CNT3004 - Computer Network Concepts

Dr. C. Tidwell, Fall 2020

Chapter 2

Network Models

2-1 PROTOCOL LAYERING

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.

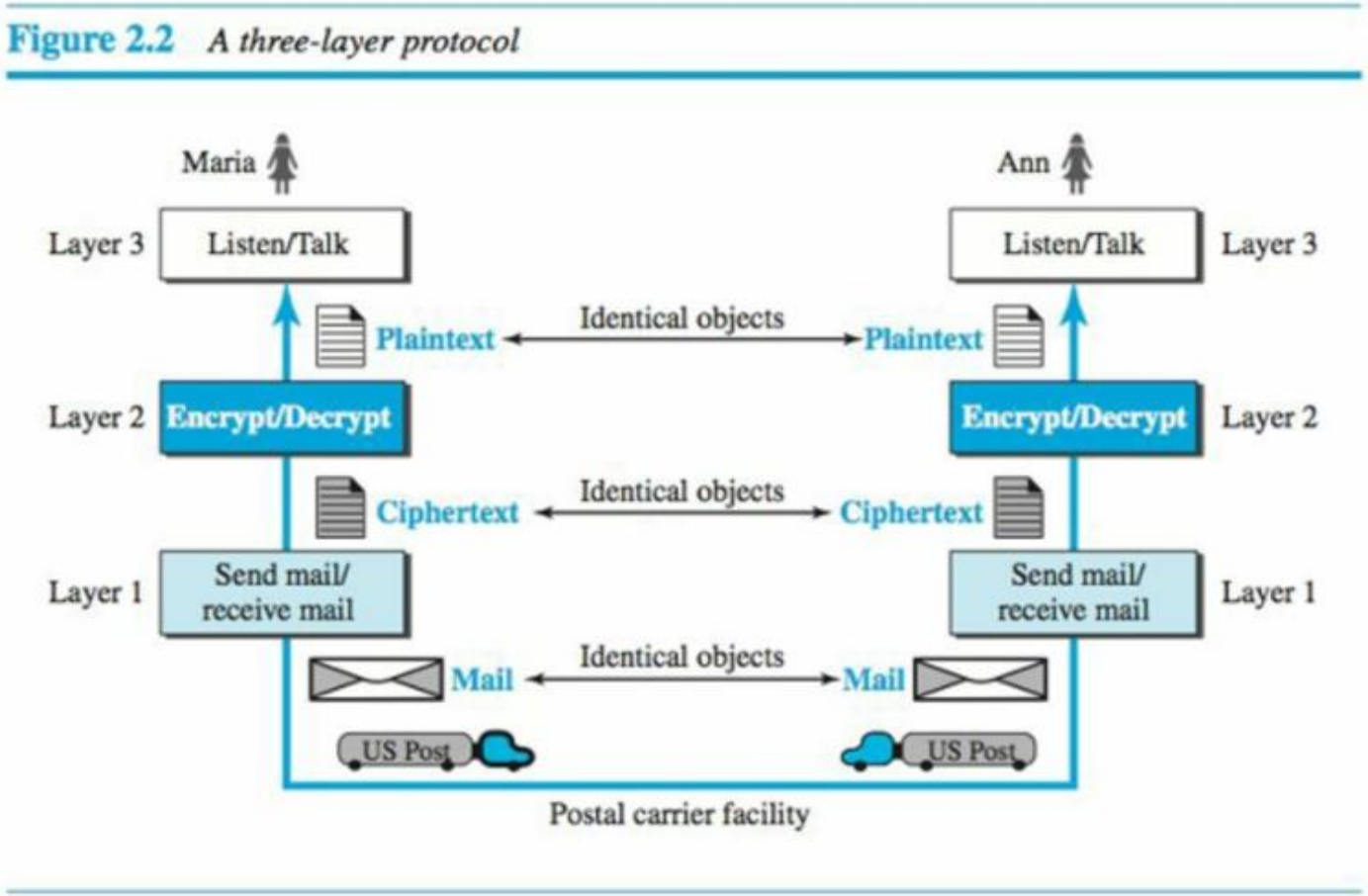
Topics discussed in this section:

Sender, Receiver, and Carrier
Hierarchy

Figure 2.1 *A single-layer protocol*

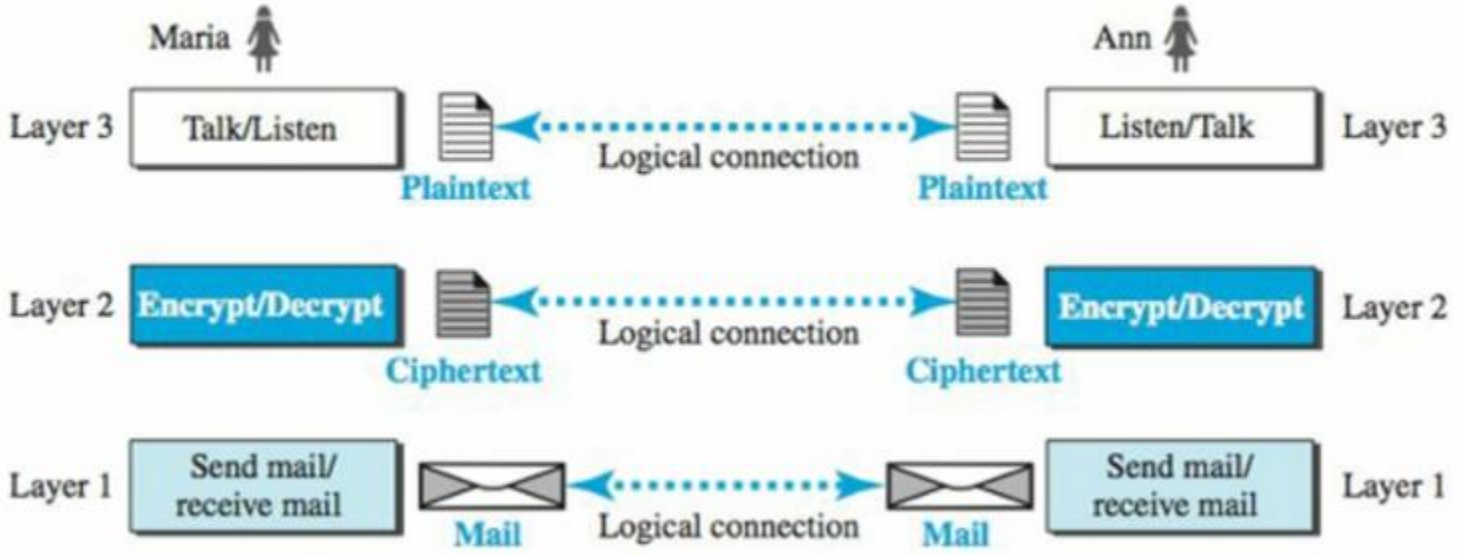
In the above simple example, the sender might be Maria and the receive Ann. The protocols used would be their language, volume, speed, etc. of their communication. They also have to talk in turns. The transmission media is the Air.

Figure 2.2 Tasks involved in sending a letter



Layered structure makes a complex system easy to construct, understand, and manage

Figure 2.3 *Logical connection between peer layers*



2-2 THE TCP/IP MODEL

- *TCP/IP is a stack of protocols that were created at the start of networking (prior to the OSI model).*
- *TCP/IP is the standard for the Internet and for most networks today.*
- *TCP/IP stands for the 2 major protocols in the stack. Transmission Control Protocol and Internet Protocol.*
- *It is defined as 5 (sometimes 4) layers (the OSI model is 7 layers).*

Topics discussed in this section:

Layered Architecture
Layers in the TCP/IP suite
Description of Layers and more

LAYERED ARCHITECTURE

Figure 2.4 *Layers in the TCP/IP protocol suite*

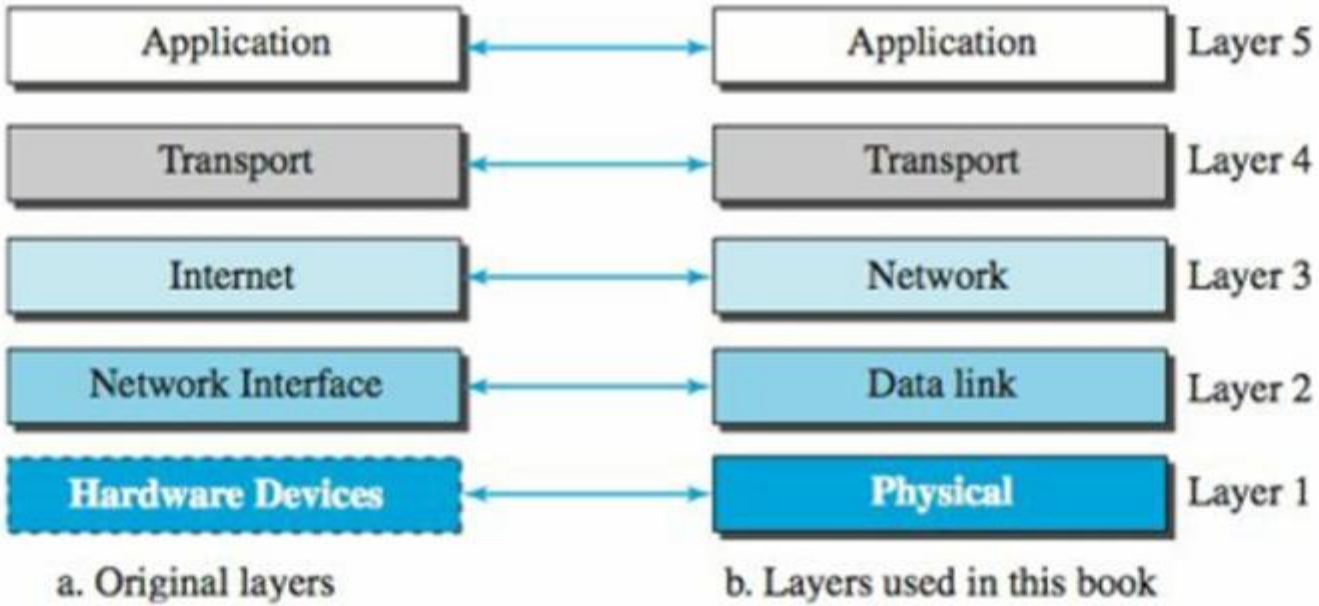


Figure 2.5 *Communication through an internet*

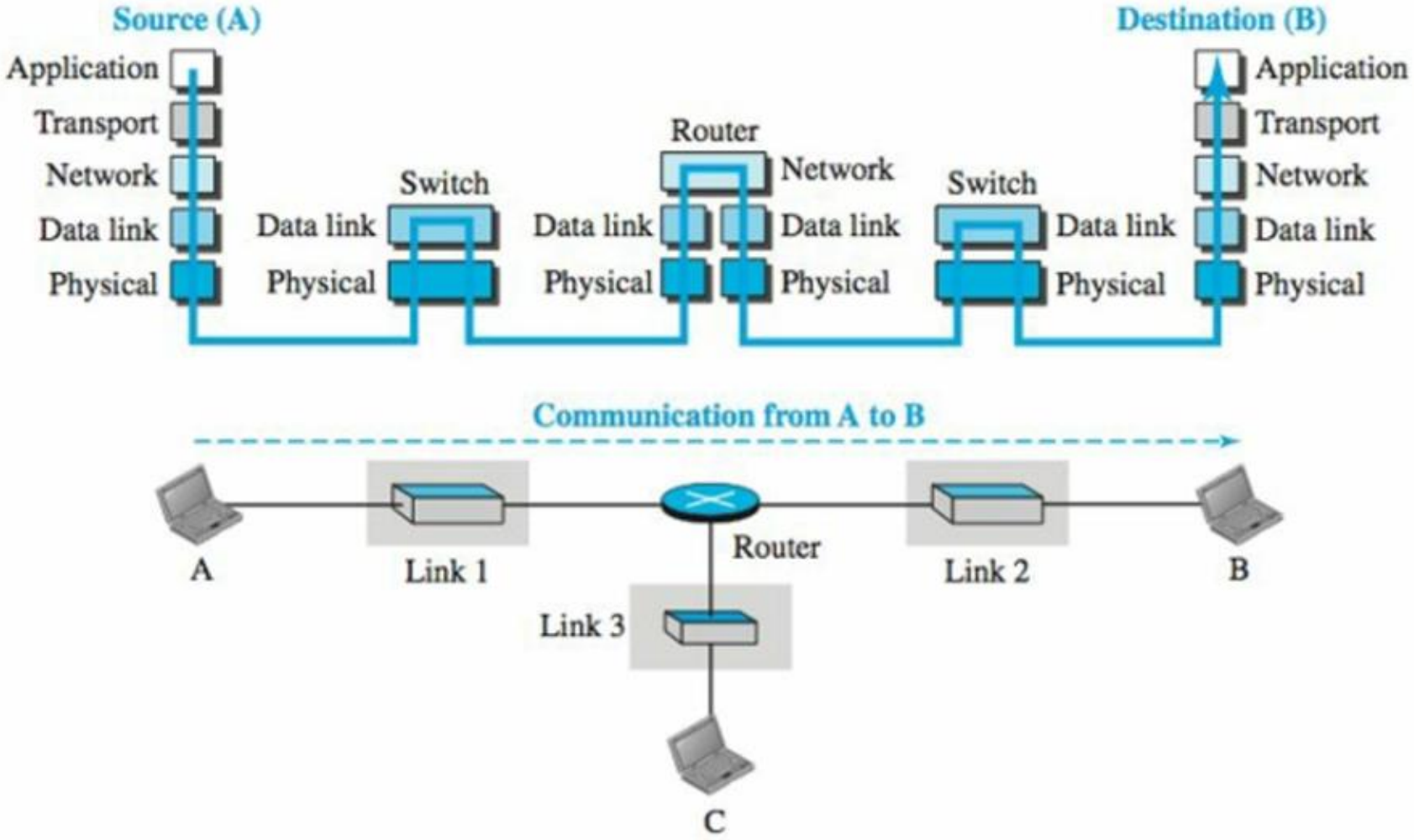


Figure 2.6 *Logical connections between layers of the TCP/IP protocol suite*

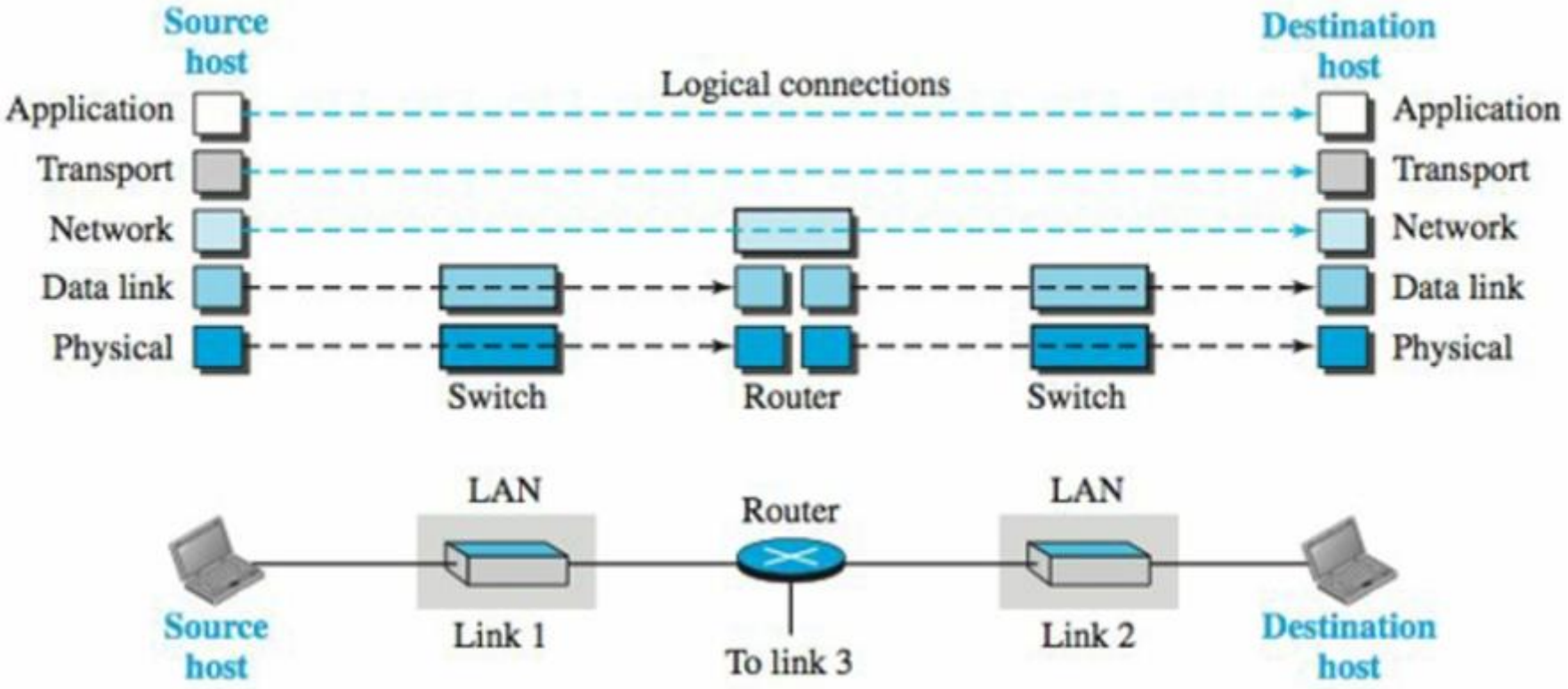


Figure 2.7 *Identical objects in the TCP/IP protocol suite*

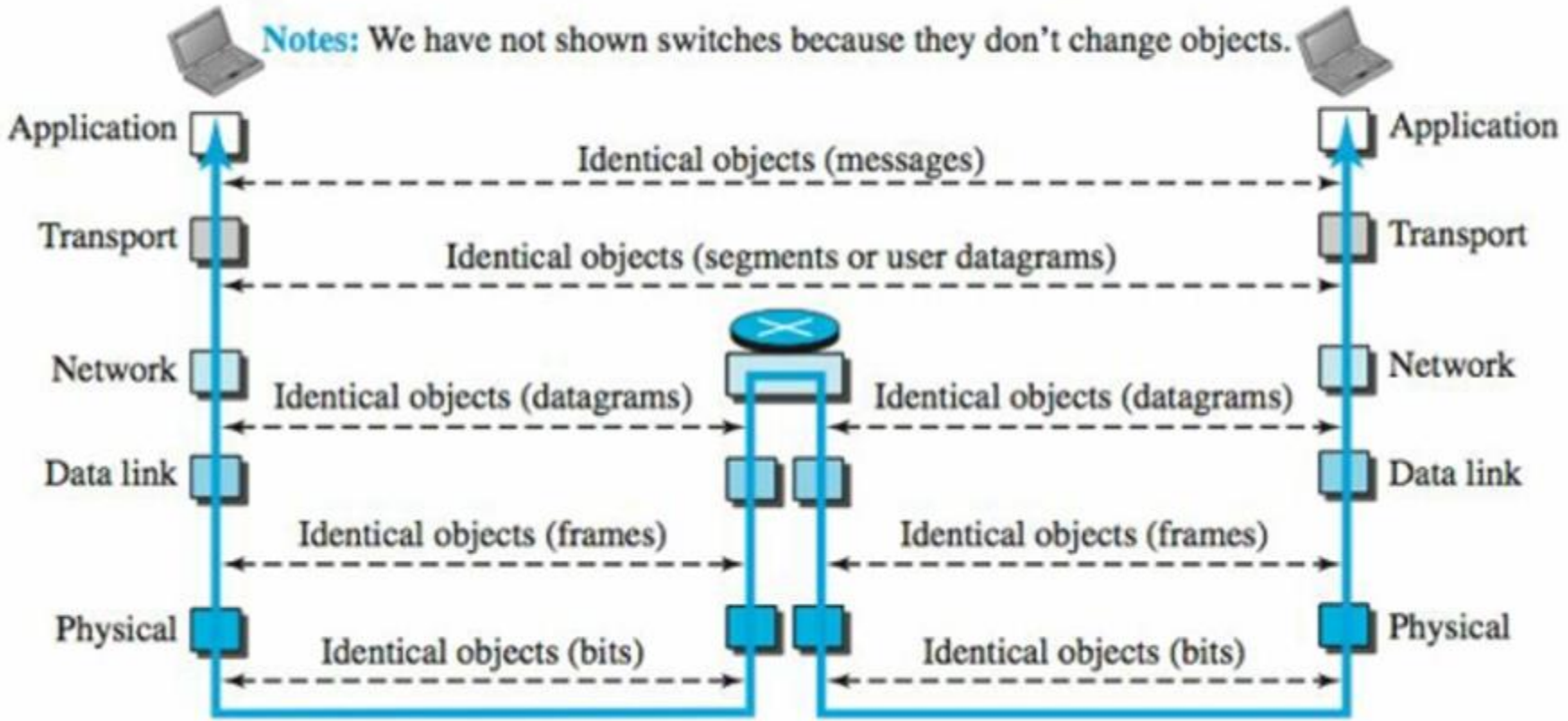


Figure 2.8 *Encapsulation/Decapsulation*

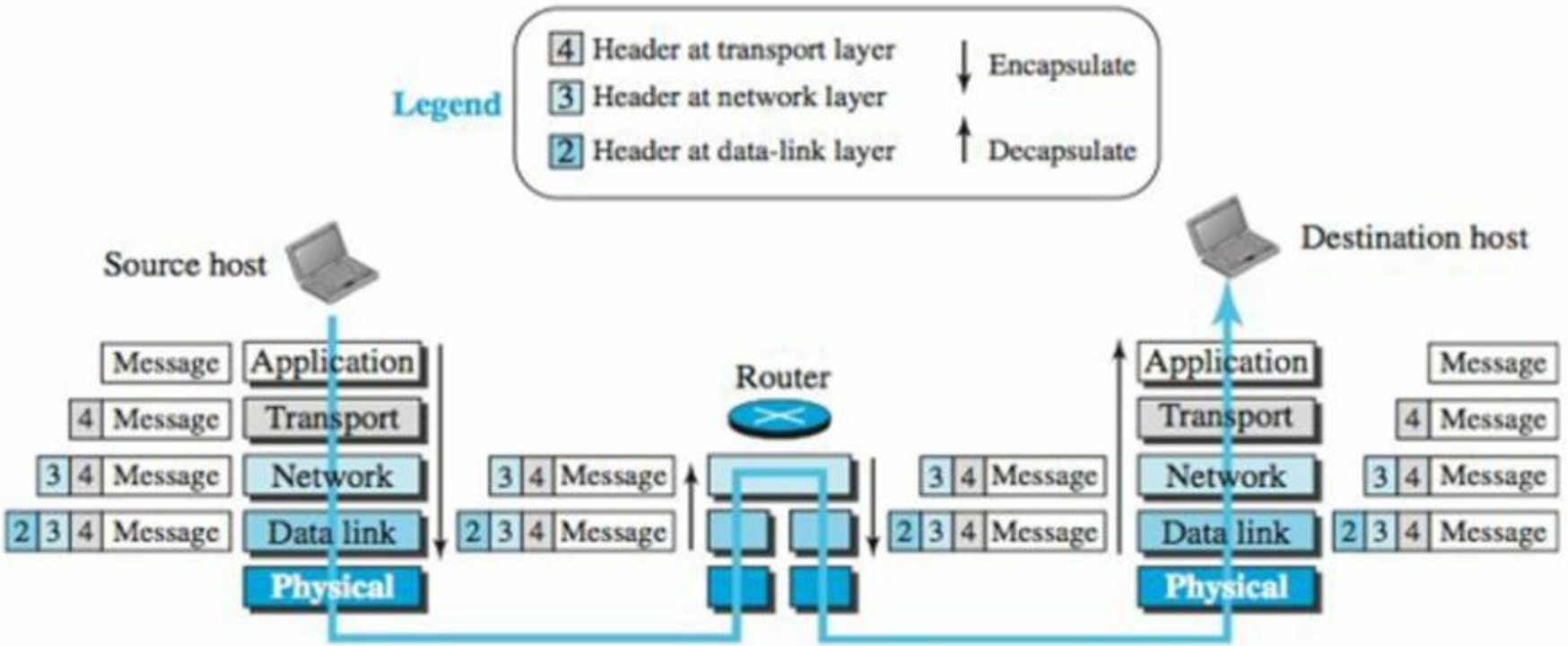
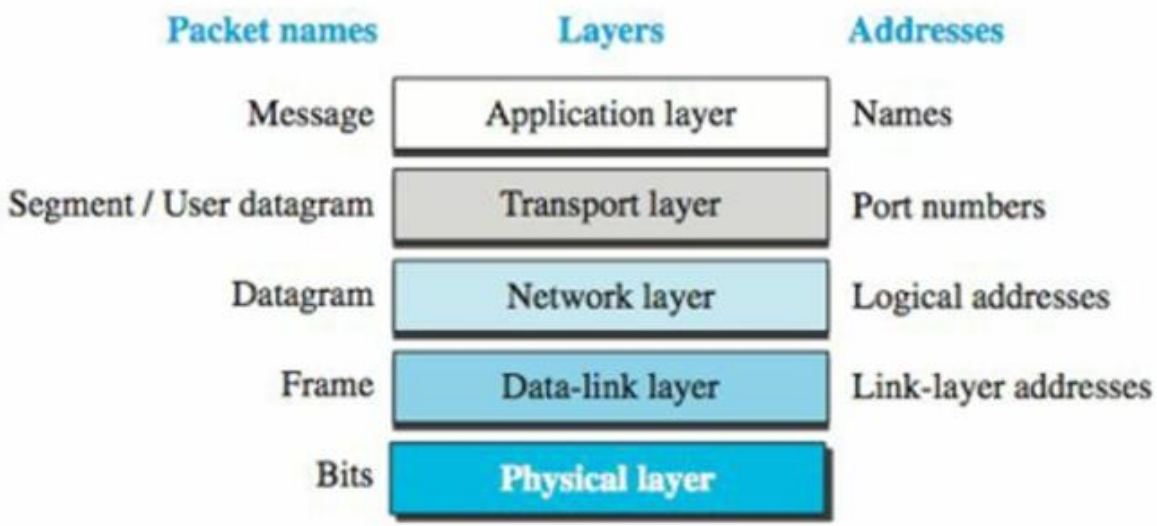


Figure 2.9 *Addressing in the TCP/IP protocol suite*



2-3 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.

Topics discussed in this section:

Layered Architecture
Peer-to-Peer Processes
Encapsulation

Note

ISO is the organization.
OSI is the model.

Figure 2.11 *Seven layers of the OSI model*

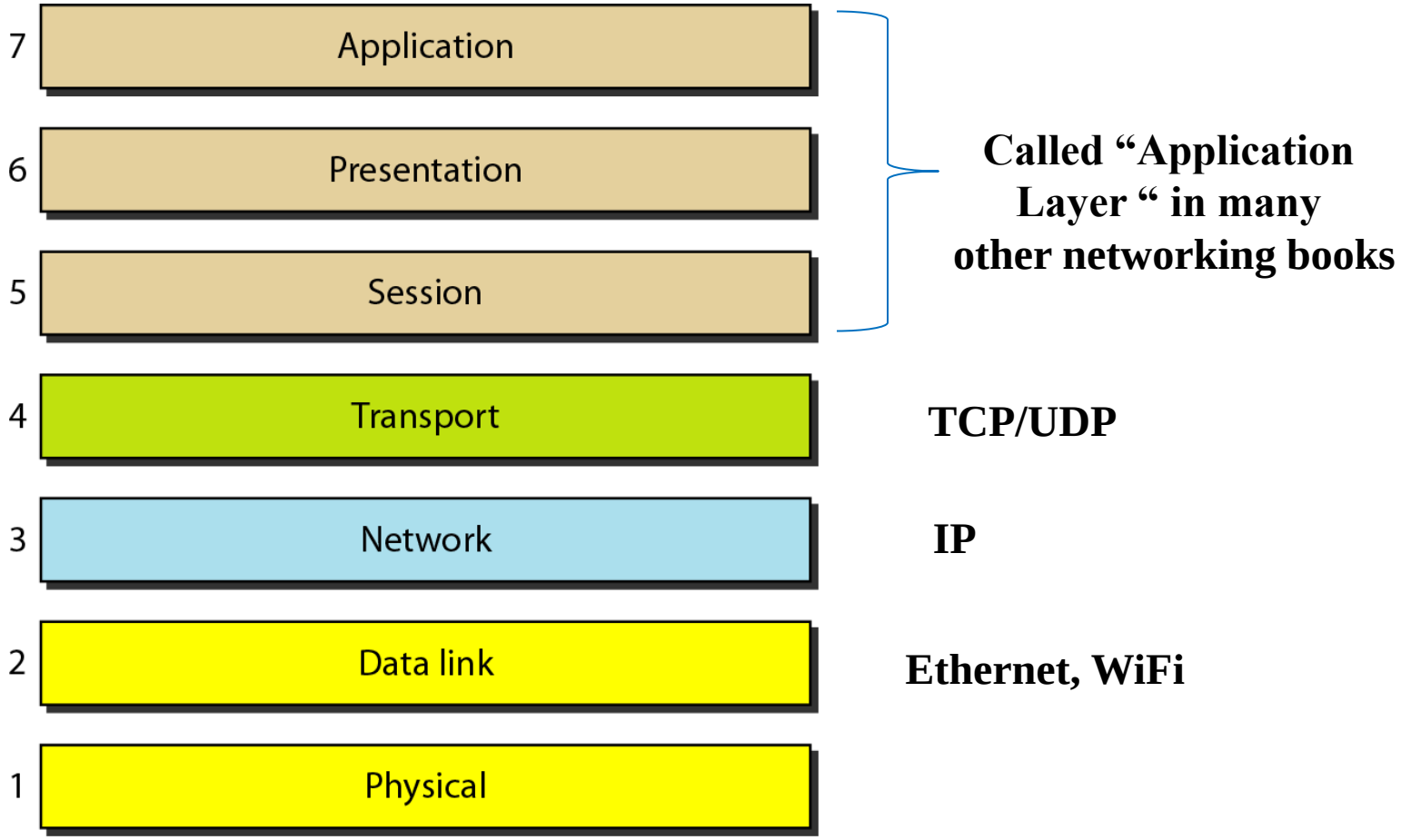


Figure 2.12 *TCP/IP and OSI model*

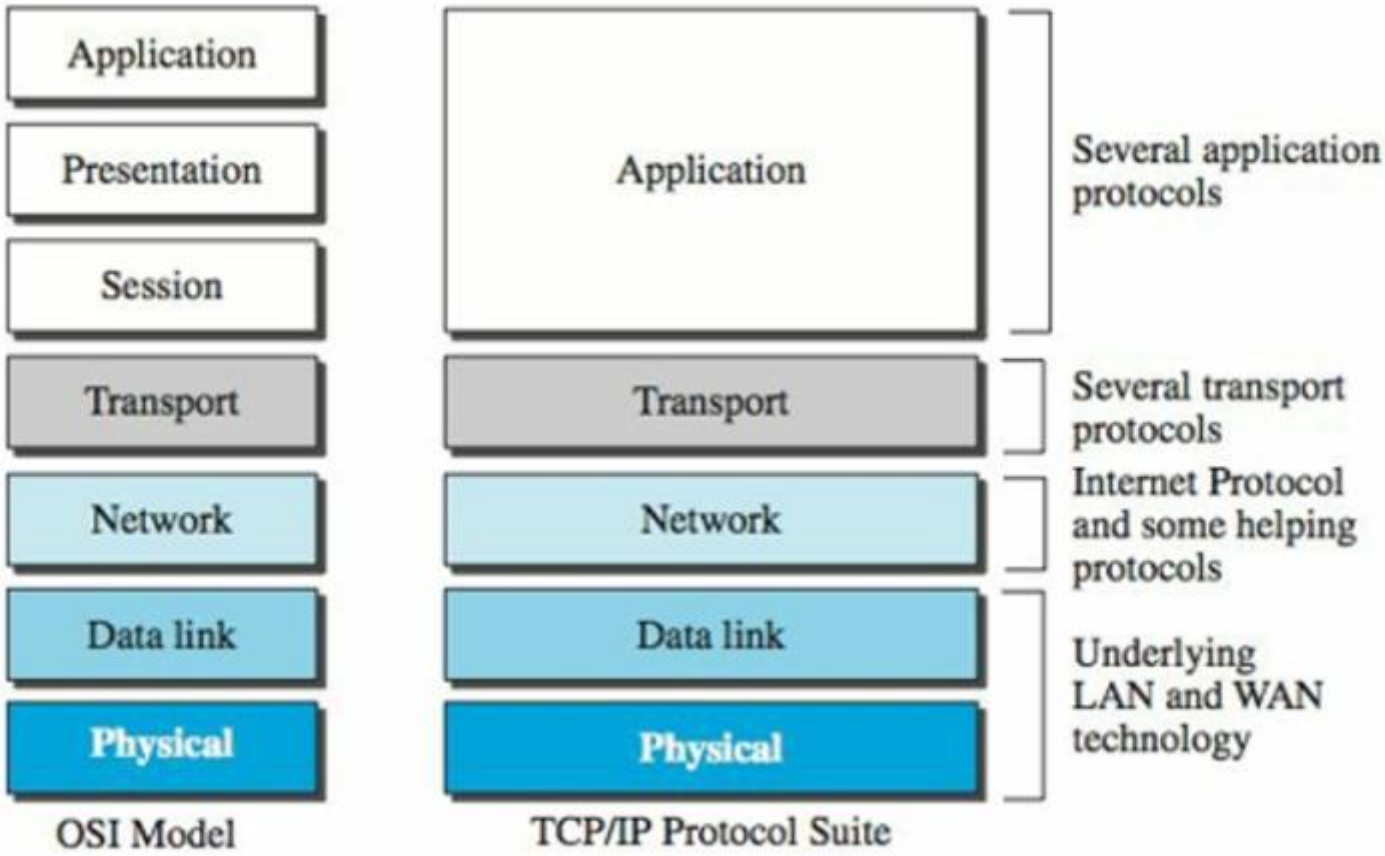


Figure 2.13 *The interaction between layers in the OSI model*

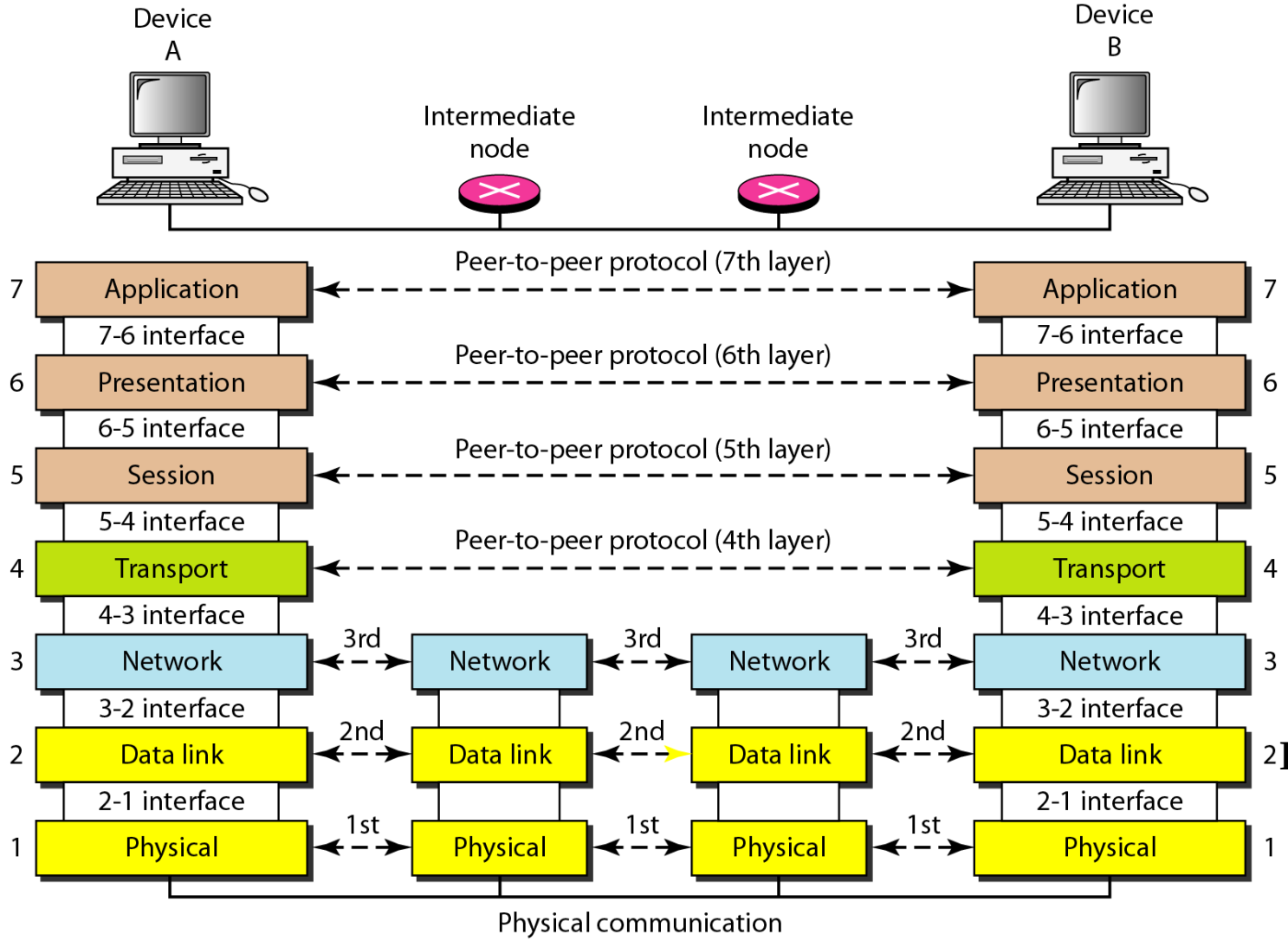
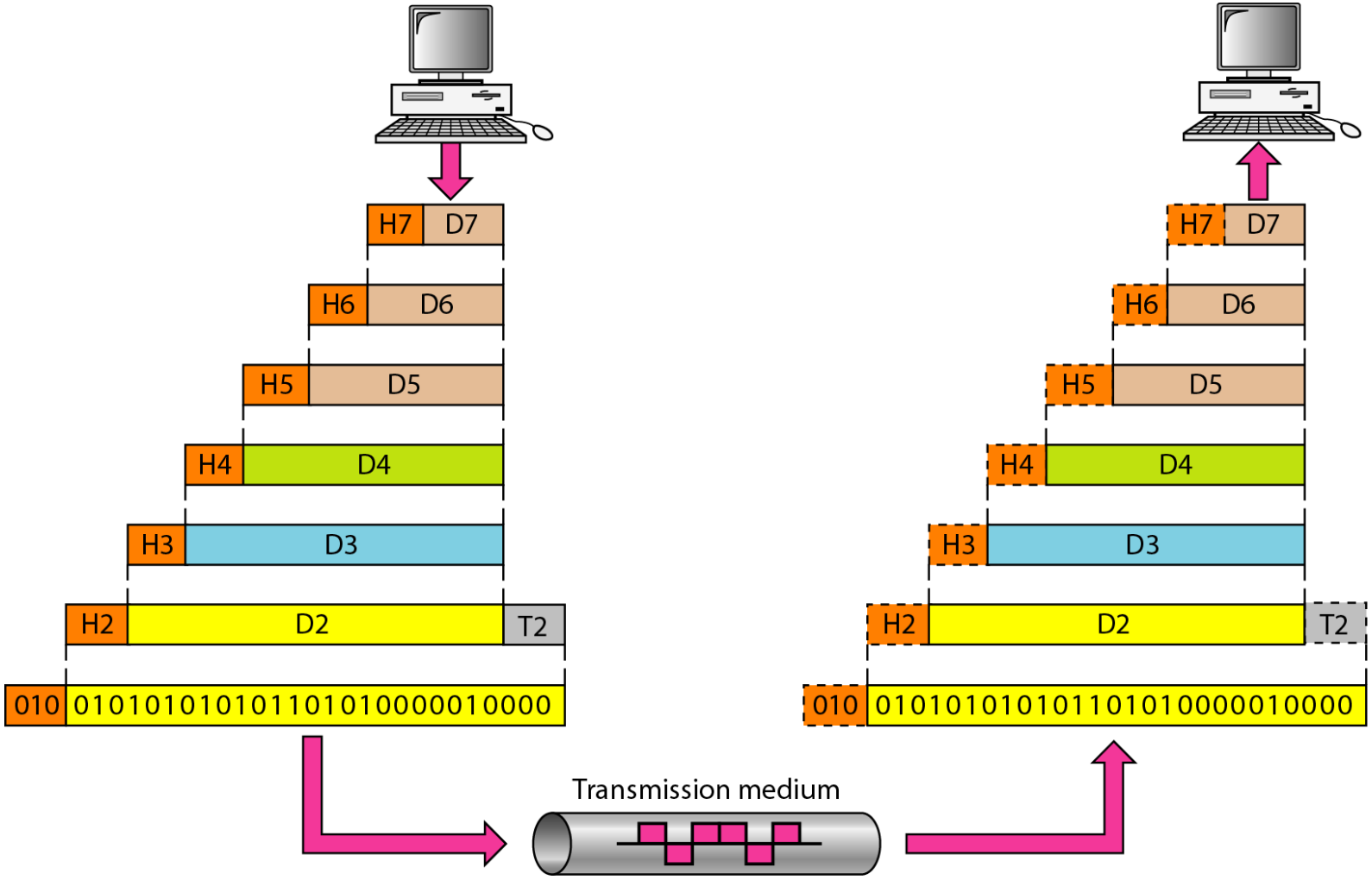


Figure 2.14 *An exchange using the OSI model (encapsulation)*



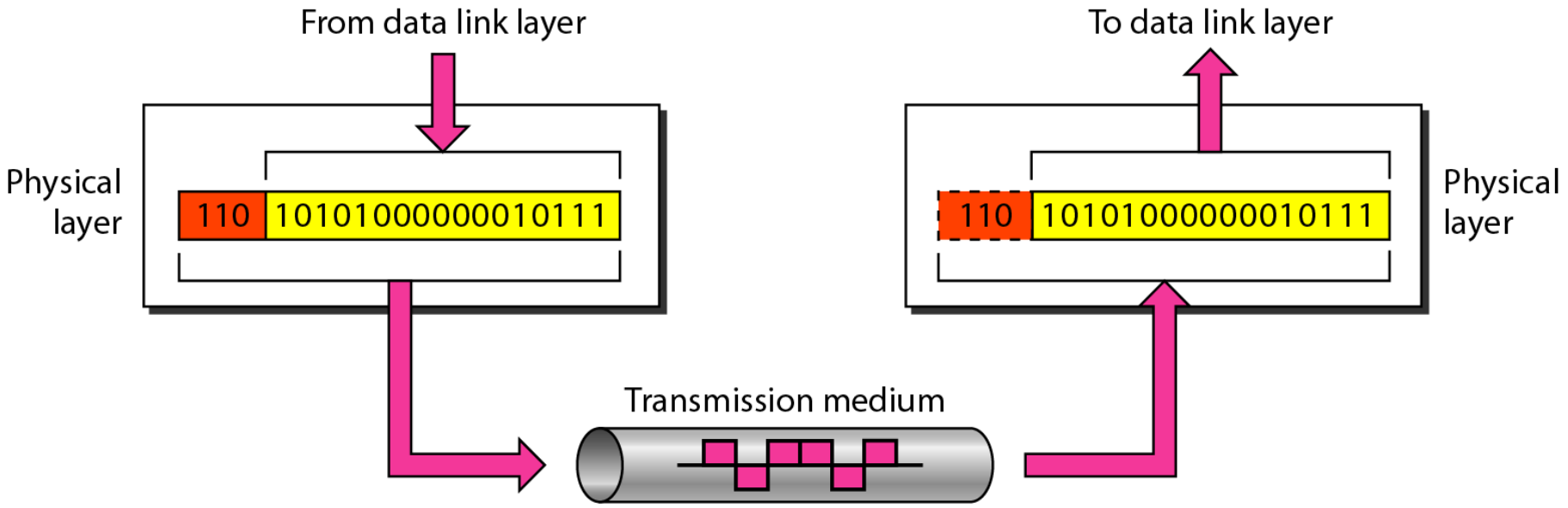
2-3 LAYERS IN THE OSI MODEL

In this section we briefly describe the functions of each layer in the OSI model.

Topics discussed in this section:

Physical Layer
Data Link Layer
Network Layer
Transport Layer
Session Layer
Presentation Layer
Application Layer

Figure 2.15 *Physical layer*



Physical medium:

- **direct digital signals (e.g., Ethernet, optical fiber)**
- **modulated signals (e.g., WiFi, 3G)**

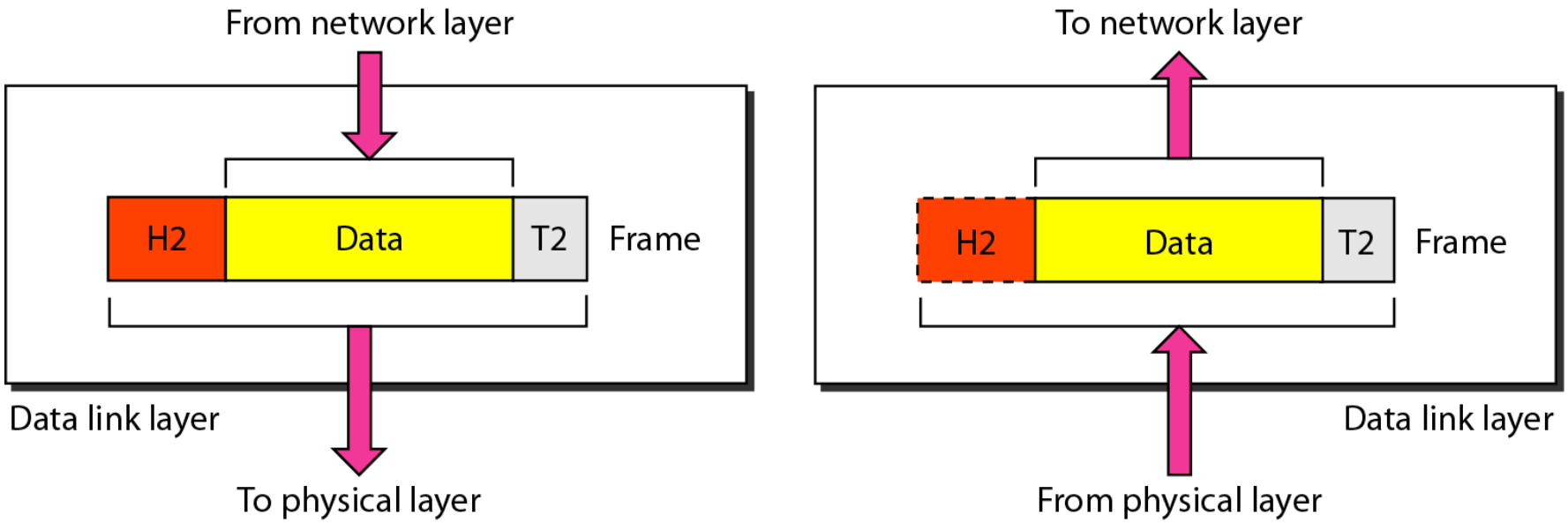
Note

The physical layer is responsible for movements of *individual bits* from one hop (node) to the next.

Physical Layer

- Physical characteristics of interfaces and medium.
- Representation of bits (many different coding).
- Data rate.
- Synchronization of bits.
- Line configuration (point-to-point or multipoint).
- Physical topology (bus, star, ring).
- Transmission mode: simplex, half/full duplex

Figure 2.16 *Data link layer*



Note

The data link layer is responsible for moving *frames* from one hop (node) to the next.

Data Link Layer

- Framing (frame is also called packet in Internet).
- Physical addressing (MAC address)
- Flow control
  - Constrain sender from overwhelming receiver
- Error control
  - Adding error detection/correction bits
  - Detect error, correct error
- Access control
  - Resolve how multiple nodes share the same data channel

Figure 2.17 *Hop-to-hop delivery for data link layer*

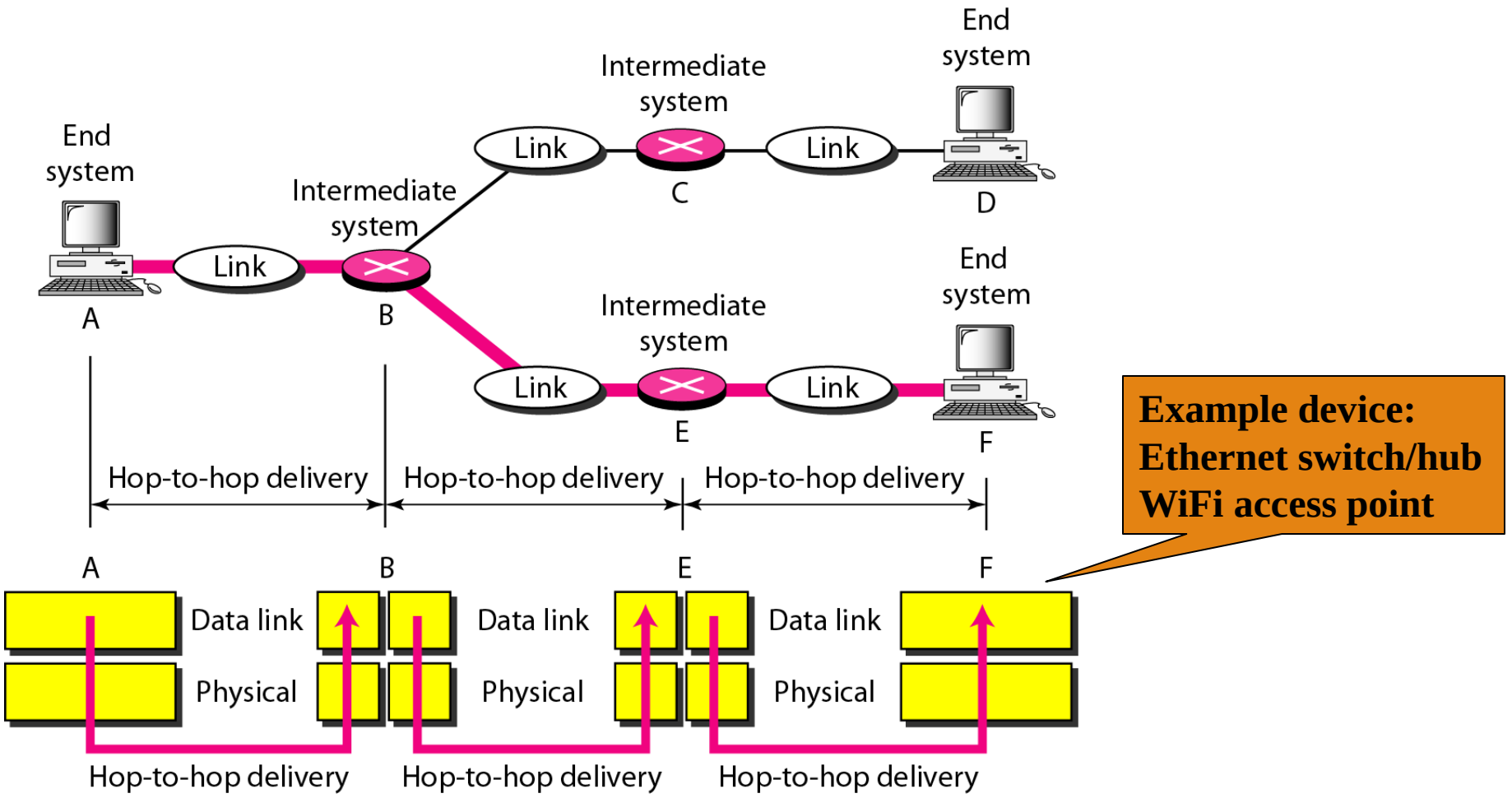
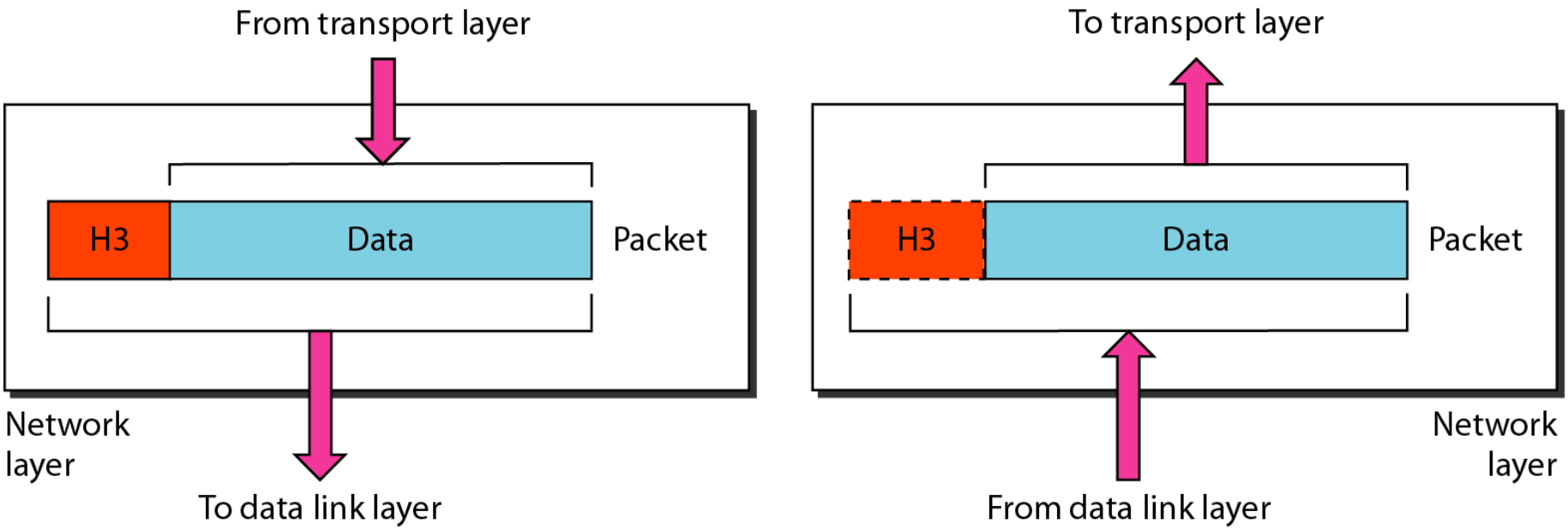


Figure 2.18 *Network layer*



Note

The network layer is responsible for the delivery of individual packets from the source host to the destination host.

The two hosts can be many hops away

The data link layer is responsible for moving *frames* from one hop (node) to the next.

Single hop delivery

Network Layer

- Logical addressing : IP addresses
  - Data link layer address: MAC address
- Routing.

Figure 2.19 *Source-to-destination delivery*

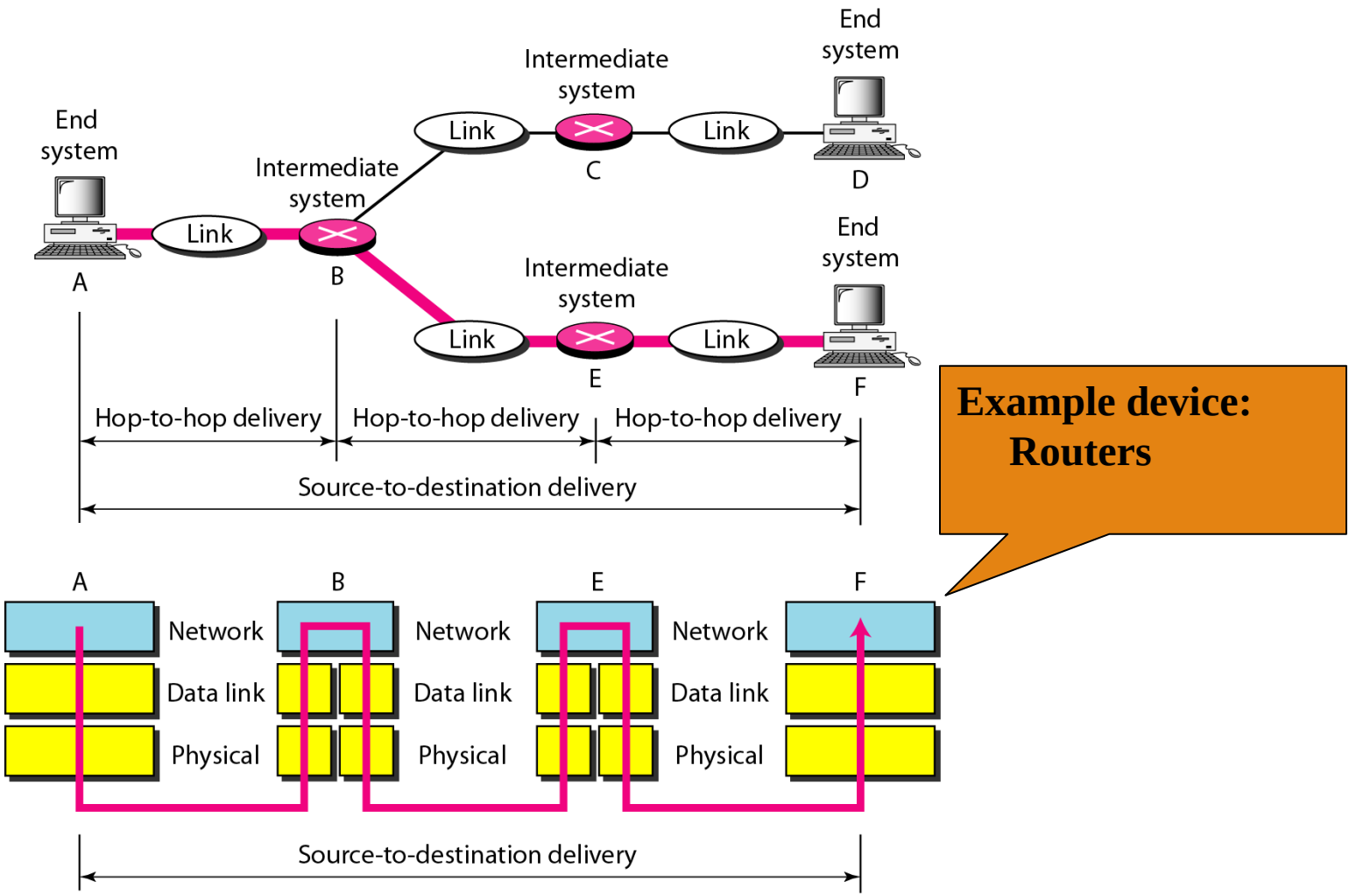
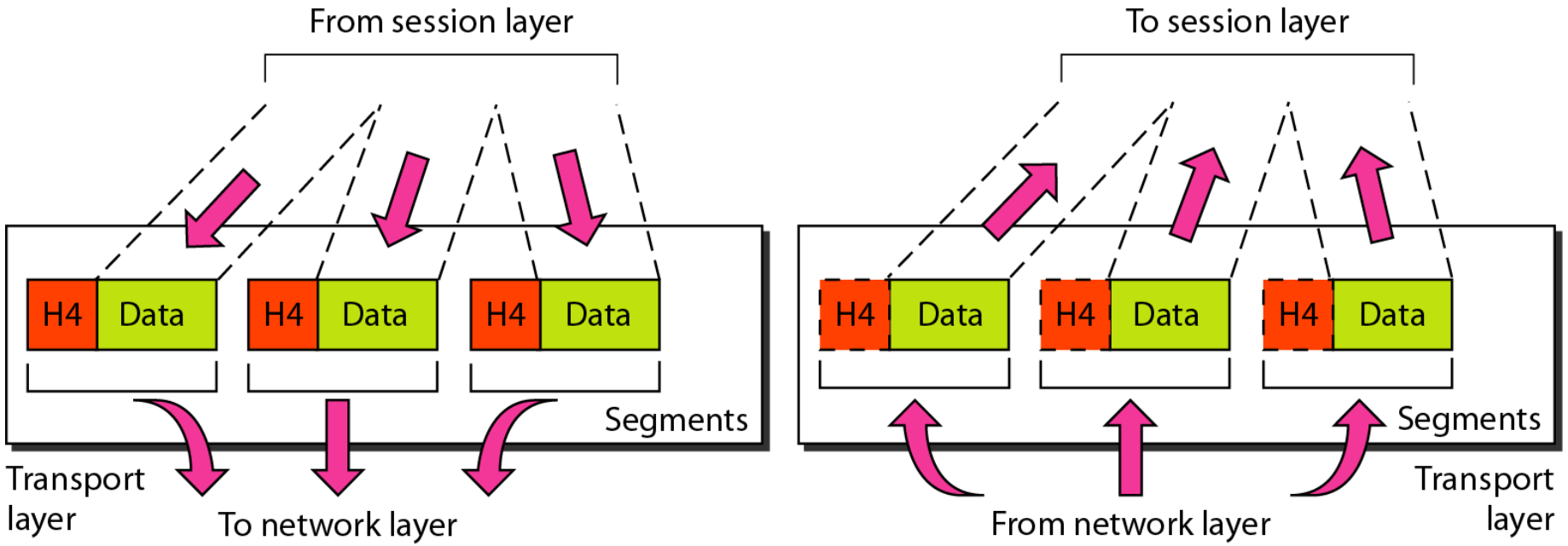


Figure 2.20 *Transport layer*



Note

The transport layer is responsible for the delivery of a message from one *process* to another.

Transport vs. network layer

network layer: logical communication between hosts

transport layer: logical communication between processes

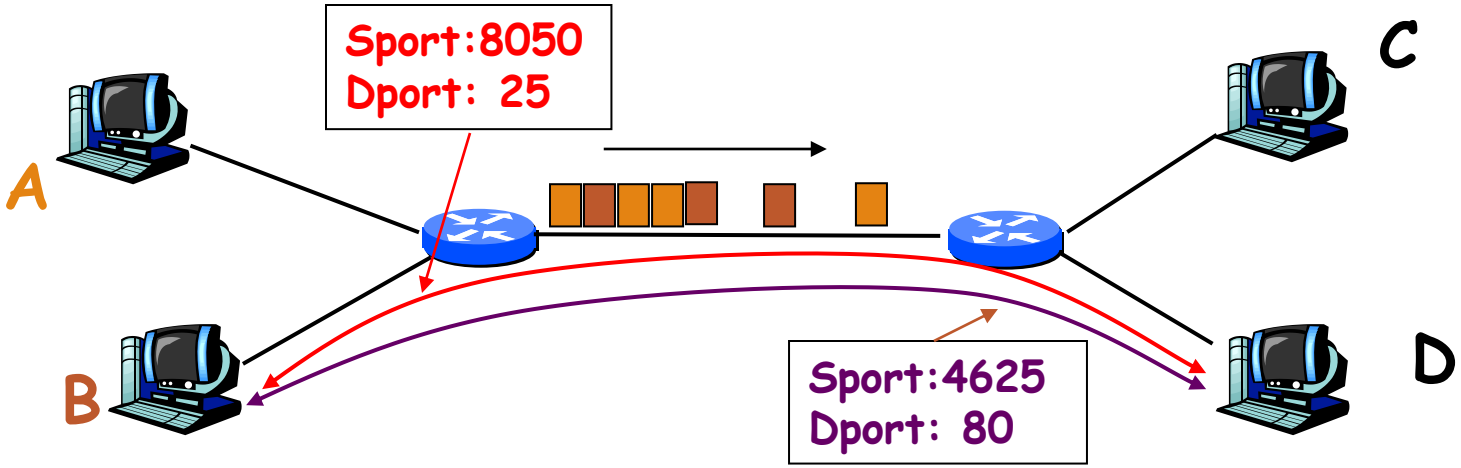
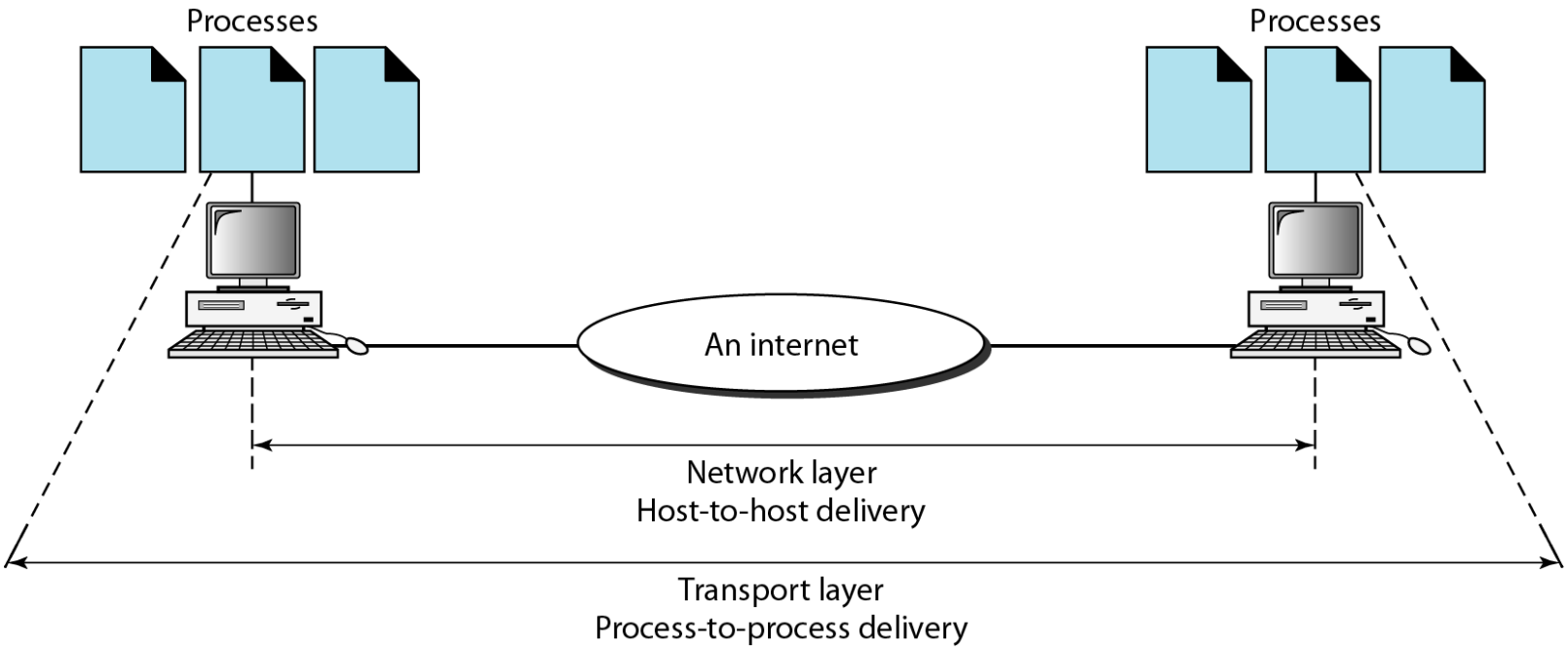


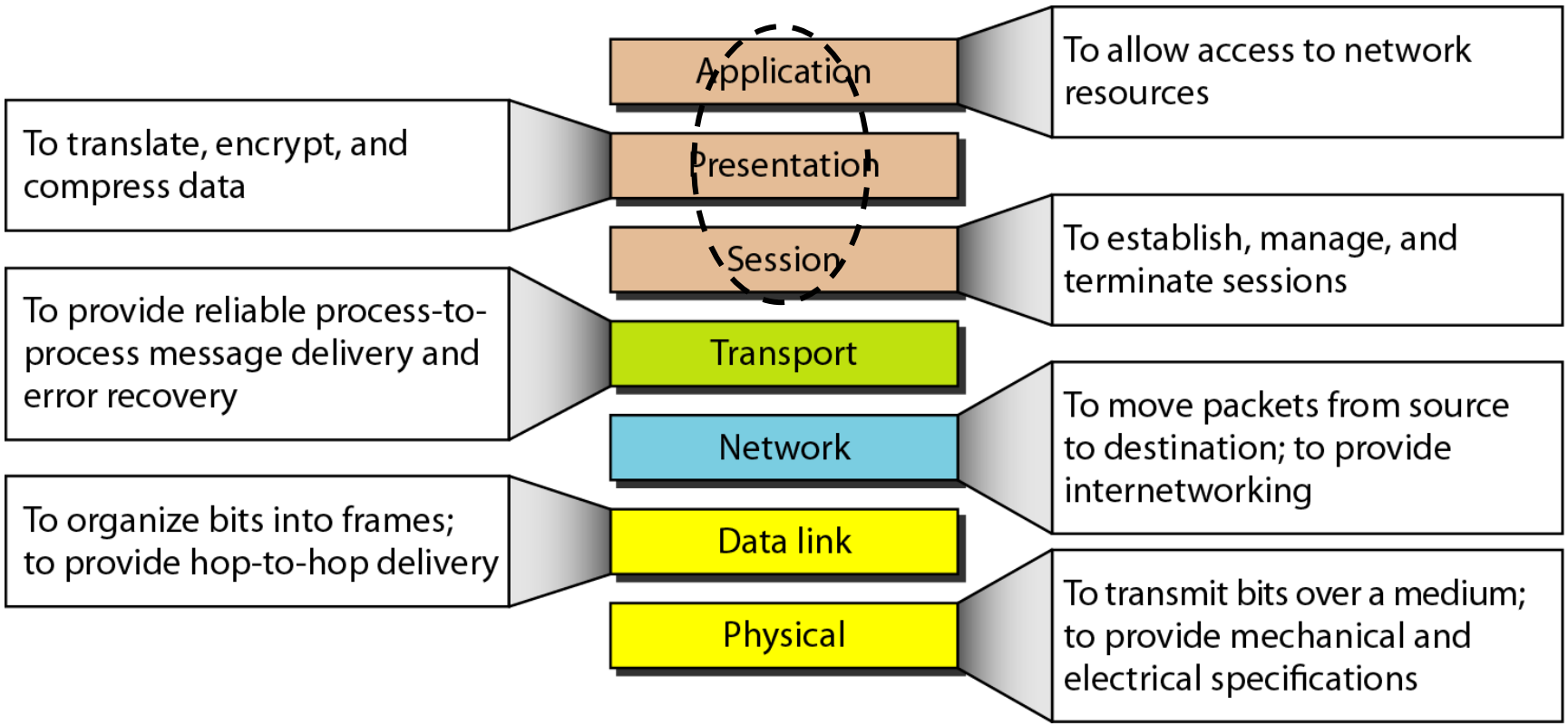
Figure 2.21 *Reliable process-to-process delivery of a message*



Transport Layer

- Service point addressing: service port number
- Segmentation and reassembly.
  - Message break into sequence of packets
  - Reconstruct message at the receiver
- Connection control.
  - Connectionless (UDP), connection-oriented (TCP)
- Flow control.
- Error control.

Figure 2.22 *Summary of layers*



CONCLUSION

1. Now everything is interconnected to some type of network (even appliances, outlets, and more).

2. Understanding the foundation of communications is key to understanding how every device communicates with other devices.

3. The five parts of communications include: the Message, Sender, Receiver, Transmission Media, and Protocol.

4. Networks come in different types; from PANs (Personal Area networks), to WANs (Wide Area Networks – like the Internet).

5. Protocols and Standards are important for understanding how networks are developed, and how data flows in a standardized way.