



The University of Danang
University of Science and Technology

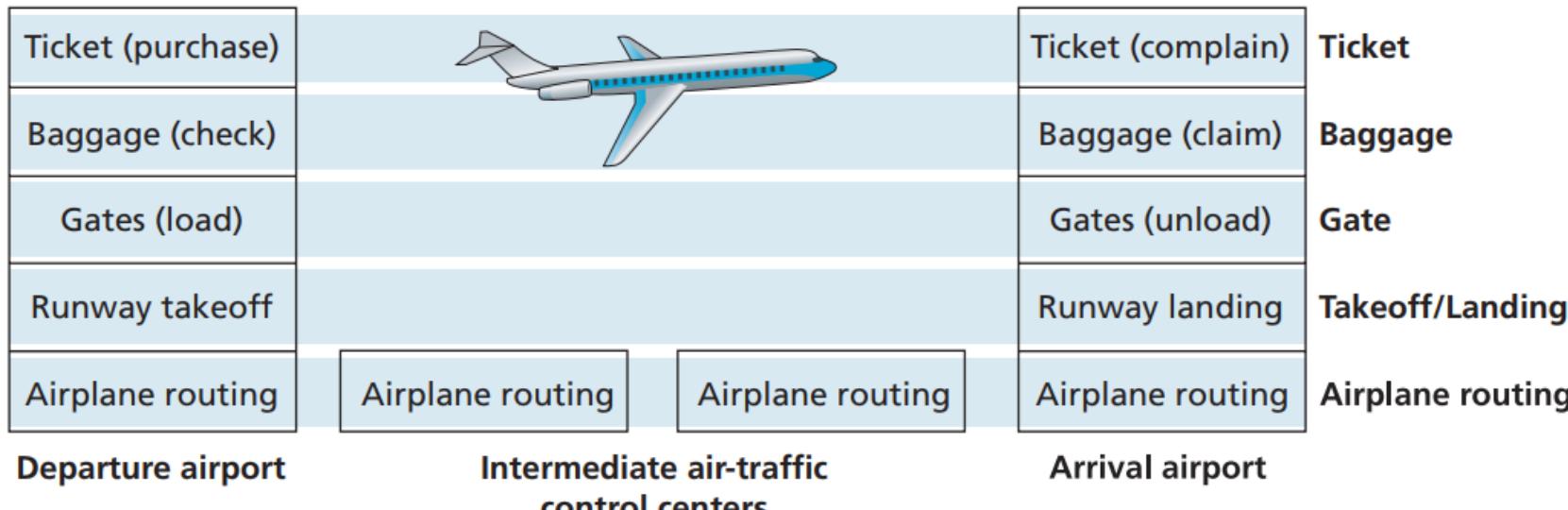
OSI MODEL & TCP/IP



FACULTY OF INFORMATION TECHNOLOGY
PhD. LE TRAN DUC

LAYERING OF AIRLINE FUNCTIONALITY

Look at the functionality in a *horizontal* manner

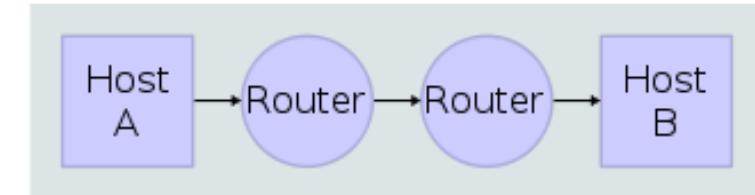


→ The airline functionalities are divided into layers

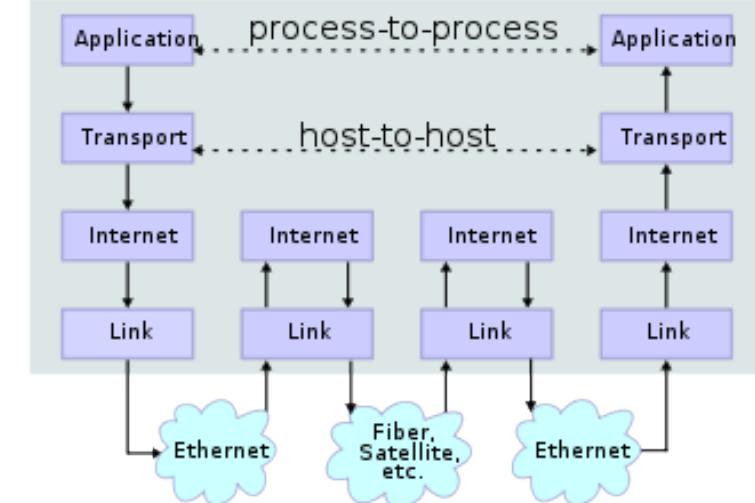
Layers: each layer implements a service

- by performing certain actions within that layer
- relying on services provided by layer below

Network Topology



Data Flow



WHAT IS A NETWORKING MODEL?

Networking **models** categorize and provide a structure for networking **protocols** and standards.

logical

A set of rules defining how network devices and software should work.

NETWORKING MODEL

protocol

protocol

protocol

standard

protocol

protocol

protocol

standard

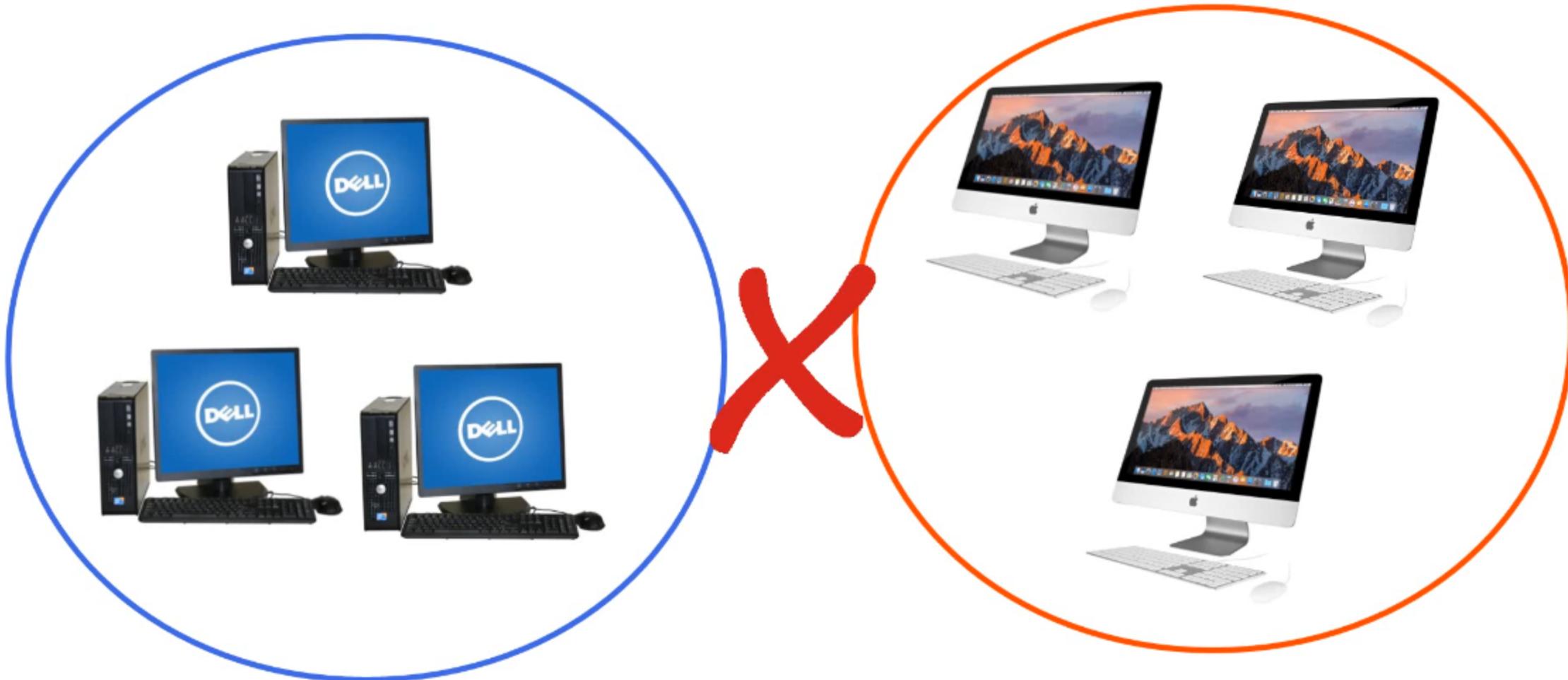
protocol

protocol

protocol

standard

NETWORK WITHOUT STANDARDIZATION

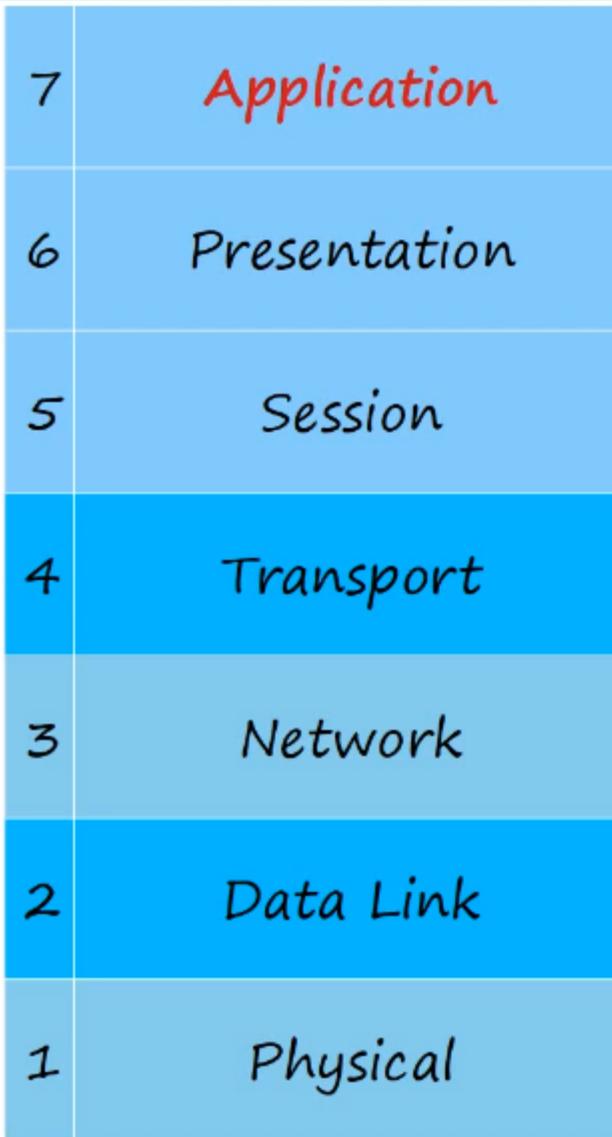


OSI MODEL



- 'Open Systems Interconnection' model
- A conceptual model that categorizes and standardizes the different functions in a network.
- Created by the 'International Organization for Standardization' (ISO).
- Functions are divided into 7 'Layers'.
- These layers work together to make the network work.

OSI MODEL – APPLICATION LAYER



- This layer is closest to the end user.
- Interacts with software applications, for example your web browser (Brave, Firefox, Chrome, etc)
- HTTP and HTTPS are Layer 7 protocols (<https://www.cisco.com>)

Functions of Layer 7 include:

- Identifying communication partners
- Synchronizing communication

OSI MODEL – PRESENTATION LAYER



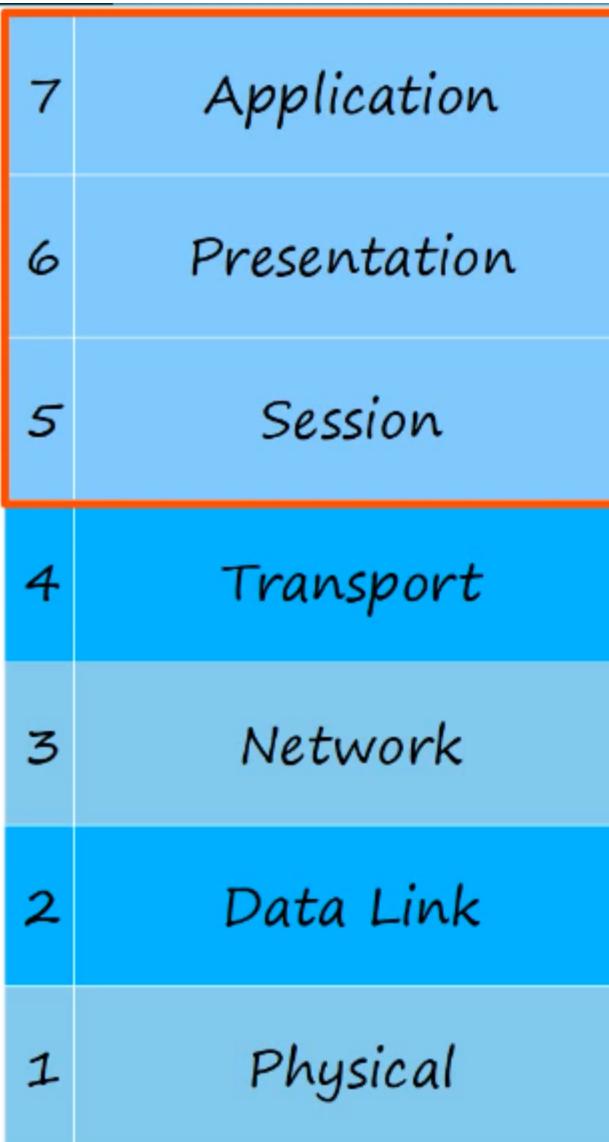
- Data in the application layer is in 'application format'.
- It needs to be 'translated' to a different format to be sent over the network.
- The Presentation Layer's job is to translate between application and network formats.
- For example, encryption of data as it is sent, and decryption of data as it is received.
- Also translates between different Application-Layer formats.

OSI MODEL – SESSION LAYER



- Controls dialogues (sessions) between communicating hosts.
- Establishes, manages, and terminates connections between the local application (for example, your web browser) and the remote application (for example, YouTube).

OSI MODEL – THE UPPER LAYERS



- Network engineers don't usually work with the top 3 layers.
- Application developers work with the top layers of the OSI model to connect their applications over networks.

OSI MODEL – THE TRANSPORT LAYER



- Segments and reassembles data for communications between end hosts.
- Breaks large pieces of data into smaller segments which can be more easily sent over the network and are less likely to cause transmission problems if errors occur.
- Provide host-to-host communication.

OSI MODEL – THE NETWORK LAYER

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

- Provides connectivity between end hosts on different networks (ie. outside of the LAN).
- Provides logical addressing (IP addresses).
- Provides path selection between source and destination.
- Routers operate at Layer 3.

OSI MODEL – THE DATA LINK LAYER



- Provides node-to-node connectivity and data transfer (for example, PC to switch, switch to router, router to router).
- Defines how data is formatted for transmission over a physical medium (for example, copper UTP cables)
- Detects and (possibly) corrects Physical Layer errors.
- Uses Layer 2 addressing, separate from Layer 3 addressing.
- Switches operate at Layer 2.

OSI MODEL – THE PHYSICAL LAYER

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

- Defines physical characteristics of the medium used to transfer data between devices.
- For example, voltage levels, maximum transmission distances, physical connectors, cable specifications, etc.
- Digital bits are converted into electrical (for wired connections) or radio (for wireless connections) signals.
- All of the information in Day 2's video (cables, pin layouts, etc.) is related to the Physical Layer.

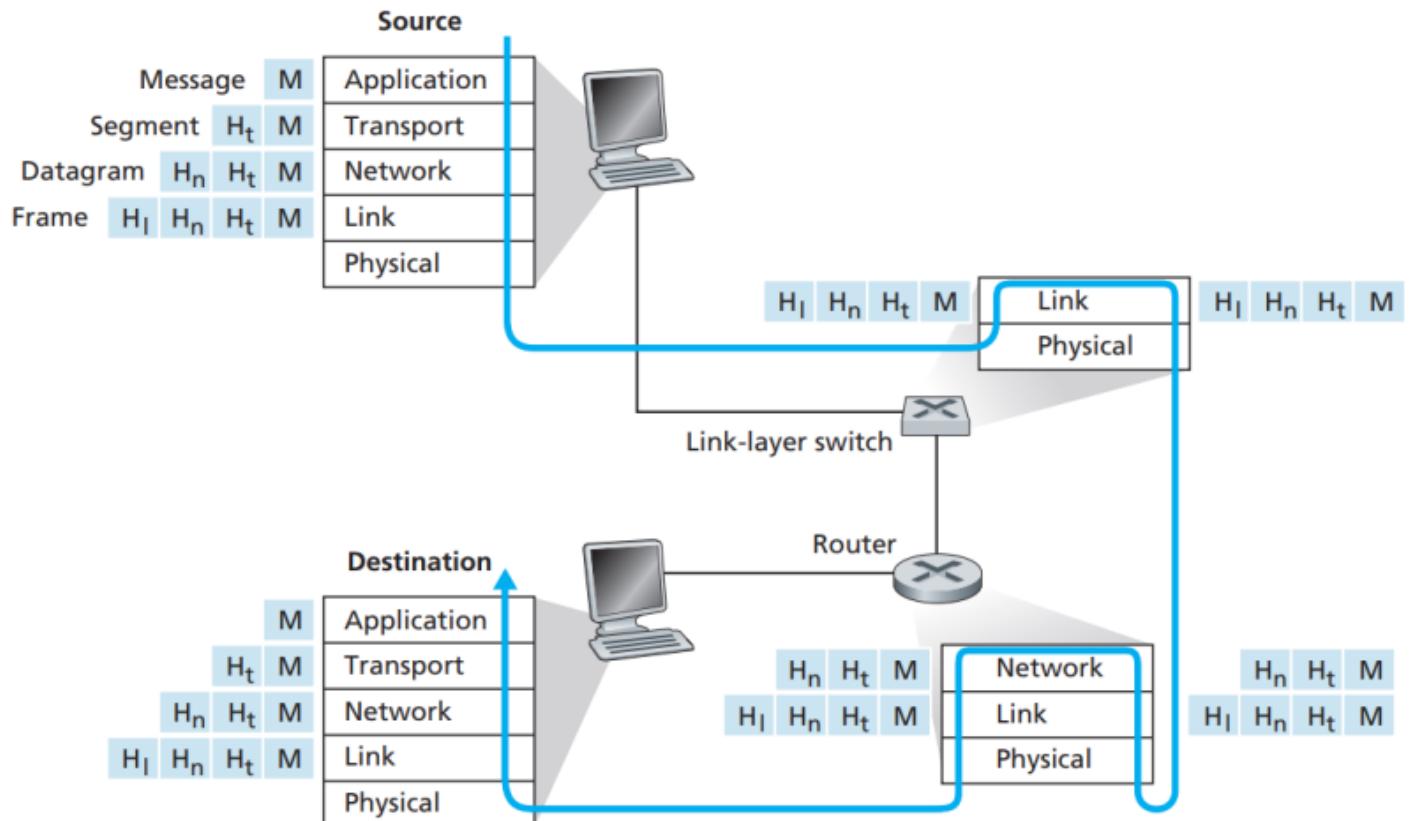
ENCAPSULATION

Figure shows the physical path:

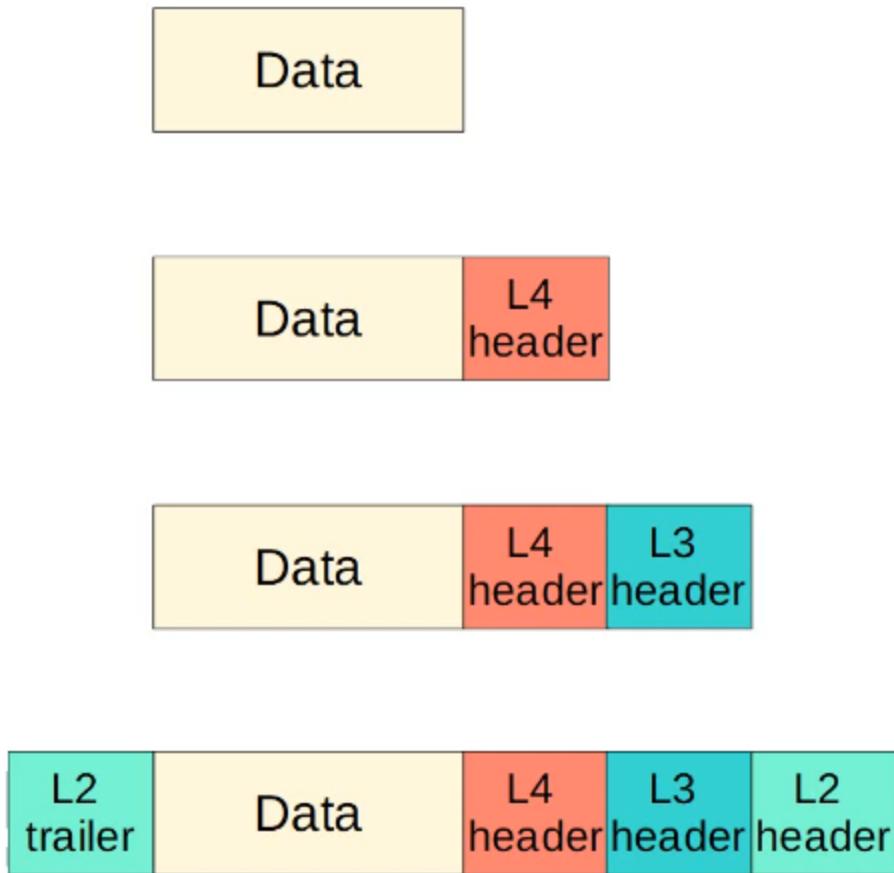
- data takes down a sending end system's protocol stack
- up and down the protocol stacks of a link-layer switch and router
- up the protocol stack at the receiving end system.

A packet has two types of fields: **header fields** and a **payload field**.

The payload is typically a packet from the layer above.



OSI MODEL – PDUs



Segment

Packet

Frame

Data

Protocol Data Units (PDUs)

Layer 1 PDU = Bit

OSI MODEL – ACCRONYMS

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

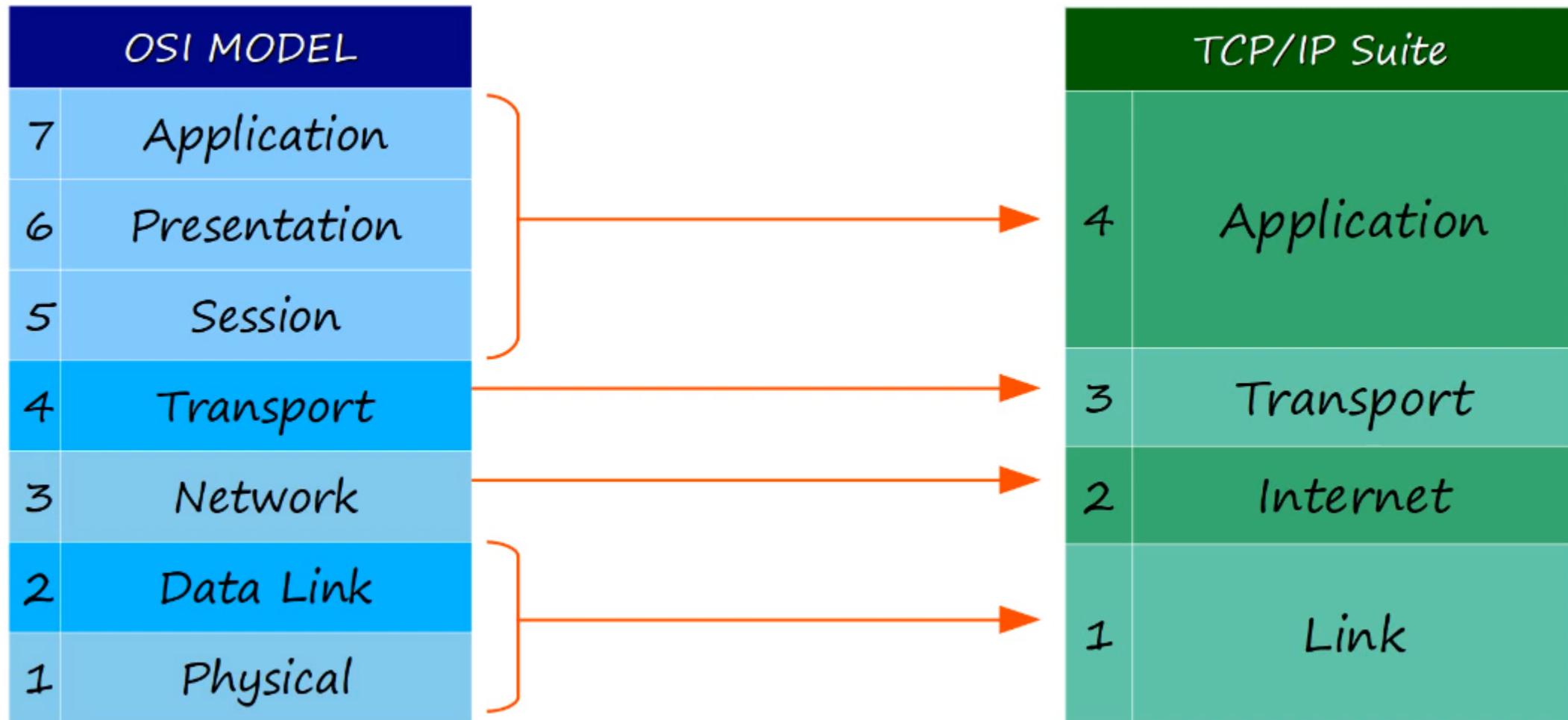
All
People
Seem
To
Need
Data
Processing

Acronyms
Pointless
Students
Teach
Not
Do
Please

TCP/IP SUITE

- Conceptual model and set of communications protocols used in the Internet and other networks.
- Known as TCP/IP because those are two of the foundational protocols in the suite.
- Developed by the United States Department of Defense through DARPA (Defense Advanced Research Projects Agency)
- Similar structure to the OSI Model, but with fewer layers.
- This is the model actually in use in modern networks.
- NOTE: The OSI model still influences how network engineers think and talk about networks.

OSI vs TCP/IP

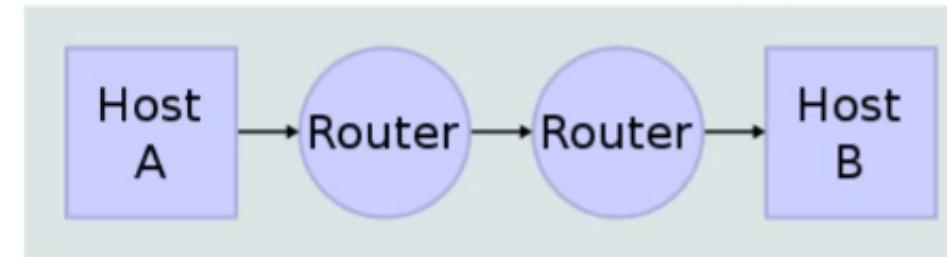


TCP/IP SUITE

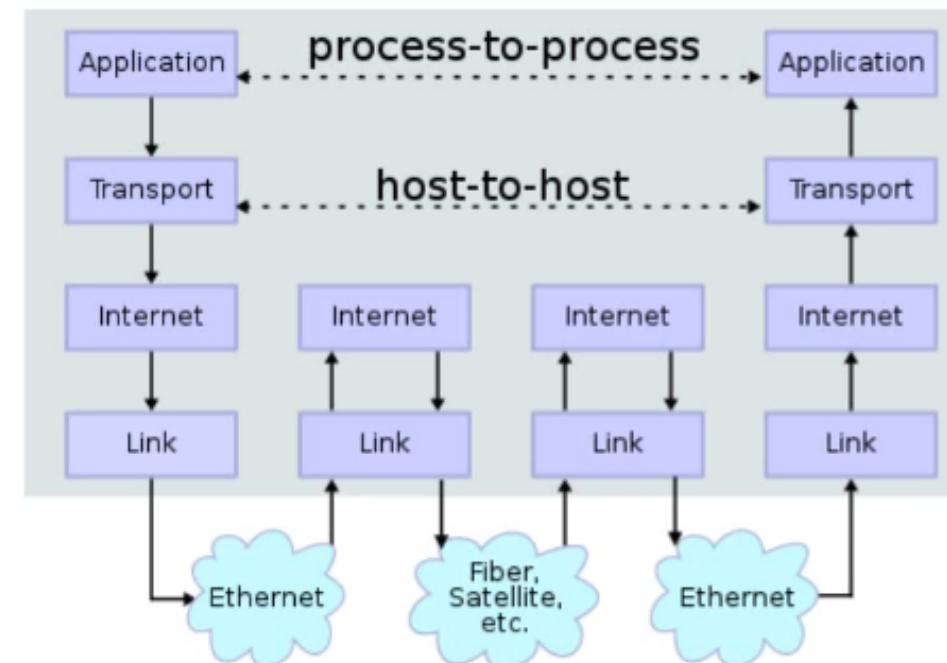
RFC 1122 ^[4] , Internet STD 3 (1989)	Cisco Academy ^[31]	Kurose, ^[32] Forouzan ^[33]	Comer, ^[34] Kozierok ^[35]	Stallings ^[36]	Tanenbaum ^[37]	Arpanet Reference Model (RFC 871 ^[5])	OSI model
Four layers	Four layers	Five layers	Four+one layers	Five layers	Five layers	Three layers	Seven layers
"Internet model"	"Internet model"	"Five-layer Internet model" or "TCP/IP protocol suite"	"TCP/IP 5- layer reference model"	"TCP/IP model"	"TCP/IP 5-layer reference model"	"Arpanet reference model"	OSI model
Application	Application	Application	Application	Application	Application	Application/Process	Application
							Presentation
							Session
Transport	Transport	Transport	Transport	Host-to-host or transport	Transport	Host-to-host	Transport
Internet	Internetwork	Network	Internet	Internet	Internet		Network
Link	Network interface	Data link	Data link (Network interface)	Network access	Data link	Network interface	Data link
		Physical	(Hardware)	Physical	Physical		Physical

TCP/IP SUITE

Network Topology



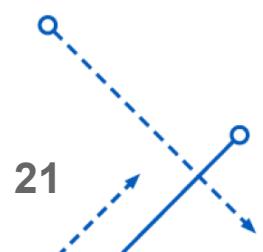
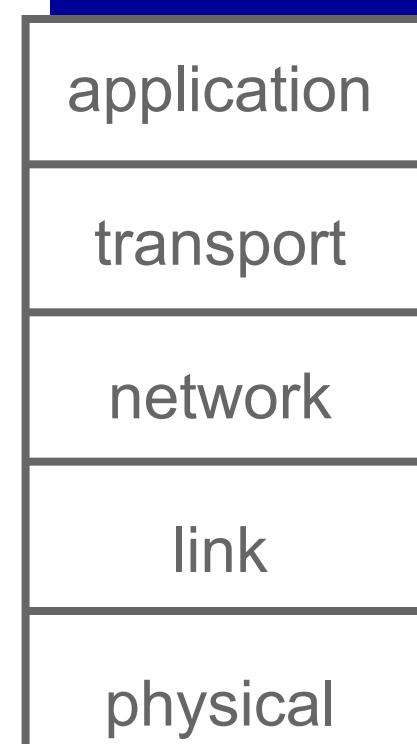
Data Flow



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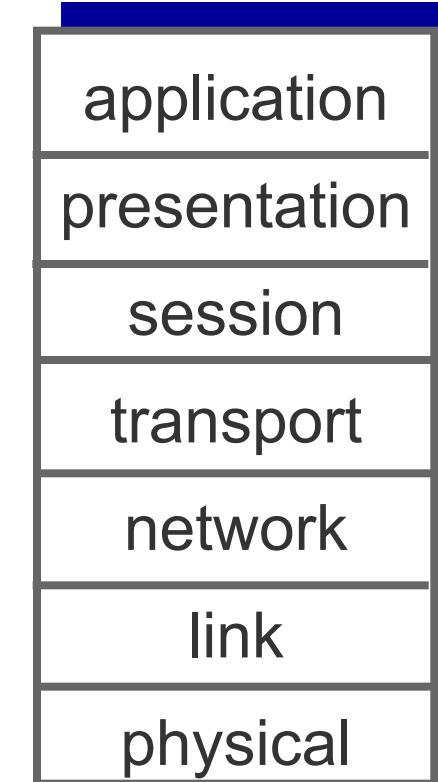
INTERNET PROTOCOL STACK

- **Application:** supporting network applications
 - FTP, SMTP, HTTP, DNS
 - The app. in one end system using the protocol to exchange **message** (packets of information) with the app. in another end system
- **Transport:** process-process data transfer, flow control
 - TCP, UDP
 - Reliable **end-to-end** delivery service
 - Transport application-layer messages
 - Transport-layer packet = **segment**
- **Network:** routing of **IP packet** from source to destination
 - Provides the service of delivering the segment **through a series of routers** to the transport layer in the destination host
 - IP, routing protocols
- **Link-layer:** data transfer between neighboring network elements
 - To move a **frame** from **one node to the next node** in the route
 - Reliable delivery between 2 adjacent nodes
 - Ethernet, 802.11 (Wi-Fi), PPP
- **Physical:** bits “on the wire” → Move individual bits within the frame from one node to the next



OSI REFERENCE MODEL

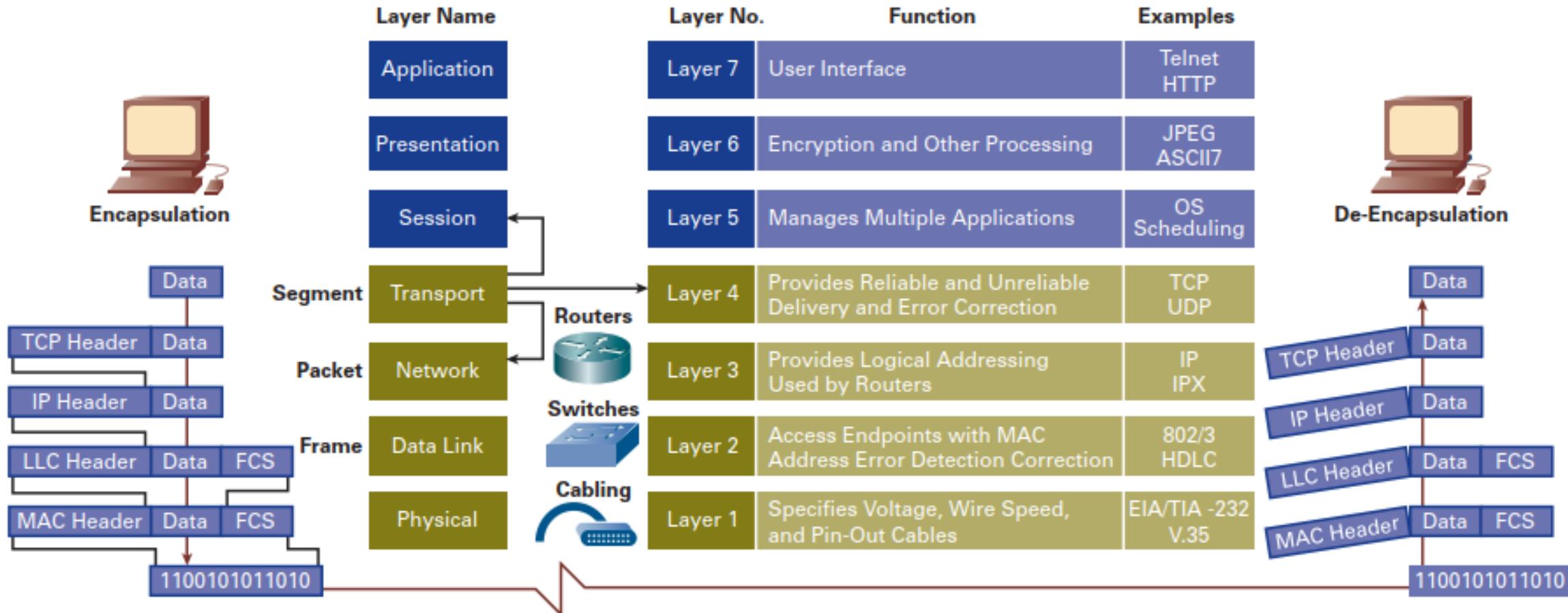
- ***presentation***: allow applications to interpret meaning of data, e.g., encryption, compression, machine-specific conventions
- ***session***: synchronization, checkpointing, recovery of data exchange
- Internet stack “**missing**” these layers!
 - these services, *if needed*, must be implemented in application
 - needed?



OSI REFERENCE MODEL

OSI model				
Layer		Protocol data unit (PDU)	Function ^[19]	
Host layers	7	Application	Data	High-level APIs, including resource sharing, remote file access
	6	Presentation		Translation of data between a networking service and an application; including character encoding, data compression and encryption/decryption
	5	Session		Managing communication sessions, i.e., continuous exchange of information in the form of multiple back-and-forth transmissions between two nodes
	4	Transport	Segment, Datagram	Reliable transmission of data segments between points on a network, including segmentation, acknowledgement and multiplexing
Media layers	3	Network	Packet	Structuring and managing a multi-node network, including addressing, routing and traffic control
	2	Data link	Frame	Reliable transmission of data frames between two nodes connected by a physical layer
	1	Physical	Bit, Symbol	Transmission and reception of raw bit streams over a physical medium

OSI REFERENCE MODEL



WIRESHARK

