CS-461 Internetworking

Dr. Mohamed Aboutabl

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Chapter 1

Introduction

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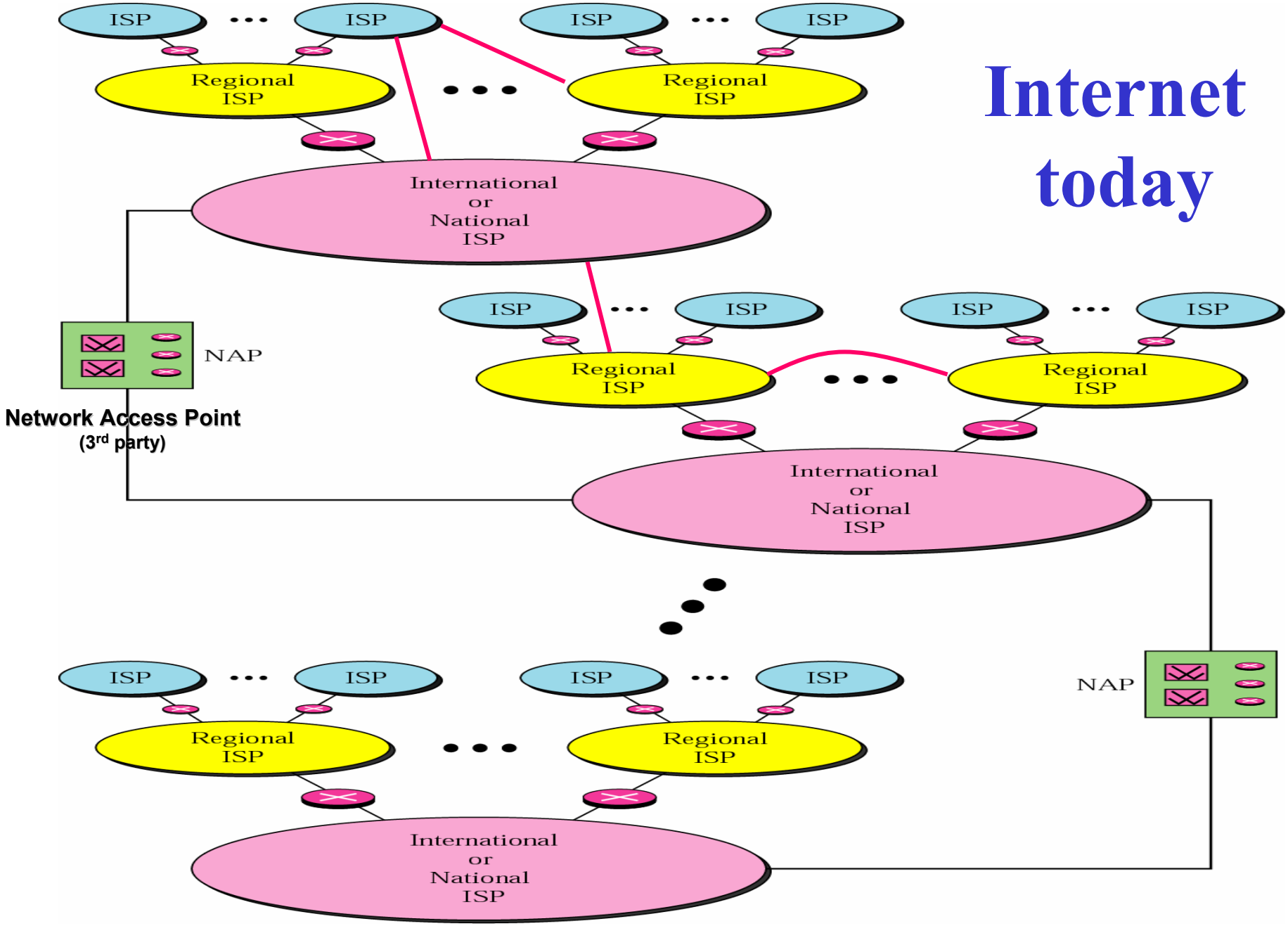
Internet today



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Protocols

- Set of rules governing communication between network elements (e.g. computers) defining:
  1. Syntax = What
  2. Semantics = How
  3. Timing = When (and how fast)

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Standards

- **Agree-upon rules enabling interoperability**
- **Thoroughly tested and adhered to.**
- **Established by Standard Organizations:**
  - **International Standards Organization (ISO)**
  - **International Telecommunications Union Telecommunication Standards Sector (ITU-T)**
  - **American National Standards Institute (ANSI)**
  - **Institute of Electrical and Electronics Engineers (IEEE)**
  - **Electronic Industries Association (EIA)**

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Chapter 2

The OSI Model and TCP/IP Protocol Suite

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CONTENTS

- THE OSI MODEL
- LAYERS IN THE OSI MODEL
- TCP/IP PROTOCOL SUITE
- ADDRESSING
- TCP/IP VERSIONS

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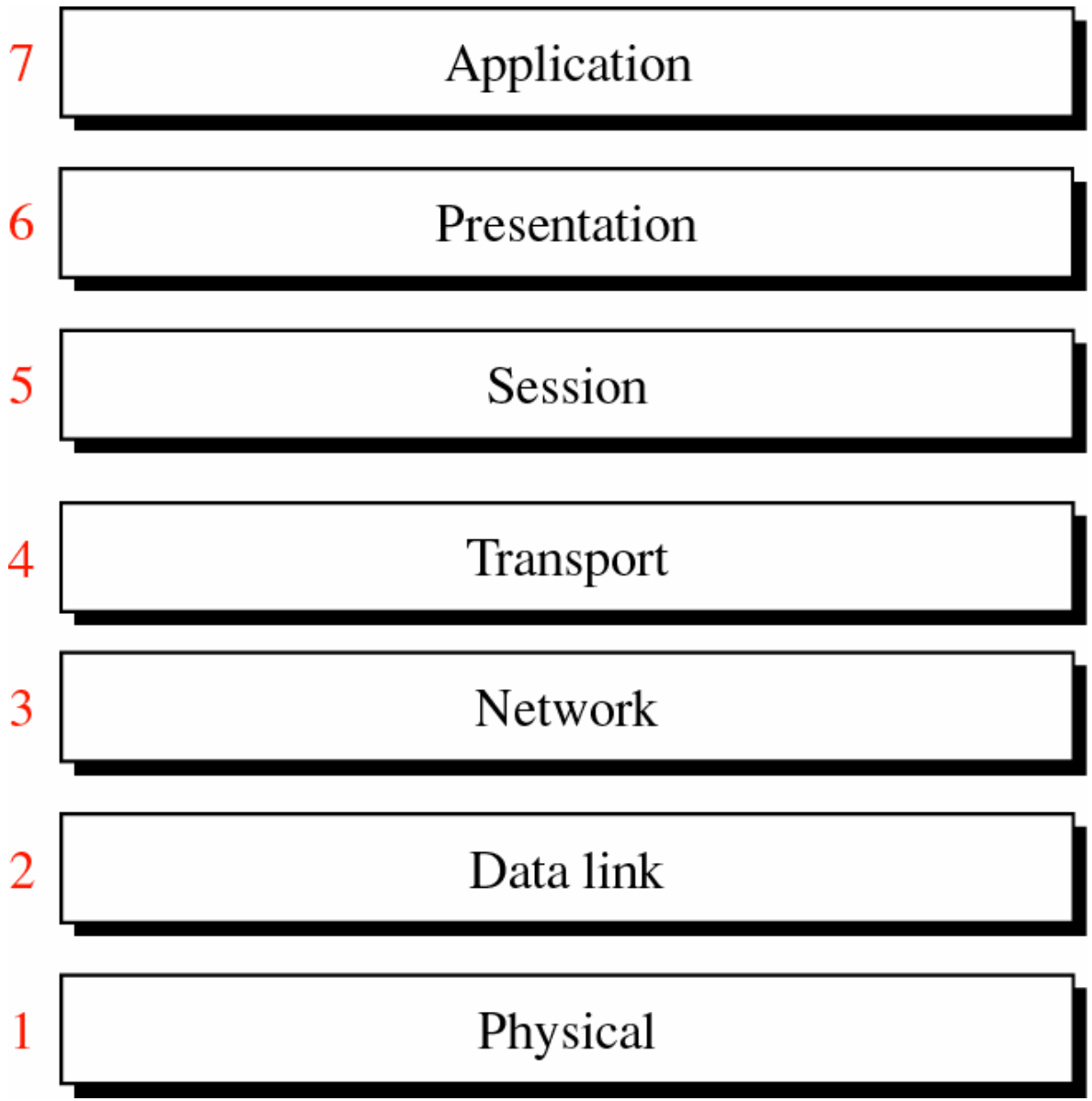
Open Systems Interconnection Model

- Layered framework for the design of network systems
- Never fully implemented ✪ ✪ ✪



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OSI layers

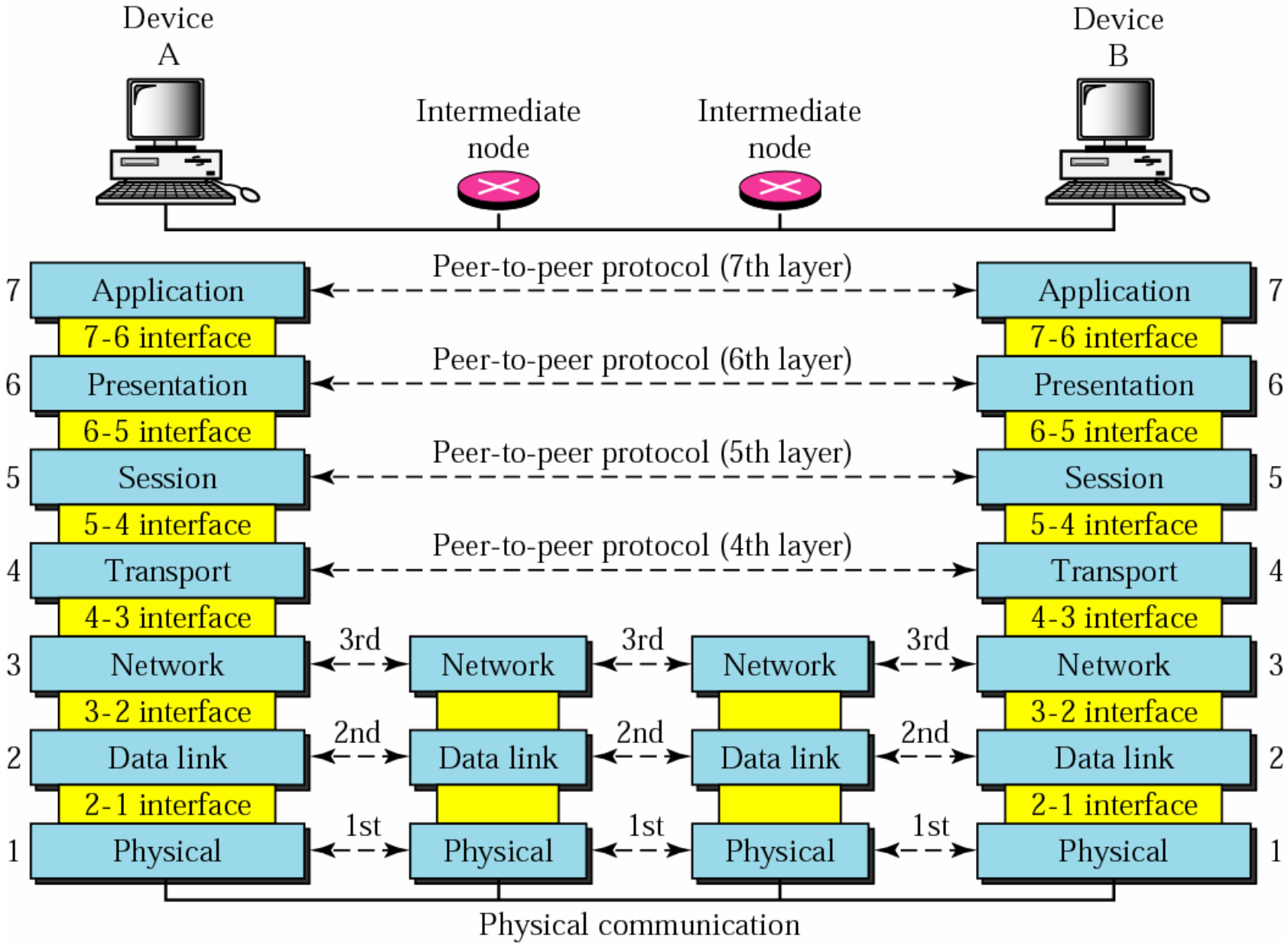

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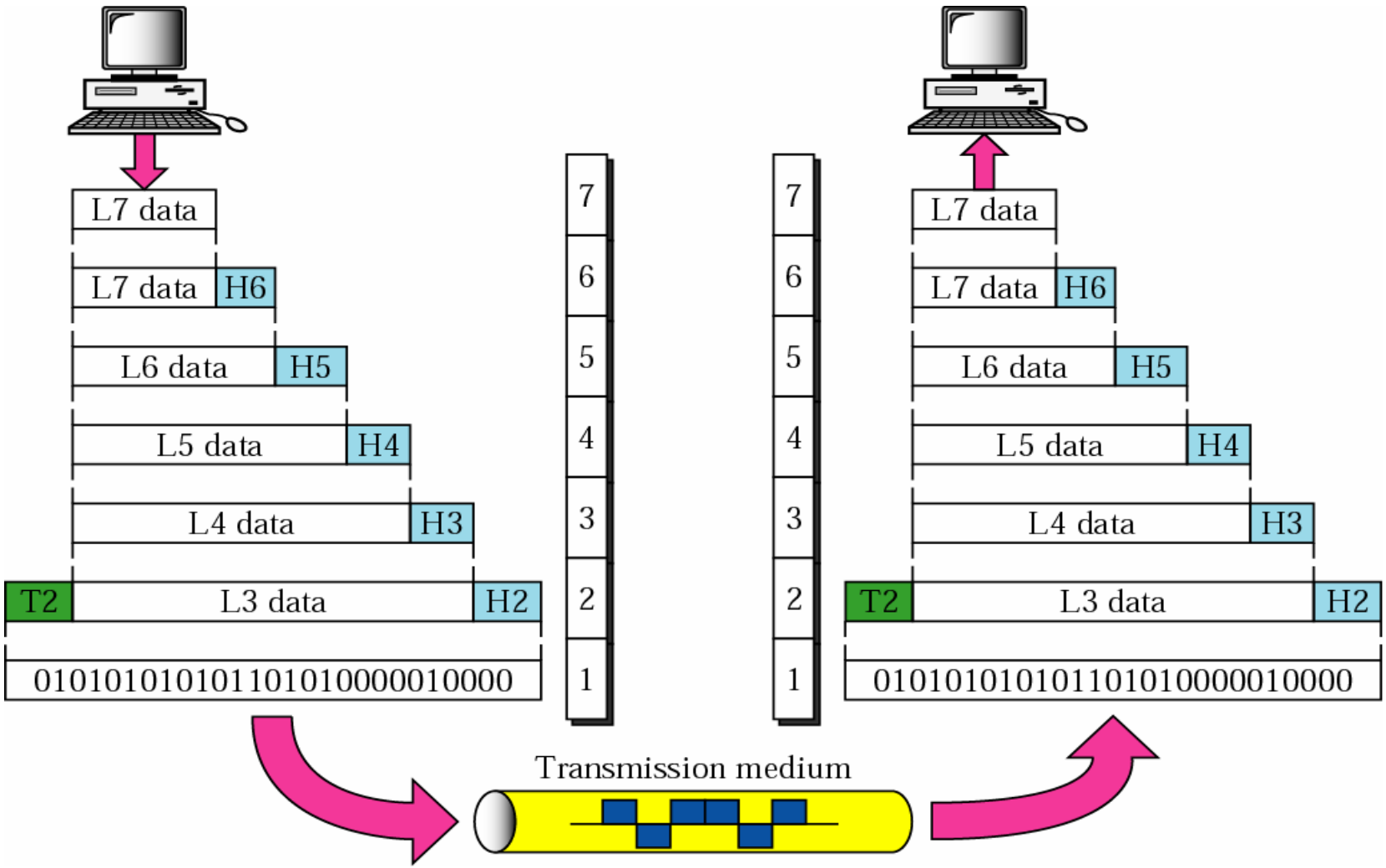
Figure 2-3

An exchange using the OSI model



Headers are added to the data at layers 6, 5, 4, 3, and 2.
Trailers are usually added only at layer 2.

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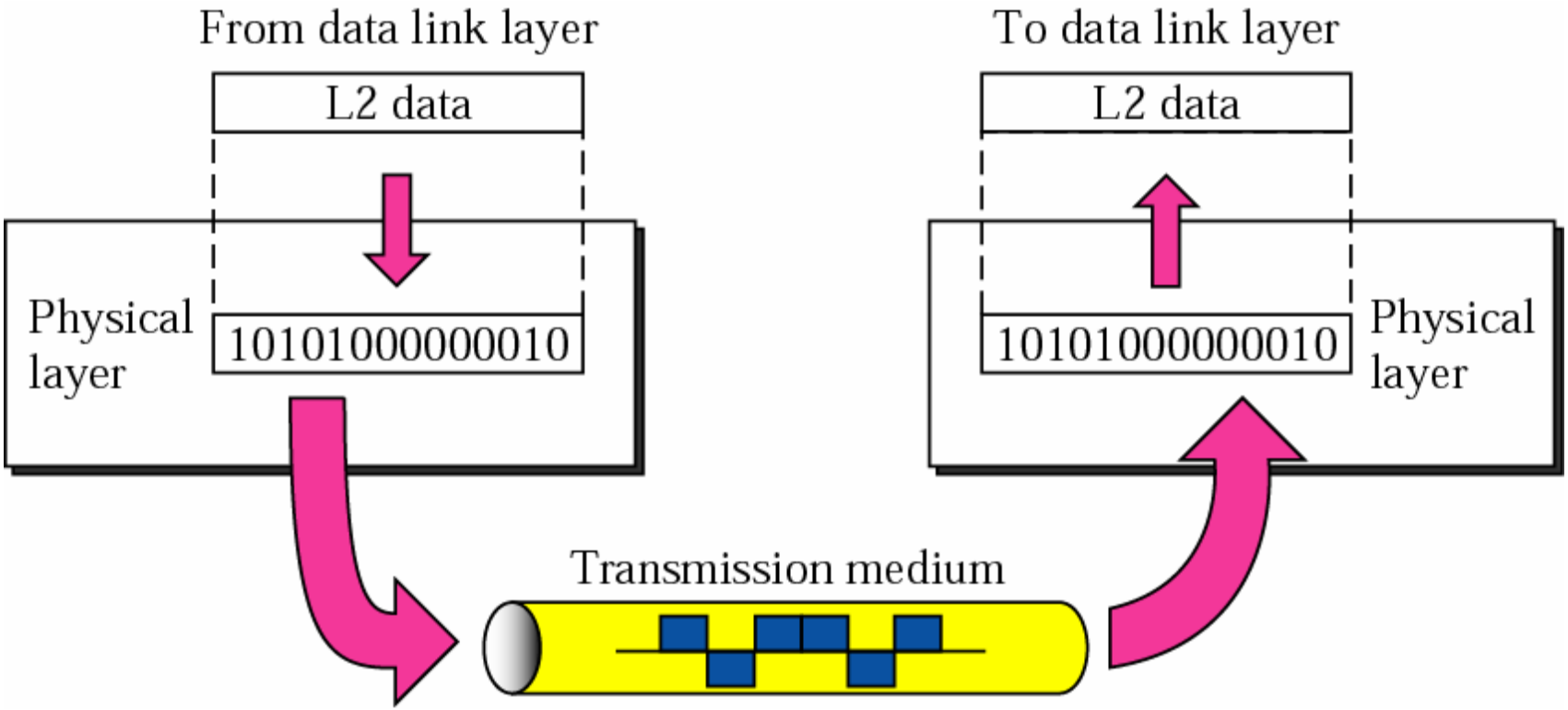
Physical Layer

Bit Streams Transmission



- Physical media
- Bit representation (ie encoding)
- Transmission rate

- Bit synchronization
- Physical topology (star, ring, bus)
- Transmission mode (simplex, half-, full-duplex)

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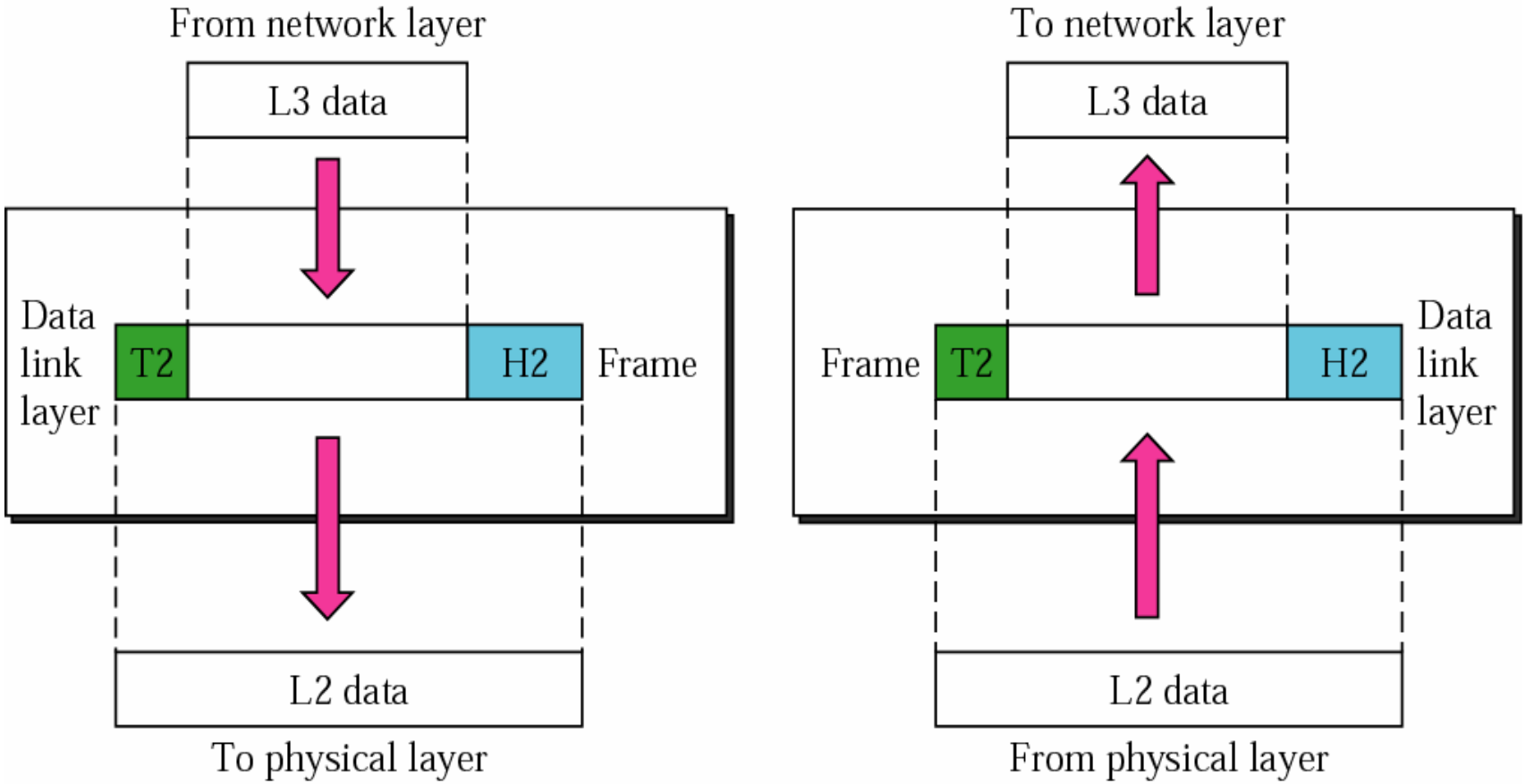
Data Link Layer

Hop-to-Hop Frame Delivery inside same network



- Framing (cut into *frames*)
- Physical addressing (source/destination)
- Flow control (speed up/slow down)
- Error control (detection, retransmission, duplication) via trailer T2
- Access control (to the link)

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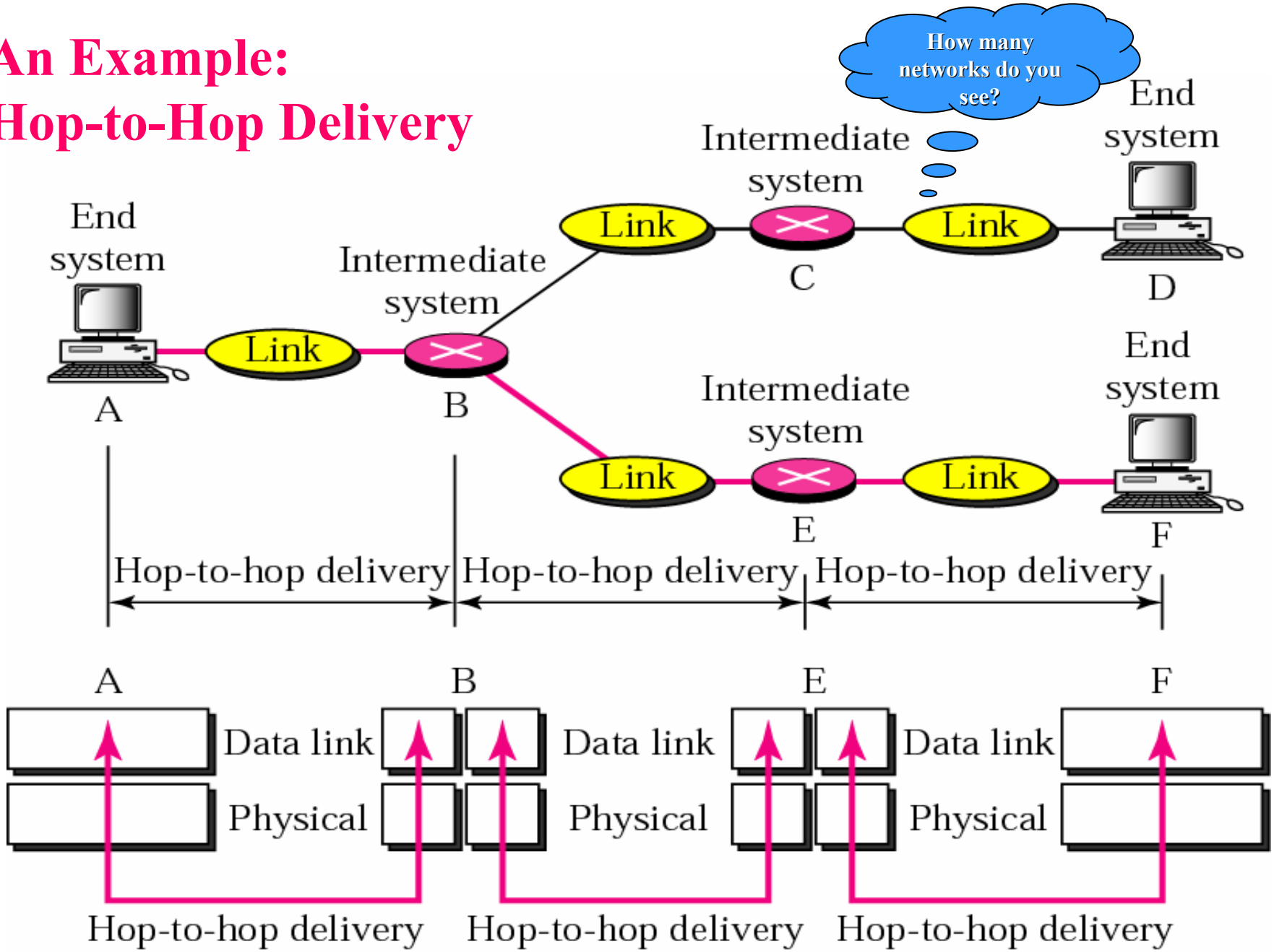
An Example: Hop-to-Hop Delivery



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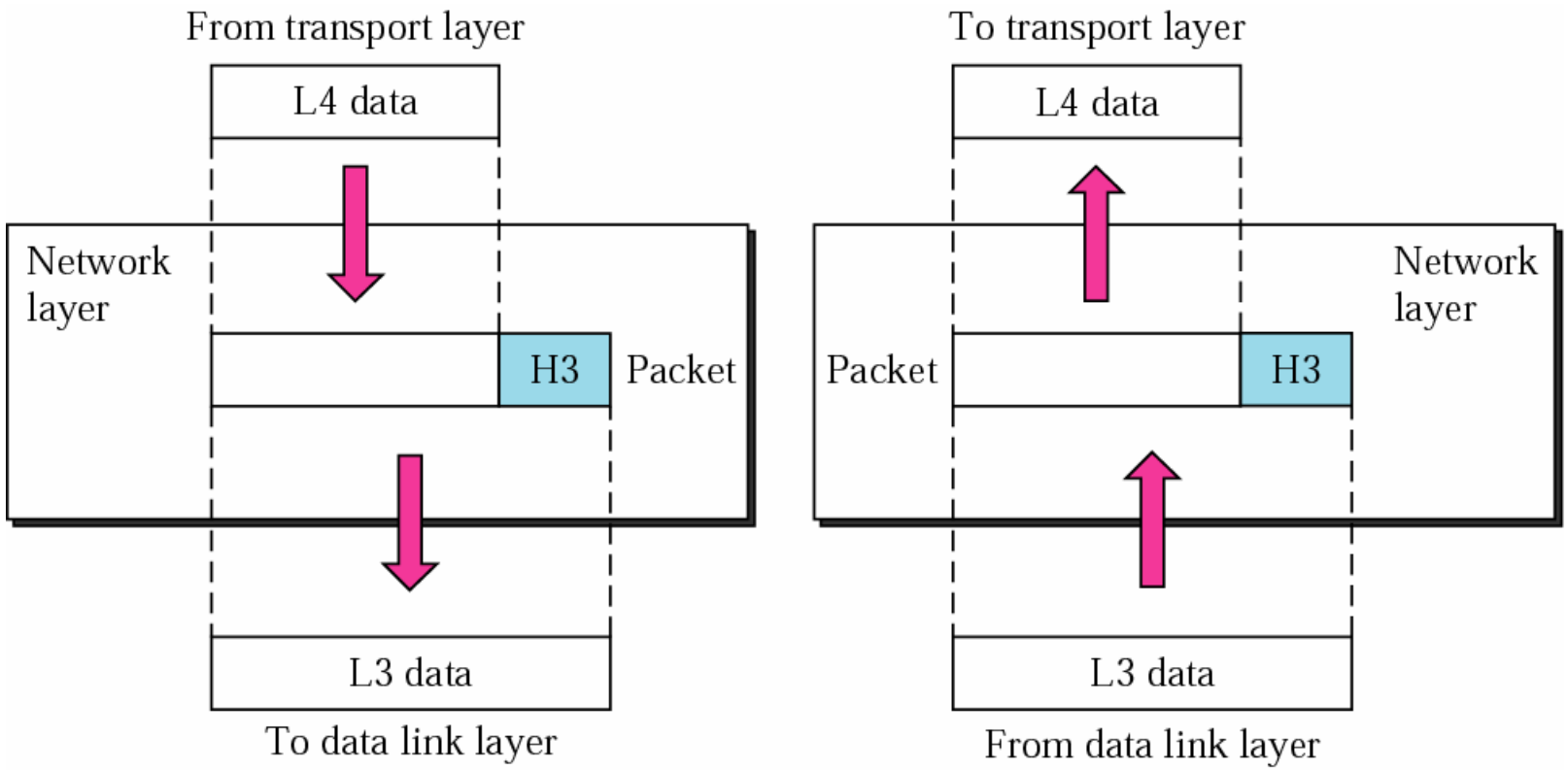
Network Layer

End-to-End Packet Delivery across networks



- Delivery of *Packets* (parts of a message). Does not recognize relationship between individual packets.
- Logical addressing (of source & destination)
- Routing across different networks

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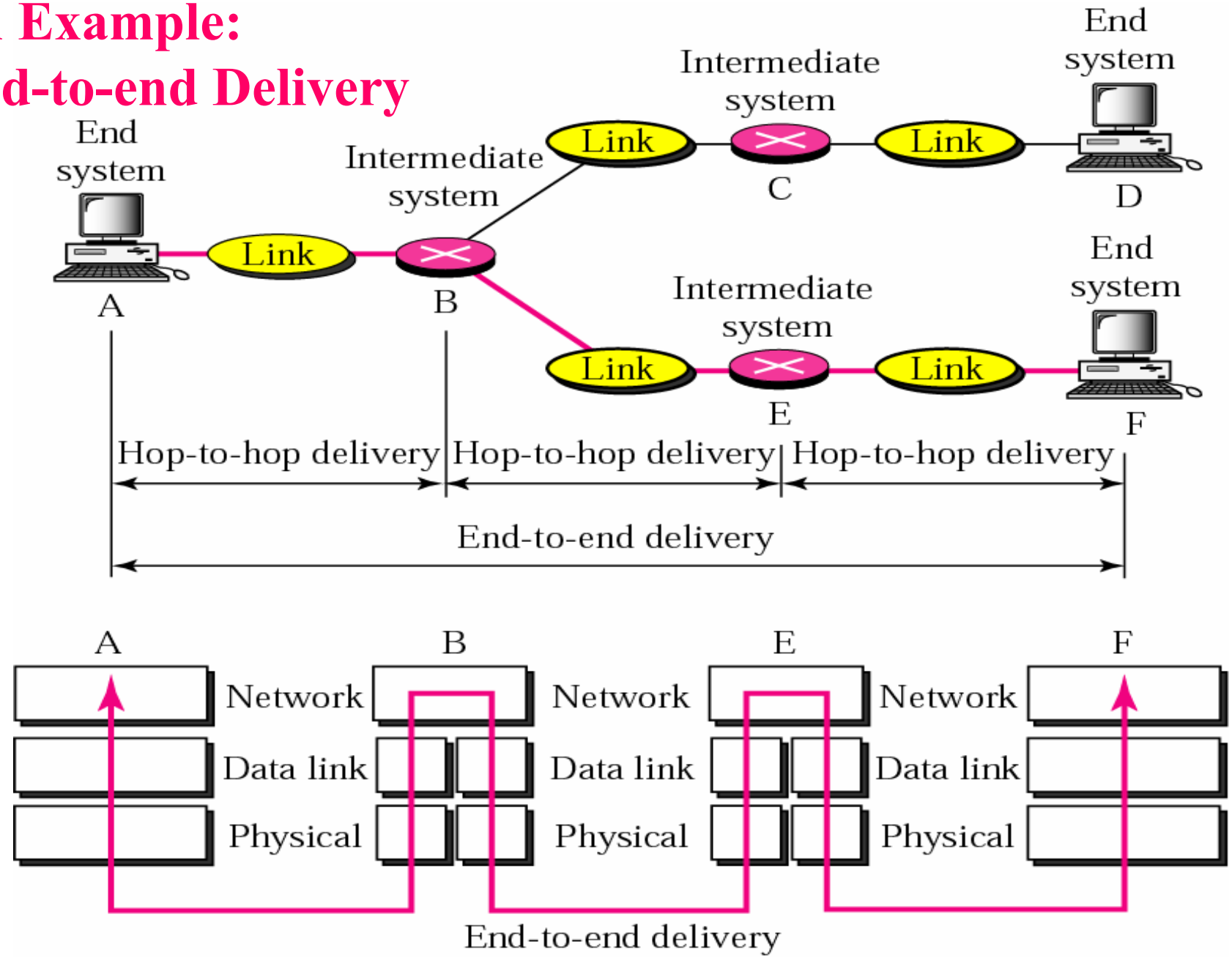
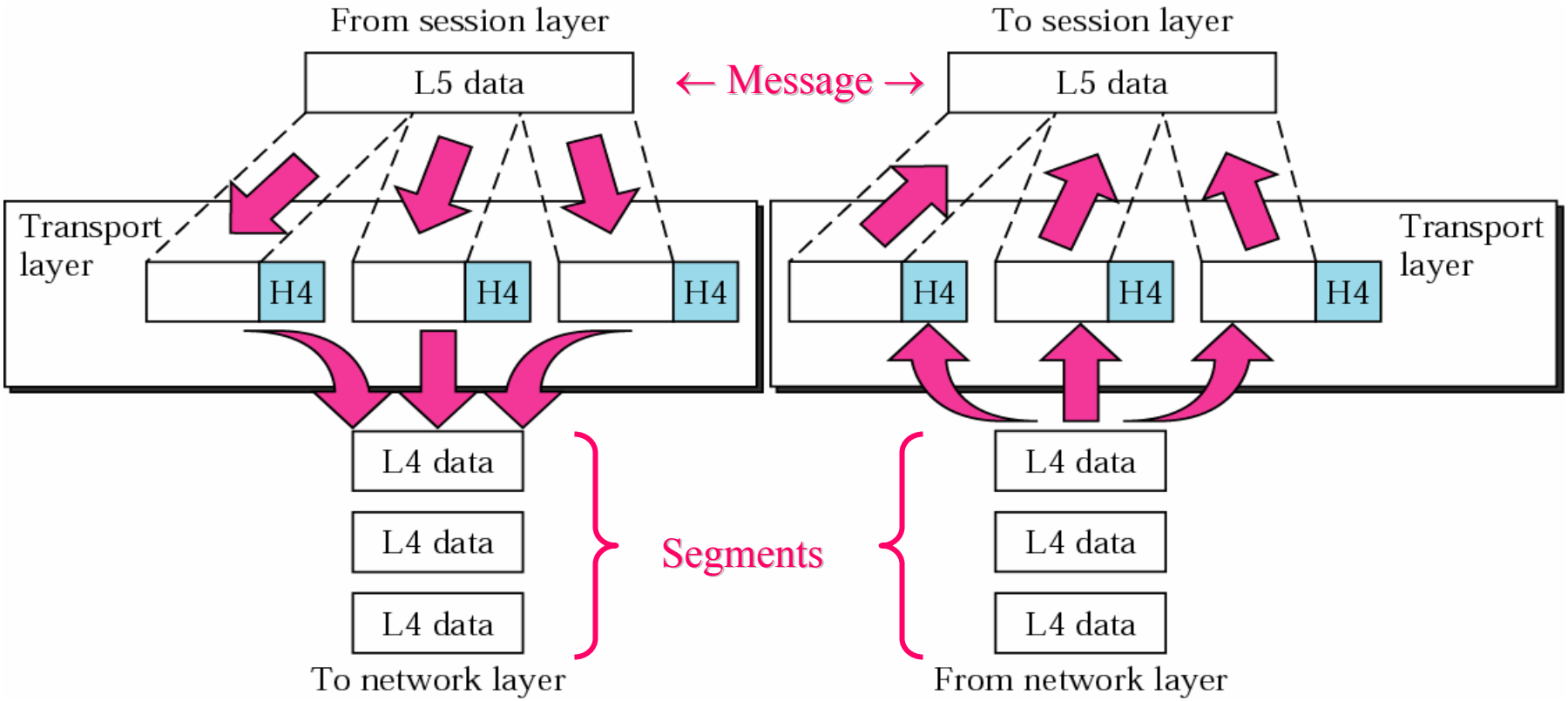
An Example: End-to-end Delivery



Transport Layer

End-to-End Message Delivery across networks



- Service-point Addressing: *ports*
- Segmentation & Reassembly: (message ↔ segments with seq#s), reordering.
- Error control (end-to-end): Duplicate/Lost/Damaged segments
- Flow Control (end-to-end)

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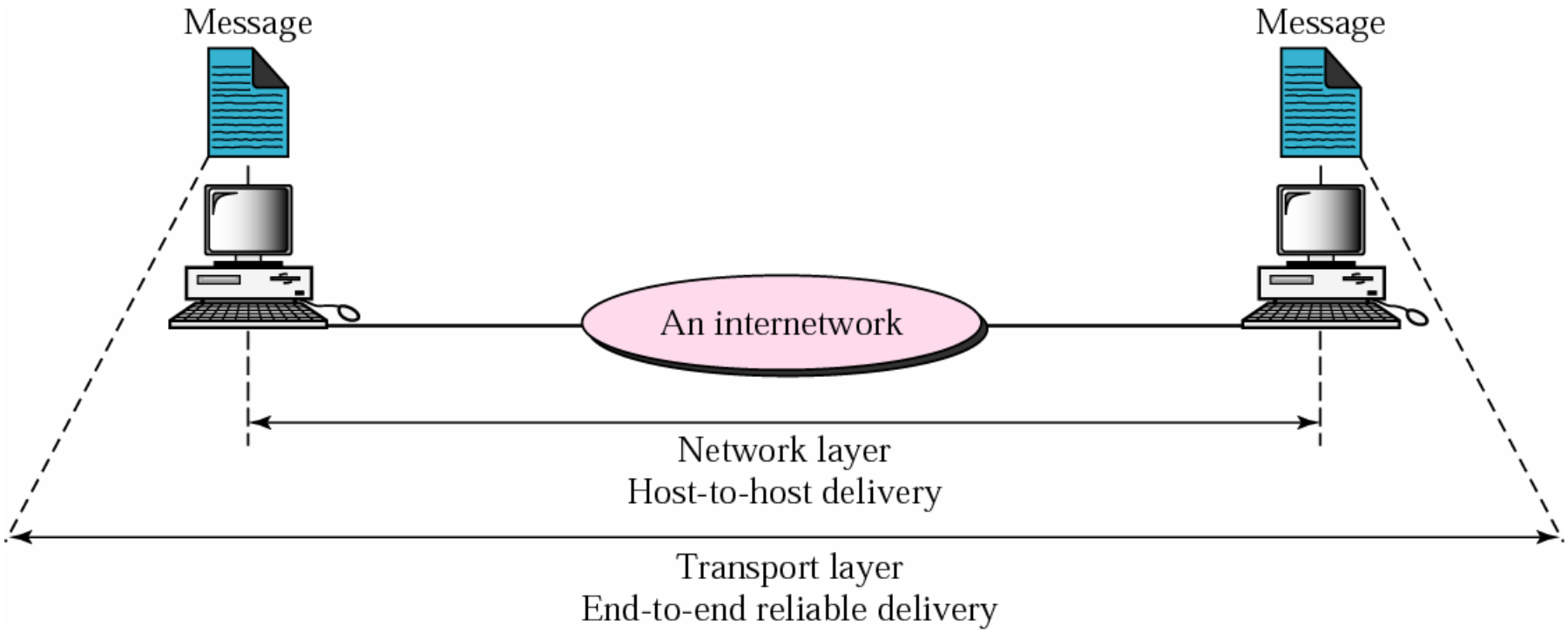
Reliable end-to-end delivery of a message



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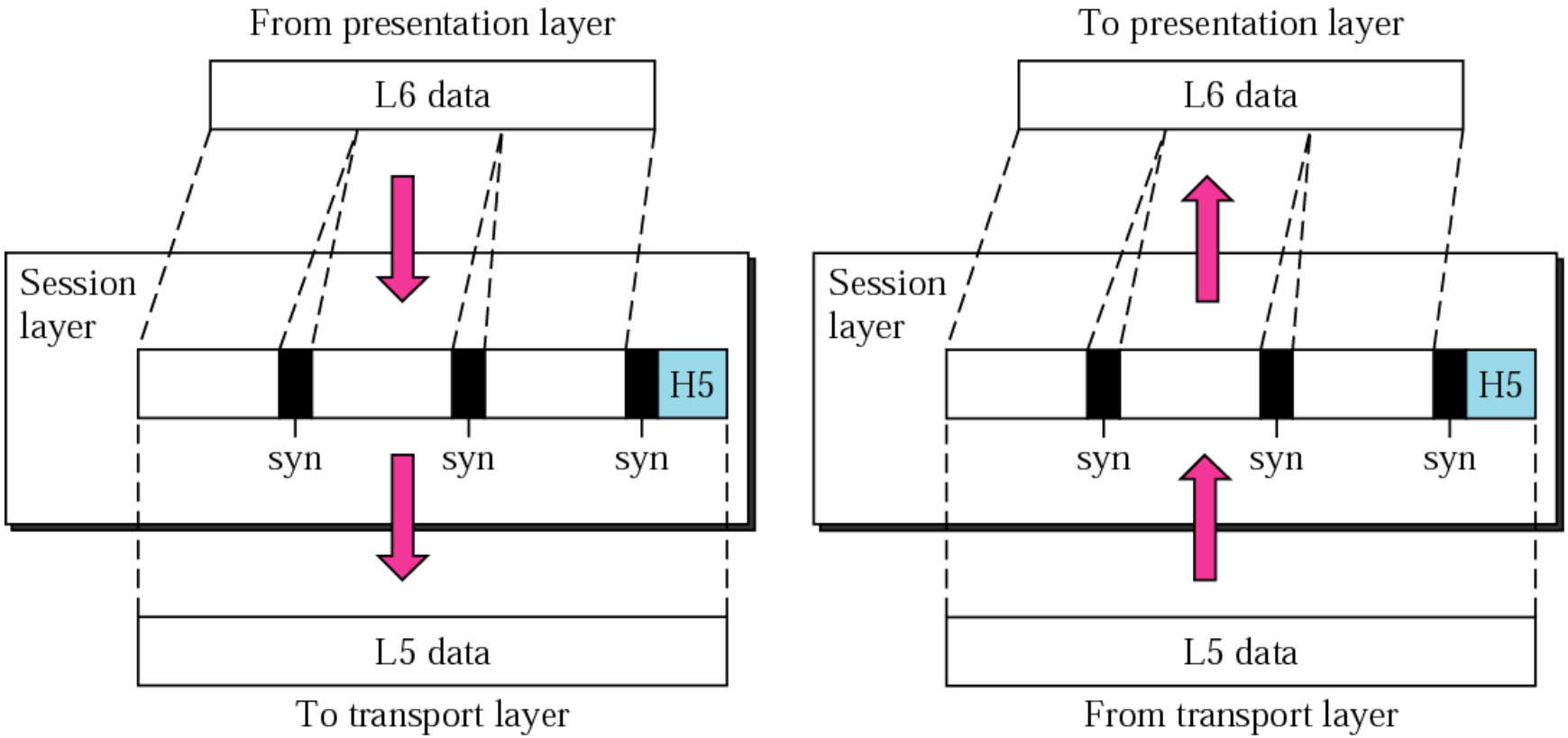
Session Layer



- If needed by communicating processes, the session layer may offer its synchronization service to facilitate transmission of really large data.

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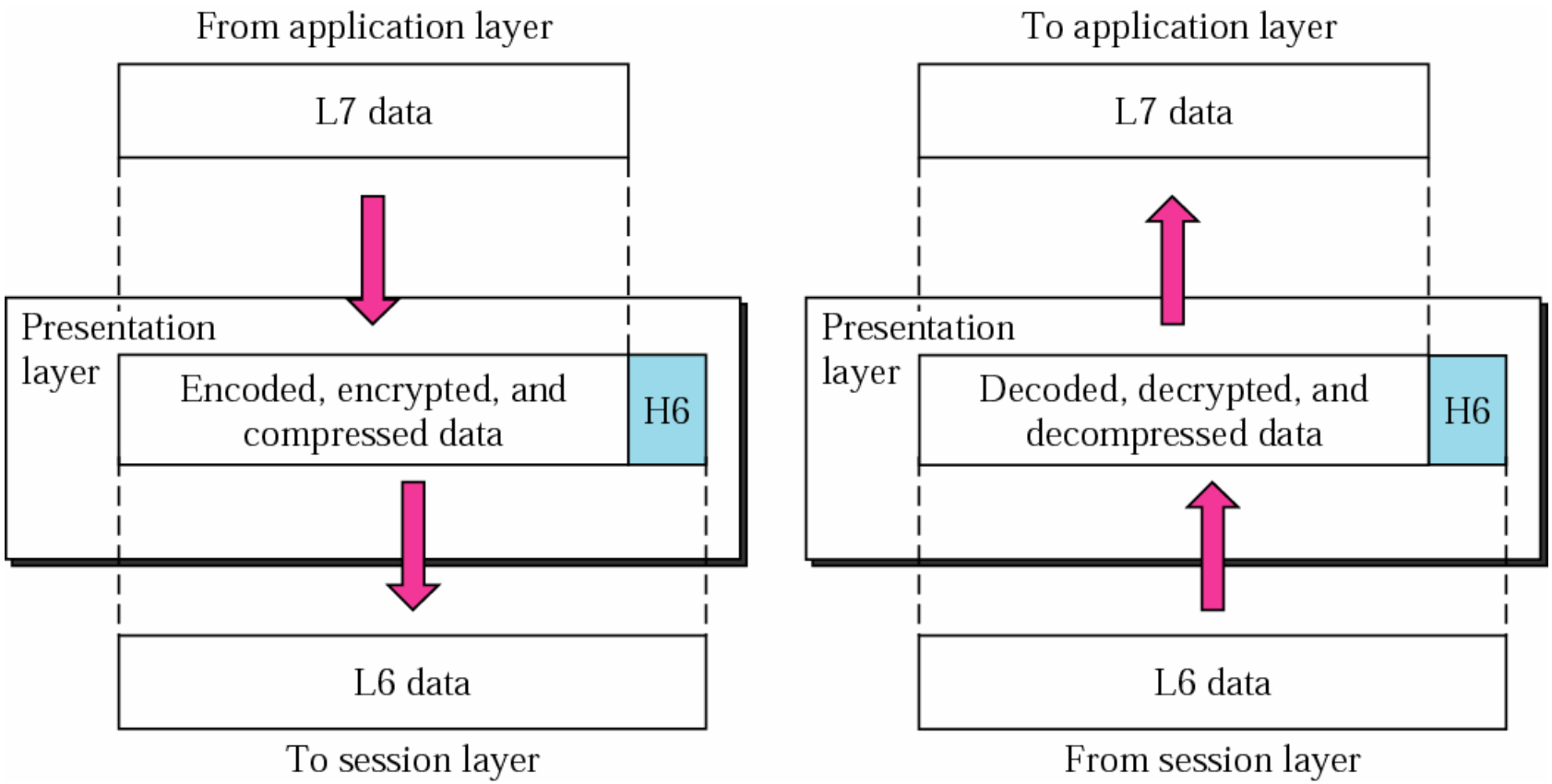
Presentation Layer



- Translation: e.g. ASCII ↔ EBCDIC, Little Endian ↔ Big Endian.
- Encryption
- Compression: text, audio, video, images.

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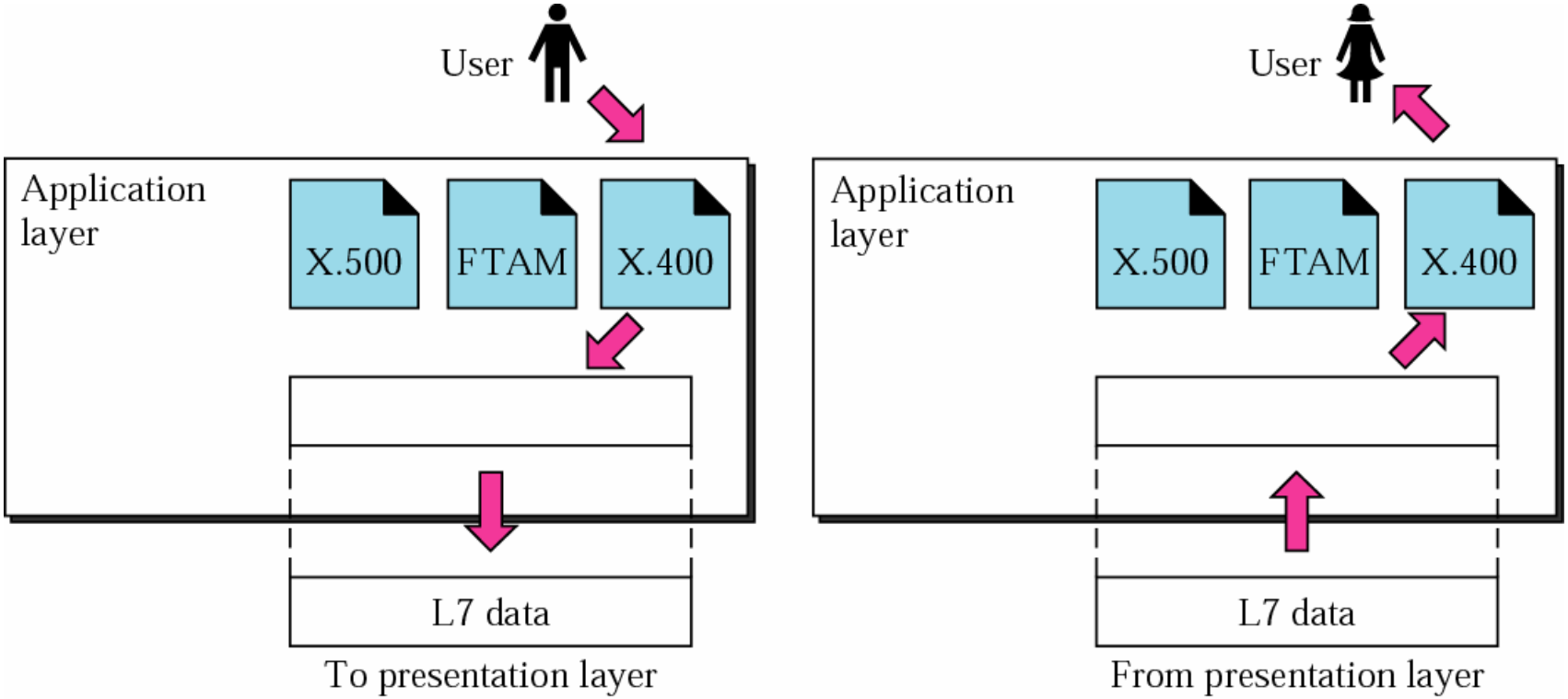
Application Layer



- Electronic Mail.
- File Transfer.
- Network Virtual Terminal.

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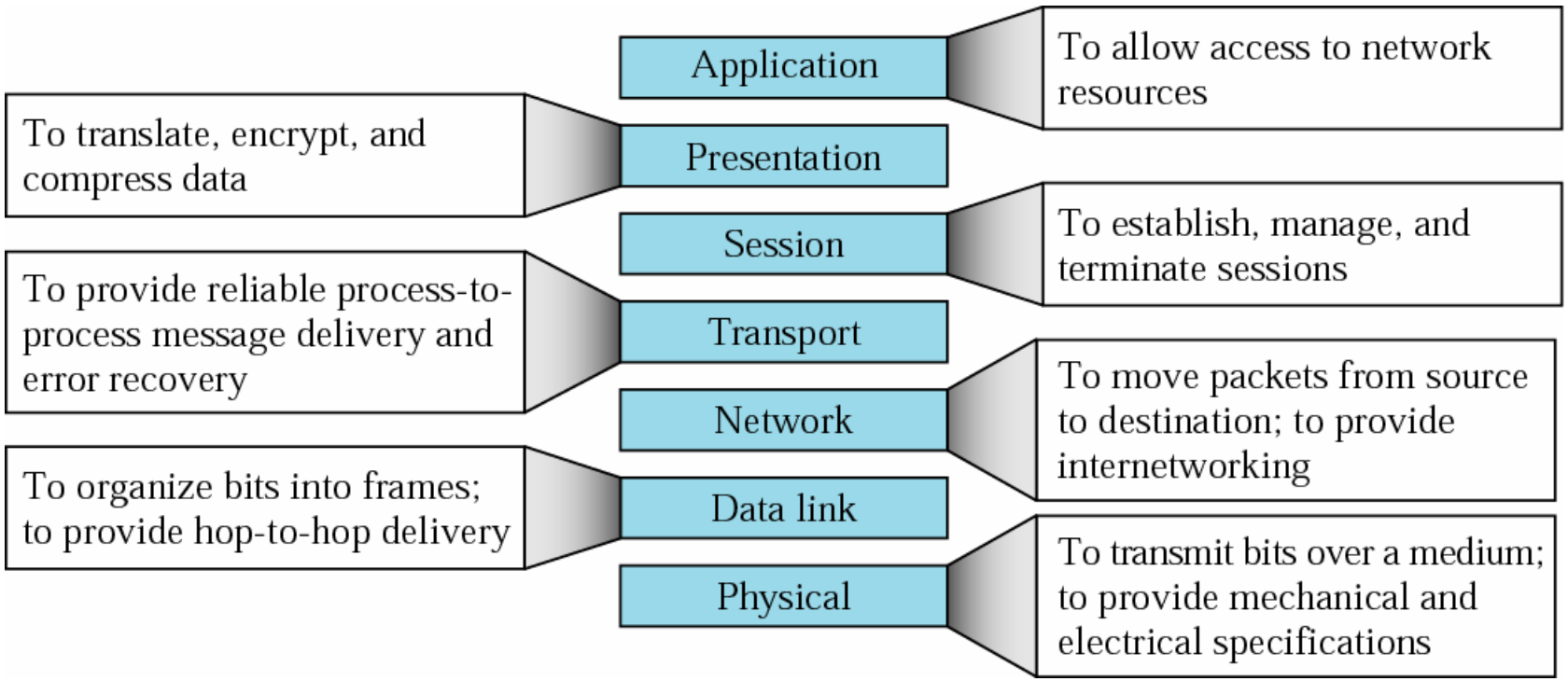
Summary of layers



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2.3

TCP/IP PROTOCOL SUITE

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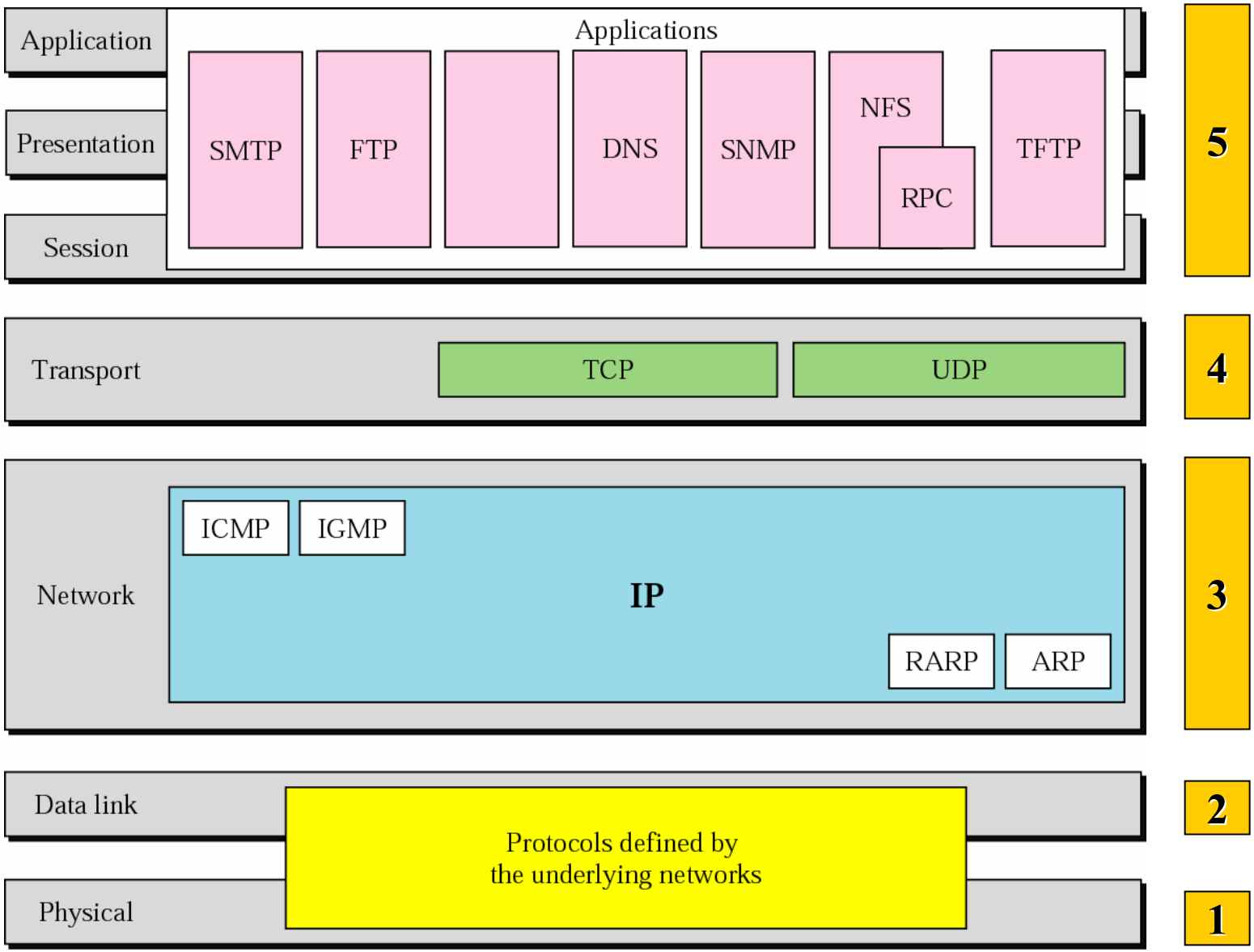
TCP/IP and OSI model



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TCP/IP Layers

- Physical & Data Link Layers
  - Undefined by TCP/IP: any network; LAN, MAN, WAN, etc.
- Network (*actually Internetworking*) Layer
  - Internetworking Protocol: transports *datagrams*, each one is independent. Datagrams may travel different routs, arrive out of order, be duplicated, or get lost. IP is unreliable, connectionless
  - IP is Supported by:
    1. Address Resolution Protocol: IP → Physical NIC address.
    2. Reverse ARP: Physical NIC address → IP, when booting up.
    3. Internet Control Message Protocol: notify sender of problems.
    4. Internet Group Message Protocol: Multicast datagrams to a group.

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TCP/IP Layers (Cont'd)

- Transport Layer: Deliver a *message* from a "sender" process to a "receiver" process. Defines two protocols:
  1. User Datagram Protocol: *The minimal service:*
     - connectionless process-to-process protocol
     - adds only port address,checksum, length information
  2. Transmission Control Protocol: *The full service*:
     - *Stream* (i.e. connection-oriented) transport: streams are cut into *segments* (with sequence number for reordering)
     - Segments are carried inside IP datagrams.
     - Reliable transportation:
       - checks for lost&duplicate segments,
       - in-order delivery.
- Application Layer:
  - = OSI (Session+Presentation + Application)
  - Various protocols.

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2.4

ADDRESSING

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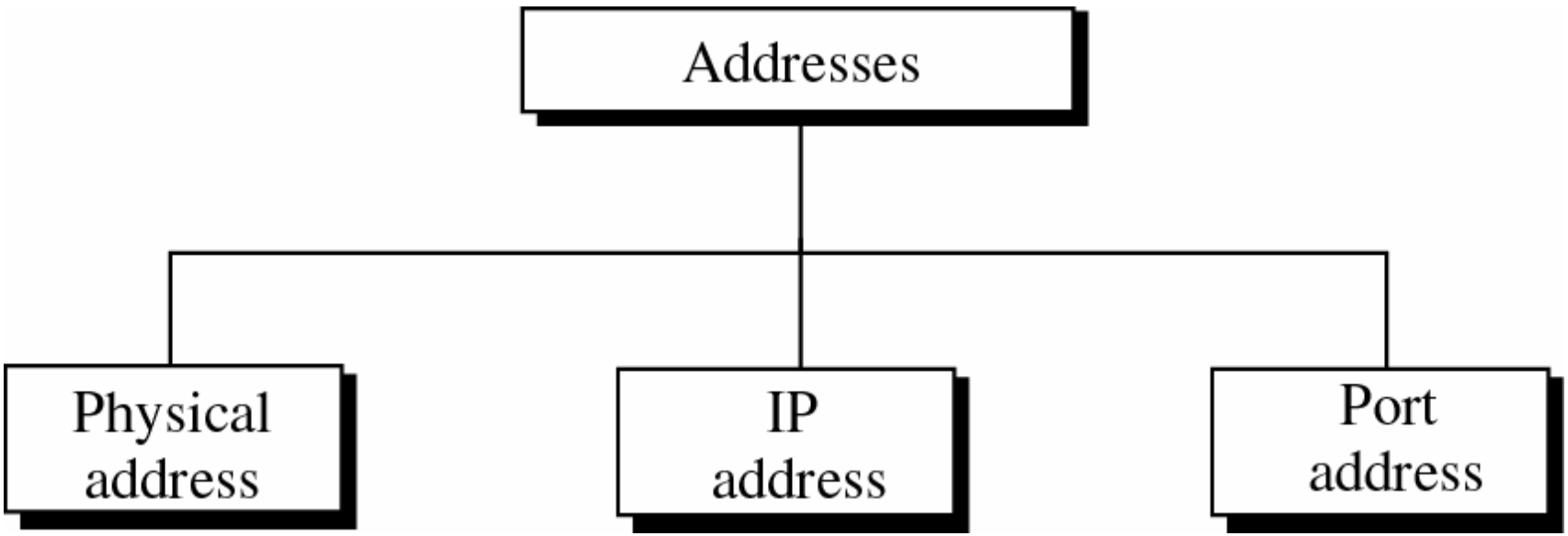
Addresses in TCP/IP



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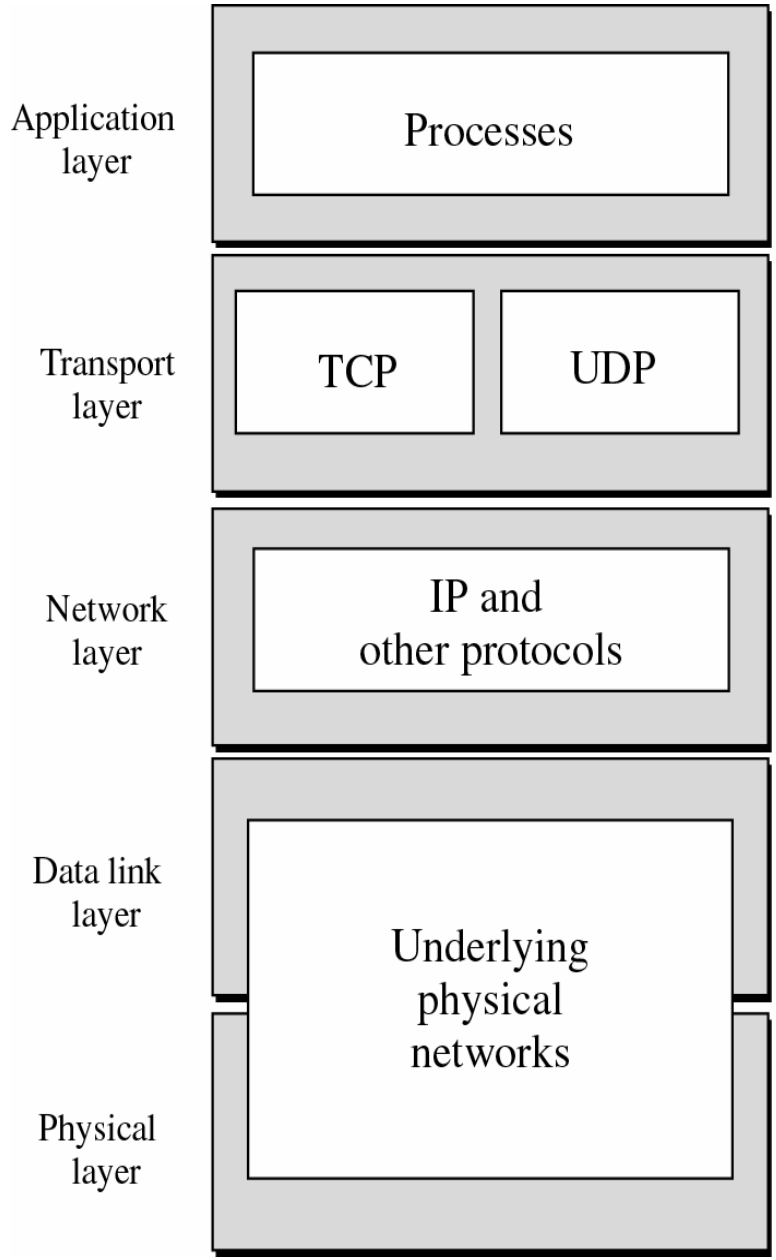
Relationship of layers and addresses in TCP/IP



Port address

2-byte port address

identifies sending and receiving processes

IP address

4-byte universally unique IP address

Unicast, multicast, limited broadcast.

Physical address

e.g. 6-byte Ethernet address

Unicast, multicast, broadcast addressing

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