COMPUTER NETWORKS

Computer Networks and the Internet

Team Networks
Department of Computer Science and Engineering

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Protocol Layers

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Unit – 1 Computer Networks and the Internet

1.1 Introduction to Computer Networks

1.2 What is the Internet?

- A nuts-and-bolts and Services description, Protocol

1.3 Network edge

- End systems, Access networks, Physical media

1.4 Network core

- Packet switching, Circuit switching, Network structure

1.5 Delay, Loss & Throughput in networks

1.6 Protocol layers, Service models

- OSI model and TCP/IP protocol suite

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"Protocol Layers" and reference models

Networks are complex, with many "pieces":

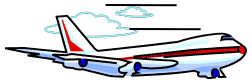
- hosts
- routers
- links of various media
- applications
- protocols
- hardware, software

Question:

is there any hope of *organizing* structure of network?

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

Example: Organization of Air Travel

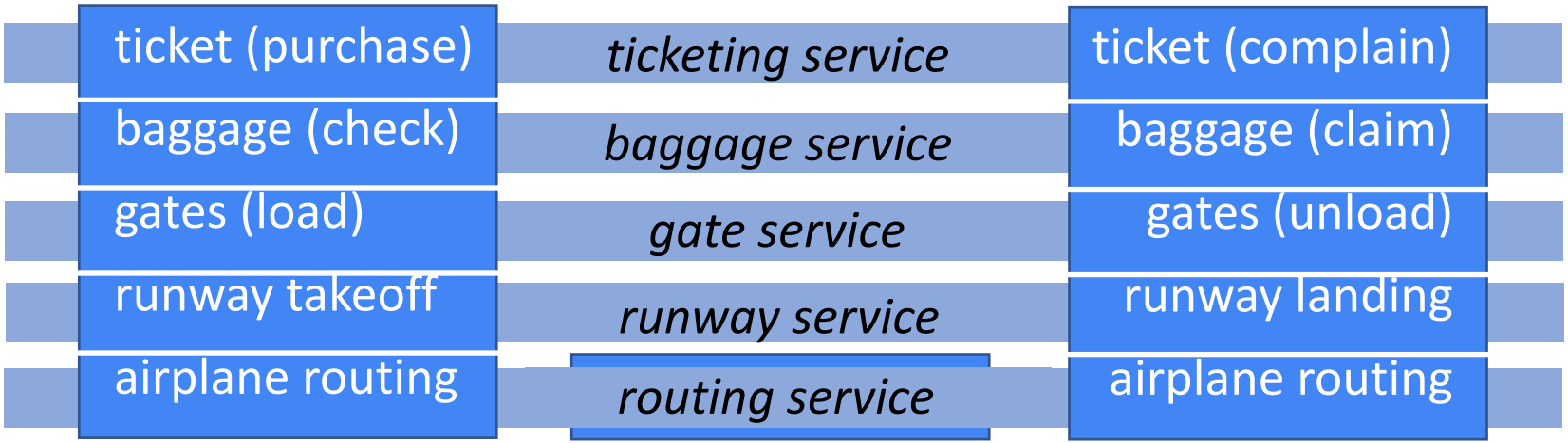


ticket (purchase)	ticket (complain)
baggage (check)	baggage (claim)
gates (load)	gates (unload)
runway takeoff	runway landing
airplane routing	airplane routing

airplane routing

airline travel: a series of steps, involving many services

Layering of Airline functionality



layers: each layer implements a service
- via its own internal-layer actions
- relying on services provided by layer below

Q: describe in words the service provided in each layer above

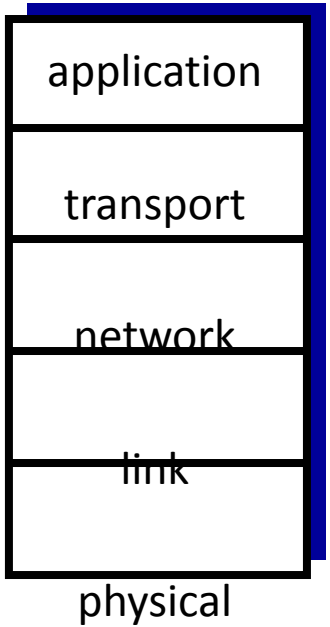
Why layering?

dealing with complex systems:

- explicit structure allows identification, relationship of complex system's pieces
  - layered *reference model* for discussion
- modularization eases maintenance, updating of system
  - change in layer's service *implementation*: transparent to rest of system
  - e.g., change in gate procedure doesn't affect rest of system
- layering considered harmful?
- layering in other complex systems?

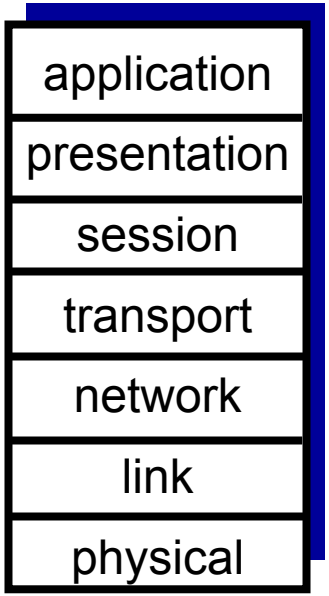
Internet Protocol Stack

- *application:* supporting network applications (access to network resources)
  - IMAP, SMTP, HTTP
- *transport:* process-process data transfer (segmentation & reassembly, sockets, connection, flow and error control)
  - TCP, UDP
- *network:* routing of datagrams from source to destination (addressing, routing)
  - IP, routing protocols
- *link:* data transfer between neighboring network elements (framing, addressing, flow & error control)
  - Ethernet, 802.11 (WiFi), PPP
- *physical:* bits “on the wire”



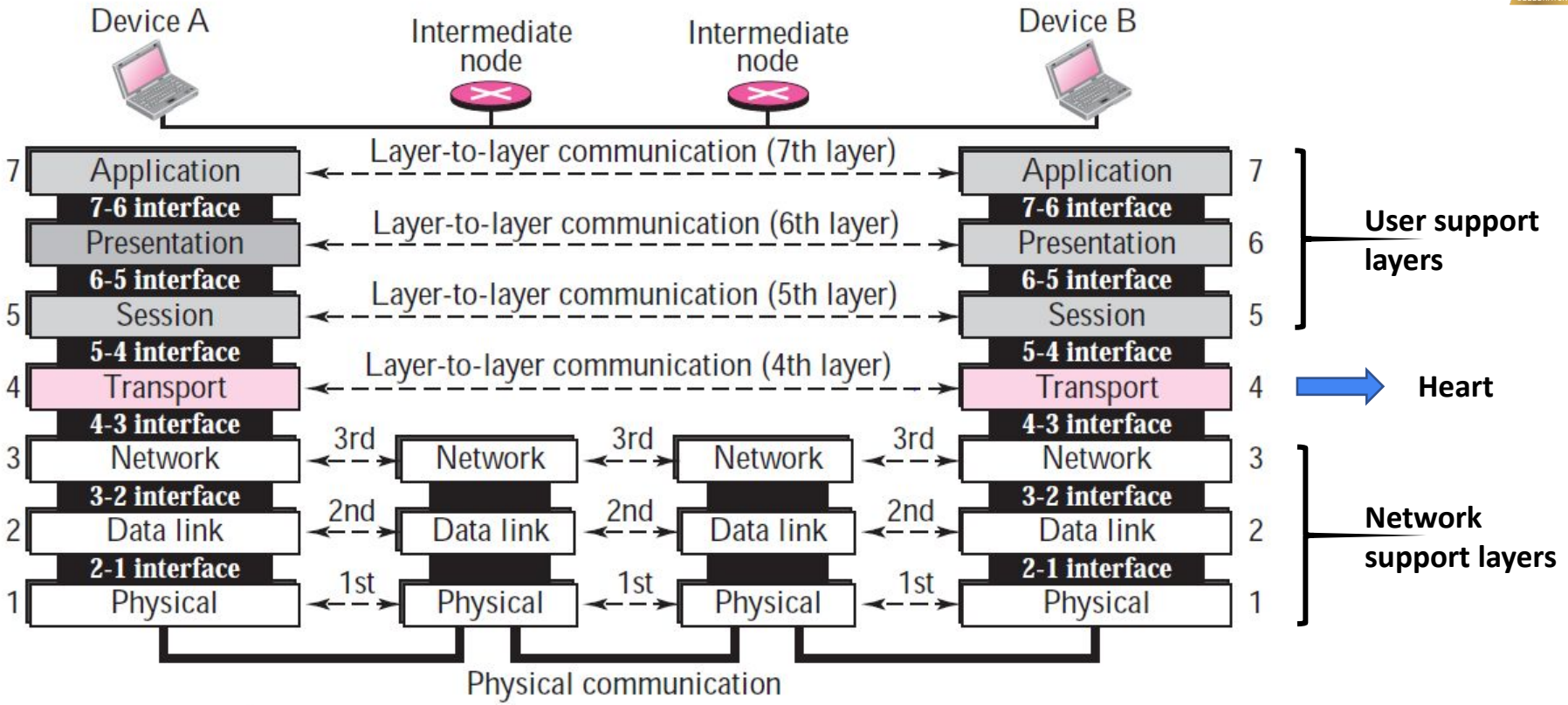
OSI reference model

- *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?



Open **S**ystems **I**nterconnection (OSI) model – introduced in late 1970s by ISO.

OSI reference model (more)



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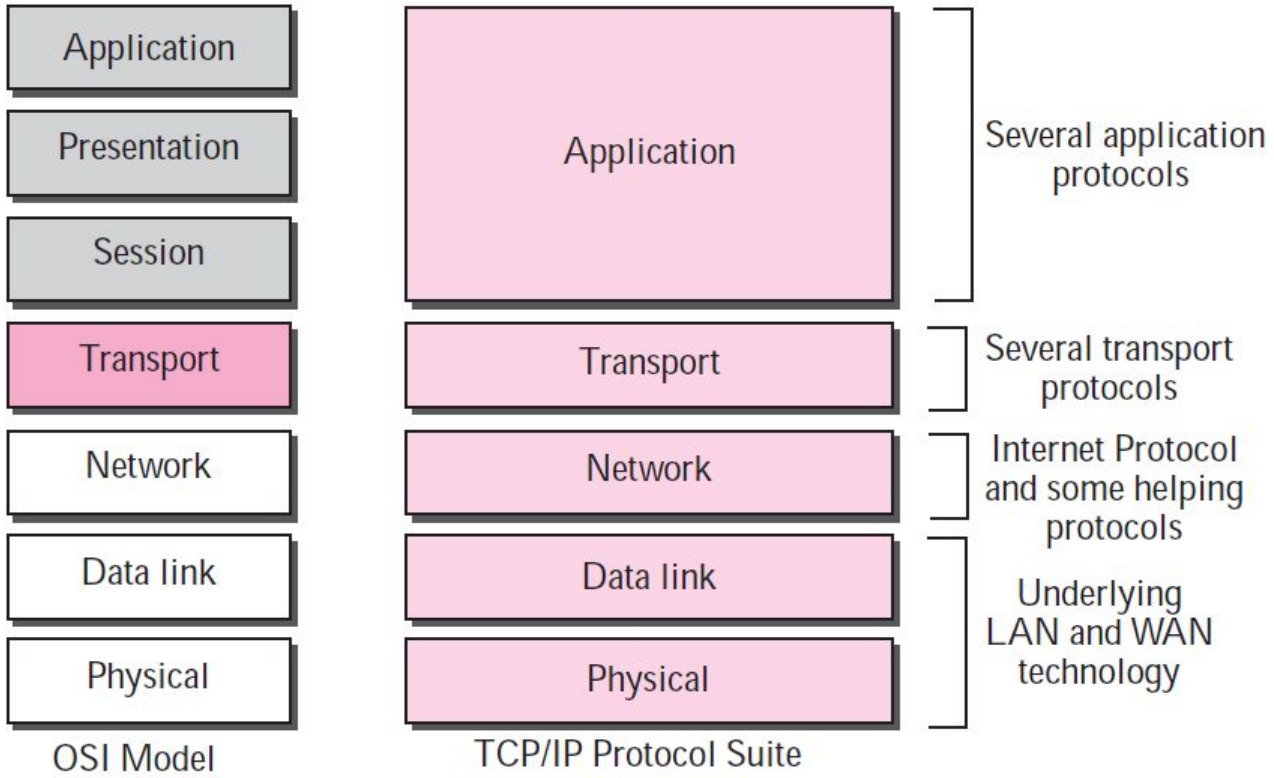
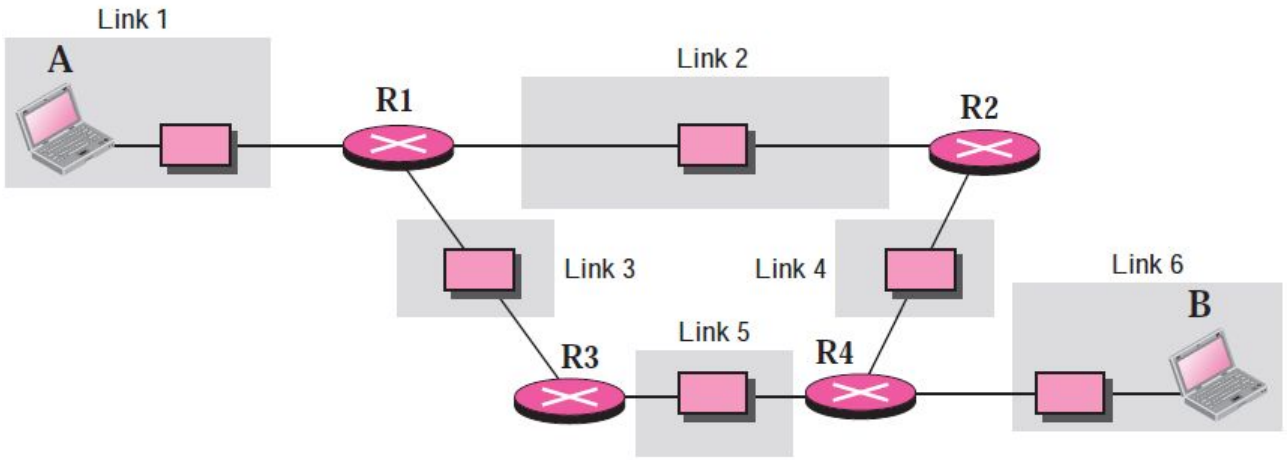
TCP/IP vs OSI reference model

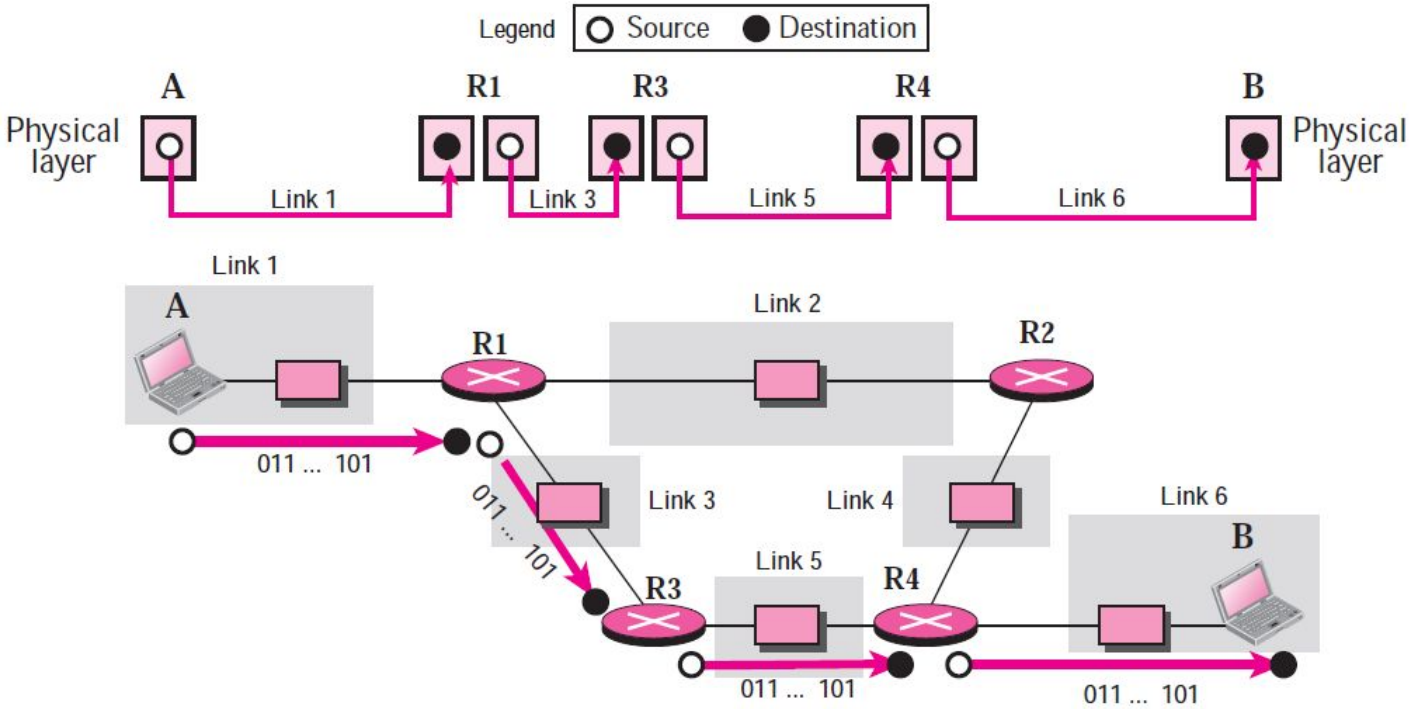


Layers in the TCP/IP Protocol Suite (more)



A private internet

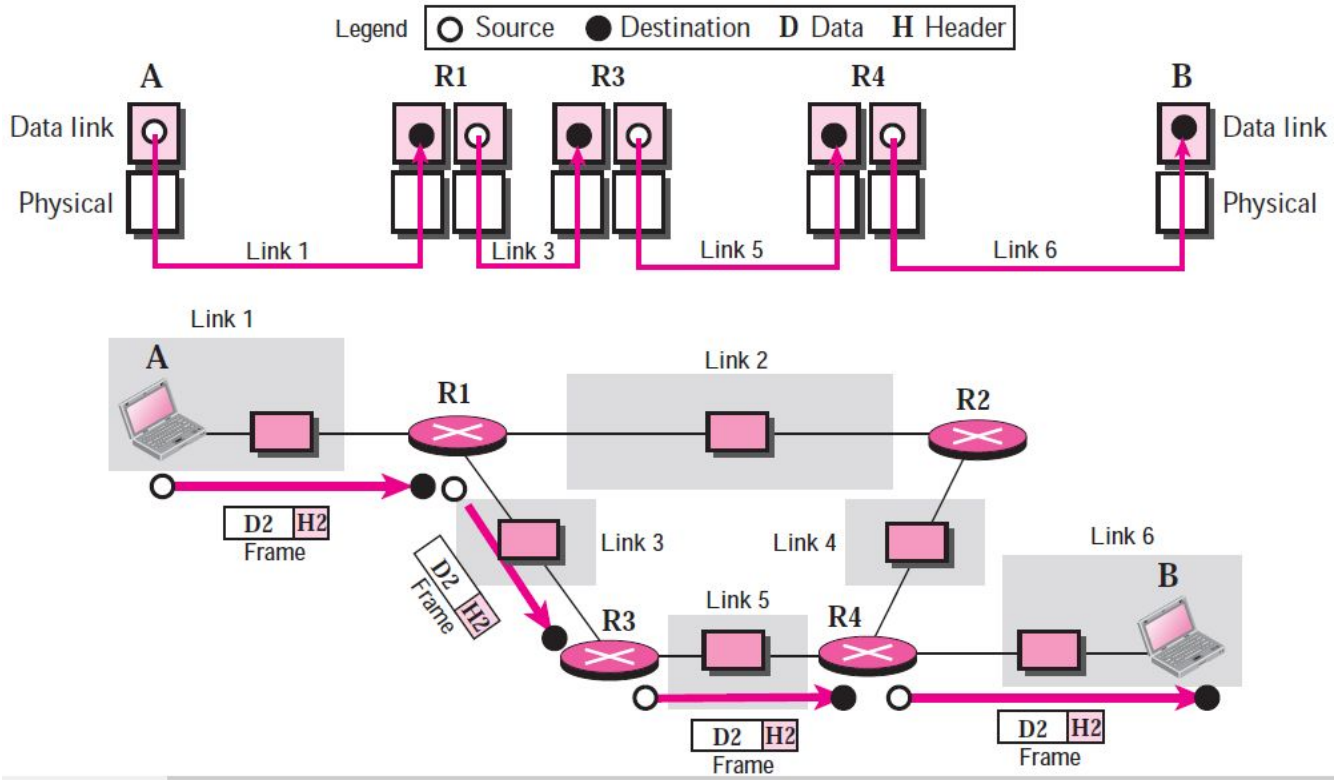
Layers in the TCP/IP Protocol Suite (more)



Communication at the physical layer

Unit of Communication – bit

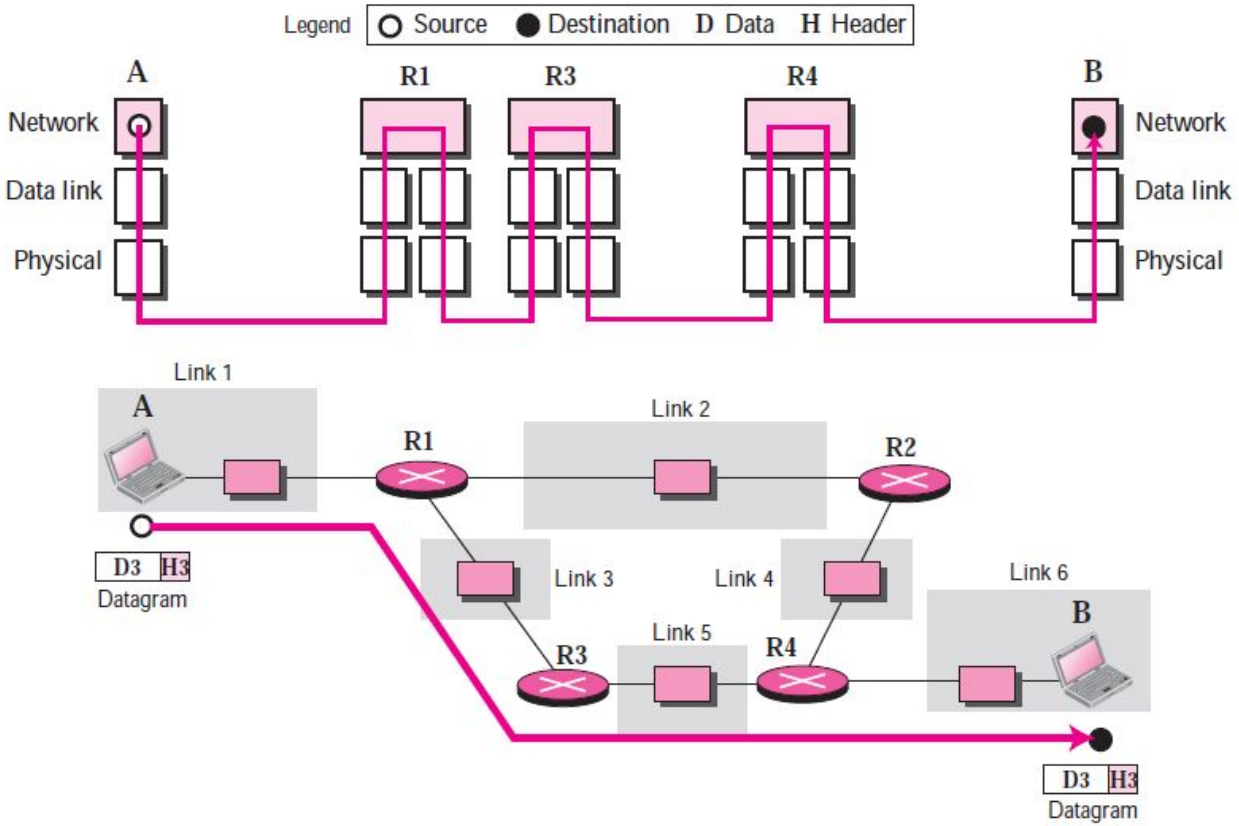
Layers in the TCP/IP Protocol Suite (more)



Communication at the data link layer

Unit of Communication – frame

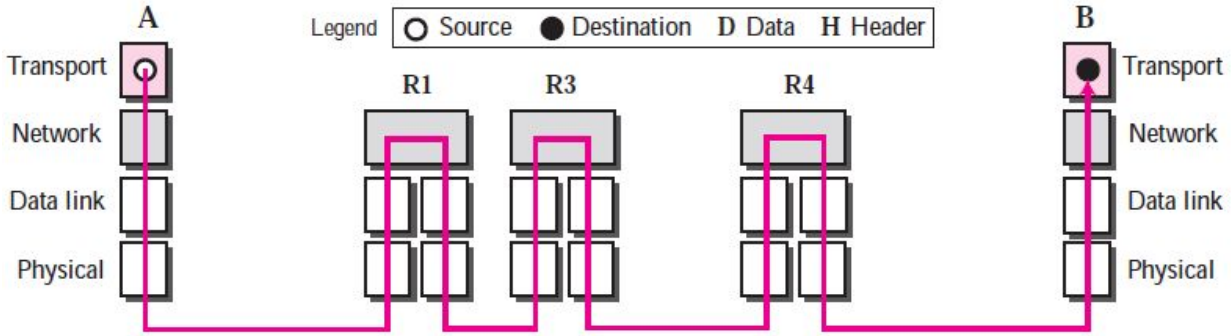
Layers in the TCP/IP Protocol Suite (more)

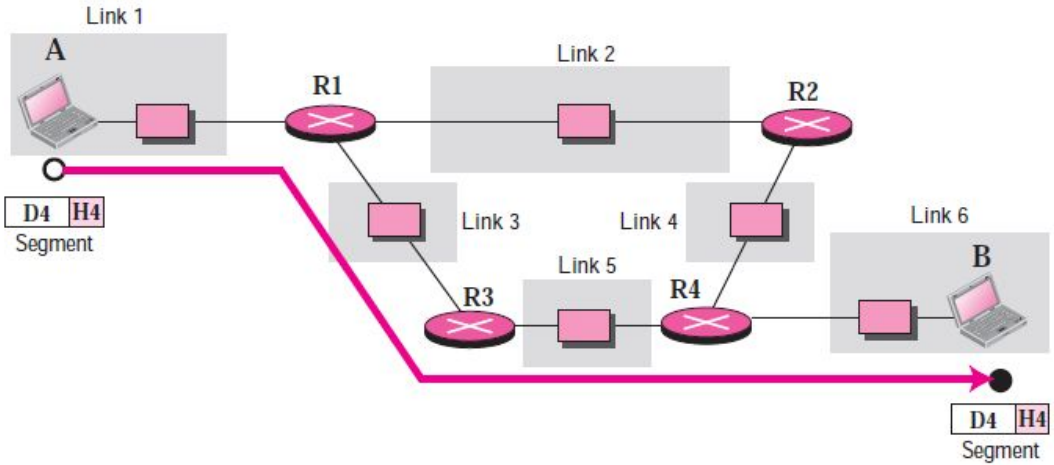


Communication at the network layer

Unit of Communication – datagram

Layers in the TCP/IP Protocol Suite (more)





Communication at the transport layer

Unit of Communication – segment/packet

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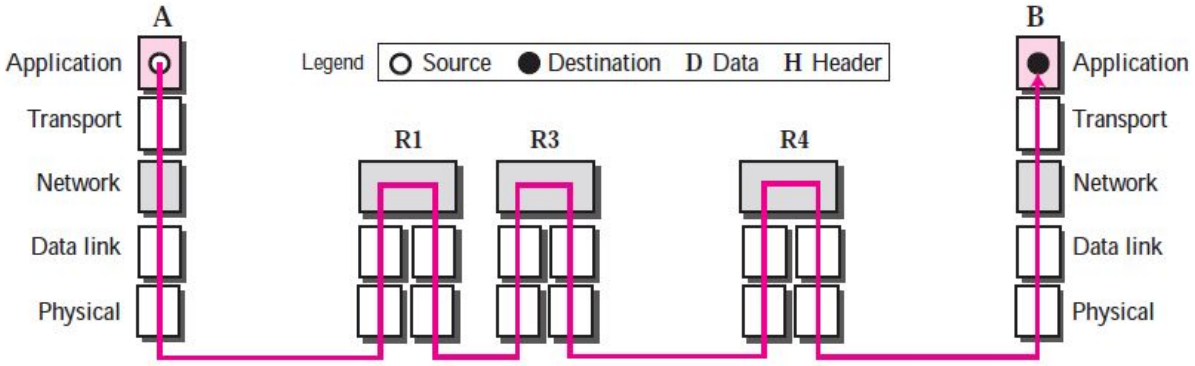
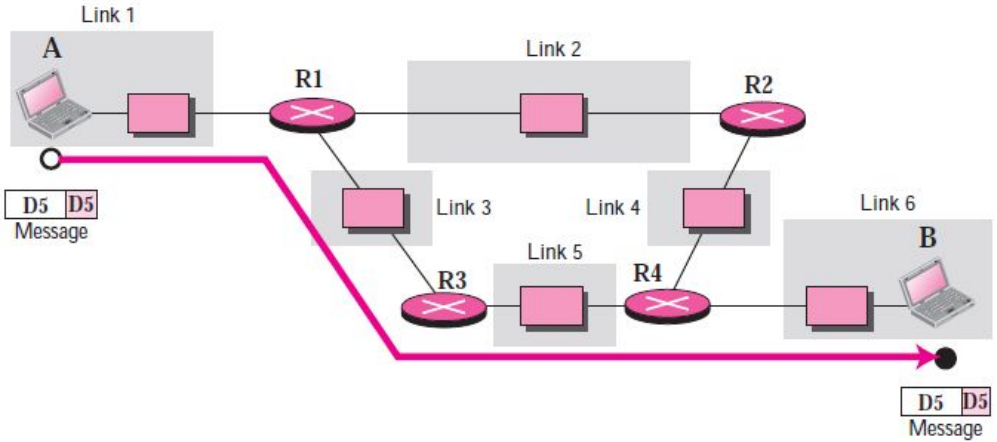
Layers in the TCP/IP Protocol Suite (more)





Communication at the application layer

Unit of Communication – message

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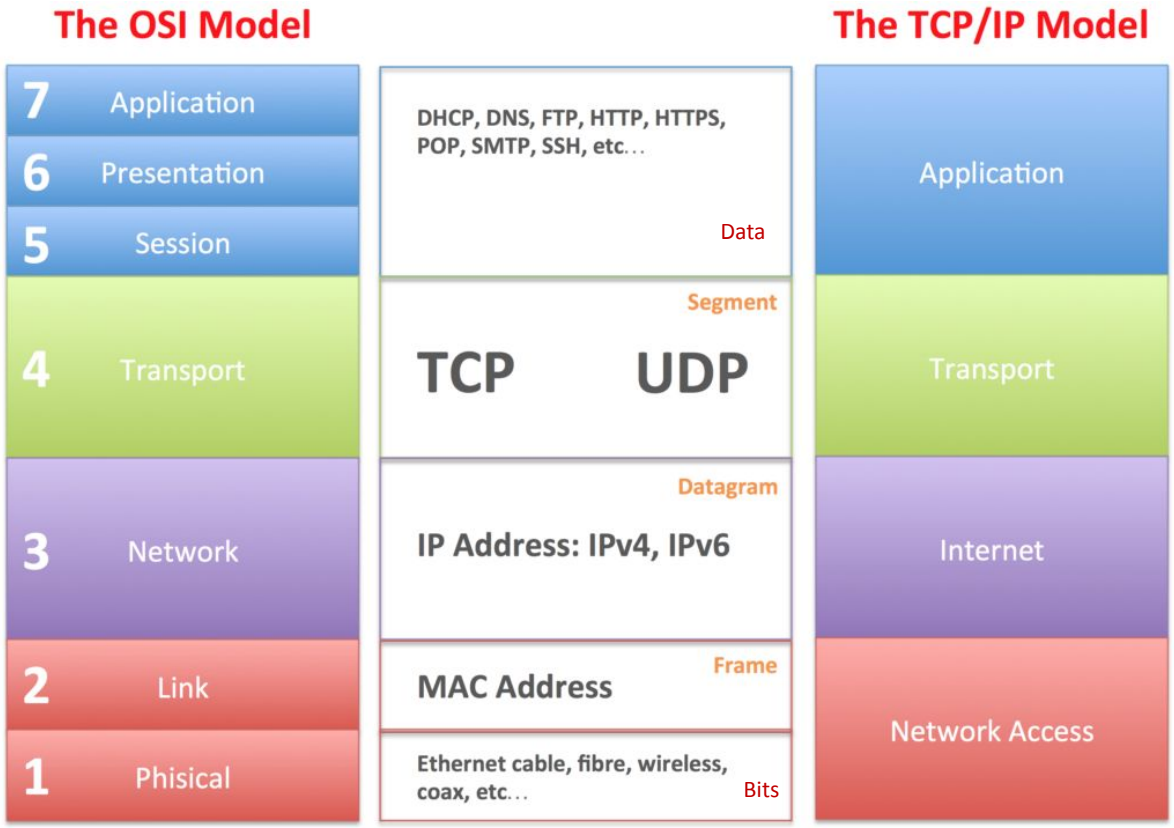
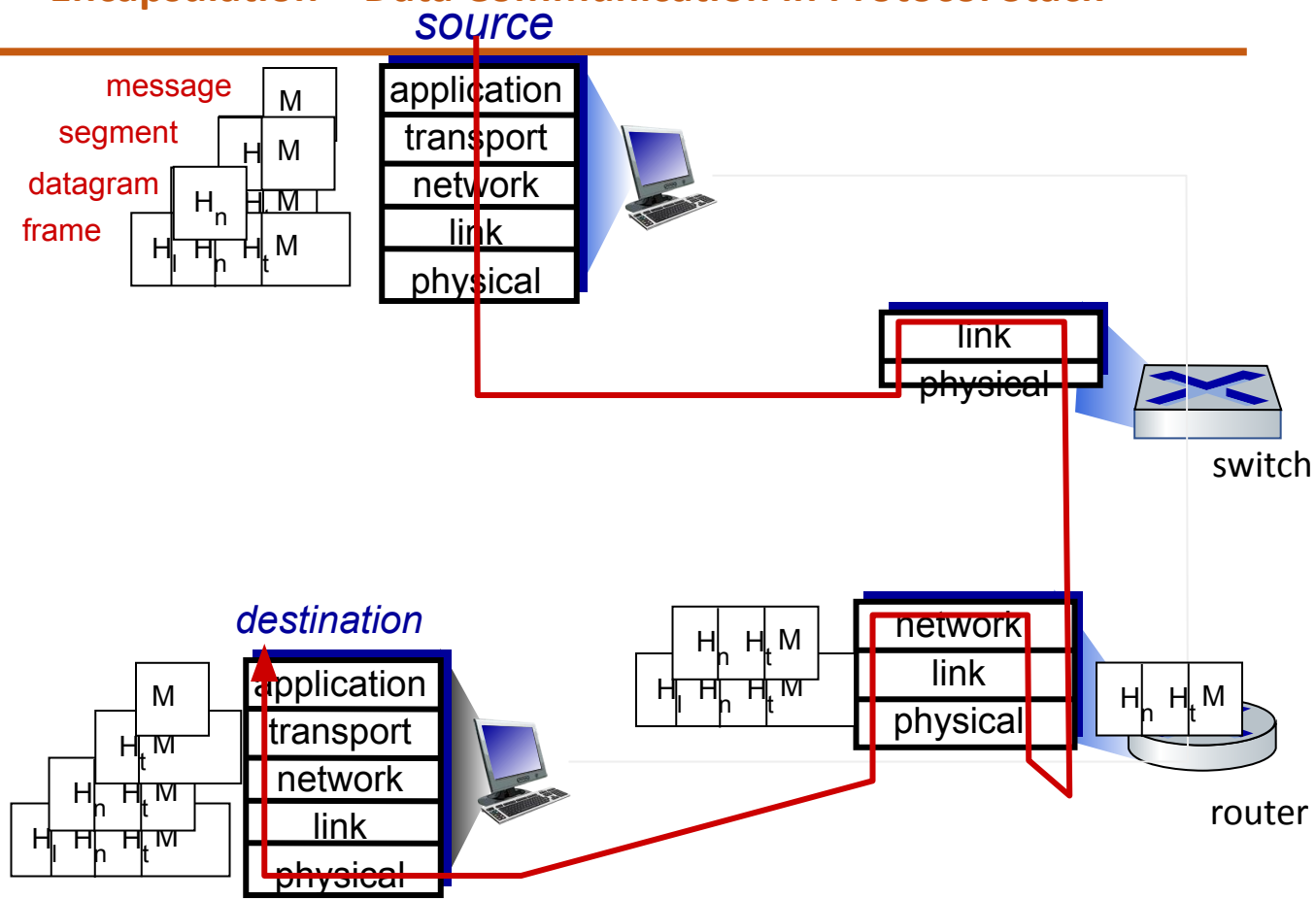
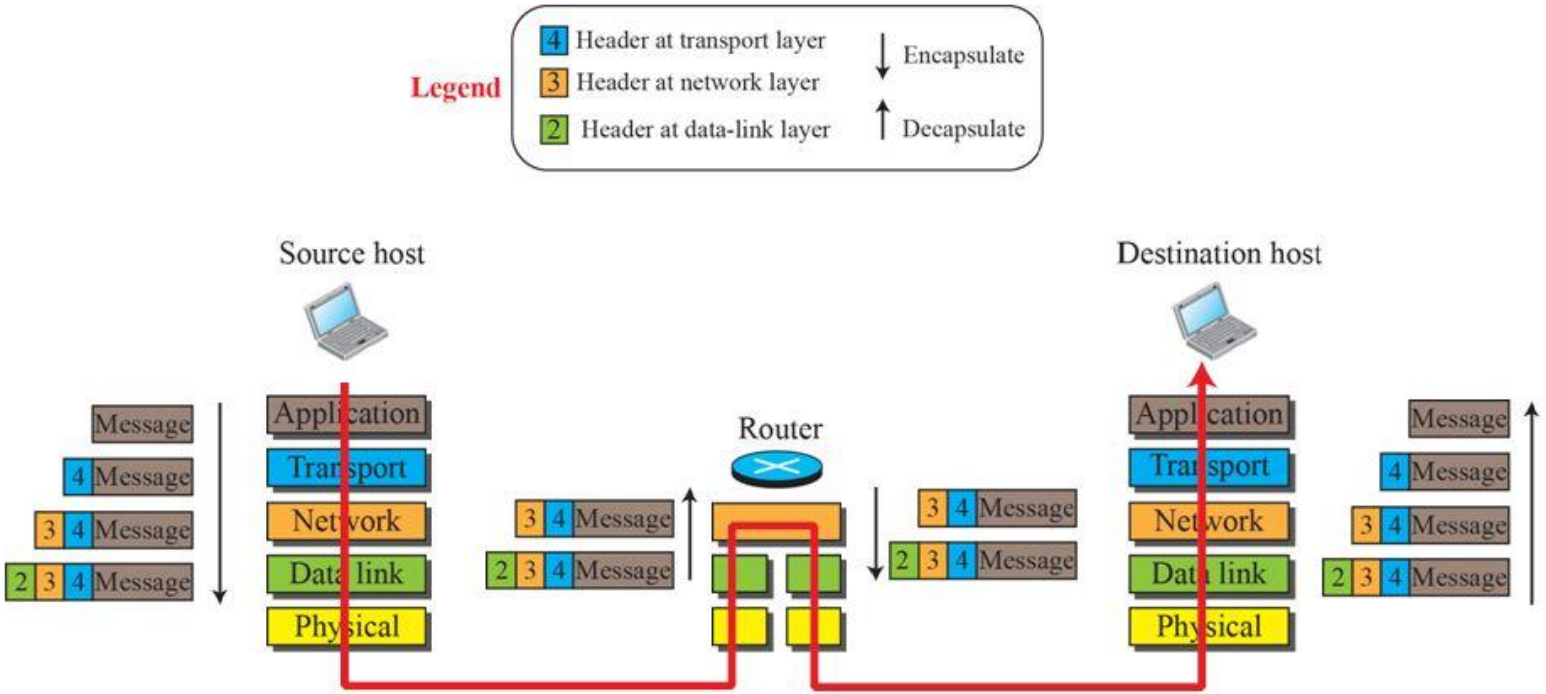
OSI vs TCP/IP Protocol Suite



Encapsulation – Data Communication in Protocol Stack



Encapsulation & Decapsulation



THANK YOU

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