

National University of Computer & Emerging Sciences

Fall 2024
Lecture 03
BS(CS)

Protocols and Service Models

Protocol “layers”

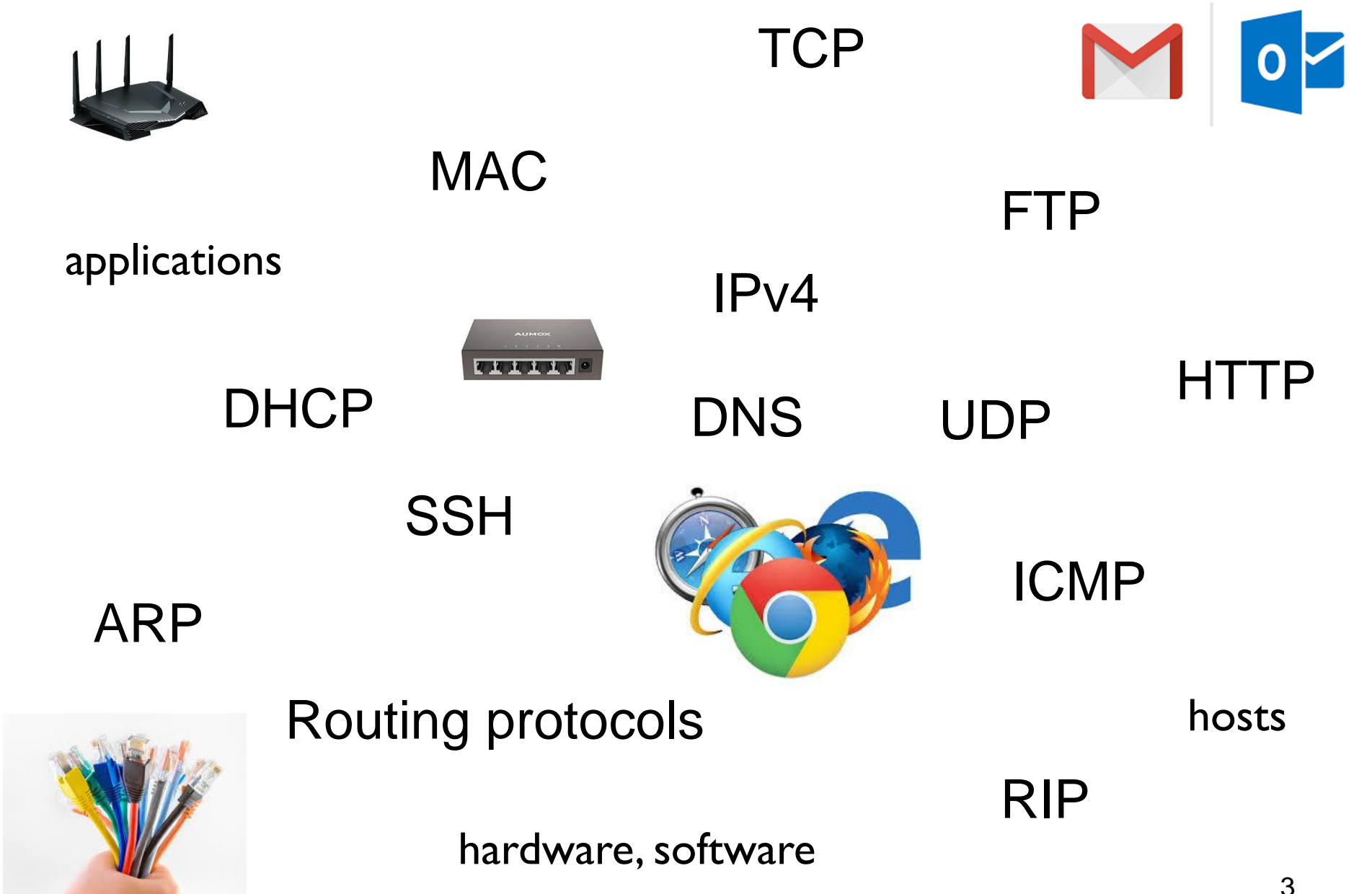
*Networks are complex,
with many “pieces”:*

- hosts
- routers
- links of various media
- applications
- protocols
- hardware, software

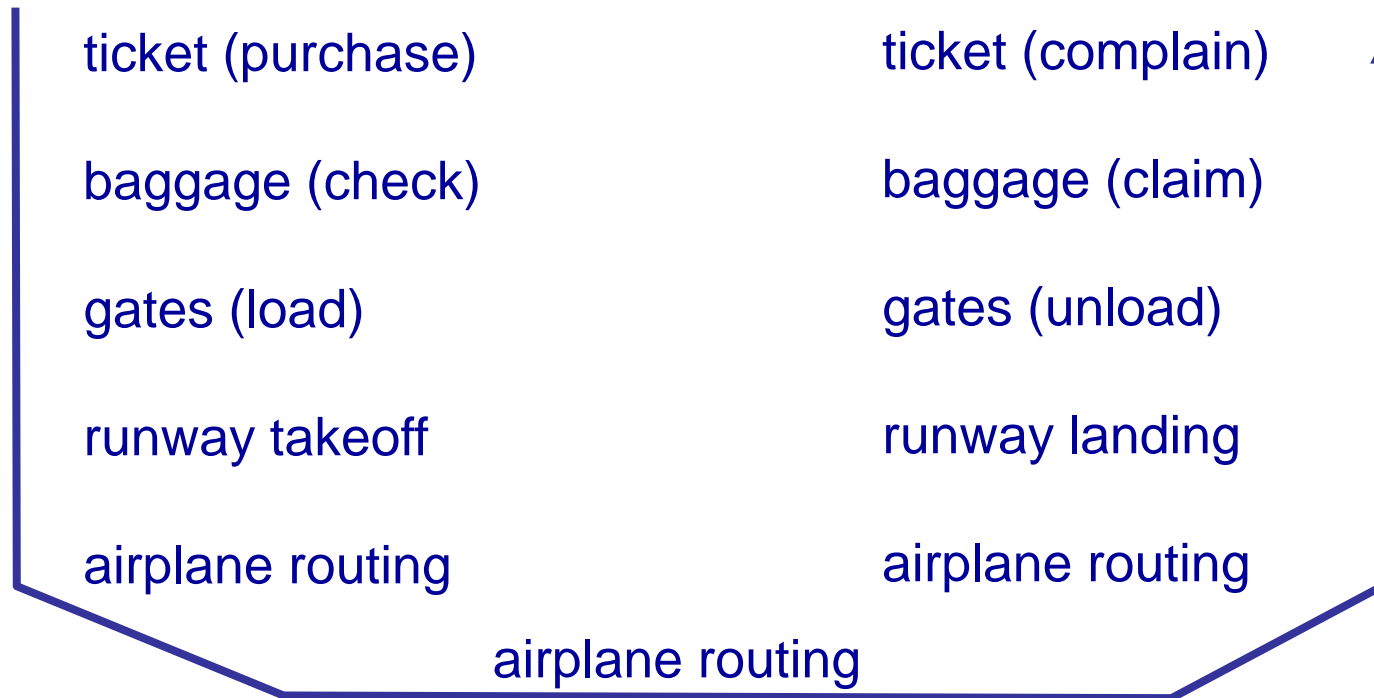
Question:

is there any way of
organizing structure of
network?

.... or at least our
discussion of networks?

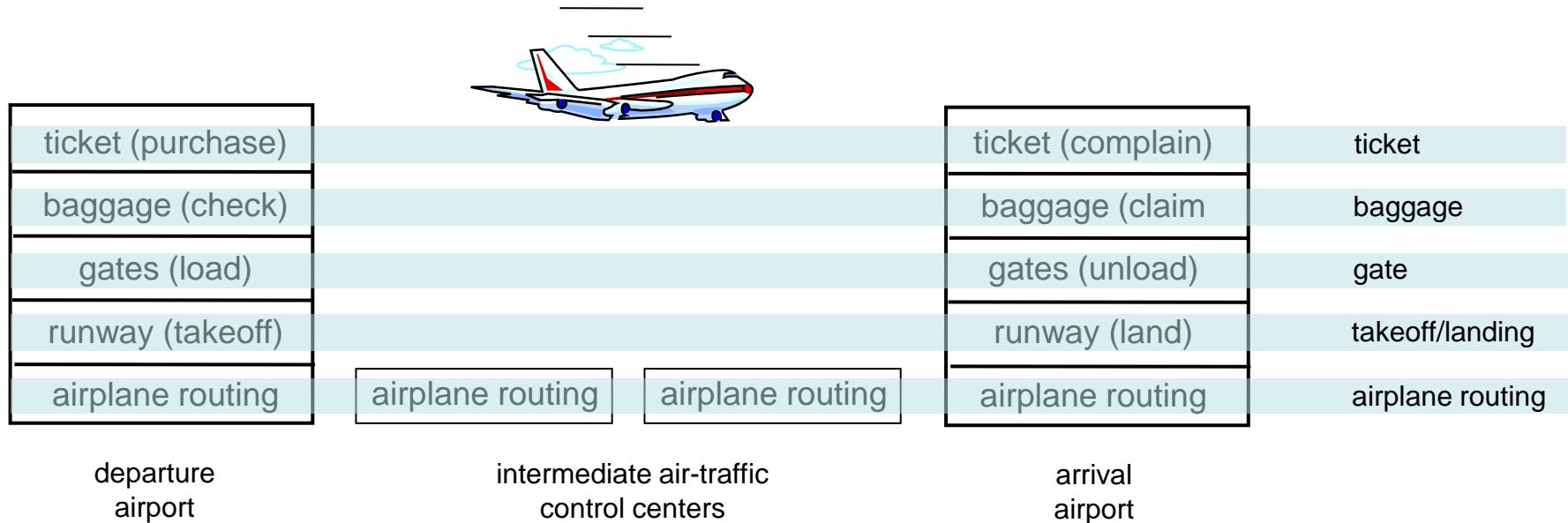


Organization of air travel



- a series of steps

Layering of airline functionality



layers: each layer implements a service

- via its own internal-layer actions
- relying on services provided by layer below

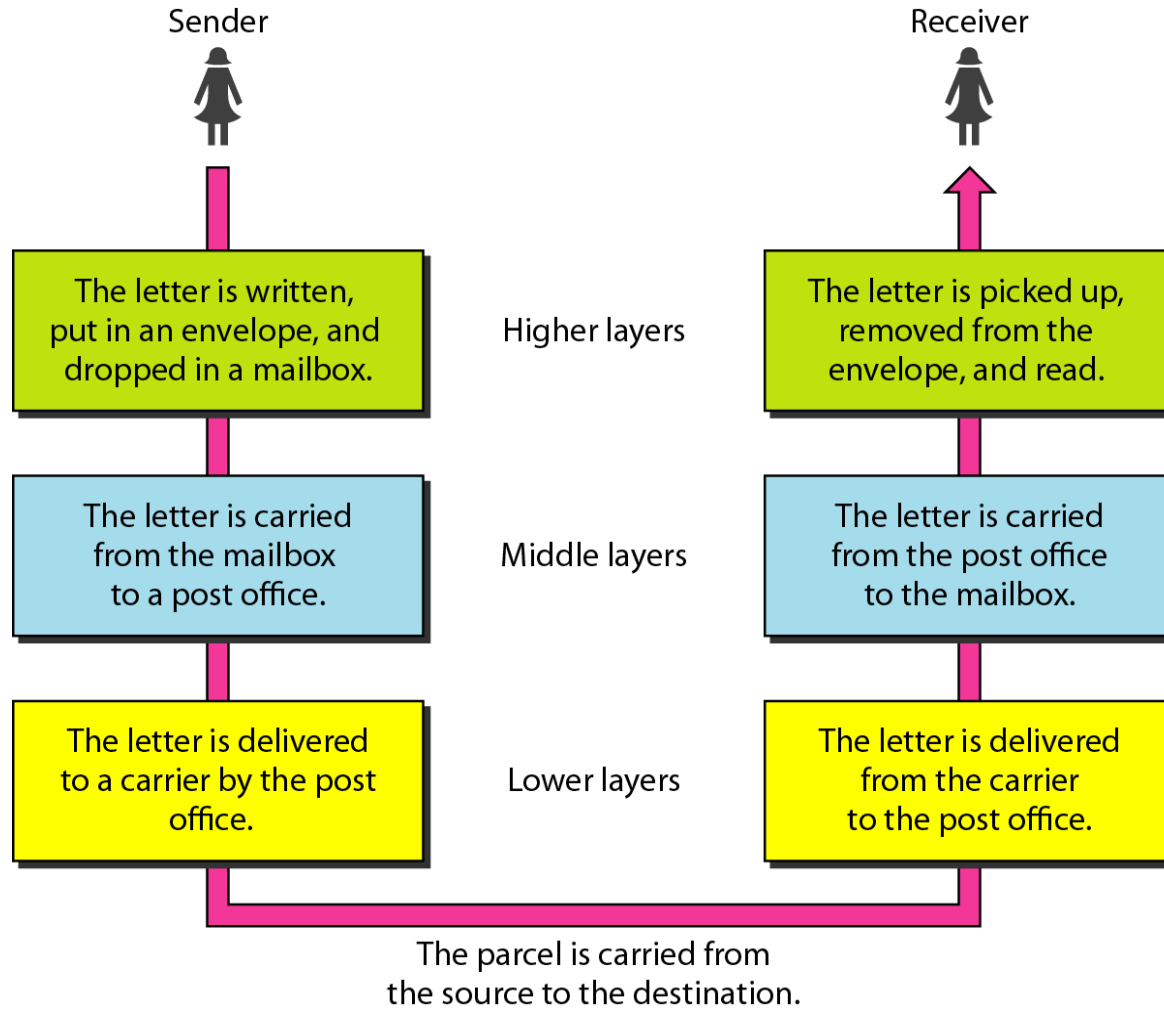
Why layering?

dealing with complex systems:

- modularization eases maintenance, updating of system
 - change of implementation of layer's service transparent to rest of system
 - e.g., change in gate procedure doesn't affect rest of system
- Led to flexibility in modifying and developing network architectures.
- Accommodates incremental changes.

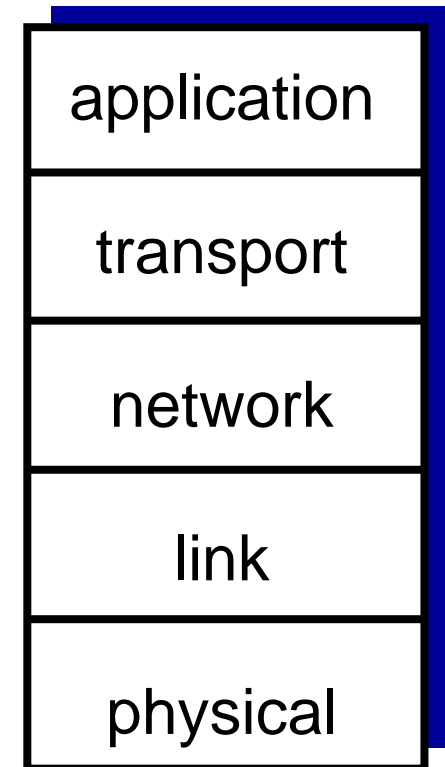
*We use the concept of **layers** in our daily life. As an example, let us consider two friends who communicate through postal mail. The process of sending a letter to a friend would be complex if there were no services available from the post office.*

Tasks involved in sending a letter



Internet protocol stack

- *application*: supporting network applications
 - FTP, SMTP, HTTP
- *transport*: process-process data transfer
 - TCP, UDP
- *network*: routing of datagrams from source to destination
 - IP, routing protocols
- *link*: data transfer between neighboring network elements
 - Ethernet, 802.111 (WiFi), PPP
- *physical*: bits “on the wire”



Note

the **application layer** provides services for an [application program](#) to ensure that effective communication with another application program in a network is possible

application: enable users/applications to access network resources

HTTP protocol (which provides for Web document request and transfer)

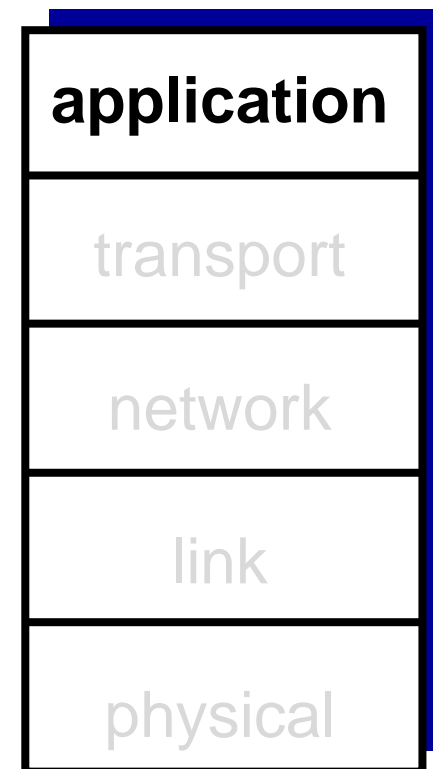
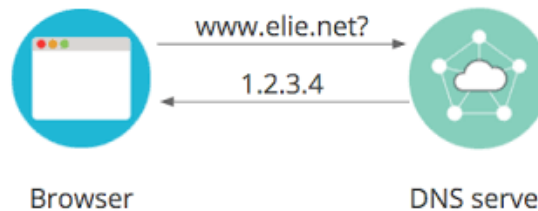


FTP protocol (transfer of files between two end systems)

SMTP (transfer of e-mail messages)

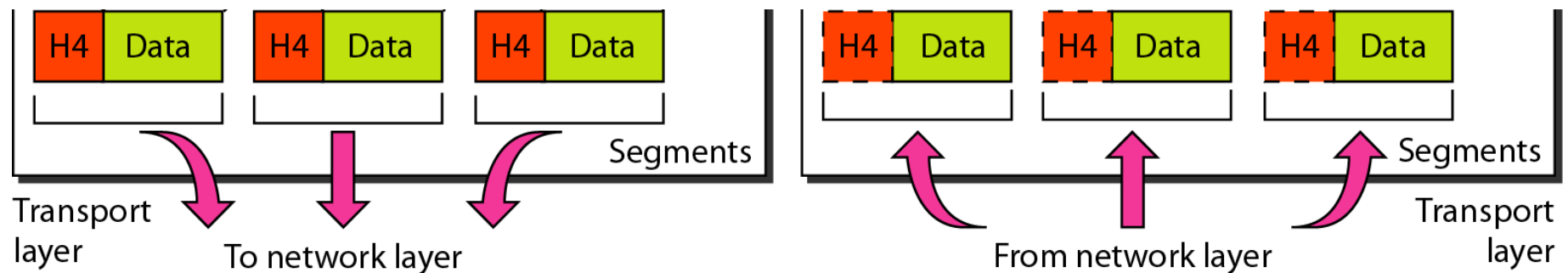


DNS (Domain name system)



Transport layer

- This layer divide the data into **segments**.
- Transport Layer is where the decision to use TCP/UDP is made. Among commonly used protocols in this layer, TCP is reliable, UDP isn't.
- Depending upon the choice made, the respective headers are attached to your packet.



Transport layer (TCP/UDP)

Application	Application-Layer Protocol	Underlying Transport Protocol
Electronic mail	SMTP	TCP
Remote terminal access	Telnet	TCP
Web	HTTP	TCP
File transfer	FTP	TCP
Remote file server	NFS	Typically UDP
Streaming multimedia	typically proprietary	UDP or TCP
Internet telephony	typically proprietary	UDP or TCP
Network Management	SNMP	Typically UDP
Routing Protocol	RIP	Typically UDP
Name translation	DNS	Typically UDP

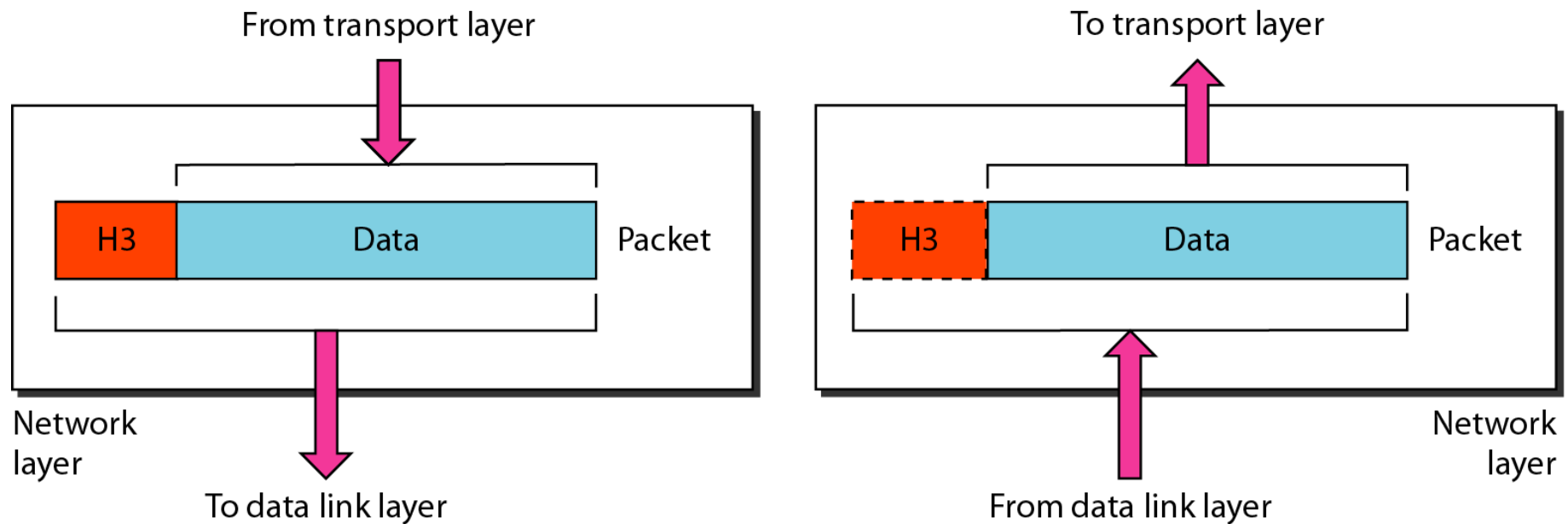
Figure 1. Popular Internet applications and their underlying transport protocols

Note

- Now, after TCP/UDP header being appended, it moves on to the Network Layer. Till this step, the remote end-point's IP address wasn't a part of the packet at all.

Network layer

- The Internet transport-layer protocol (TCP or UDP) in a source host passes a transport-layer segment and a destination address to the network layer.



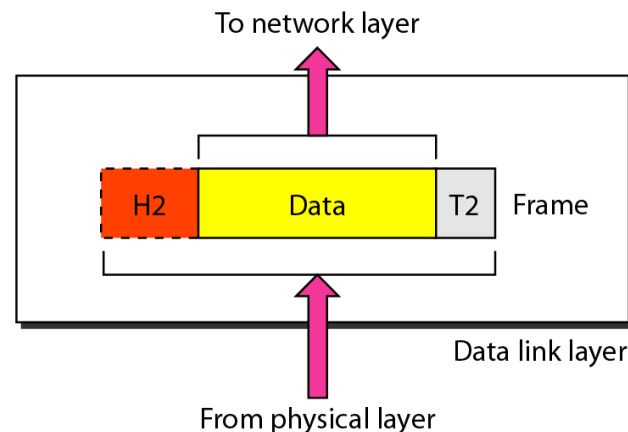
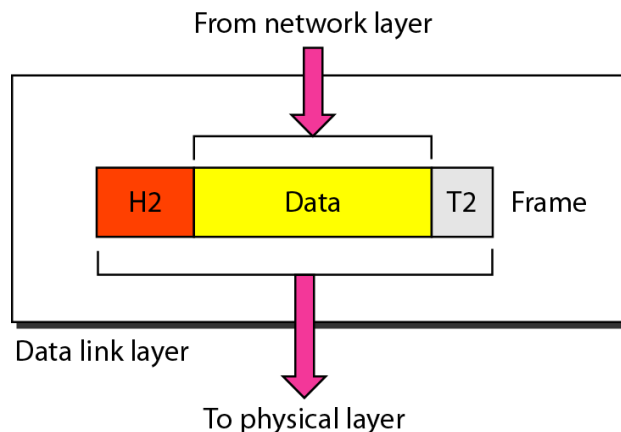
Network layer

- The first physical equipment at the Network Layer would be Routers
- It receives SEGMENTS from the upper layer and convert it into PACKETS.
- **Logical addressing:** The network layer adds a header to the packet coming from the upper layer, includes the logical addresses (IP) of the sender and receiver.
- Makes “**Best Path Determination**” decision based on logical addressing.

Link layer services

framing, link access:

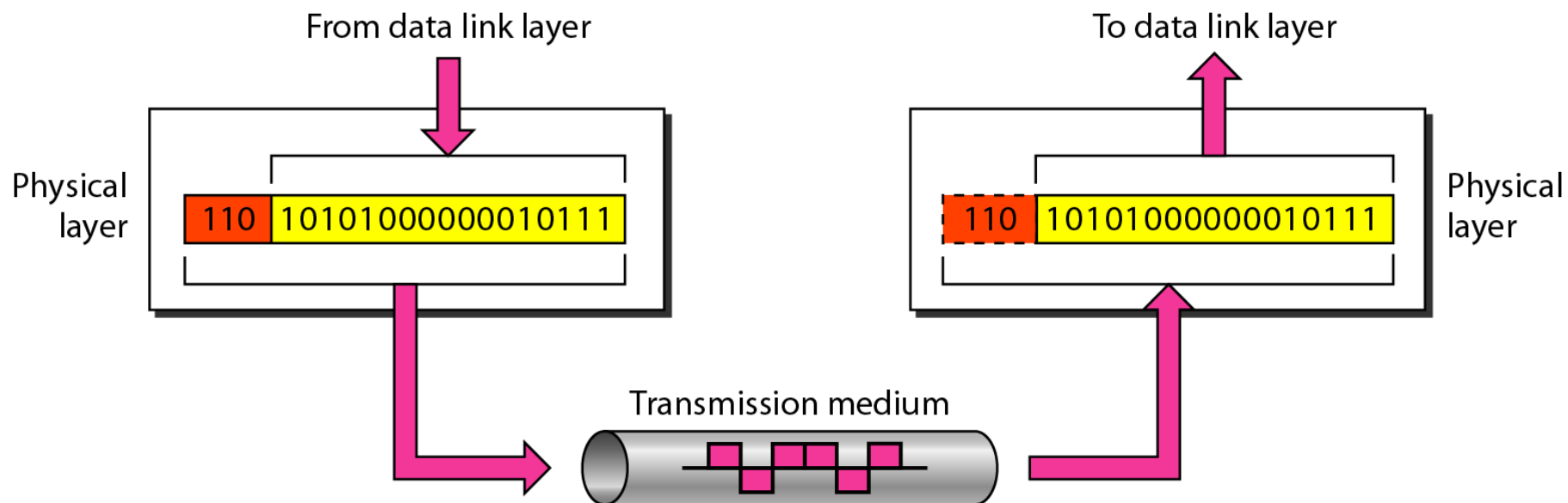
- ❖ specify the **encapsulation** of a packet into a frame and the techniques for getting the encapsulated packet on and off each medium.
- ❖ **channel access if shared medium**
 - “MAC” addresses used in frame headers to identify source, dest (different from IP address!)
- ❖ **Error checking**



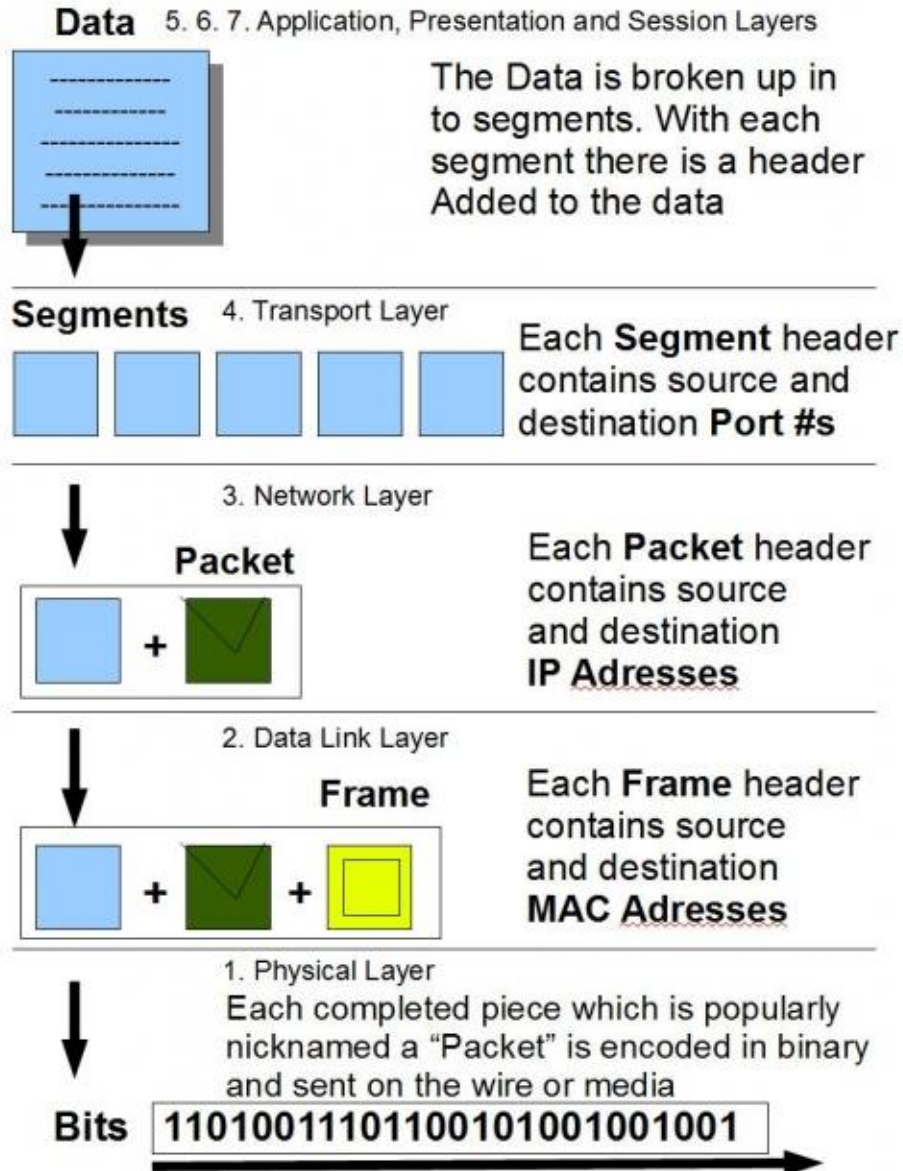
Physical layer

- Defines the physical and electrical medium for data transfer.
- Physical layer components: cables, jacks, punch blocks, hubs.

Physical layer



Lecture 03: Protocols and Service Models



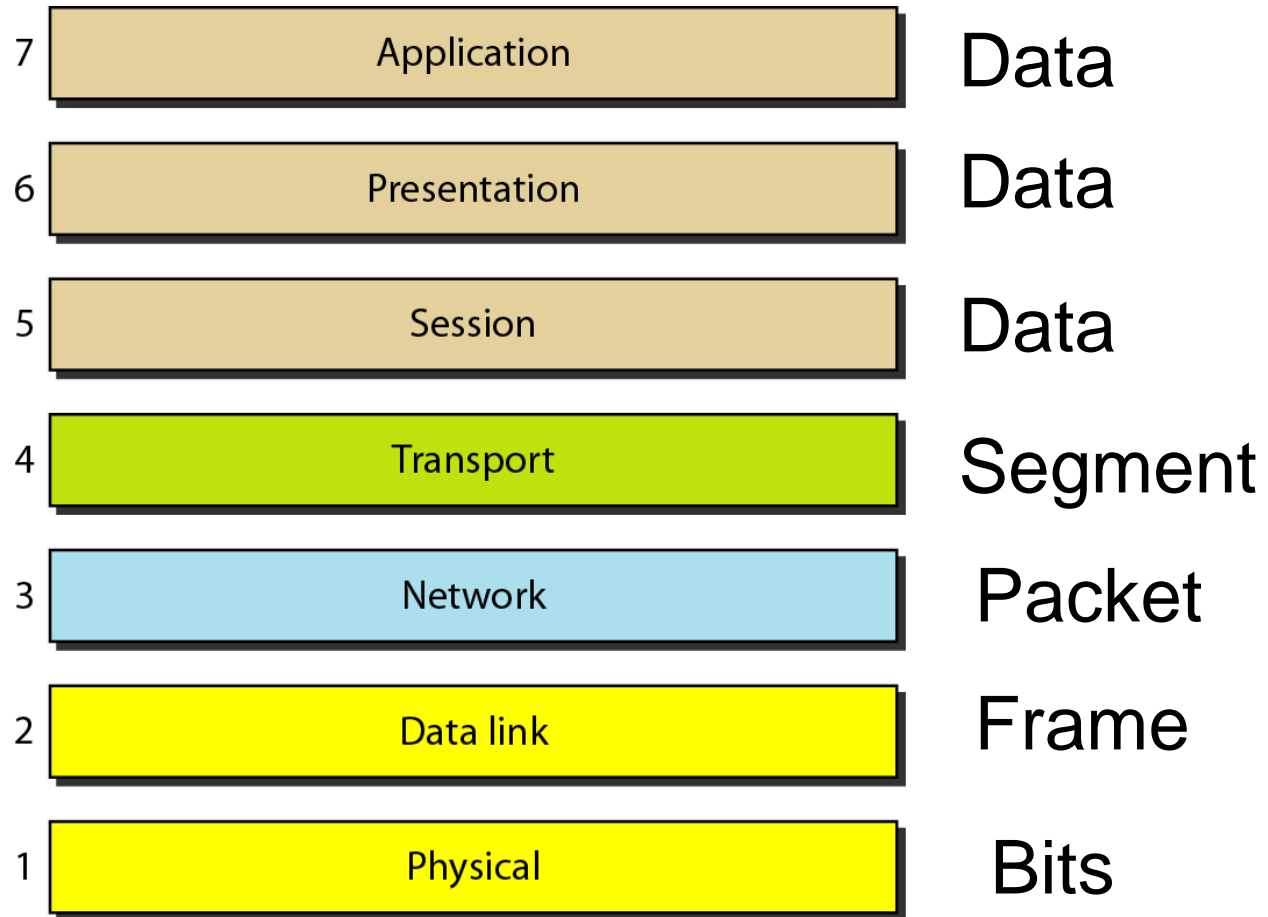
The OSI Model

Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model. It was first introduced in the late 1970s.

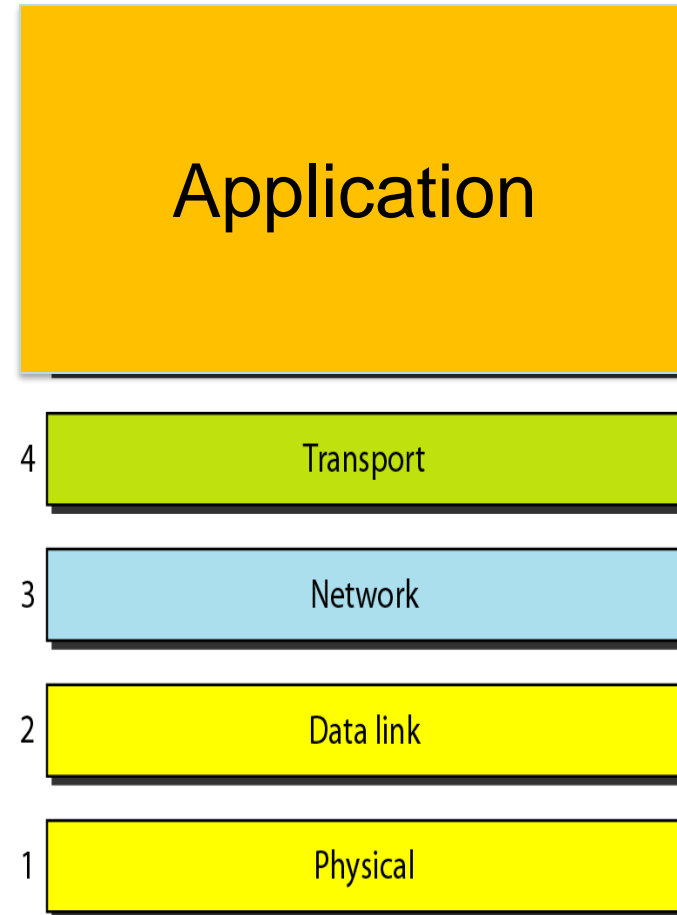
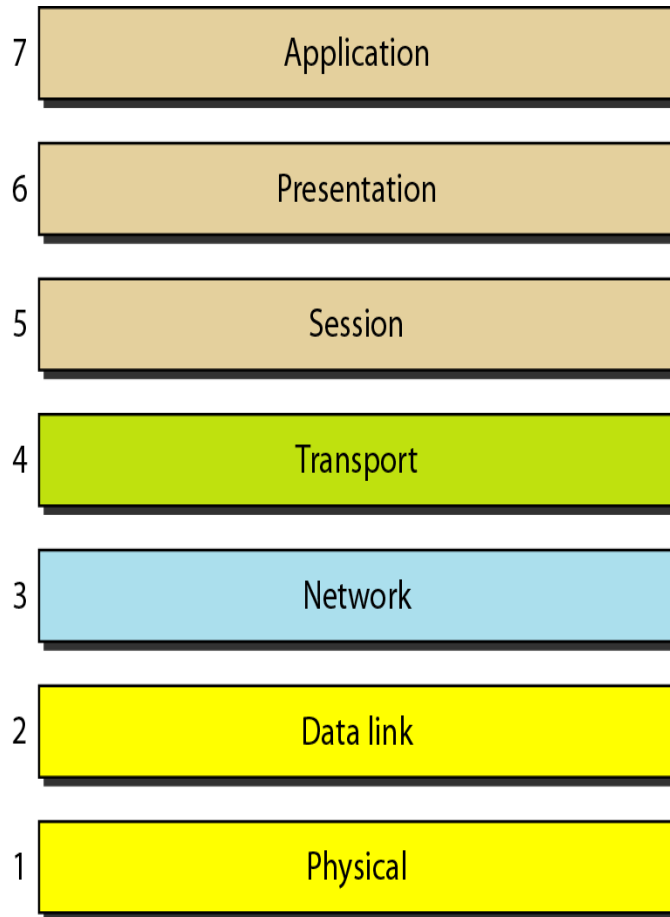
Note

ISO is the organization.
OSI is the model.

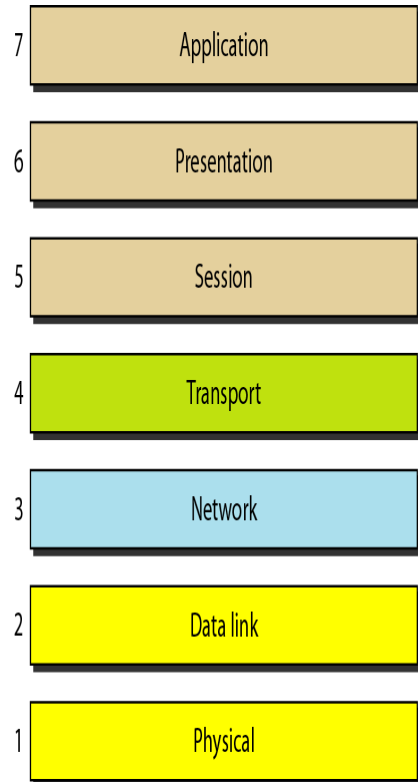
Seven layers of the OSI model



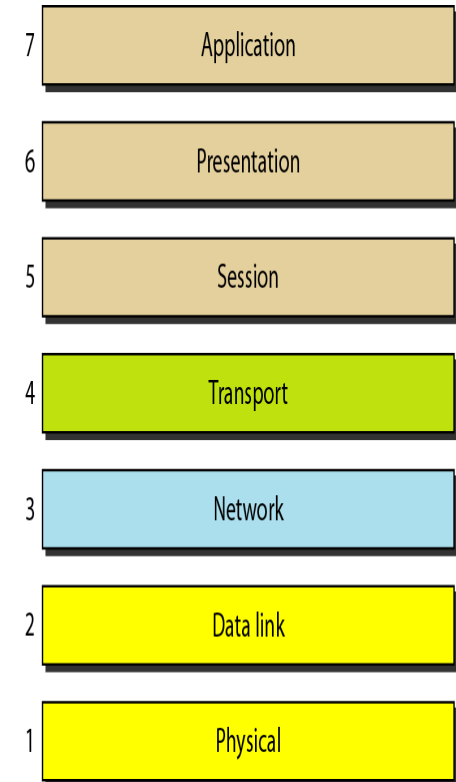
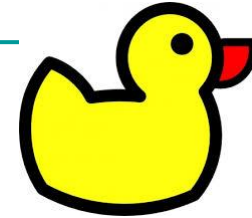
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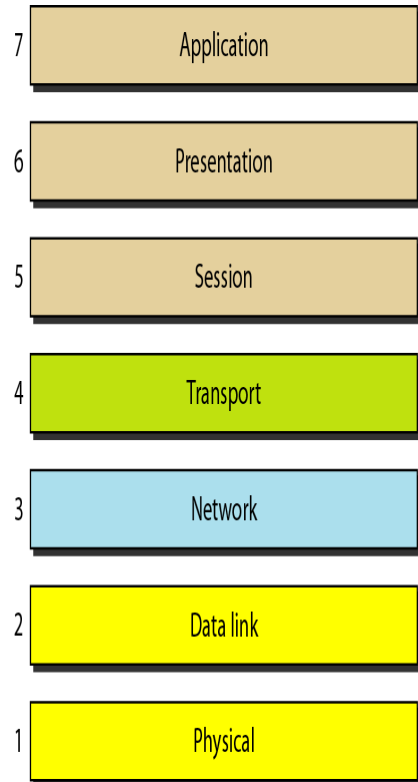
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Data

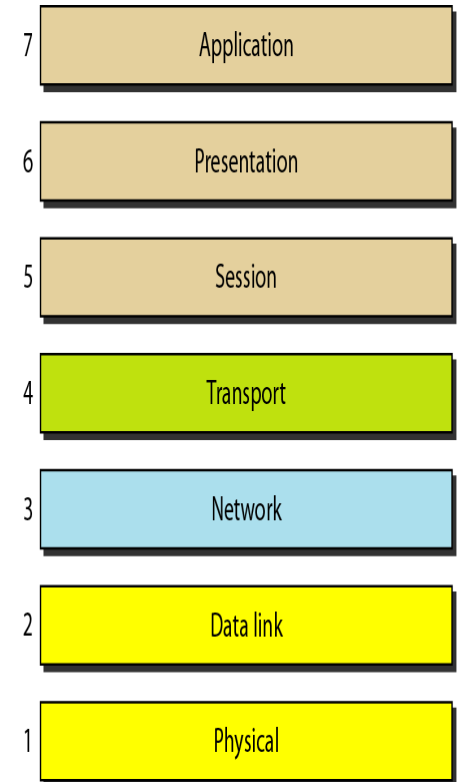
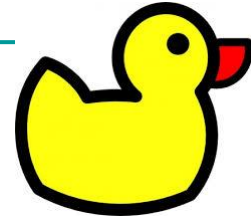


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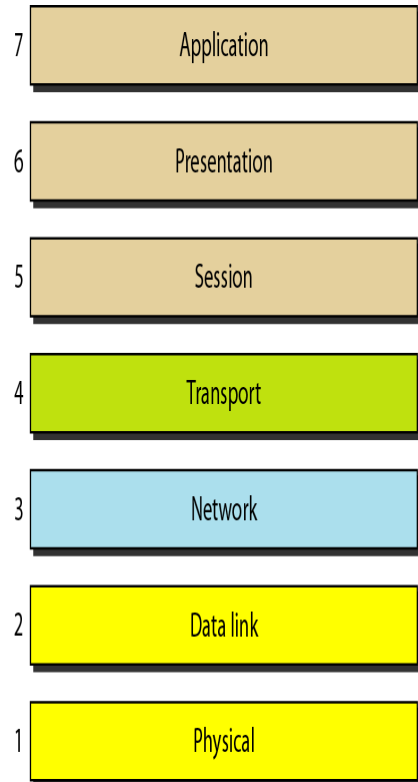
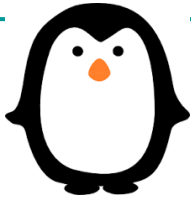


TH | Seg1

TH | Seg2

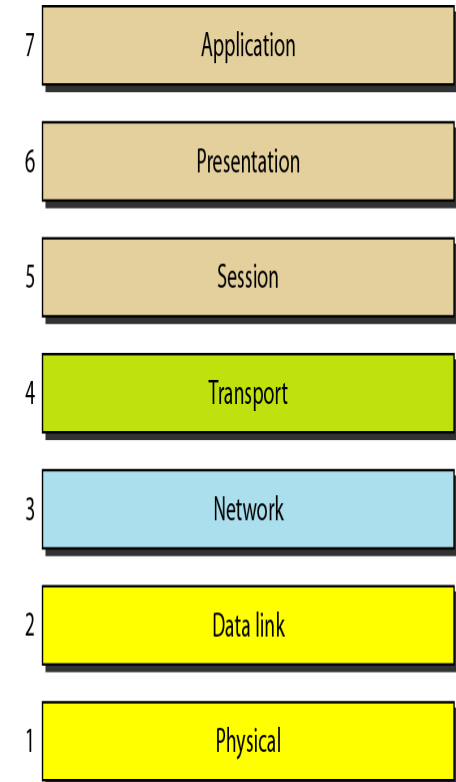
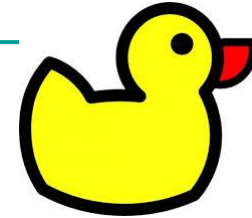


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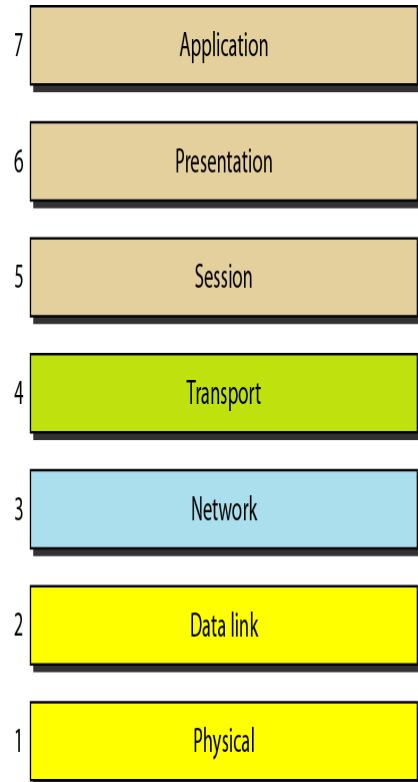
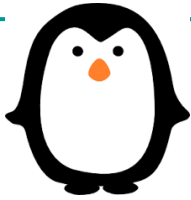


TH | Seg2

NH|TH | Seg1

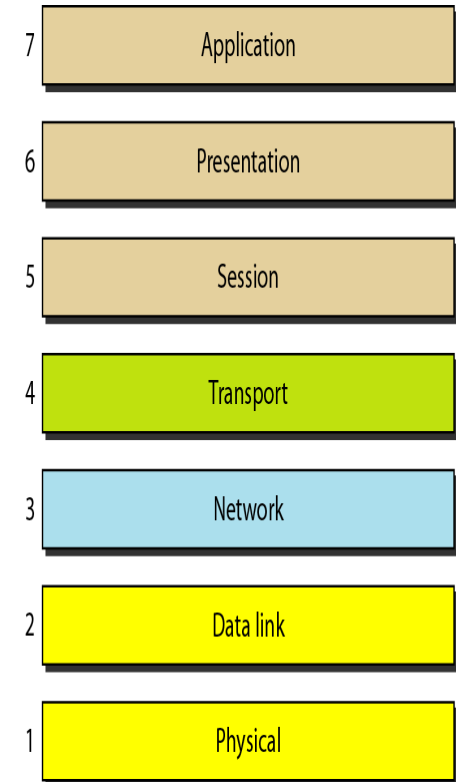
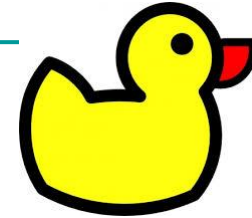


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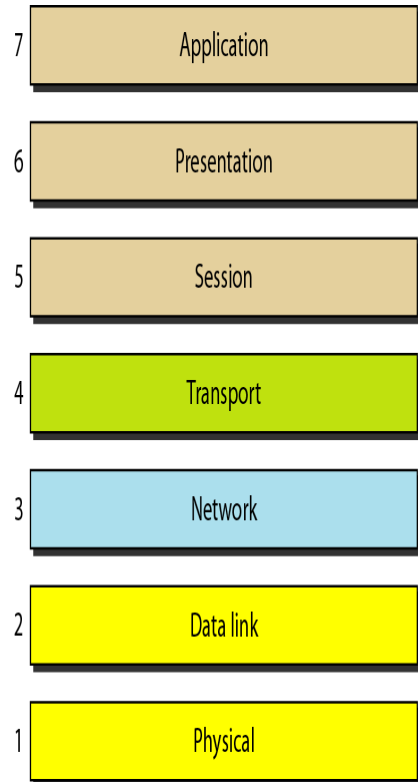
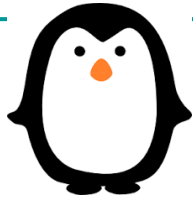


NH|TH | Seg2

DH|NH|TH | Seg1

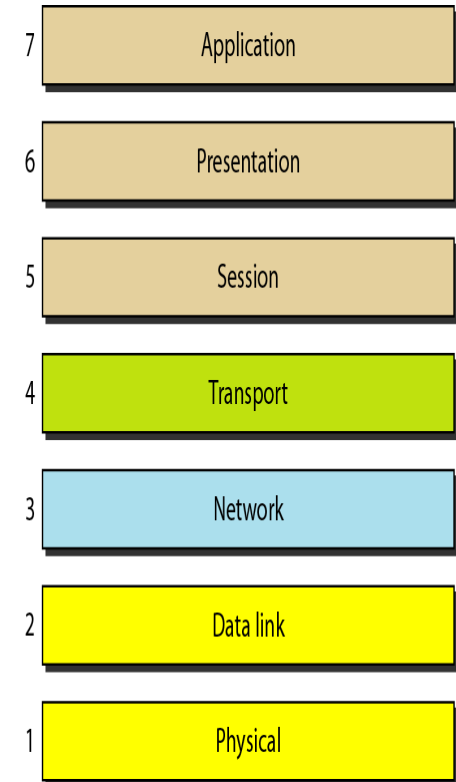
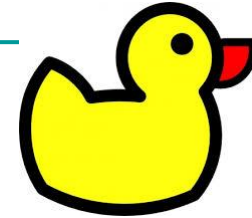


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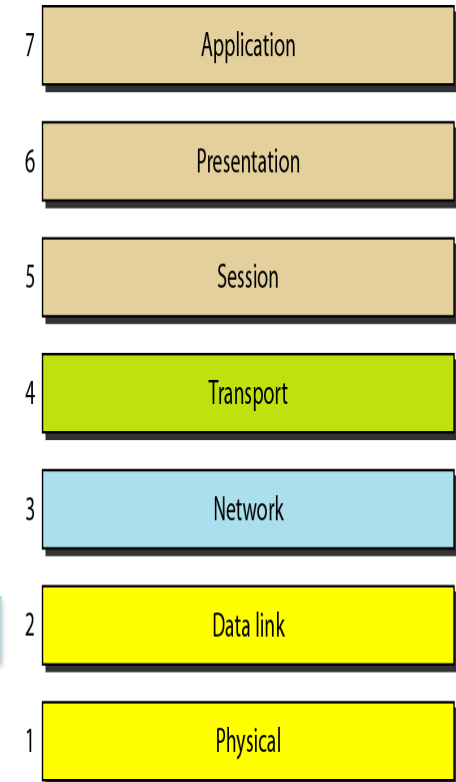
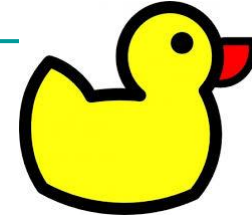
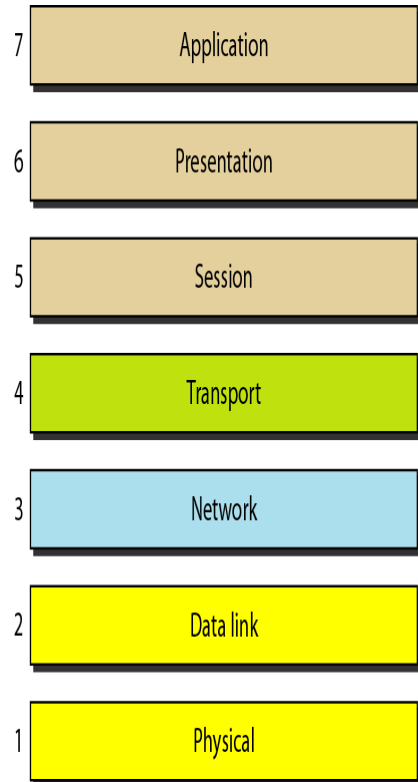


DH|NH|TH | Seg2

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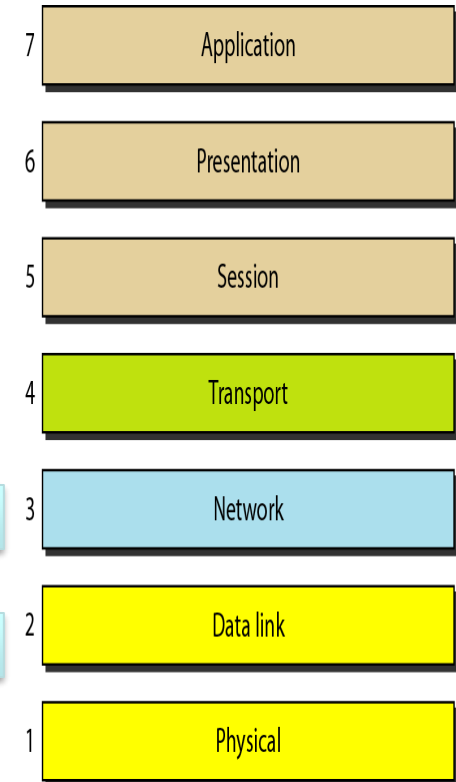
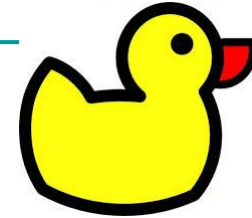
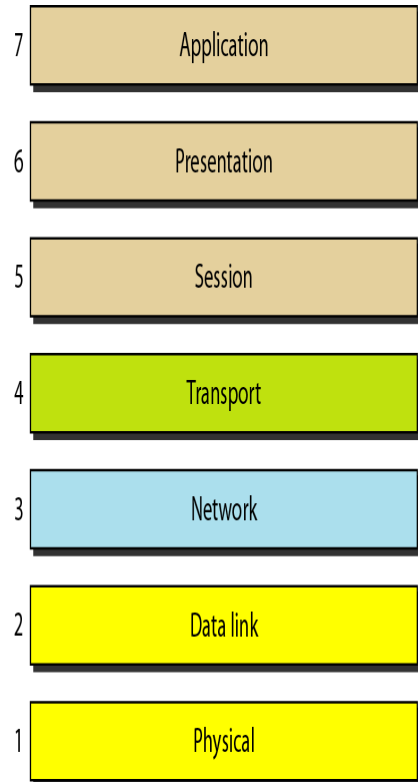
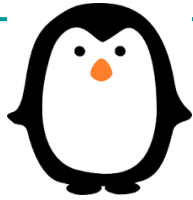
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DH|NH|TH | Seg1

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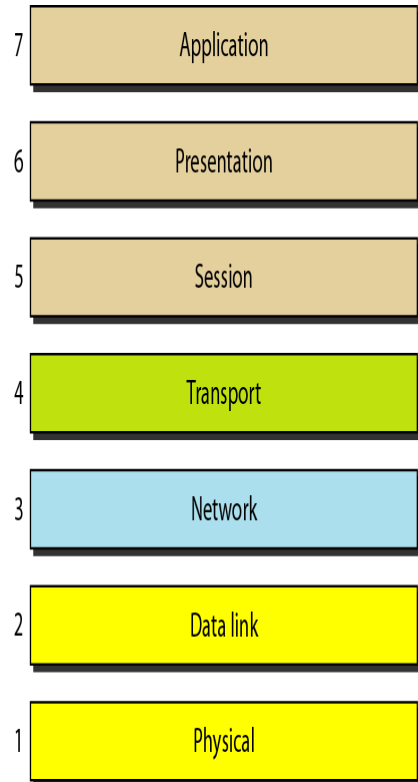
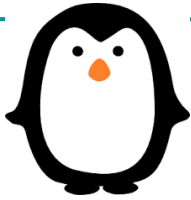
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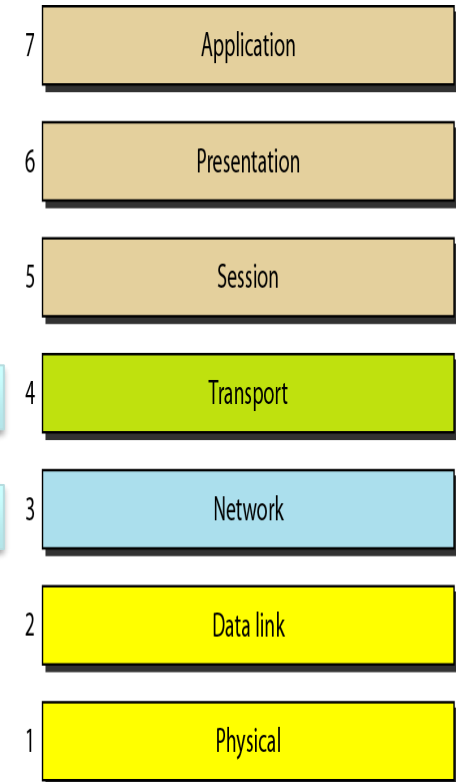
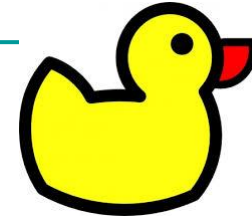
DH|NH|TH | Seg2

Seven layers of the OSI model

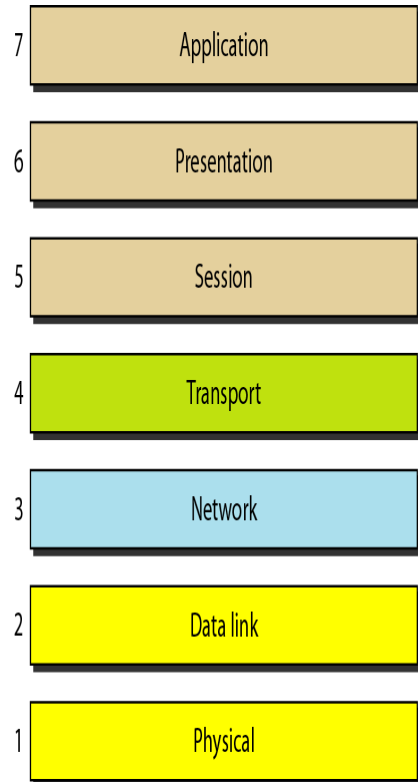
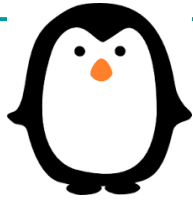


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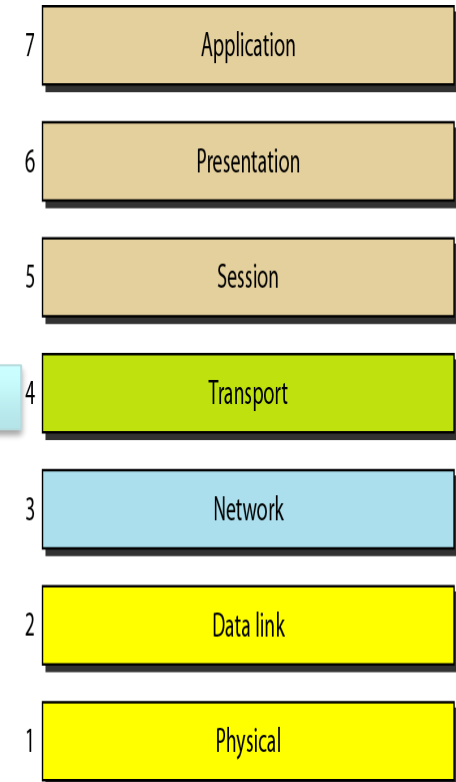
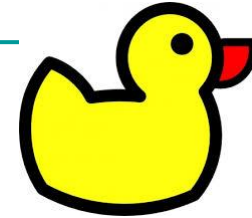
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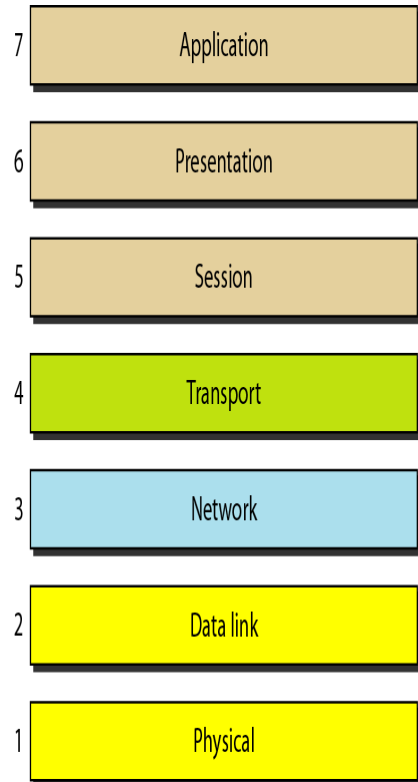
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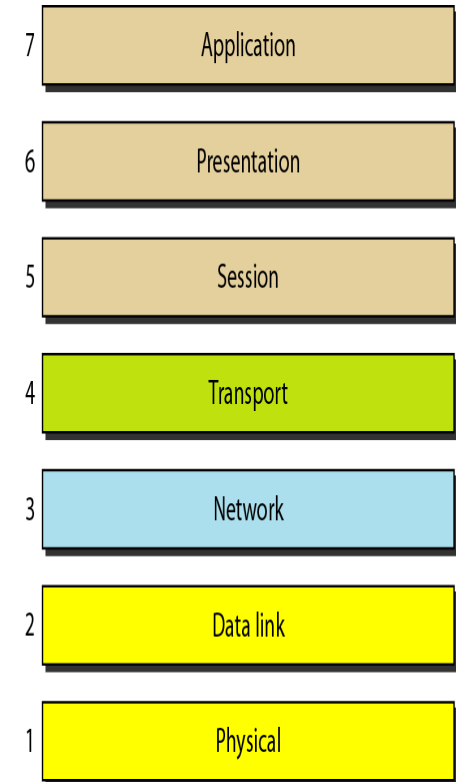
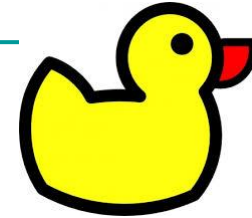
TH | Seg2 TH | Seg1



Seven layers of the OSI model



Data



Computer Networking: A Top Down Approach

8th edition

Jim Kurose, Keith Ross

Addison-Wesley

A note on the origin of these ppt slides:

These slides are freely provided by the book authors and it represents a *lot* of work on their part.
We would like to thank J.F Kurose and K.W. Ross.

Some slides adapted from the ones accompanying the book “The TCP/IP Protocol Suite”

