Review

OSI reference model
Encapsulation
Protocols, ports

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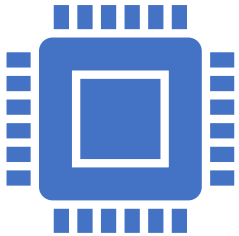
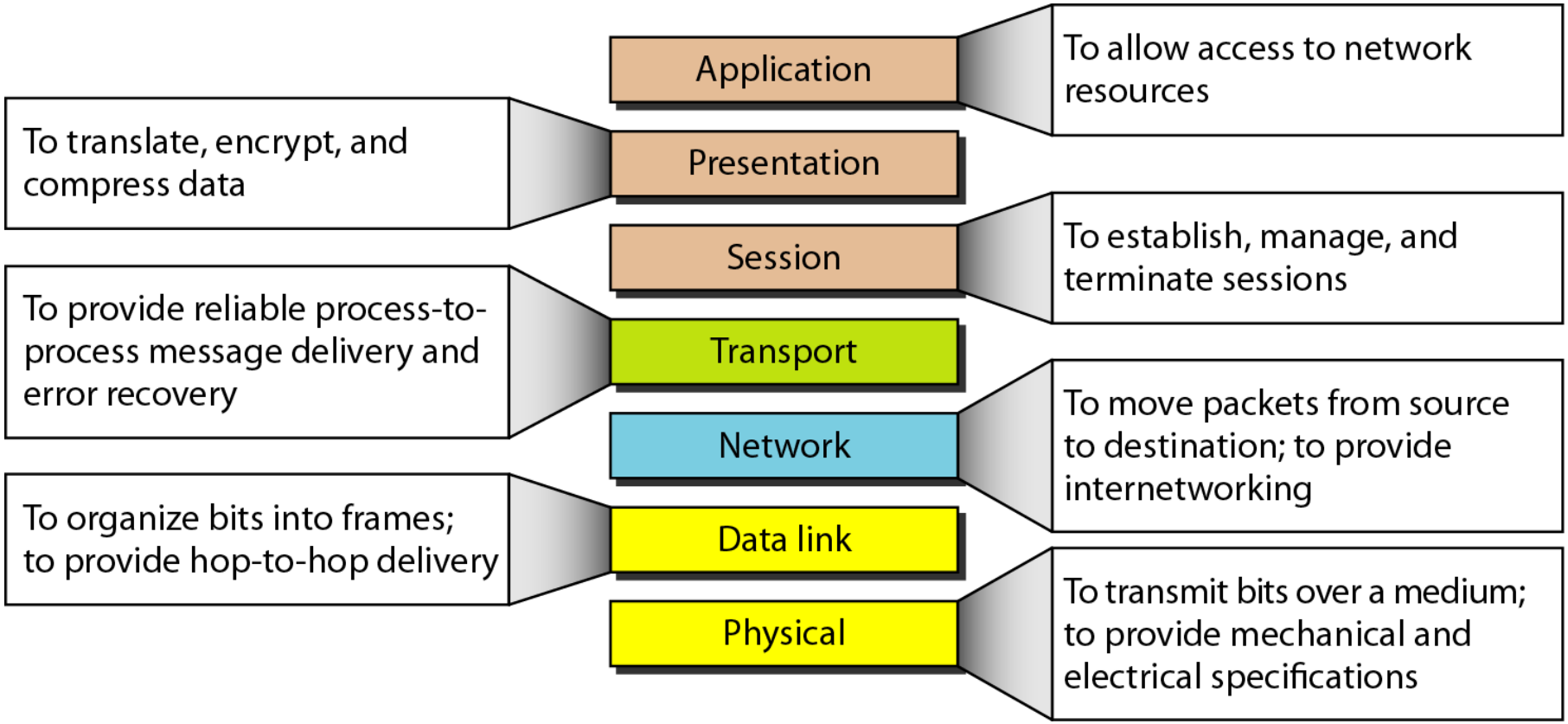


The OSI Model

The OSI (Open Systems Interconnection) isn't a physical model. Rather, it's a set of **guidelines** that application developers can use to create and implement applications that run on a network.

It also provides a **framework** for creating and implementing networking standards, devices, and internetworking schemes.

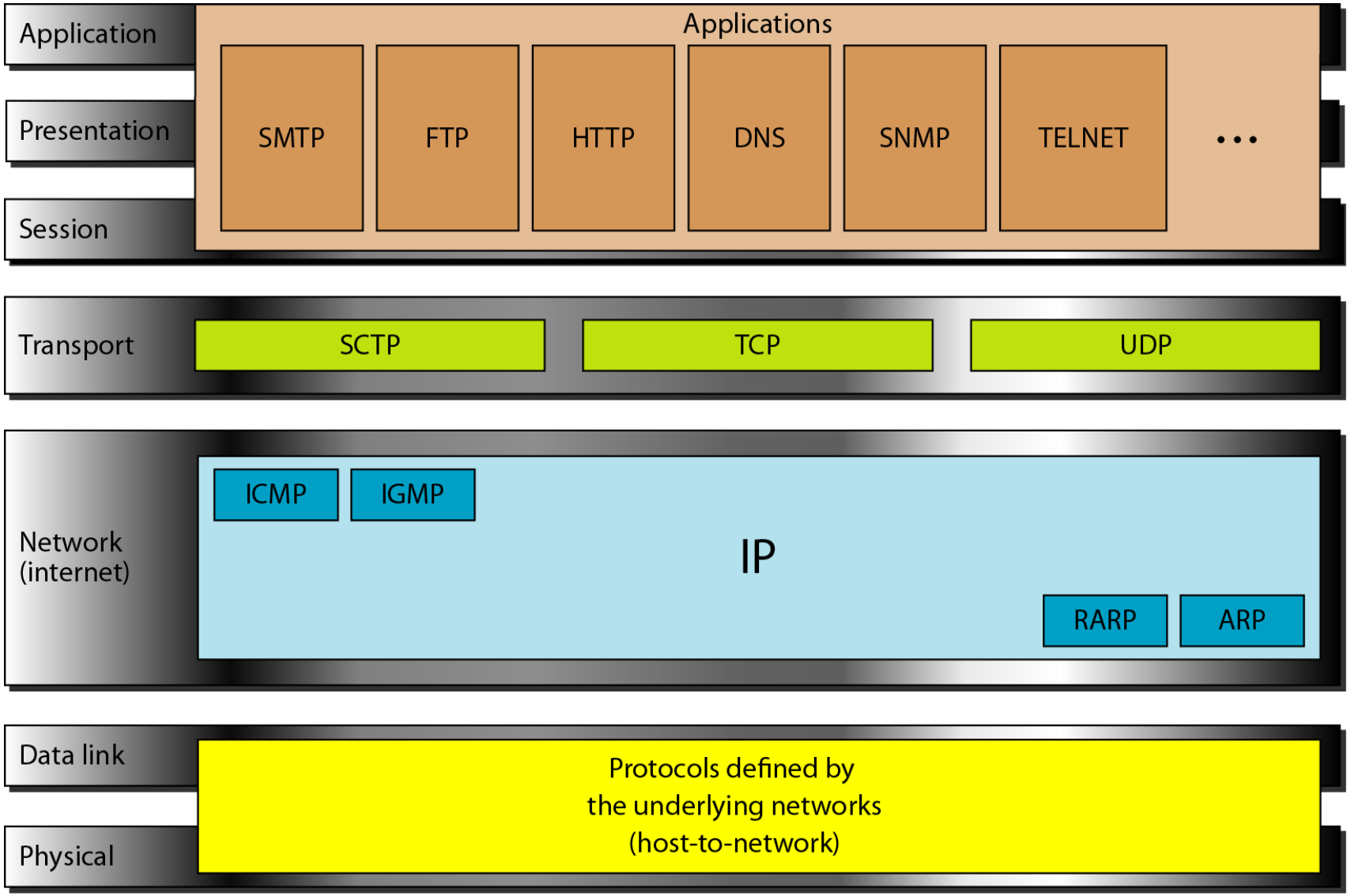
The OSI Model



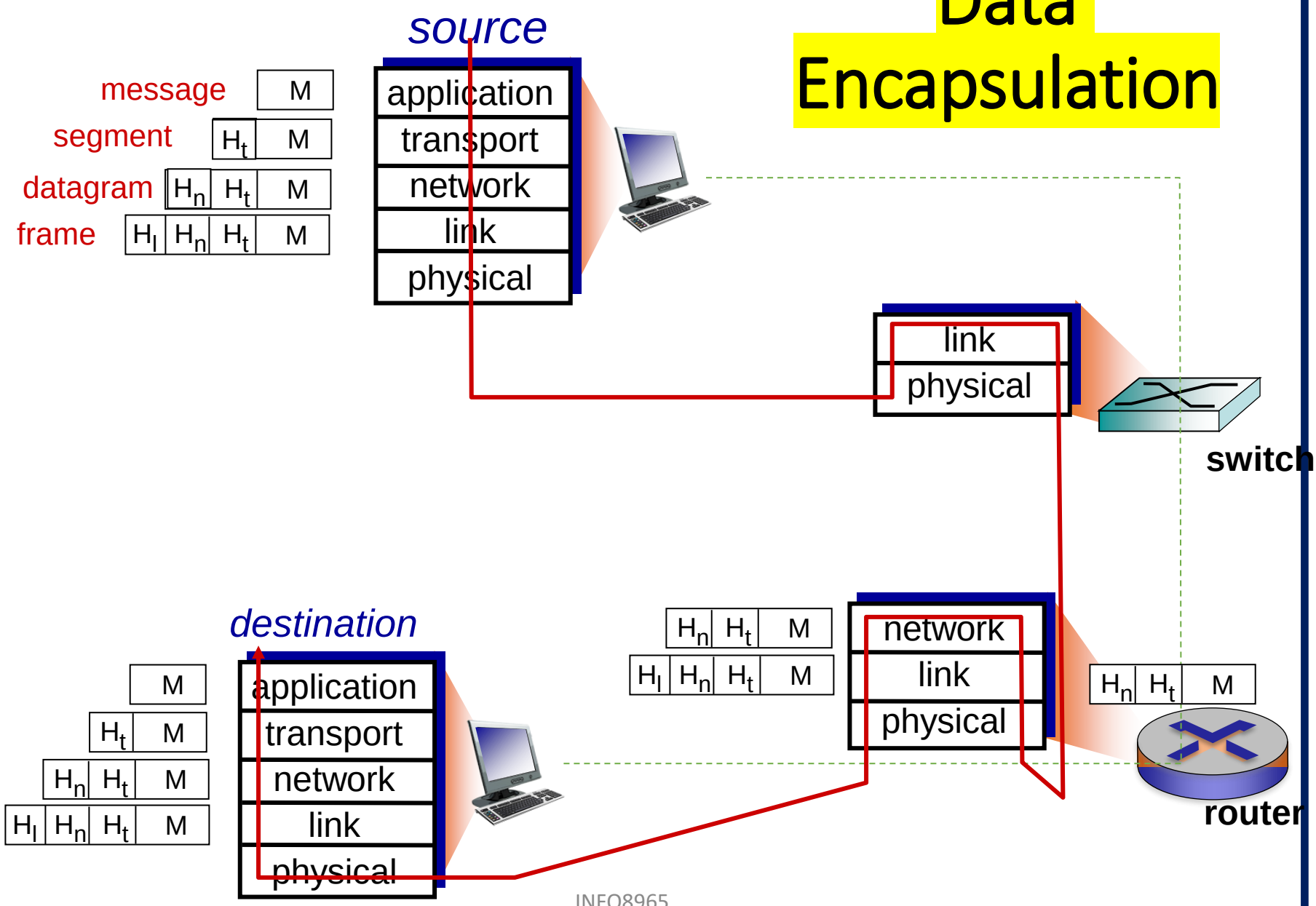
Networking Devices vs. Layers

Device	Functions	Working Layer
Repeater and Hub	• Repeat incoming signal in other port(s) • Does not understand the meaning of bits in traffic	1
Bridge	• Divide network into smaller segments (fewer node) • Learns, records and uses the MAC address	1, 2
Switch	• Divide network into smallest segment possible (ideally one node per port): Micro-segmentation • Reduce collision	1, 2
Router	• Divides networks into smaller LANs (IP-way) • Reduce broadcast traffic per LAN • Interconnects networks	1, 2, 3
Gateway	• Provide pathway for LAN traffic to go outside the network	1, 2, 3, [4, 5]
Firewall	• Controls (monitor and filter) the passage of traffic between networks	1, 2, 3, 4, 5

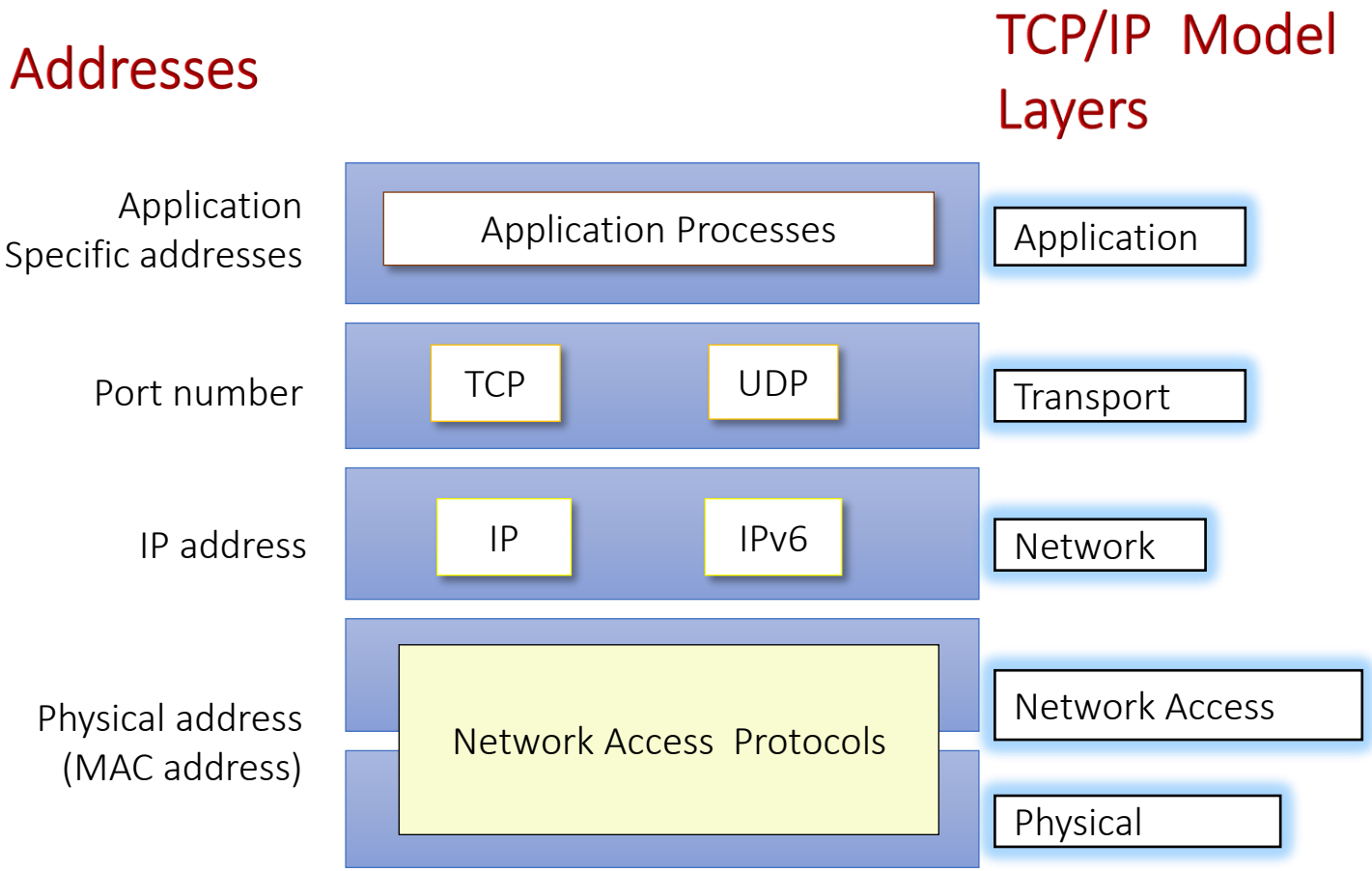
TCP/IP reference model



Data Encapsulation



Relationship of Layers and Addresses in TCP/IP



Transport Layer

Responsibilities

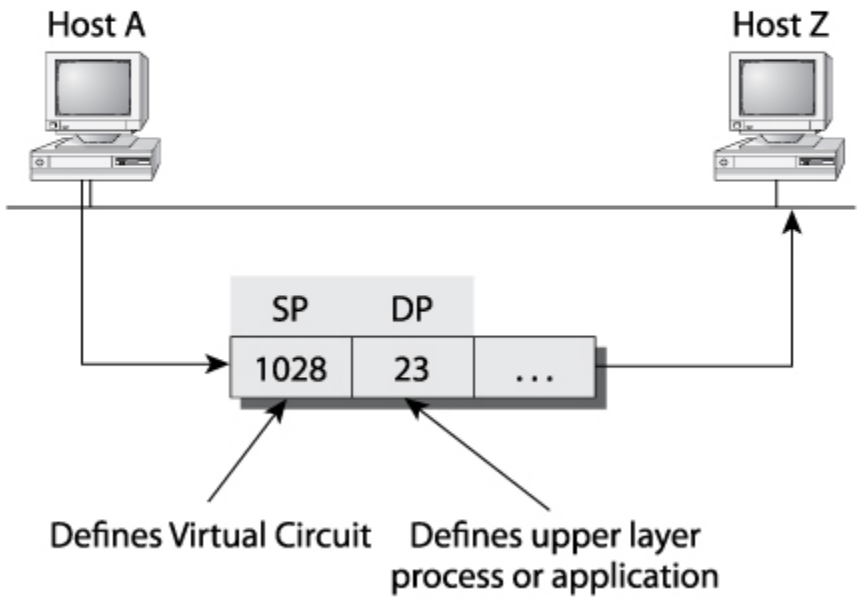
- **End-to-end**, error-free transmission and delivery between the ultimate sender and ultimate receiver
- **Flow control**
- Data segmentation into maximum transmission unit (**MTU**) size
- Messaging service for the Session layer

- Protocols that reside at the Transport layer can be **connection-oriented** or **connectionless**

- **TCP** (Transmission Control Protocol) vs **UDP** (User Datagram Protocol)

Transport Layer - Port Numbers

The Transport layer uses port numbers to define both the virtual circuit and the upper-layer process.



Network Layer

Functions

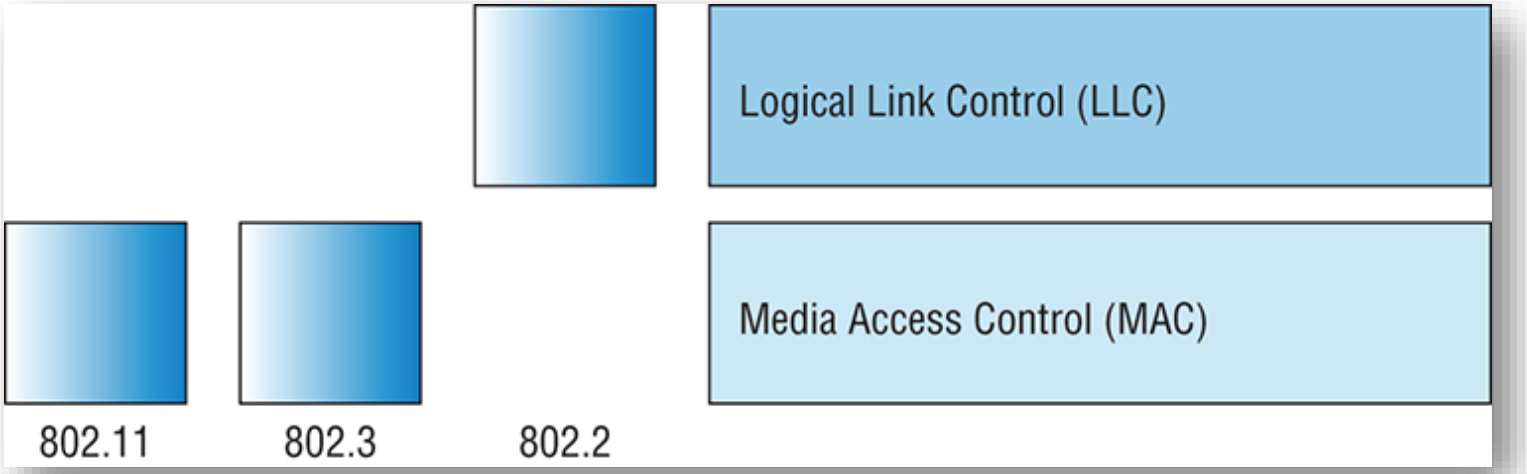
- Software/logical addressing for data **packets**, such as IP, IPX, and AppleTalk
- Data **routing** and connectivity
- Best path selection

- Responsible for **end-to-end transportation** packets
  - Data packets
  - Control packets (routing update packets)

- Protocols at the Network layer allow computers to route packets to remote networks using a **logical address**

Data Link Layer

- Some of the functions of data link layer are:
  - Encapsulation of network layer data packets into frames
  - Handles error notification
  - Frame synchronization
  - Flow control
  - Multiple access protocols for channel-access control
  - Physical addressing (MAC addressing)



Data Link & Physical Layers - Ethernet

- Ethernet is a contention **media access** method that allows all hosts on a network to share the same bandwidth of a link.

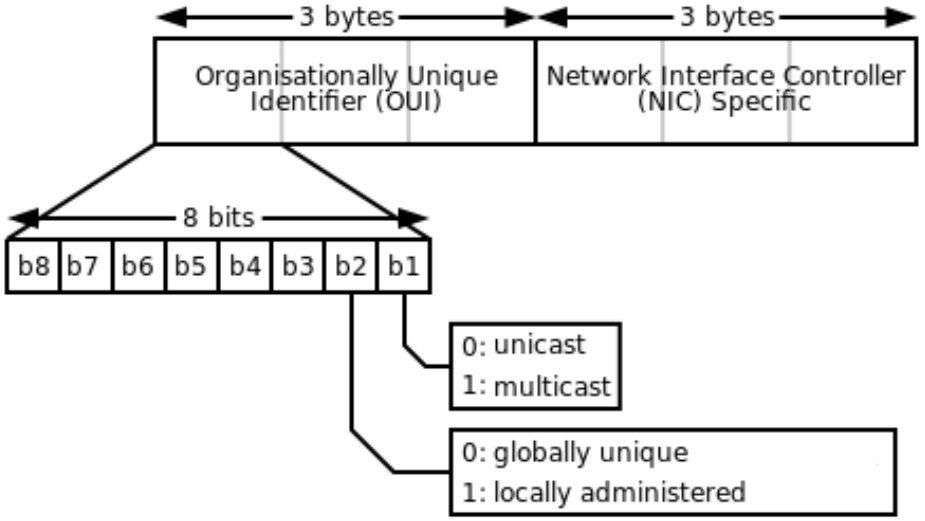
- Ethernet is popular because it's readily **scalable**, meaning that it's comparatively easy to integrate new technologies, such as Fast Ethernet and Gigabit Ethernet, into an existing network infrastructure.

- It's also relatively **simple** to implement in the first place, and with it, troubleshooting is reasonably straightforward.

Ethernet Addressing

- Ethernet is one of several protocols that uses the Medium Access Control (MAC) address, or hardware address

- **MAC address** is a 48-bit (6 bytes) value written in a hexadecimal format.



- LSB = 0 → indicate unicast address – meant to reach only one receiving NIC
- Multicast address → allow the source to send a frame to group of devices
- Broadcast address → FF FF FF FF FF FF

802.3 Ethernet packet and frame structure

- Preamble: alternating 0 and 1 – synchronize receiver clocks.
- Start Frame Delimiter (SDF): 10101011 – mark a new incoming frame
- Frame length: 64 to 1518 bytes
- Ethertype: used to indicate which protocol (IPv4, ARP, MPLS etc) is encapsulated in the payload of the frame.
- Frame check: error detection

Layer	Preamble	Start of frame delimiter	MAC destination	MAC source	802.1Q tag (optional)	Ethertype (Ethernet II) or length (IEEE 802.3)	Payload	Frame check sequence (32-bit CRC)	Interpacket gap
	7 octets	1 octet	6 octets	6 octets	(4 octets)	2 octets	46-1500 octets	4 octets	12 octets
Layer 2 Ethernet frame			← 64–1522 octets →						
Layer 1 Ethernet packet & IPG	← 72–1530 octets →								← 12 octets →

Questions