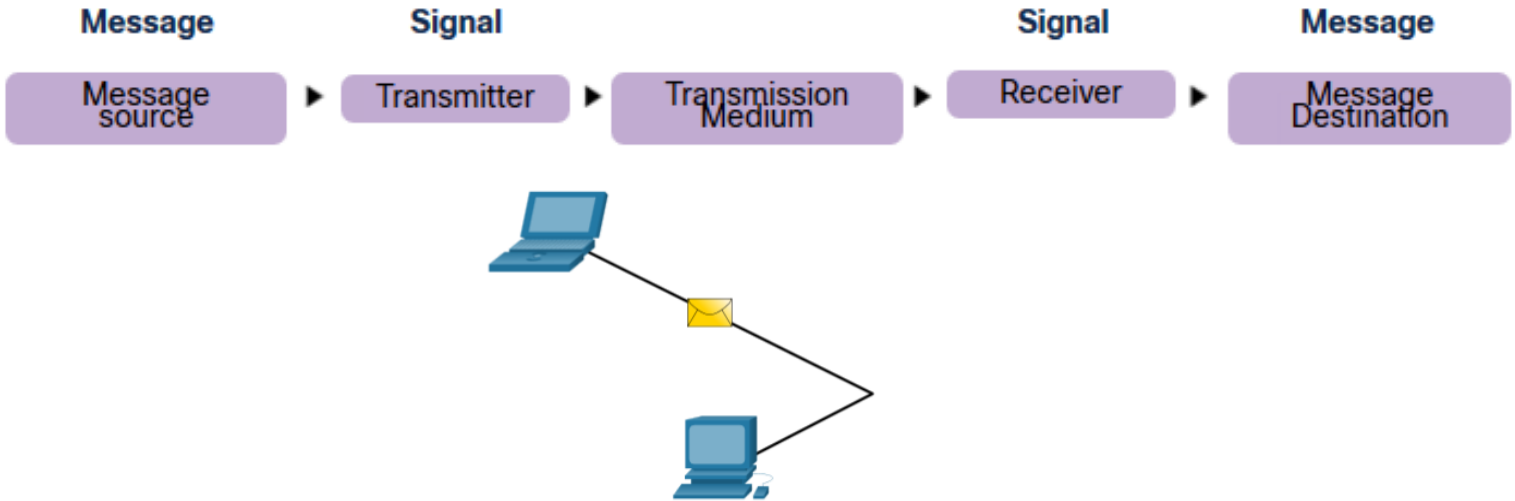
- Understanding network architecture requires knowledge of its components. There are two important components for building blocks of network architectures:

    1. Protocols
    2. Layers

2.1 Protocols

Communications Protocols

- All communications are governed by protocols.
- Protocols are the rules that communications will follow.
- These rules will vary depending on the protocol.



Communications Protocols

- A **network protocol defines rules and conventions for communication between network devices.**
- Network protocols include mechanisms for devices to identify and make connections with each other, as well as formatting rules that specify how data is packaged into sent and received messages.
- Common computer protocols must be in agreement and include the following requirements:
  1. Message encoding and decoding
  2. Message formatting
  3. Message size
  4. Message timing (flow control, response timeout and access method)
  5. Message delivery options (unicast, multicast, broadcast and anycast)

Must popular protocols: IP , ICMP , TCP , UDP , HTTP , FTP , SMTP , RIP , OSPF , BGP , SSL , TLS , …

2.2 Layers Models

Layering in Networks

Layering is a concept used in computer networking that involves dividing a complex system into a hierarchy of smaller and more manageable layers, each of which performs a specific function.

Why a layered model?

1. **Breaks down** communication into smaller, simpler parts.
2. **Easier to teach** communication process.
3. **Allows** different hardware and software to work together.
4. **Reduces** complexity

What are the layer models?

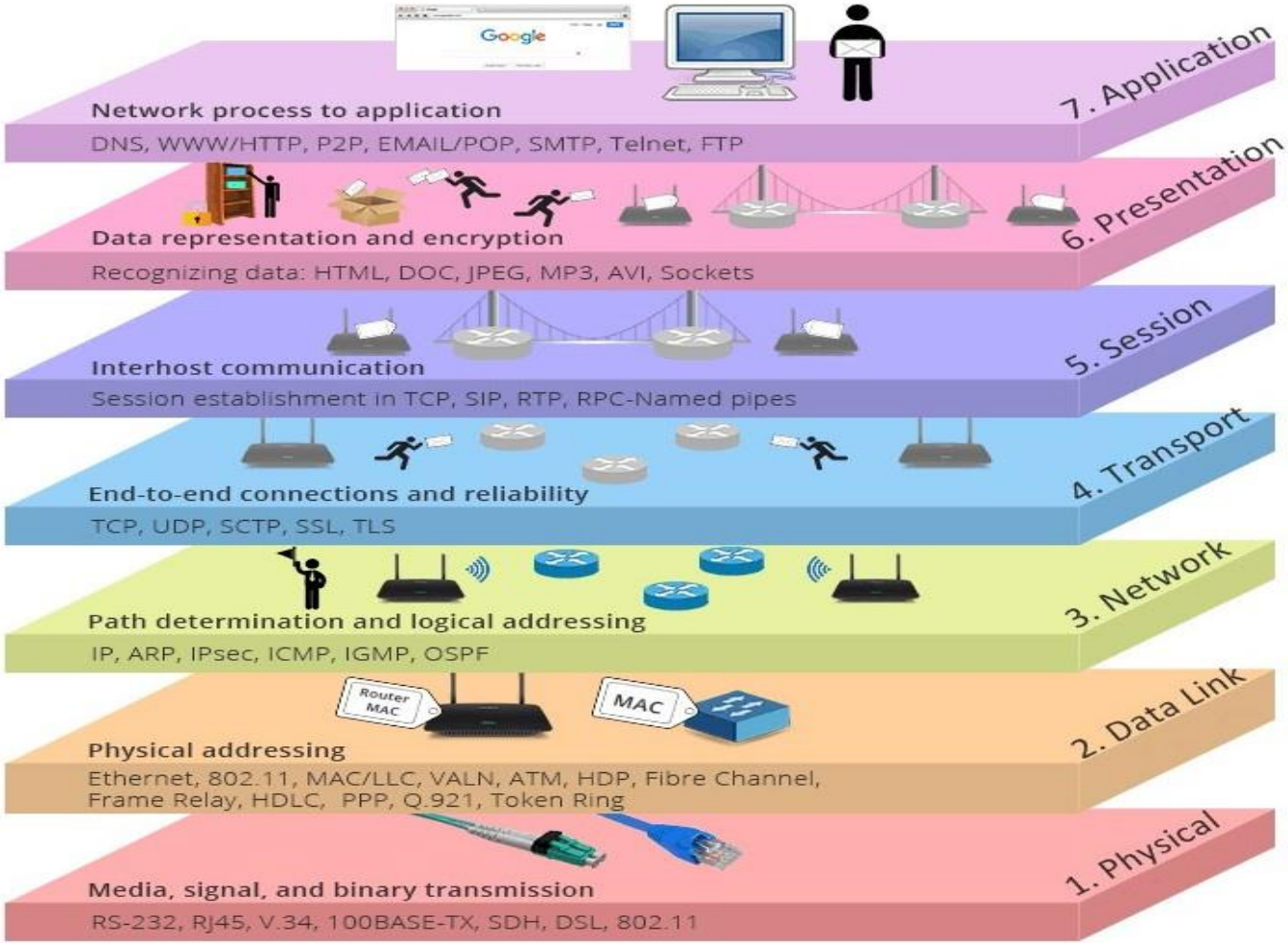
- OSI Model (Open System Interconnection)
- TCP/IP Model

2.3 OSI Model

OSI Model

Open System Interconnection (OSI) Model describes seven layers that computer systems use to communicate over a network. When we transfer information from one device to another, it travels through 7 layers of OSI model. First data travels down through 7 layers from the sender's end and then climbs back 7 layers on the receiver's end. These layers are:

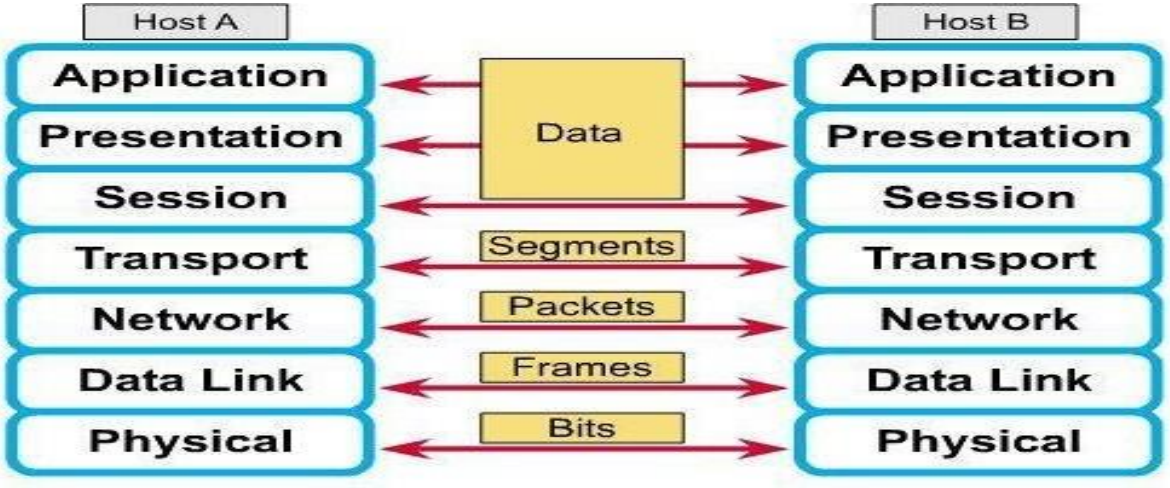
- **Layer 7: Application Layer:** Applications create the data.
- **Layer 6: Presentation Layer:** Data is formatted and encrypted.
- **Layer 5: Session Layer:** Connections are established and managed.
- **Layer 4: Transport Layer:** Data is broken into segments for reliable delivery.
- **Layer 3: Network Layer**: Segments are packaged into packets and routed.
- **Layer 2: Data Link Layer:** Packets are framed and sent to the next device.
- **Layer 1: Physical Layer:** Frames are converted into bits and transmitted physically.


7. Application
Network process to application
DNS, WWW/HTTP, P2P, EMAIL/POP, SMTP, Telnet, FTP
6. Presentation
Data representation and encryption
Recognizing data: HTML, DOC, JPEG, MP3, AVI, Sockets
5. Session
Interhost communication
Session establishment in TCP, SIP, RTP, RPC-Named pipes
4. Transport
End-to-end connections and reliability
TCP, UDP, SCTP, SSL, TLS
3. Network
Path determination and logical addressing
IP, ARP, IPsec, ICMP, IGMP, OSPF
2. Data Link
Router MAC
MAC
Physical addressing
Ethernet, 802.11, MAC/LLC, VALN, ATM, HDP, Fibre Channel,
Frame Relay, HDLC, PPP, Q.921, Token Ring
1. Physical
Media, signal, and binary transmission
RS-232, RJ45, V.34, 100BASE-TX, SDH, DSL, 802.11

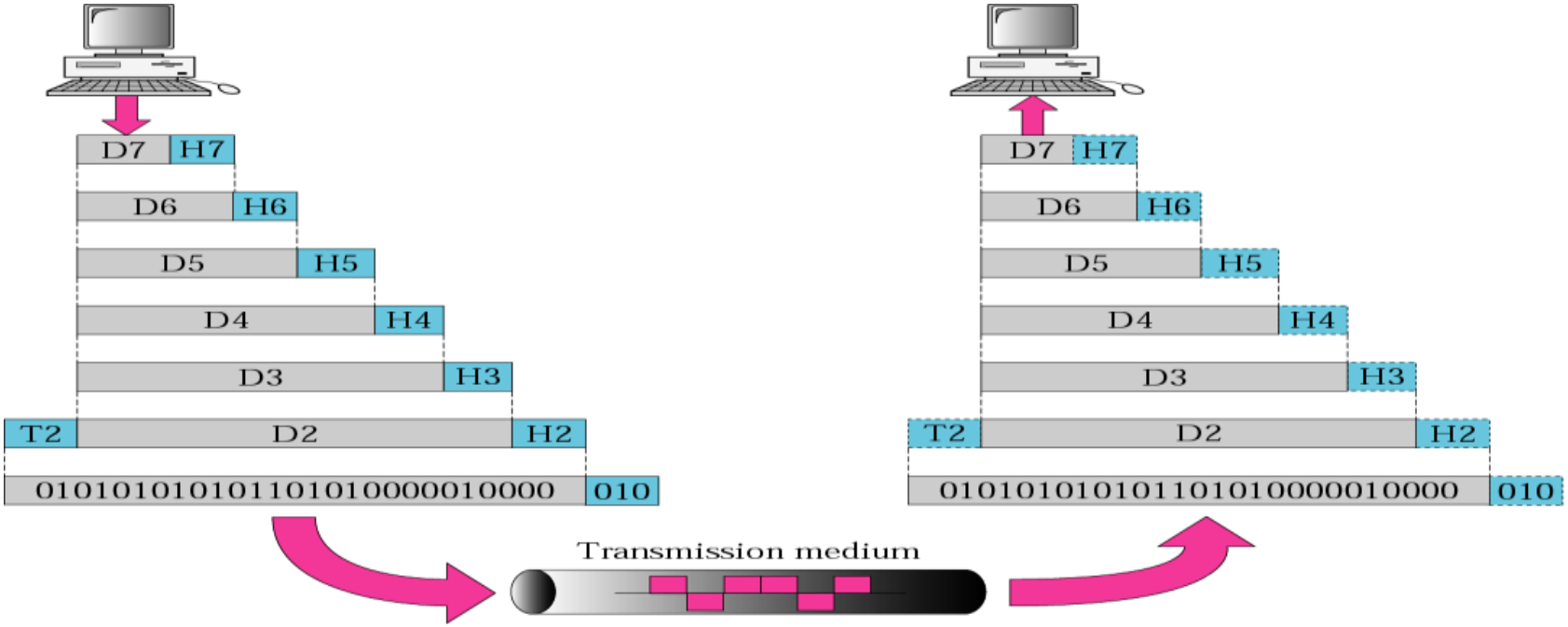
OSI Model (contd.)

Data Encapsulation

Encapsulation is the process of adding additional information when data is traveling in OSI or TCP/IP model. The additional information has been added on sender's side, starting from Application layer to Physical layer.



OSI Model (contd.)



Interconnection between OSI layers in transmitter and receiver

Where **D** indicates to the transferred data, **H**: the data header and **T**: the data trailer

OSI Model (contd.)

Layer	Main Topics
Physical Layer	• Transmission mediums (transmit bits over medium) • Encoding • Modulation • To provide mechanical and electrical specification • Repeaters and Hubs (multi-port repeater)
Data Link Layer	• Error detection and correction methods • Hop to hop delivery • physical addressing(MAC Address) • Flow control • Frame format • IEEE LAN standards • Bridges & Switches (multi-port bridges)
Network Layer	• Internetworking • Controls the operation of the subnet. • Routing algorithms(Routing packets from source to destination) • Internet Protocol (IP) addressing (Logical addressing) • Routers

Layer	Main Topics
Transport Layer	• Connection-oriented and connectionless services • Provide reliable process to process message delivery & error recovery • Transmission Control Protocol (TCP) • User Datagram Protocol (UDP) • Provides additional Quality of Service. • Port address • End-to-end flow control.
Session Layer	• Allows users on different machines to establish sessions (dialogue) between them. • managing dialogue control. • Token management. • Synchronization.
Presentation Layer	• Concerned with the syntax and semantics of the information. • Preserves the meaning of the information. • Data compression. • Data encryption.
Application Layer	• Provides protocols that are commonly needed. • To allow access to network resource • (FTP), (HTTP), (SMTP), (SNMP),(NFS),(Telnet)

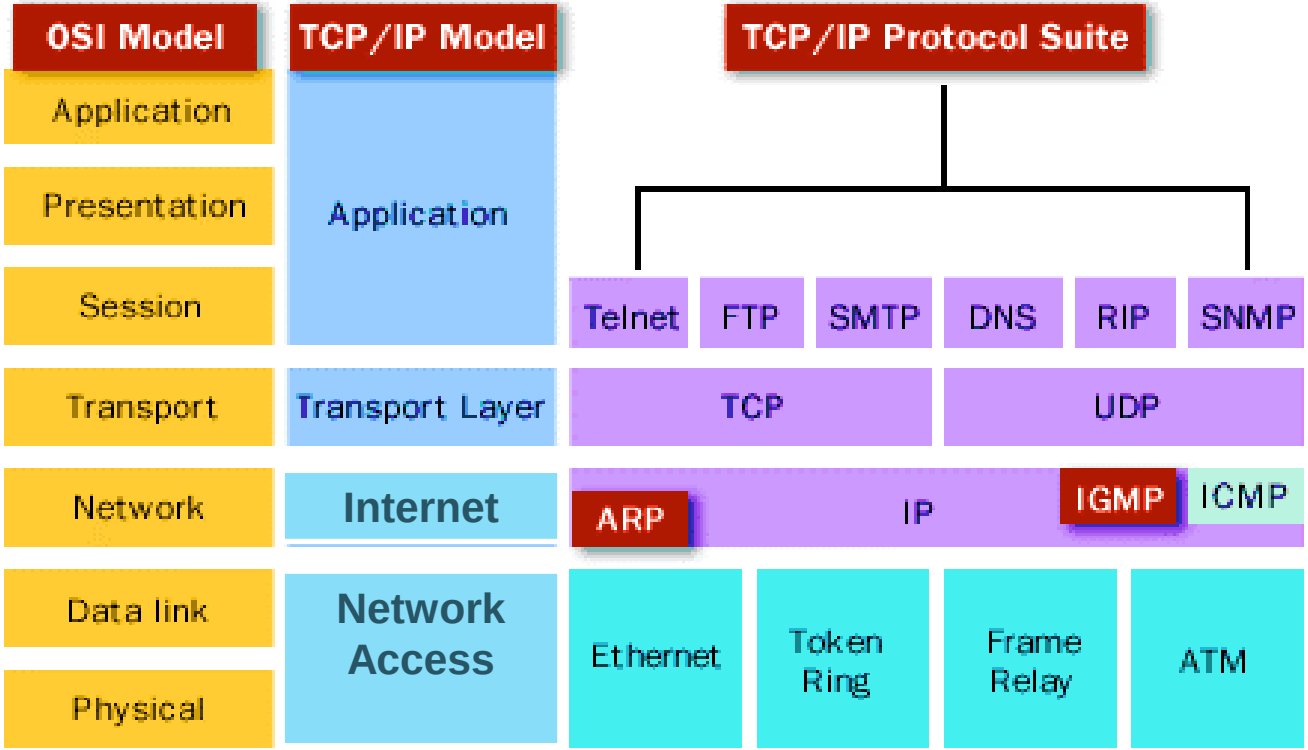
2.4 TCP / IP Model

TCP / IP Model

TCP/IP stands for **Transmission Control Protocol/Internet Protocol** and is a suite of communication protocols used to interconnect network devices on the internet. TCP/IP is also used as a communications protocol in a private computer network (an intranet or extranet).

- *TCP / IP model contain four layer :*
  - **Layer 4:** Application
  - **Layer 3:** Transport
  - **Layer 2:** Internet
  - **Layer 1:** Network access

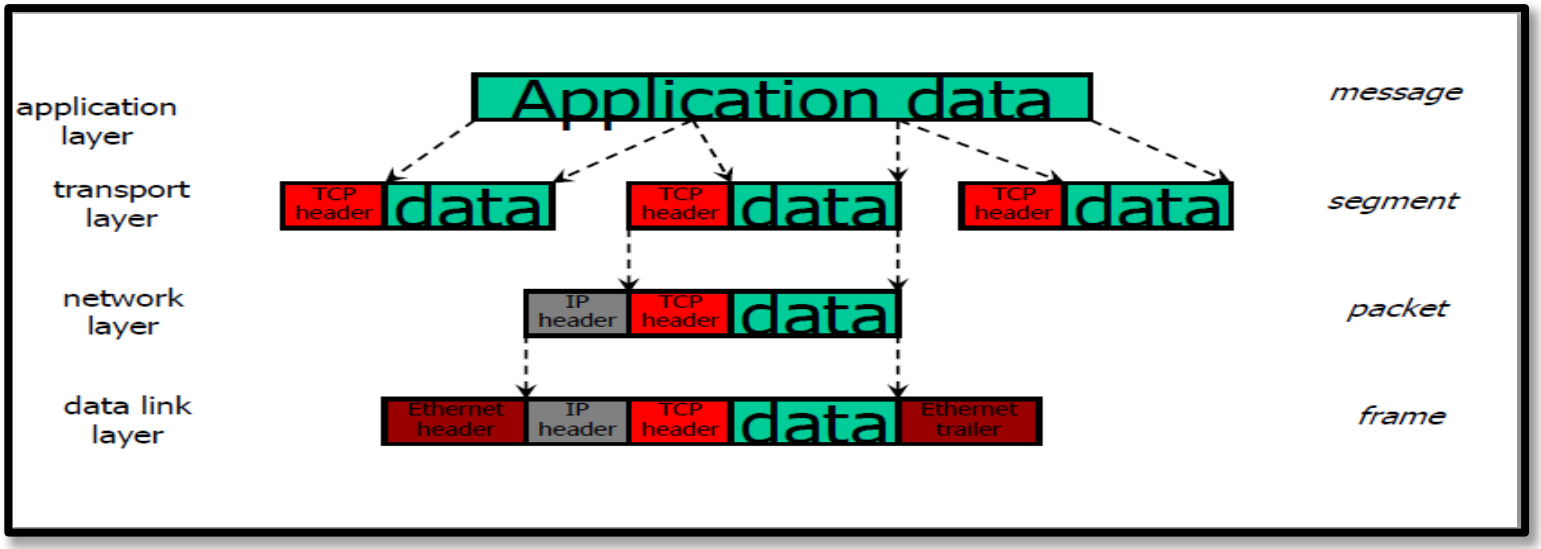
TCP / IP Model (contd.)



TCP/IP Reference Model

TCP / IP Model (contd.)

Data Encapsulation In TCP/IP



- Header (Identifies the protocol in use, the sender and intended recipient)
- Trailer (or packet trailer) (Provides data integrity checks for the payload)

TCP / IP Model (contd.)

Note

These layers will be explained in detail in the following modules