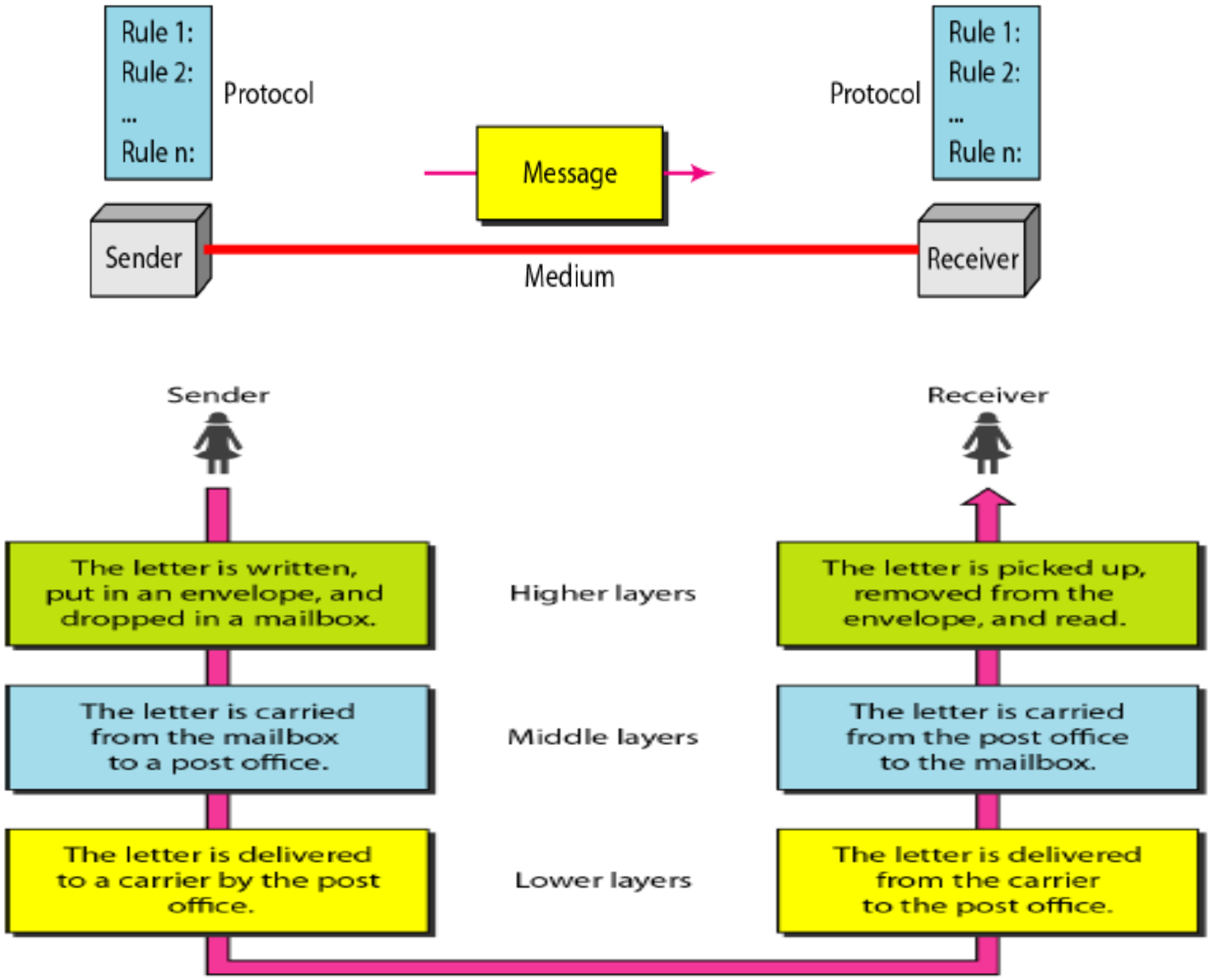
بروتوكولات الشبكات

- إن بروتوكولات الشبكة هي مجموع قوانين تقوم بإجراء اتصال الشبكة من مضيف واحد من خلال الشبكة إلى مضيف آخر.
- والبروتوكول هو وصف رسمي لمجموعة من القواعد والأعراف التي تحكم مظهرًا معينًا لكيفية اتصال الأجهزة على الشبكة.


Rule 1:
Rule 2:
...
Rule n:
Protocol
Message
Protocol
Rule 1:
Rule 2:
...
Rule n:
Sender
Medium
Receiver
Sender
Receiver
The letter is written, put in an envelope, and dropped in a mailbox.
Higher layers
The letter is picked up, removed from the envelope, and read.
The letter is carried from the mailbox to a post office.
Middle layers
The letter is carried from the post office to the mailbox.
The letter is delivered to a carrier by the post office.
Lower layers
The letter is delivered from the carrier to the post office.

- وتحدد البروتوكولات التنسيق والتوقيت والتسلسل والتحكم في الأخطاء في اتصال البيانات.
- وبدون البروتوكولات، لا يمكن للكمبيوتر إنشاء أو إعادة إنشاء تدفق وحدات البت الواردة من كمبيوتر آخر بالتنسيق الأصلي

- تتحكم البروتوكولات في جميع مظاهر اتصال البيانات، والتي تتضمن ما يلي:
- كيفية إنشاء الشبكة المادية
- كيفية اتصال أجهزة الكمبيوتر بالشبكة
- كيفية تنسيق البيانات لإرسالها
- كيفية إرسال تلك البيانات
- كيفية التعامل مع الأخطاء

- وتقوم العديد من المؤسسات واللجان المختلفة بإنشاء قواعد الشبكات والحفاظ عليها.
- تتضمن هذه المجموعات :
- معهد مهندسي الكهرباء والإلكترونيات (IEEE)،
- والمعهد القومي الأمريكي للمعايير (ANSI)،
- واتحاد صناعة الاتصالات عن بعد (TIA)،
- وجمعية الصناعات الإلكترونية (EIA)،
- والاتحاد الدولي للاتصالات عن بعد (ITU)، والذي كان يعرف سابقًا باللجنة الاستشارية للتلغراف والهاتف الدولي (CCITT).


The OSI Model

Why do we need the OSI Model?

To address the problem of networks increasing in size and in number, the International Organization for Standardization (ISO) researched many network schemes and recognized that there was a need to create a network model that would help network builders implement networks that could communicate and work together and therefore, released the OSI reference model in 1984.

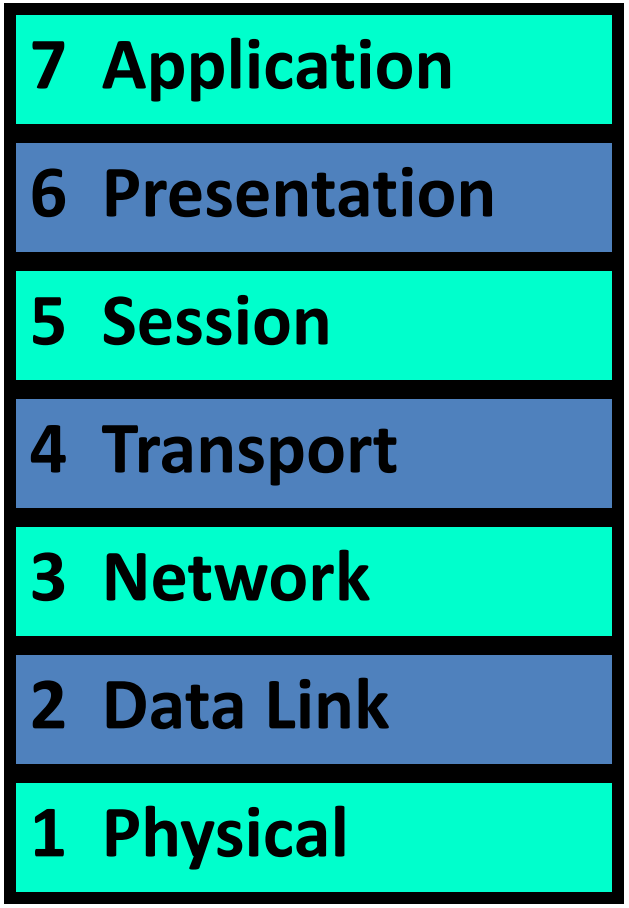
Don’t Get Confused.

ISO - International Organization for Standardization

OSI - Open System Interconnection

IOS - Internetwork Operating System

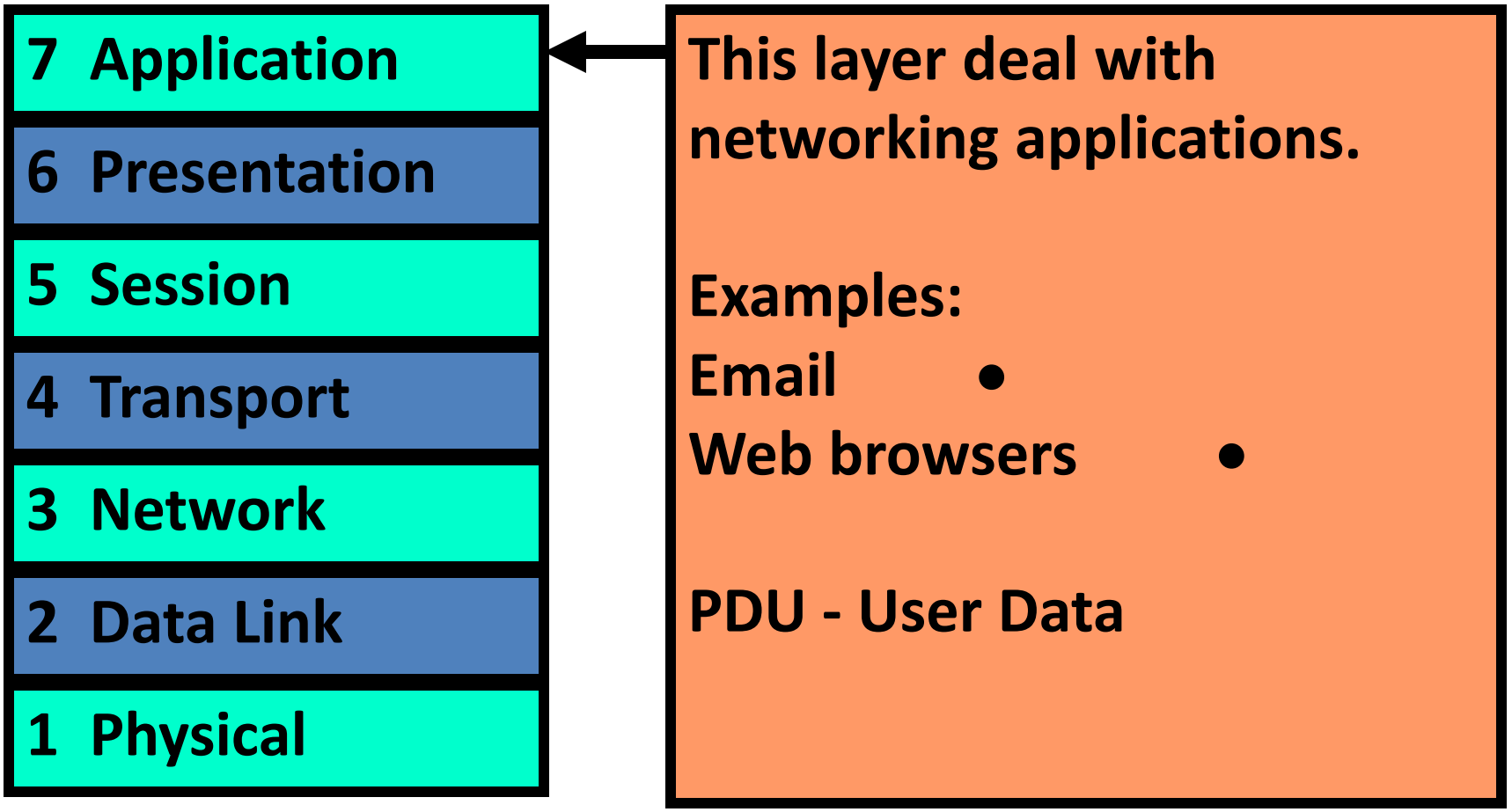
The OSI Reference Model



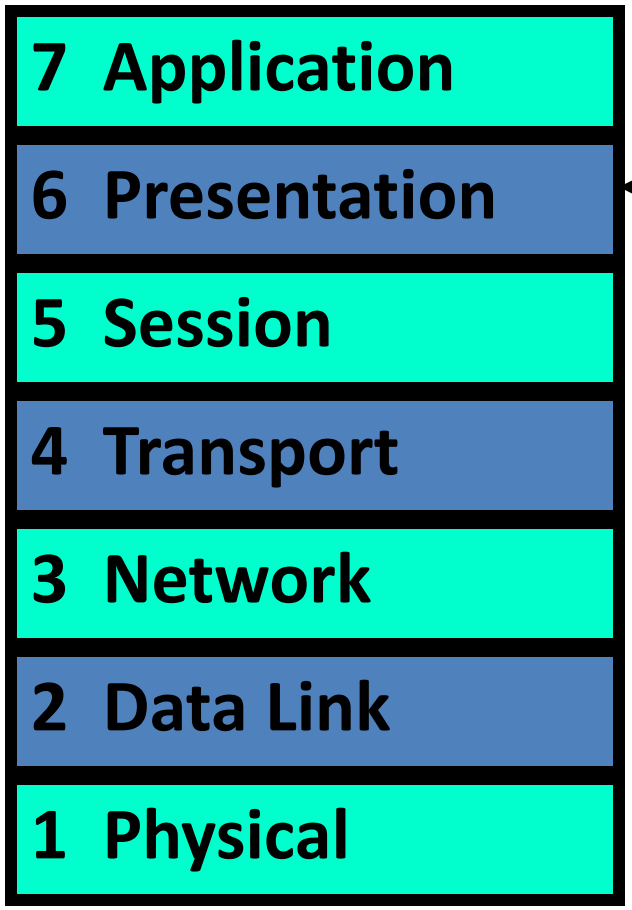
The OSI Model will be used throughout your entire networking career!

Memorize it!

Layer 7 - The Application Layer



Layer 6 - The Presentation Layer

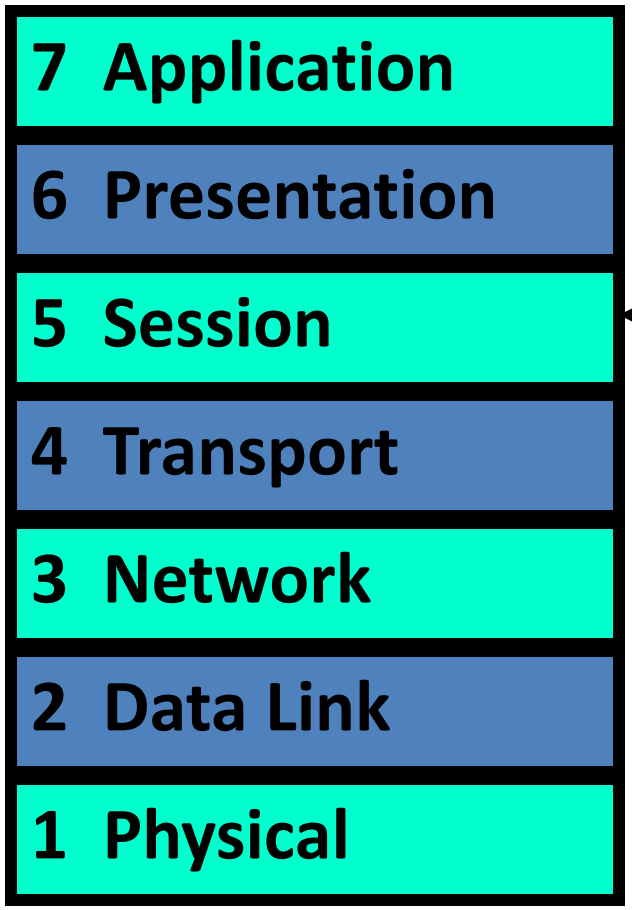


This layer is responsible for presenting the data in the required format which may include:

- Encryption
- Compression

PDU - Formatted Data

Layer 5 - The Session Layer



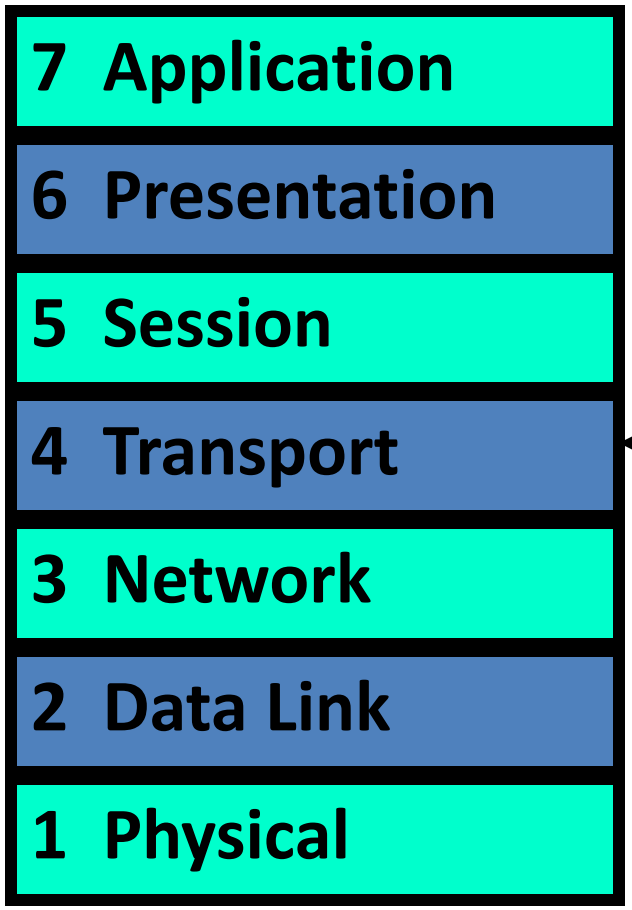
This layer establishes, manages, and terminates sessions between two communicating hosts.

Example:

- Client Software (Used for logging in)

PDU - Formatted Data

Layer 4 - The Transport Layer

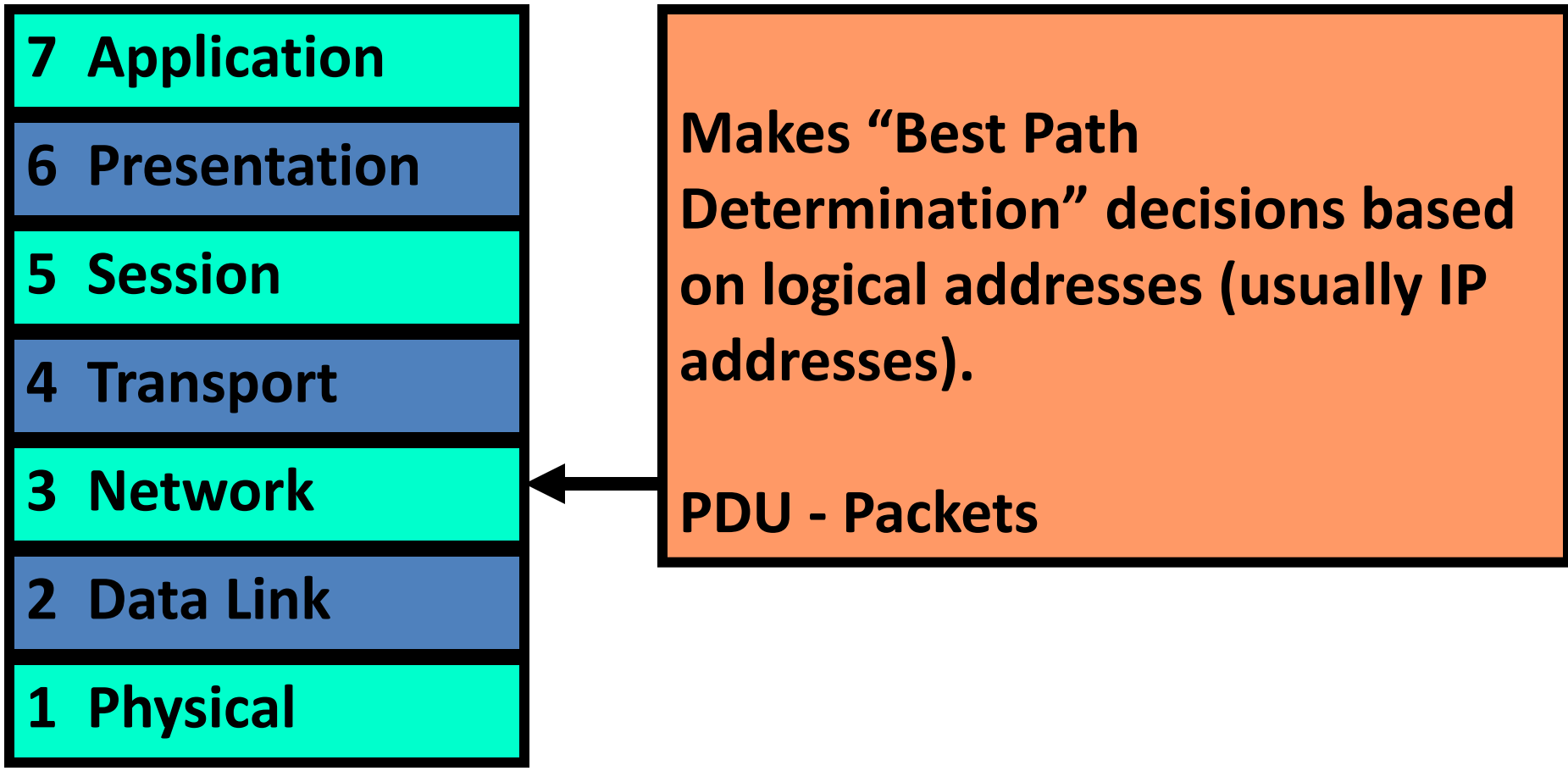


This layer breaks up the data from the sending host and then reassembles it in the receiver.

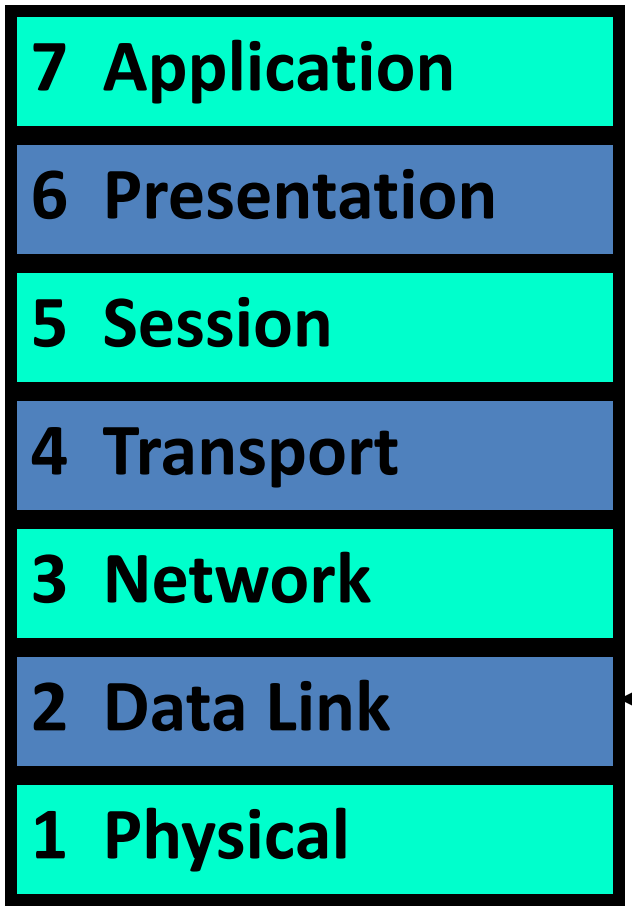
It also is used to insure reliable data transport across the network.

PDU - Segments

Layer 3 - The Network Layer



Layer 2 - The Data Link Layer

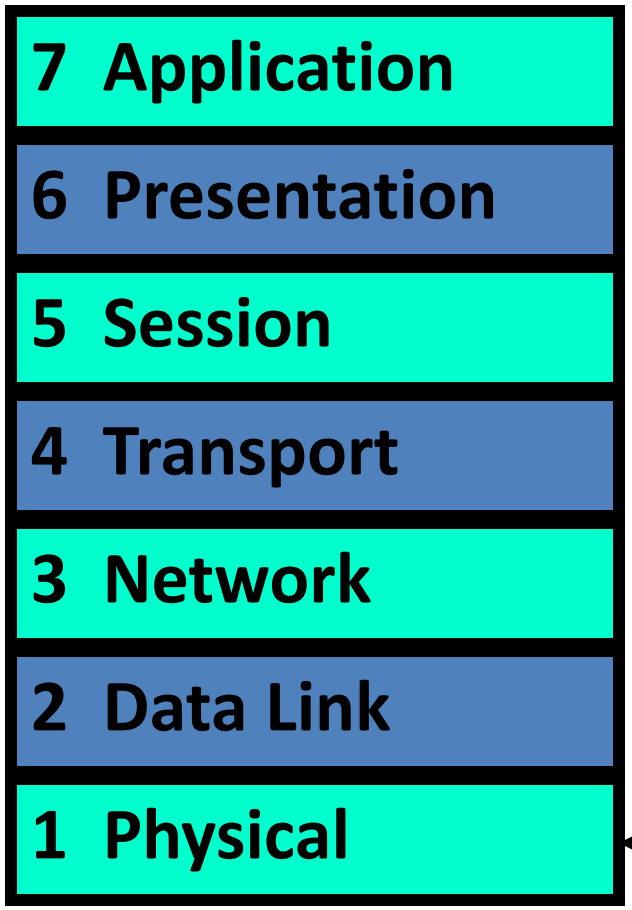


This layer provides reliable transit of data across a physical link.

Makes decisions based on physical addresses (usually MAC addresses).

PDU - Frames

Layer 1 - The Physical Layer



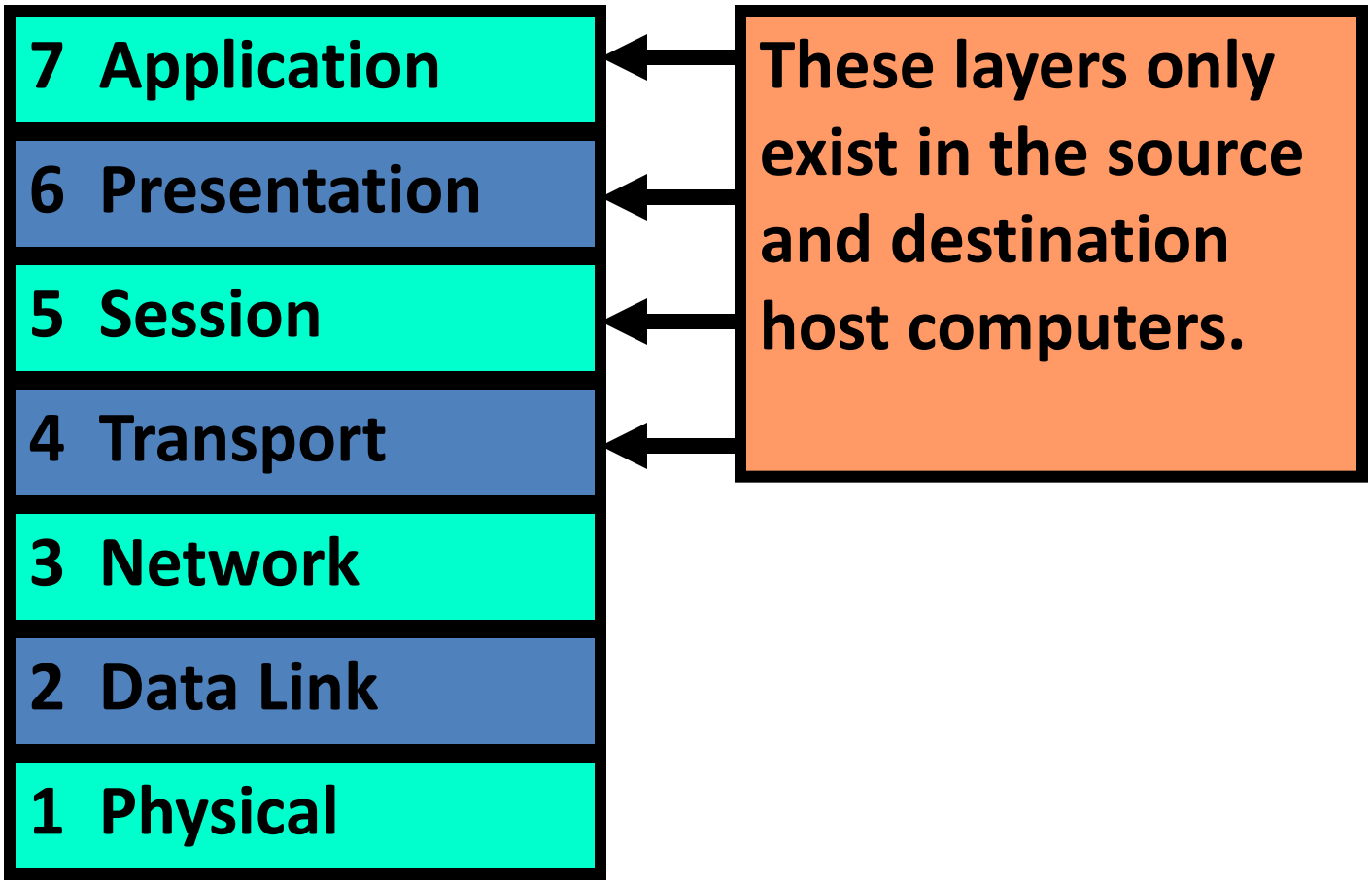
This is the physical media through which the data, represented as electronic signals, is sent from the source host to the destination host.

Examples:

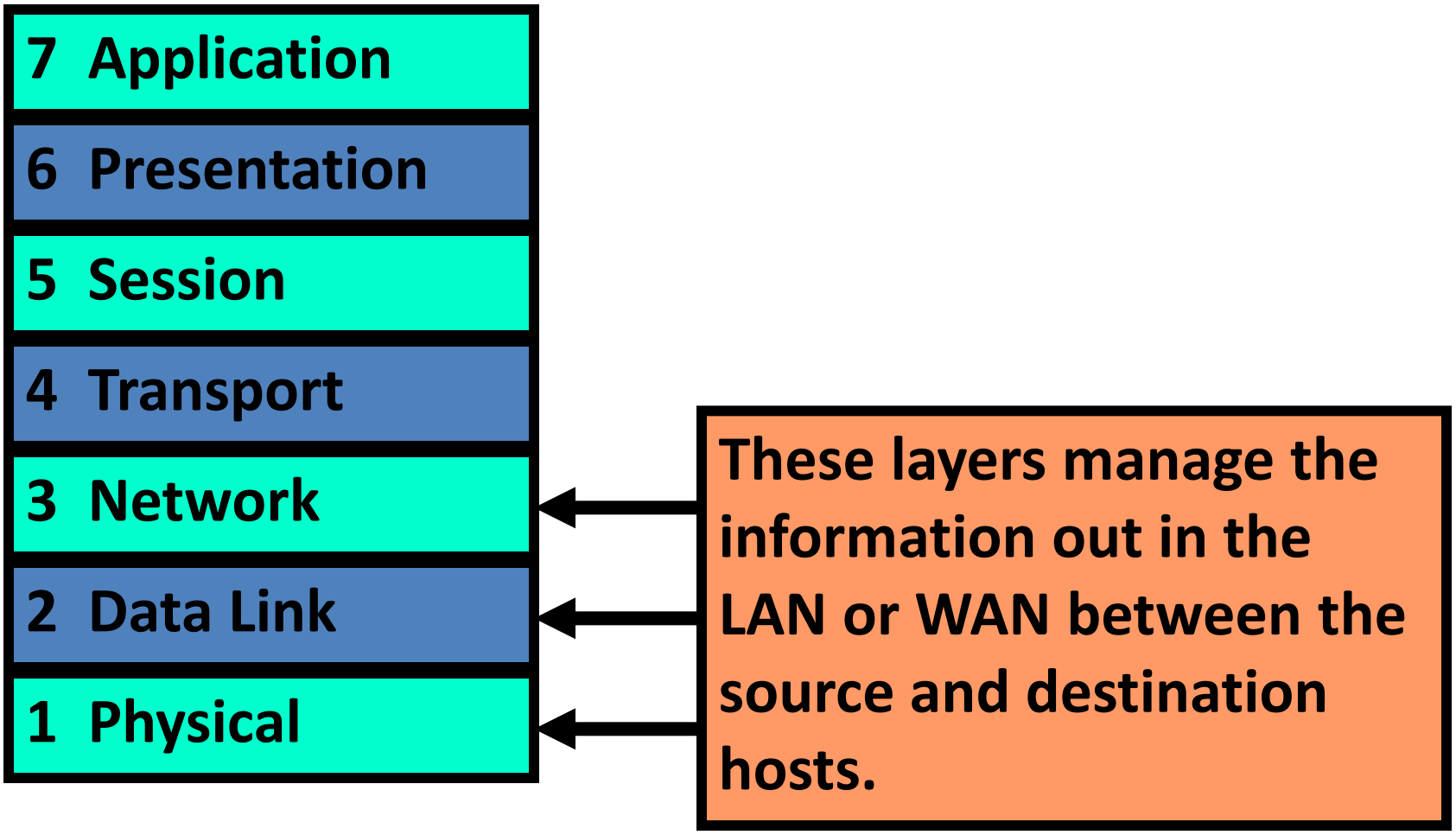
- CAT5 (what we have)
- Coaxial (like cable TV)
- Fiber optic

PDU - Bits

Host Layers


7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical
These layers only exist in the source and destination host computers.

Media Layers



The TCP/IP Model

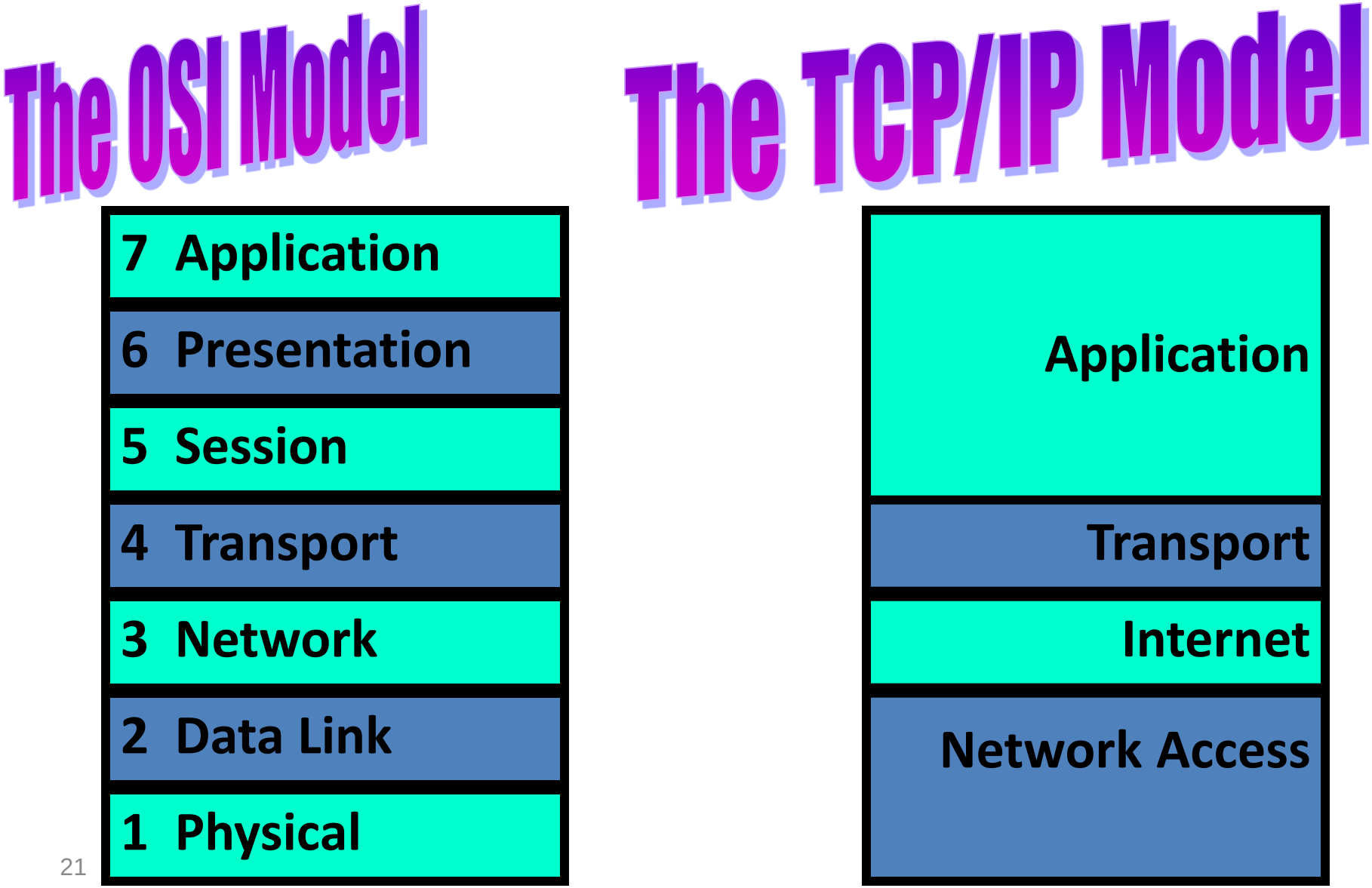
Why Another Model?

Although the OSI reference model is universally recognized, the historical and technical open standard of the Internet is Transmission Control Protocol / Internet Protocol (TCP/IP).

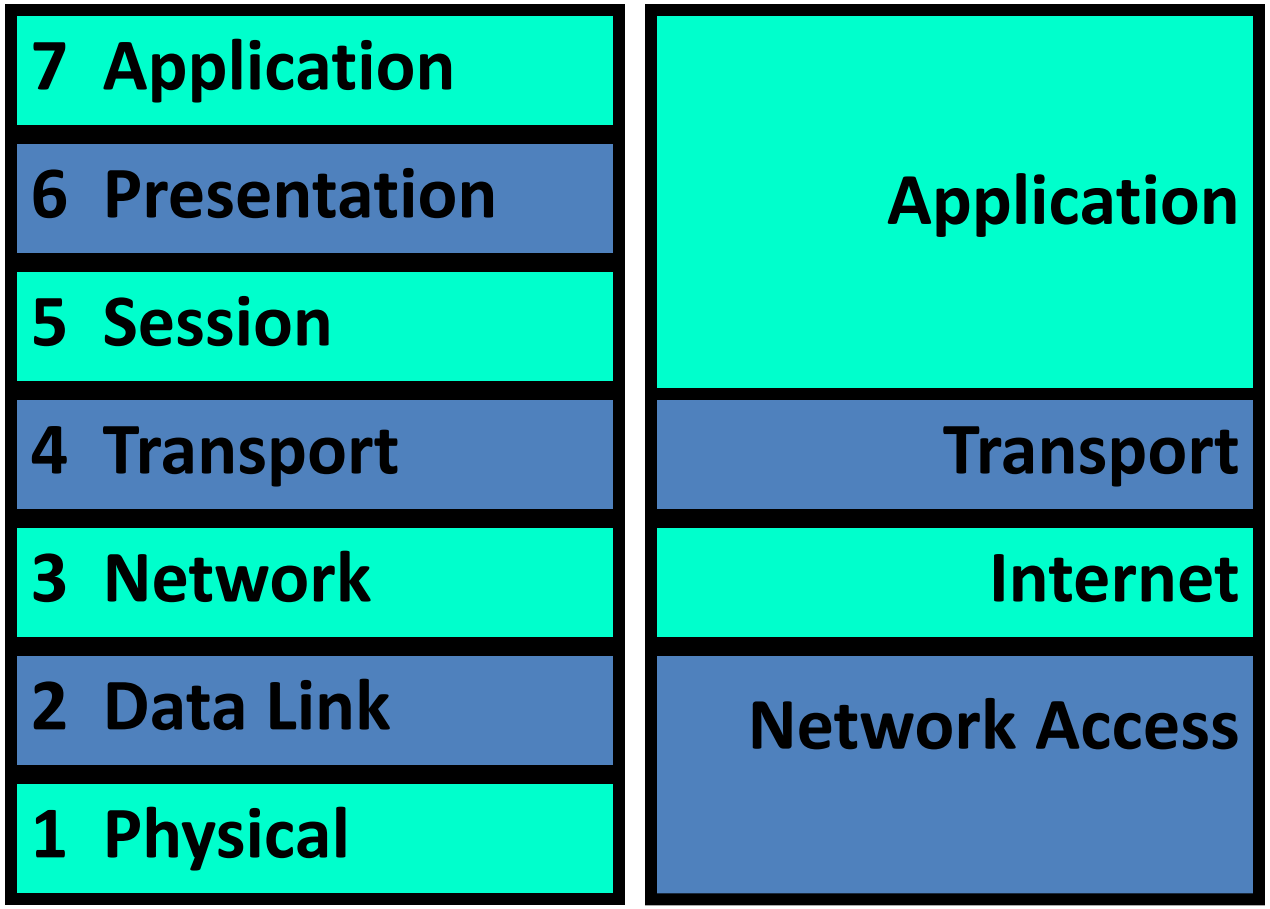
The TCP/IP reference model and the TCP/IP protocol stack make data communication possible between any two computers, anywhere in the world, at nearly the speed of light.

The U.S. Department of Defense (DoD) created the TCP/IP reference model because it wanted a network that could survive any conditions, even a nuclear war.

Don’t Confuse the Models

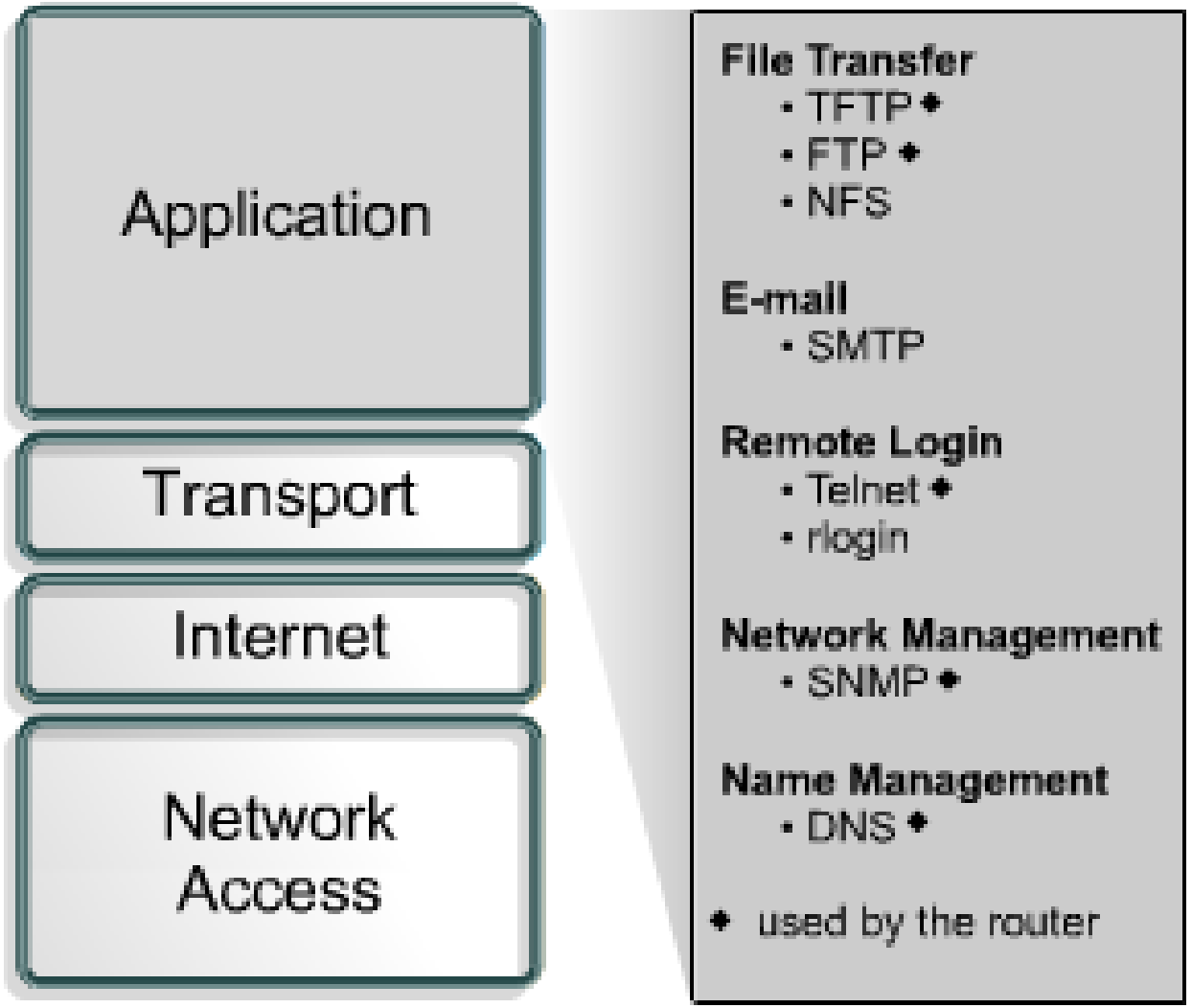


2 Models
Side-By-Side



The Application Layer

The application layer of the TCP/IP model handles high-level protocols, issues of representation, encoding, and dialog control.



The Transport Layer

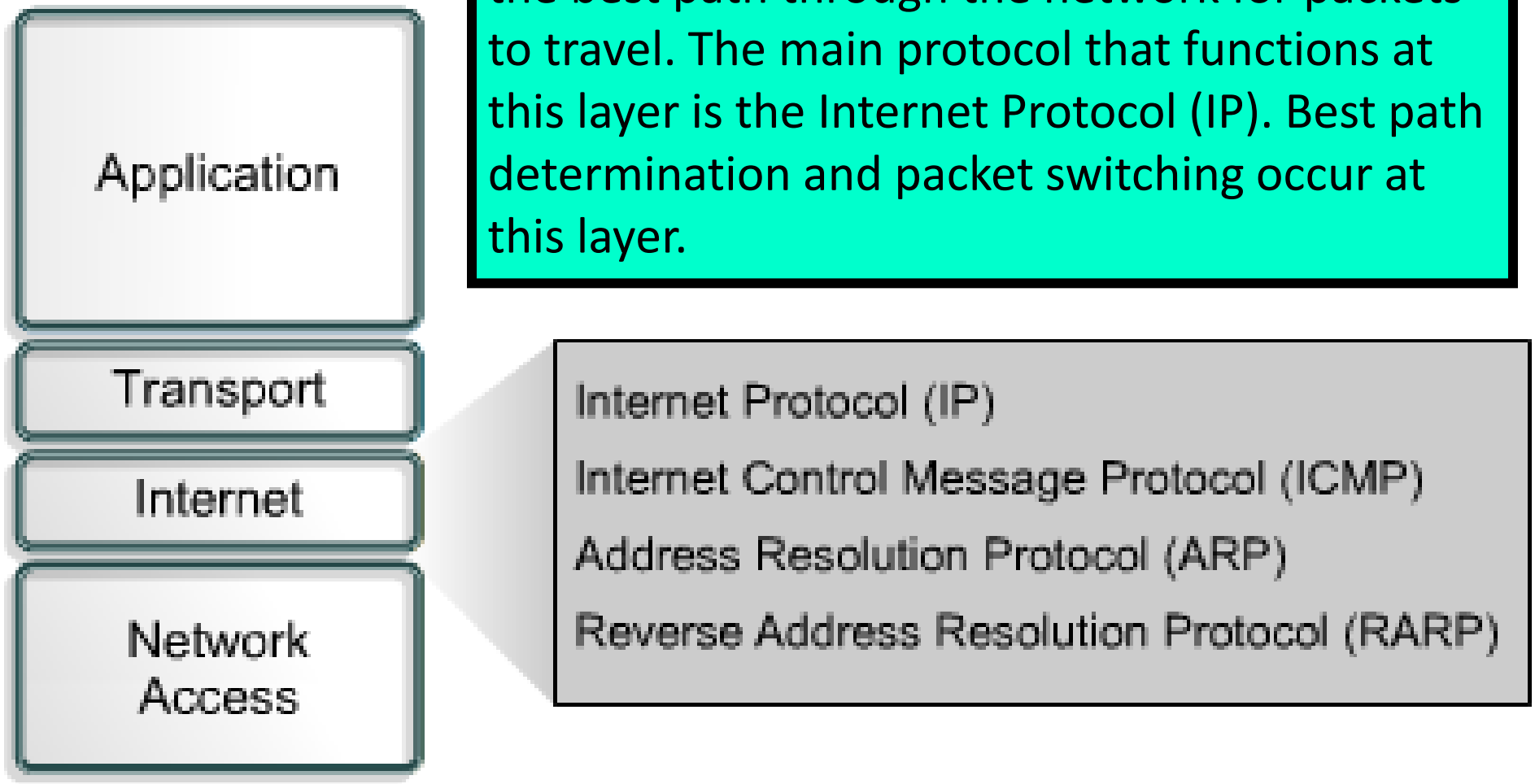
Transmission Control Protocol (TCP)
Connection-Oriented

User Datagram Protocol (UDP)
Connectionless

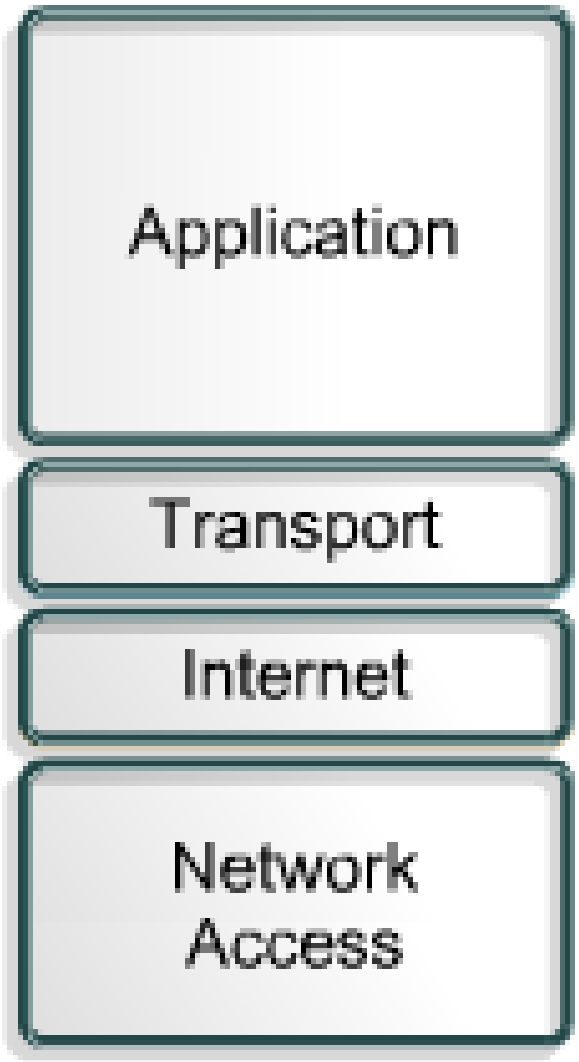
The transport layer provides transport services from the source host to the destination host. It constitutes a logical connection between these endpoints of the network. Transport protocols segment and reassemble upper-layer applications into the same data stream between endpoints.
The transport layer data stream provides end-to-end transport services.

The Internet Layer

The purpose of the Internet layer is to select the best path through the network for packets to travel. The main protocol that functions at this layer is the Internet Protocol (IP). Best path determination and packet switching occur at this layer.



The Network Access Layer

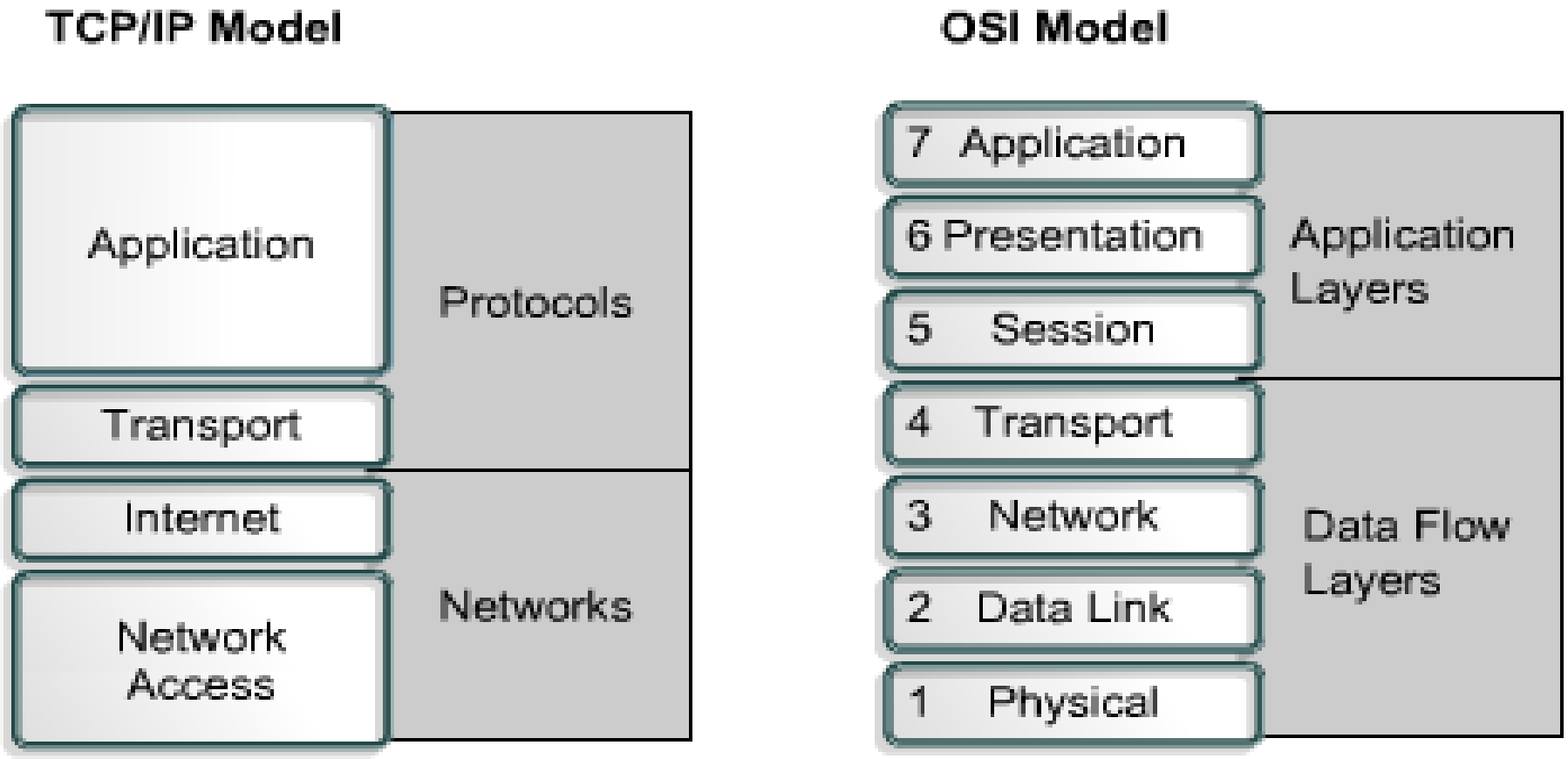


The network access layer is also called the host-to-network layer. It the layer that is concerned with all of the issues that an IP packet requires to actually make a physical link to the network media. It includes LAN and WAN details, and all the details contained in the OSI physical and data-link layers. NOTE: ARP & RARP work at both the Internet and Network Access Layers.

- Ethernet
- Fast Ethernet
- SLIP & PPP
- FDDI
- ATM, Frame Relay & SMDS
- ARP
- Proxy ARP
- RARP

Comparing TCP/IP & OSI Models

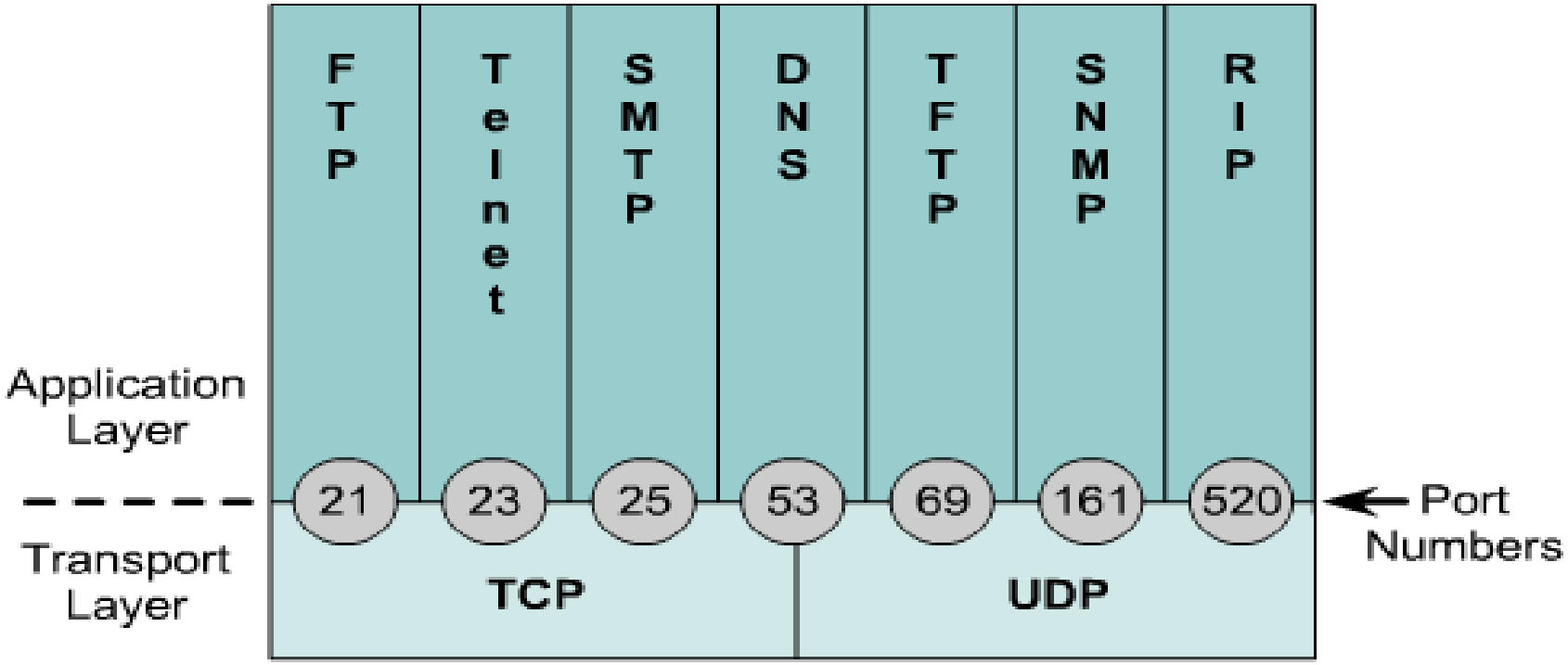
NOTE: TCP/IP transport layer using UDP does not always guarantee reliable delivery of packets as the transport layer in the OSI model does.



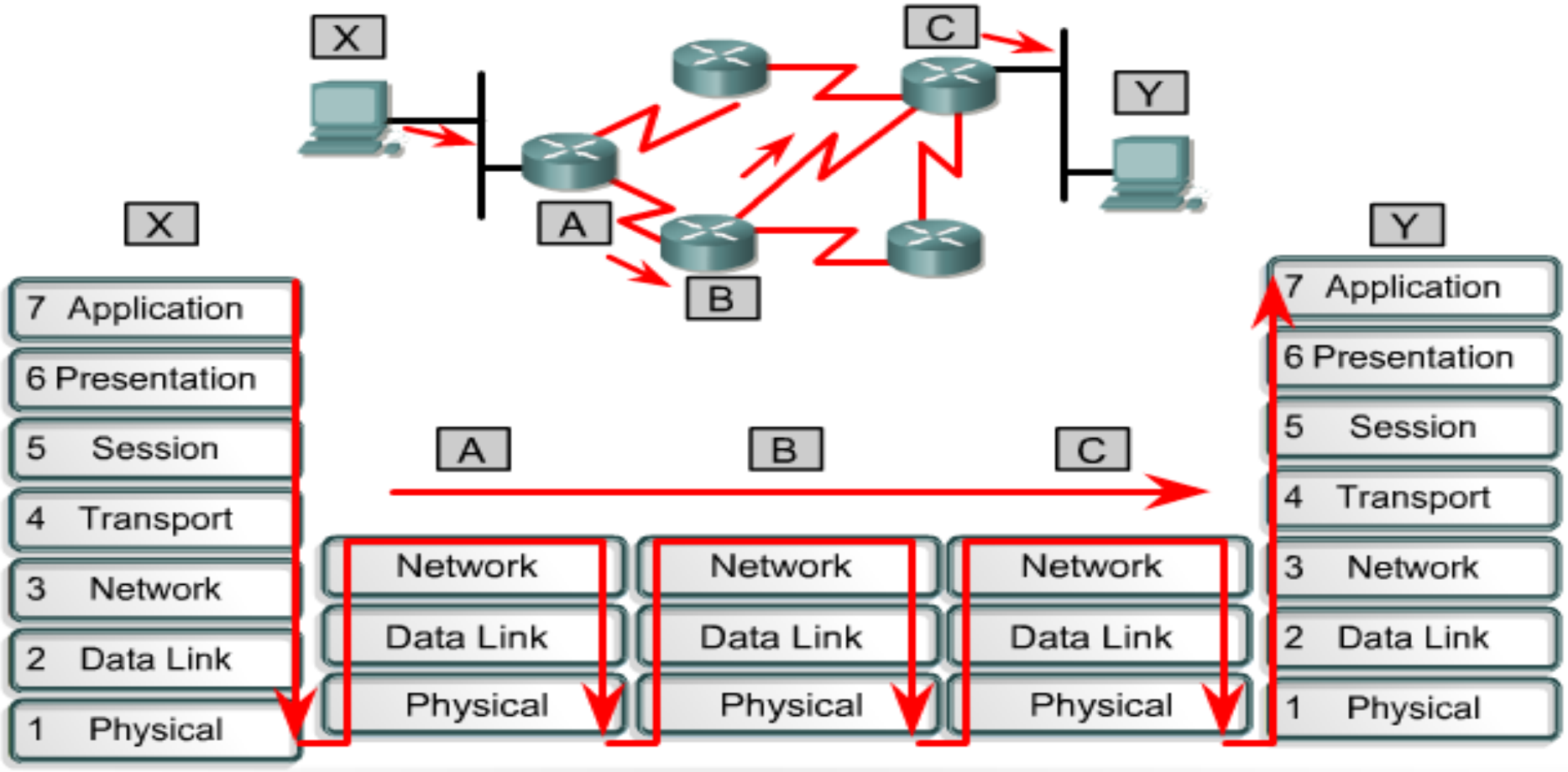
Well Known Port Numbers

The following port numbers should be memorized:

NOTE:
The curriculum forgot to mention one of the most important port numbers.
Port 80 is used for **HTTP** or **WWW** protocols. (Essentially access to the internet.)



Data Flow Through a Network



Data flow in a network focuses on layers one, two and three of the OSI model. This is after being transmitted by the sending host and before arriving at the receiving host.

2-1 LAYERED TASKS

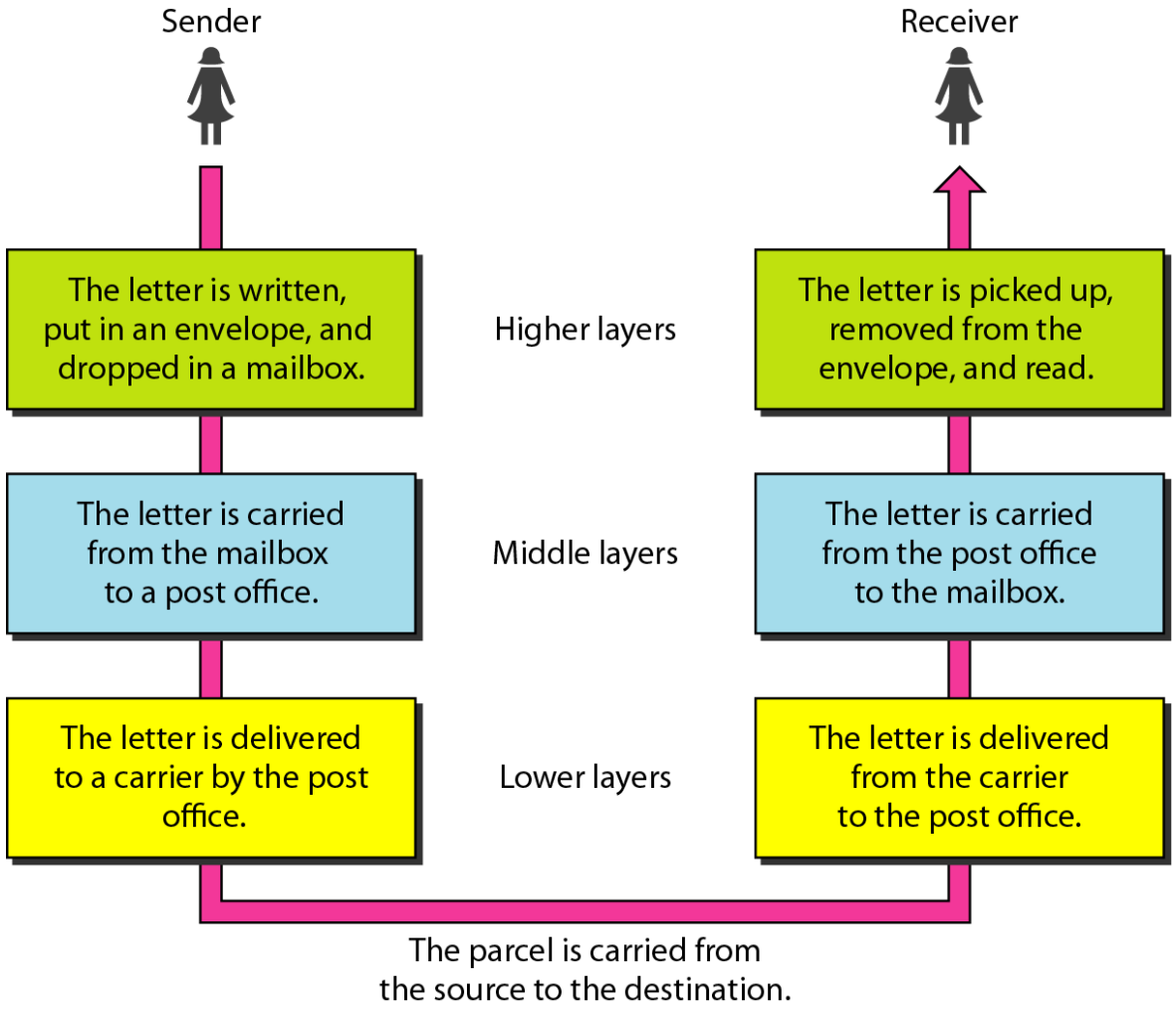
We use the concept of layers in our daily life. As an example, let us consider two friends who communicate through postal mail. The process of sending a letter to a friend would be complex if there were no services available from the post office.

Topics discussed in this section:

Sender, Receiver, and Carrier

Hierarchy

Figure 2.1 Tasks involved in sending a letter



2-2 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 2.2 *Seven layers of the OSI model*

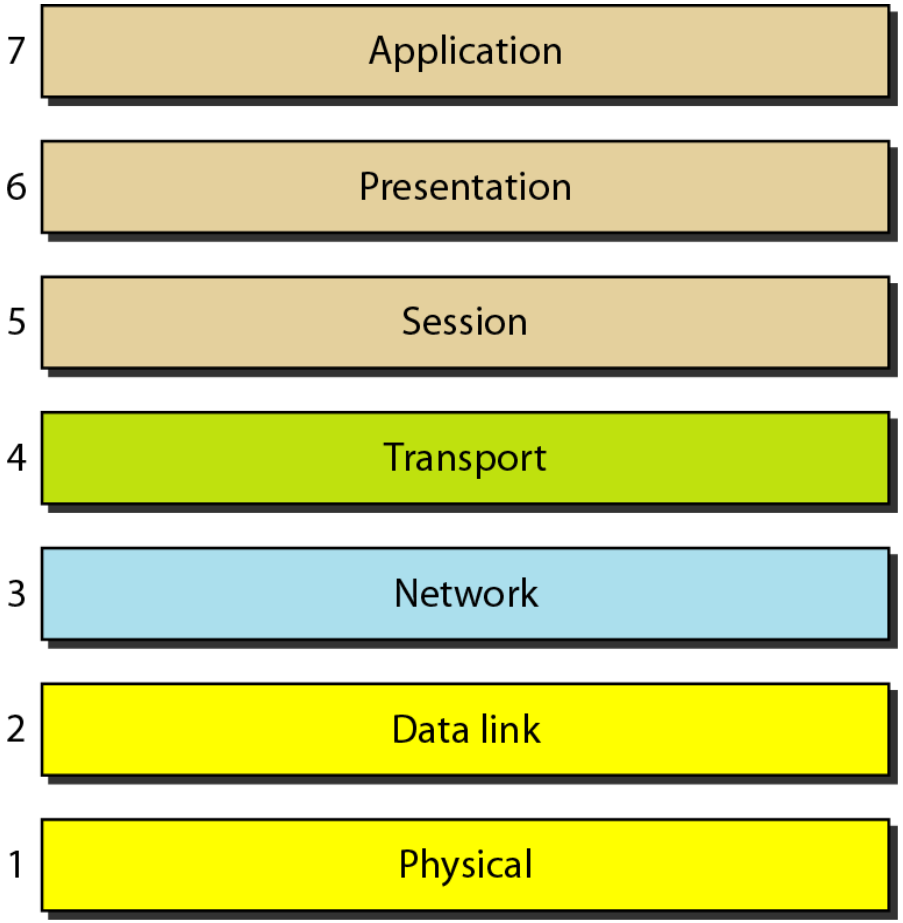


Figure 2.3 *The interaction between layers in the OSI model*

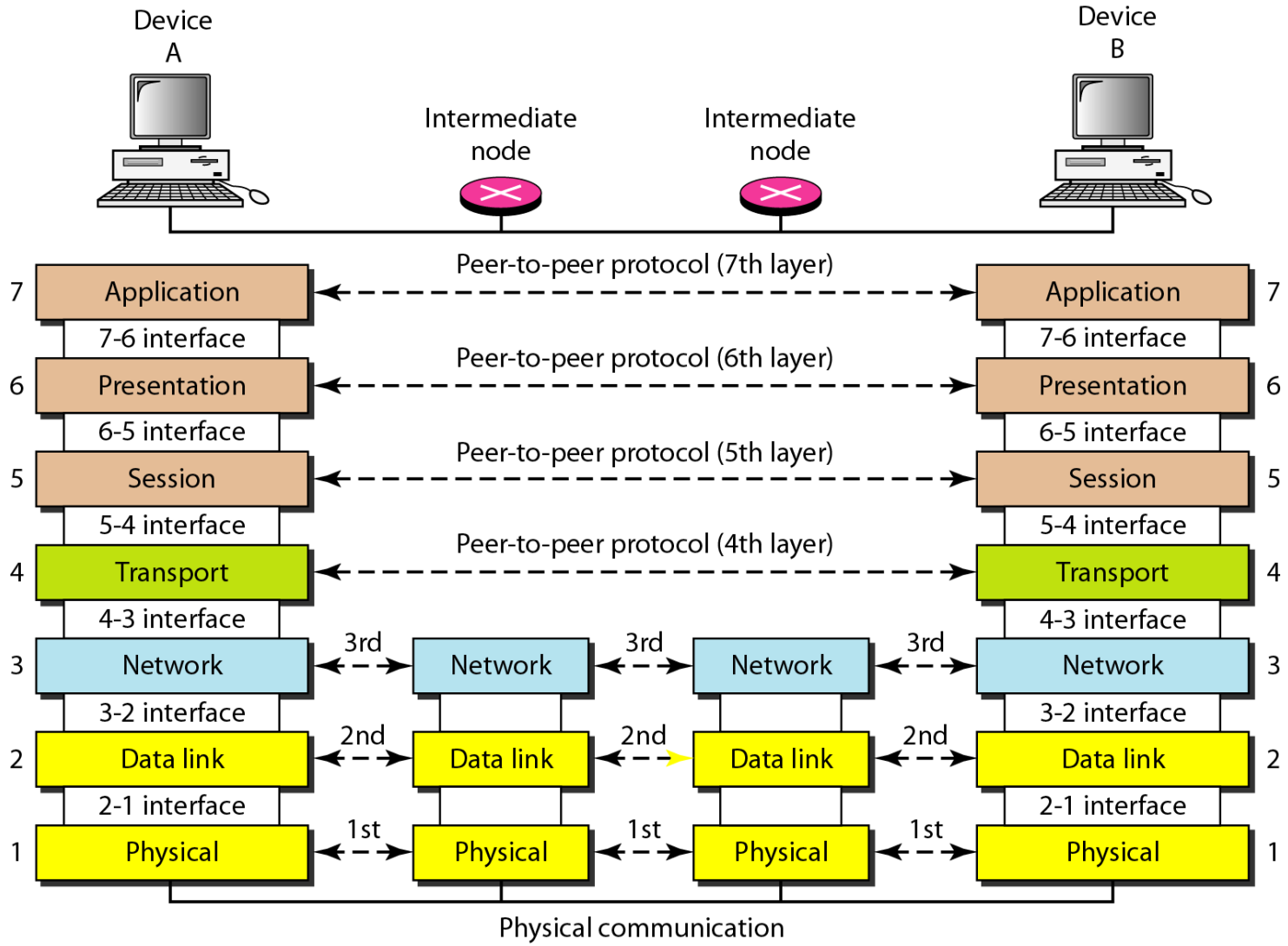
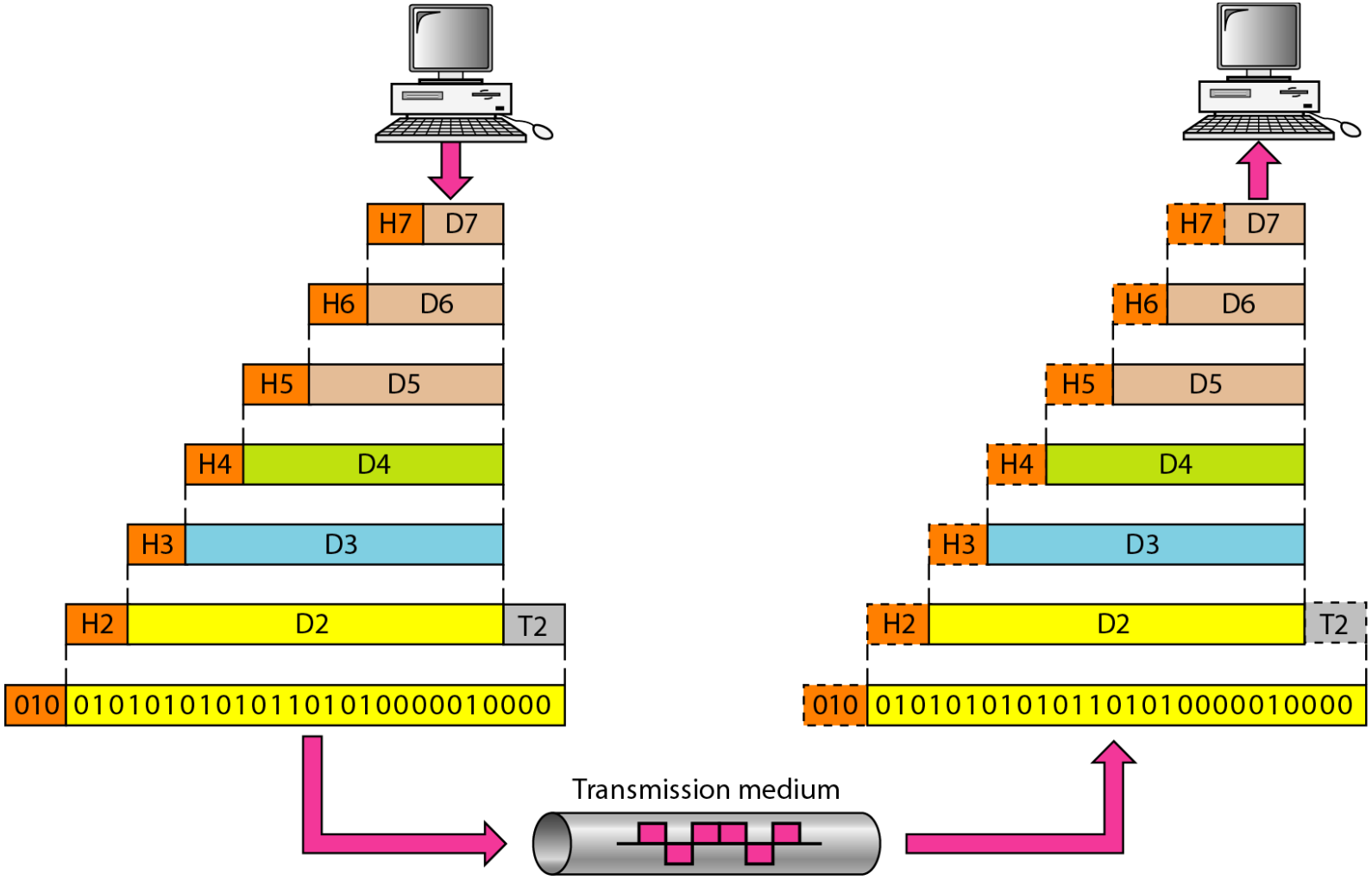


Figure 2.4 *An exchange using the OSI model*



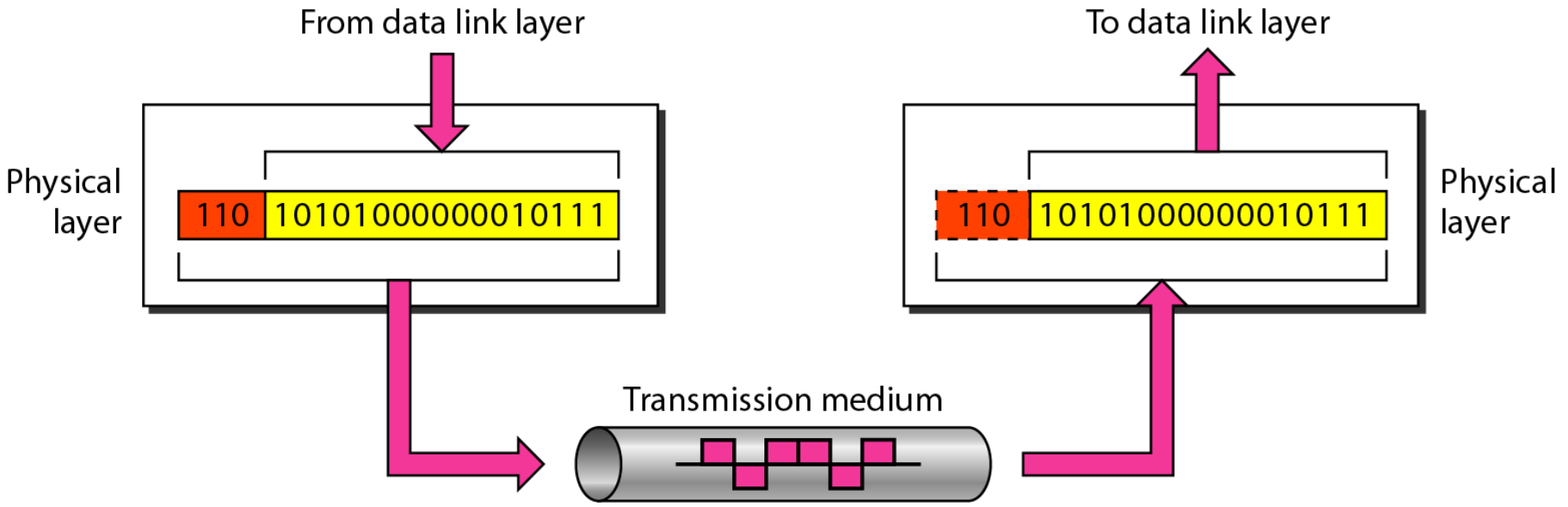
2-3 LAYERS IN THE OSI MODEL

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

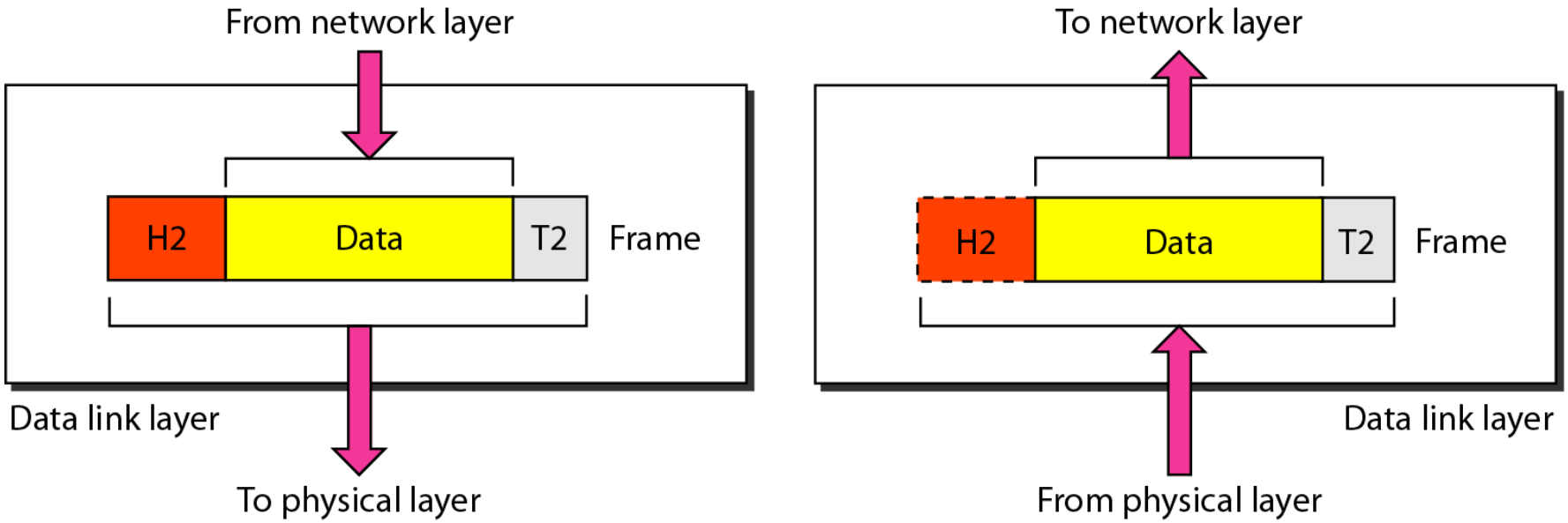
Figure 2.5 *Physical layer*



Note

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

Figure 2.6 *Data link layer*



Note

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

Figure 2.7 *Hop-to-hop delivery*

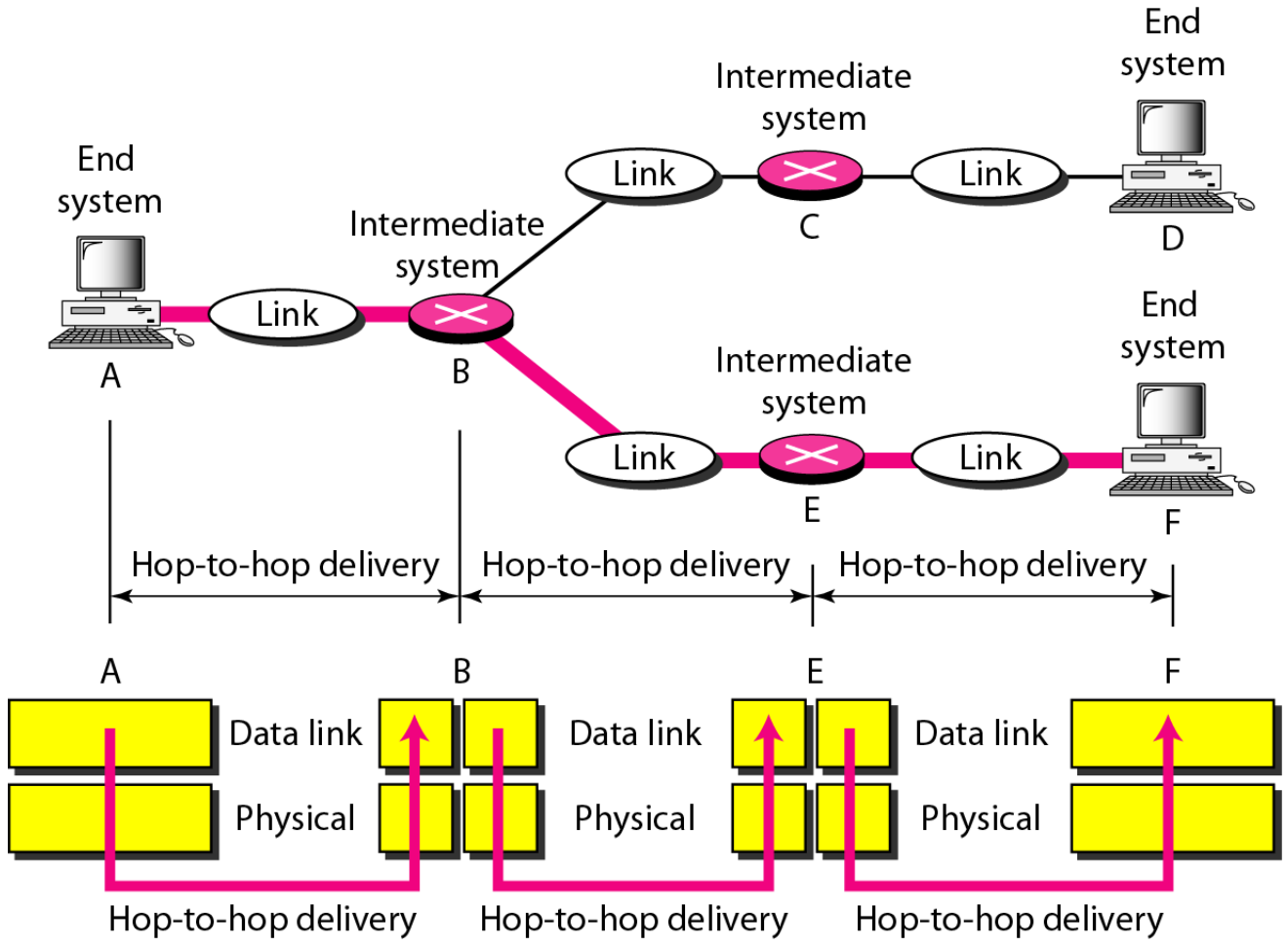
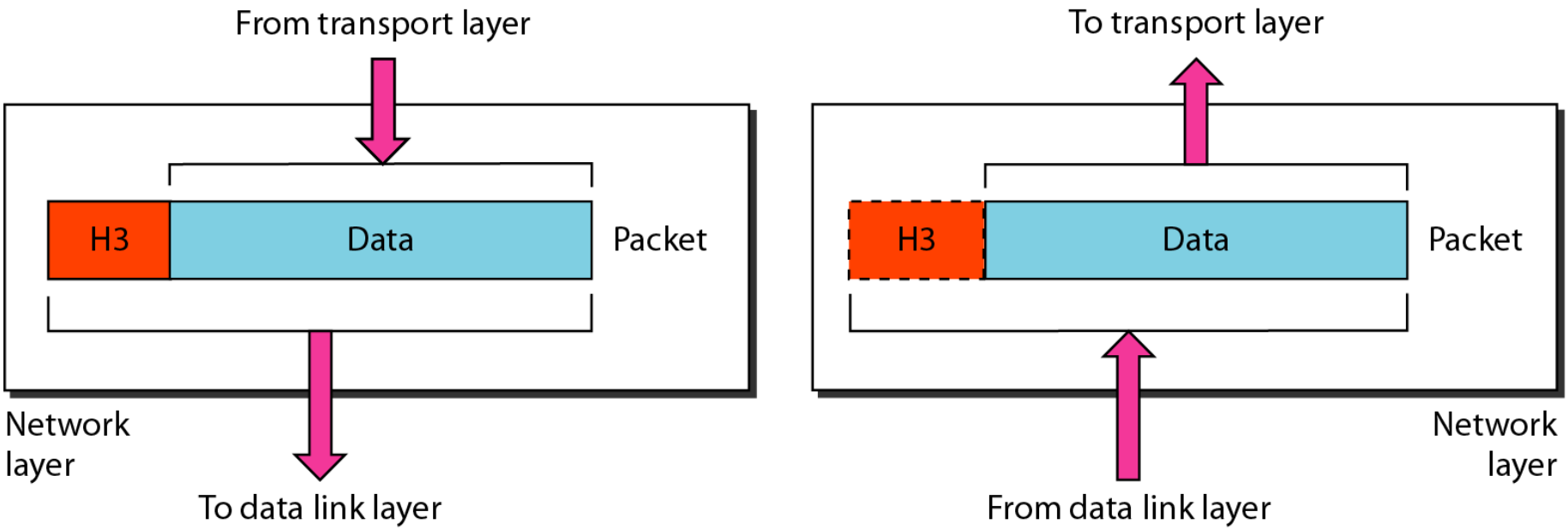


Figure 2.8 *Network layer*



Note

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

Figure 2.9 *Source-to-destination delivery*

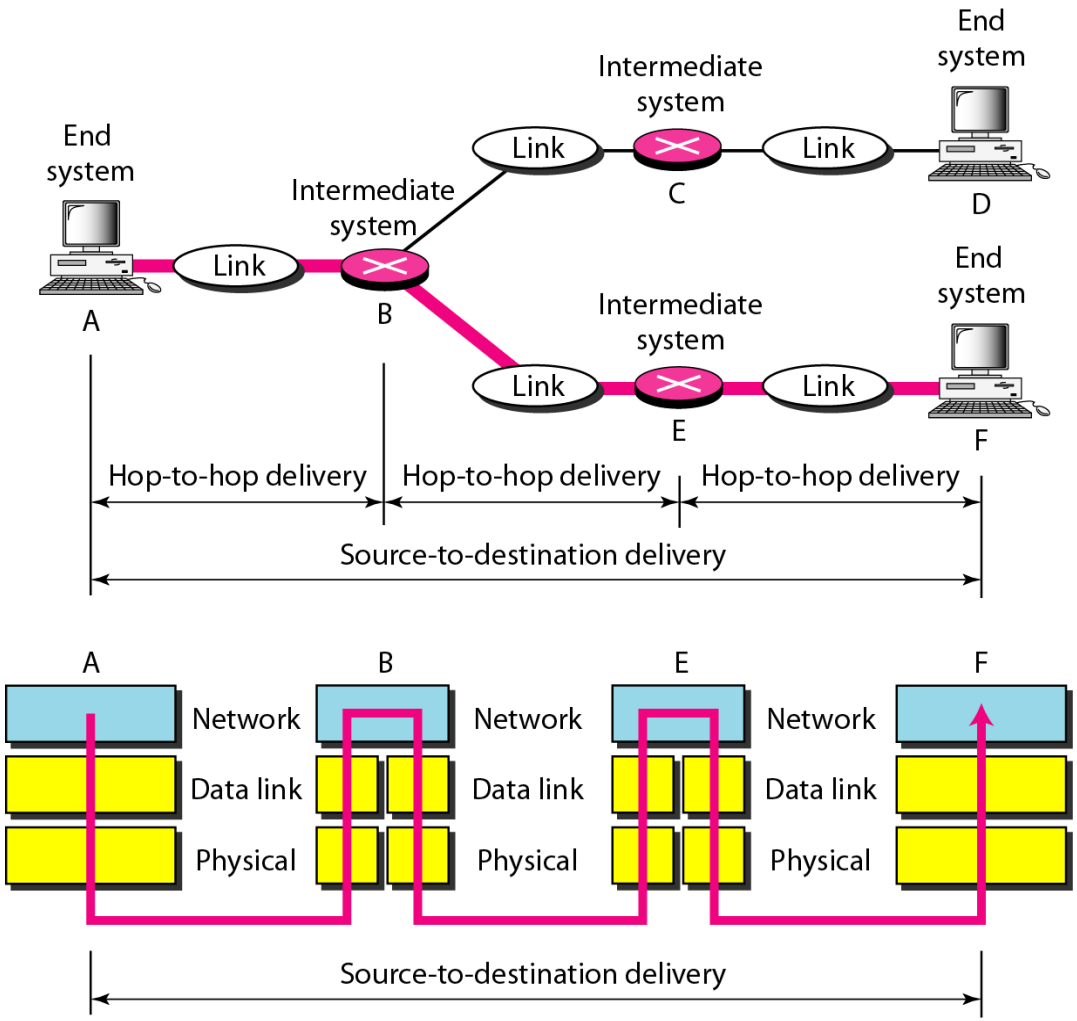
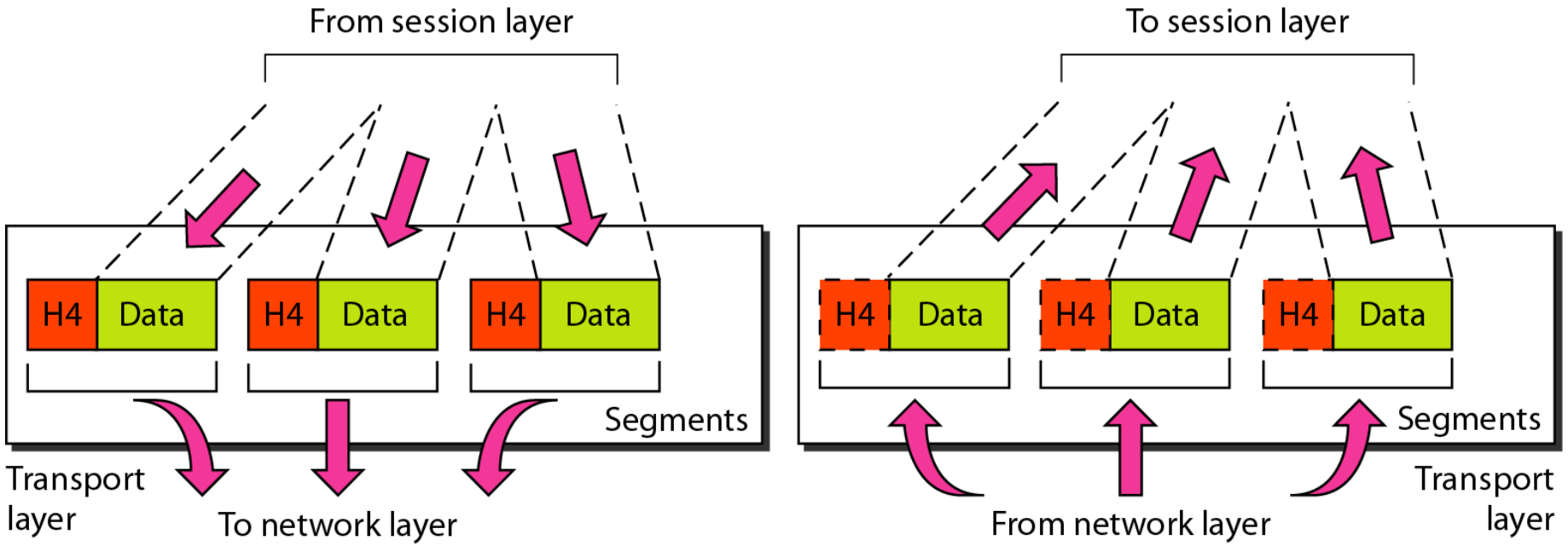


Figure 2.10 *Transport layer*



Note

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

Figure 2.11 *Reliable process-to-process delivery of a message*

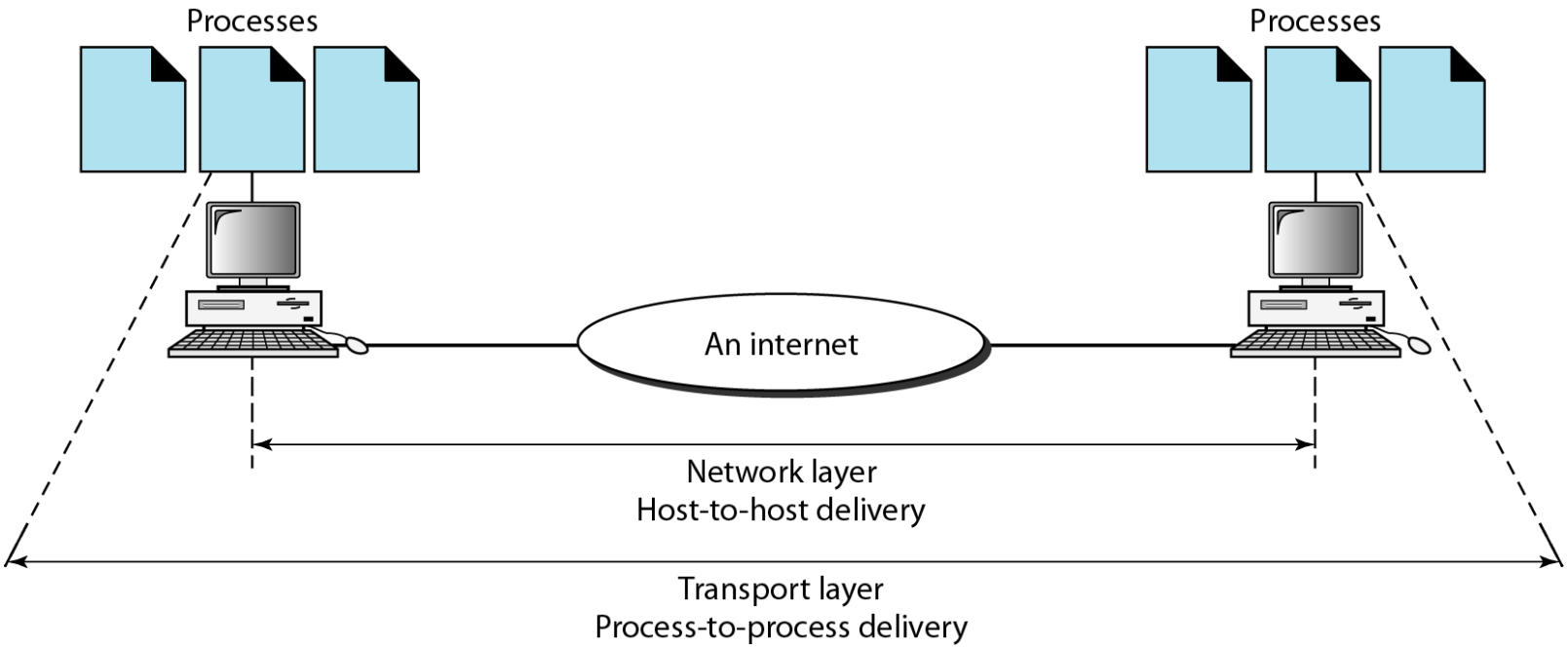
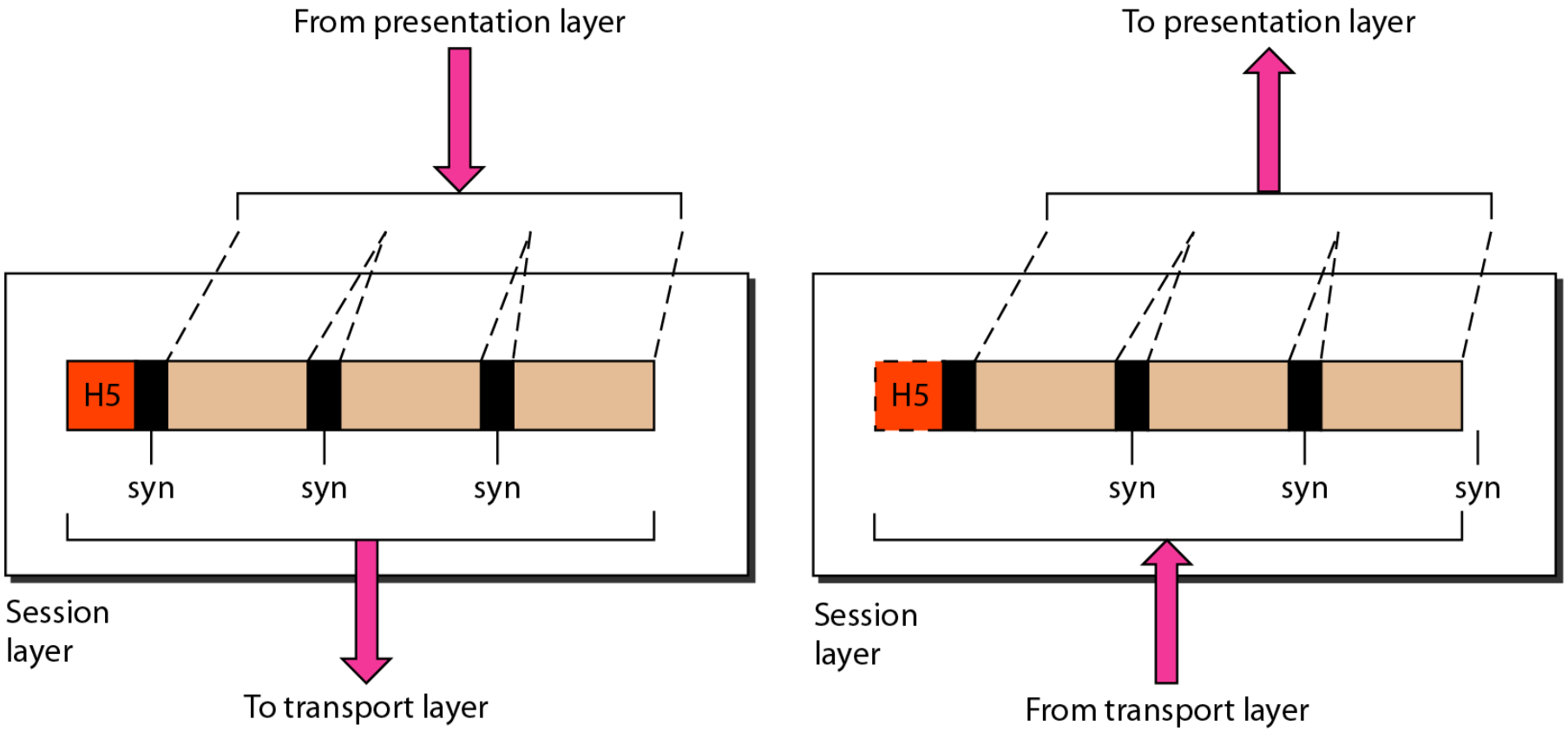


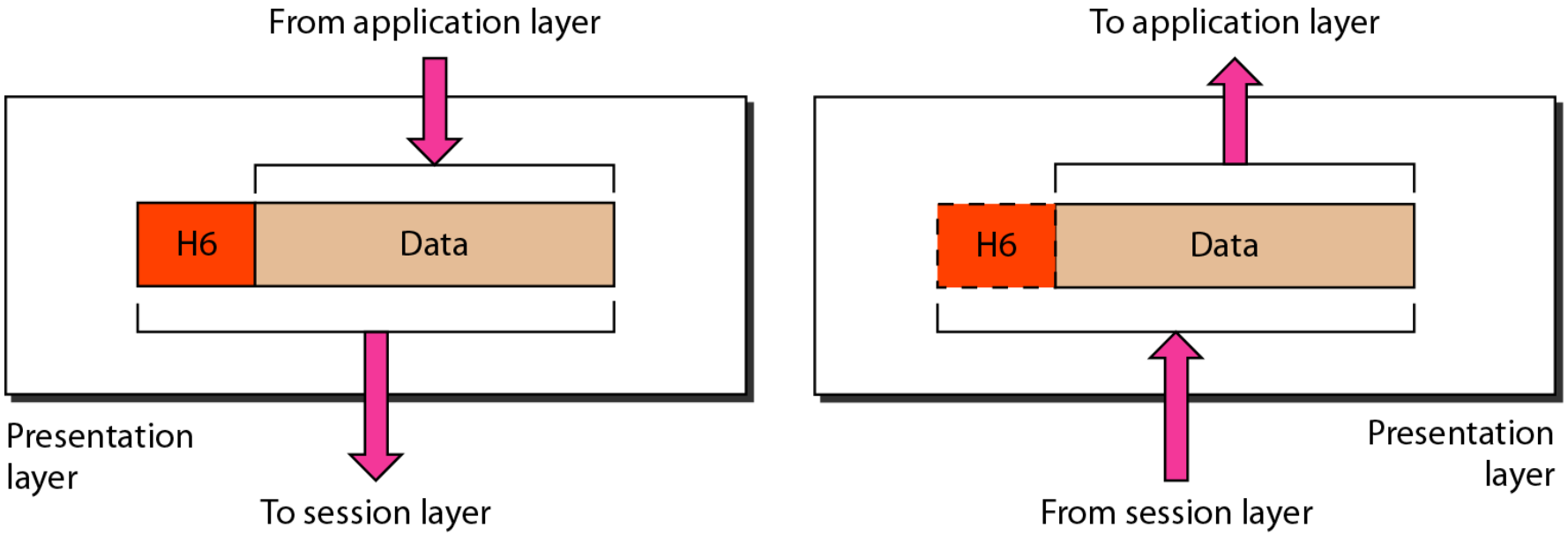
Figure 2.12 *Session layer*



Note

The session layer is responsible for dialog control and synchronization.

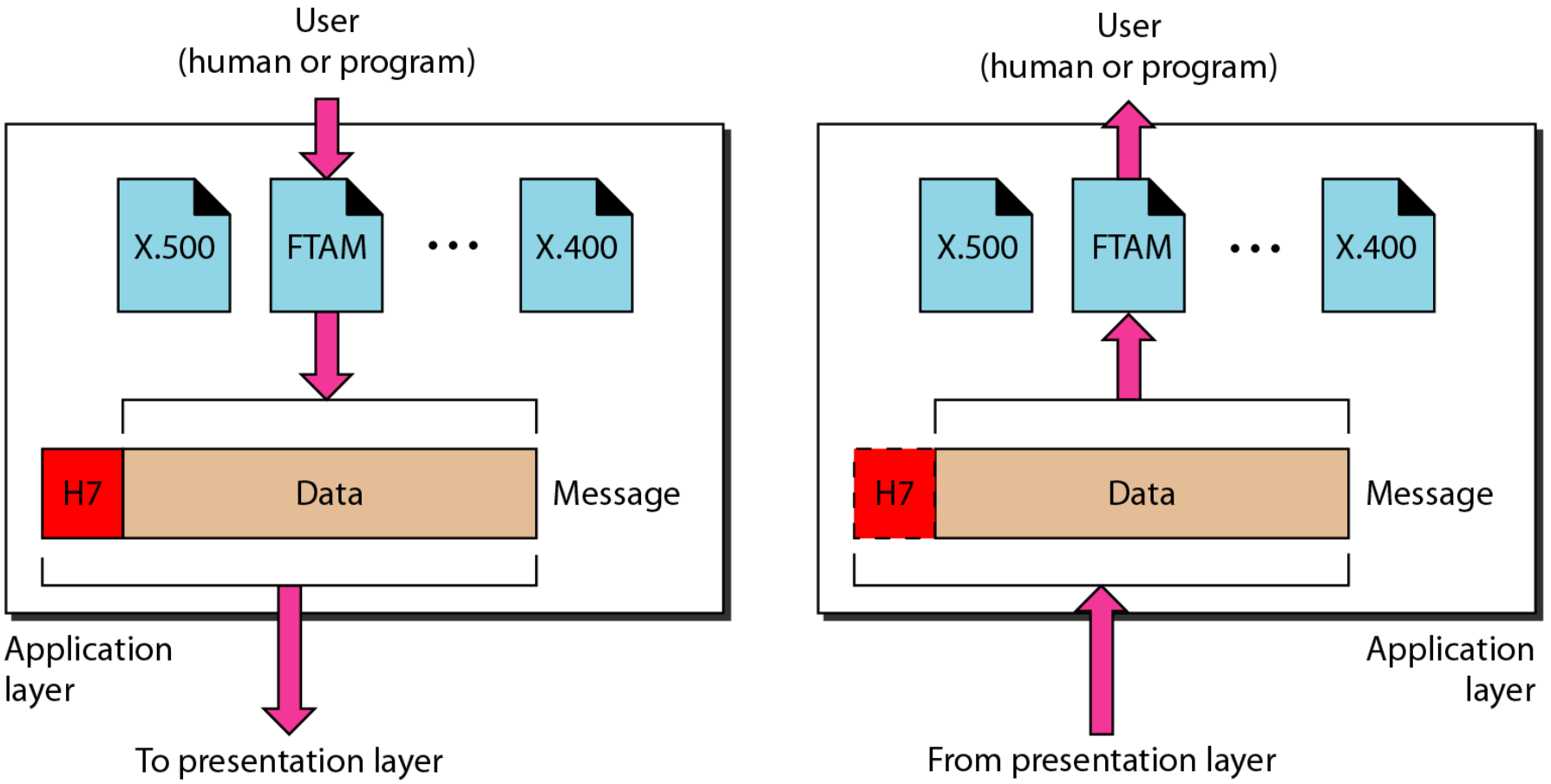
Figure 2.13 *Presentation layer*



Note

The presentation layer is responsible for translation, compression, and encryption.

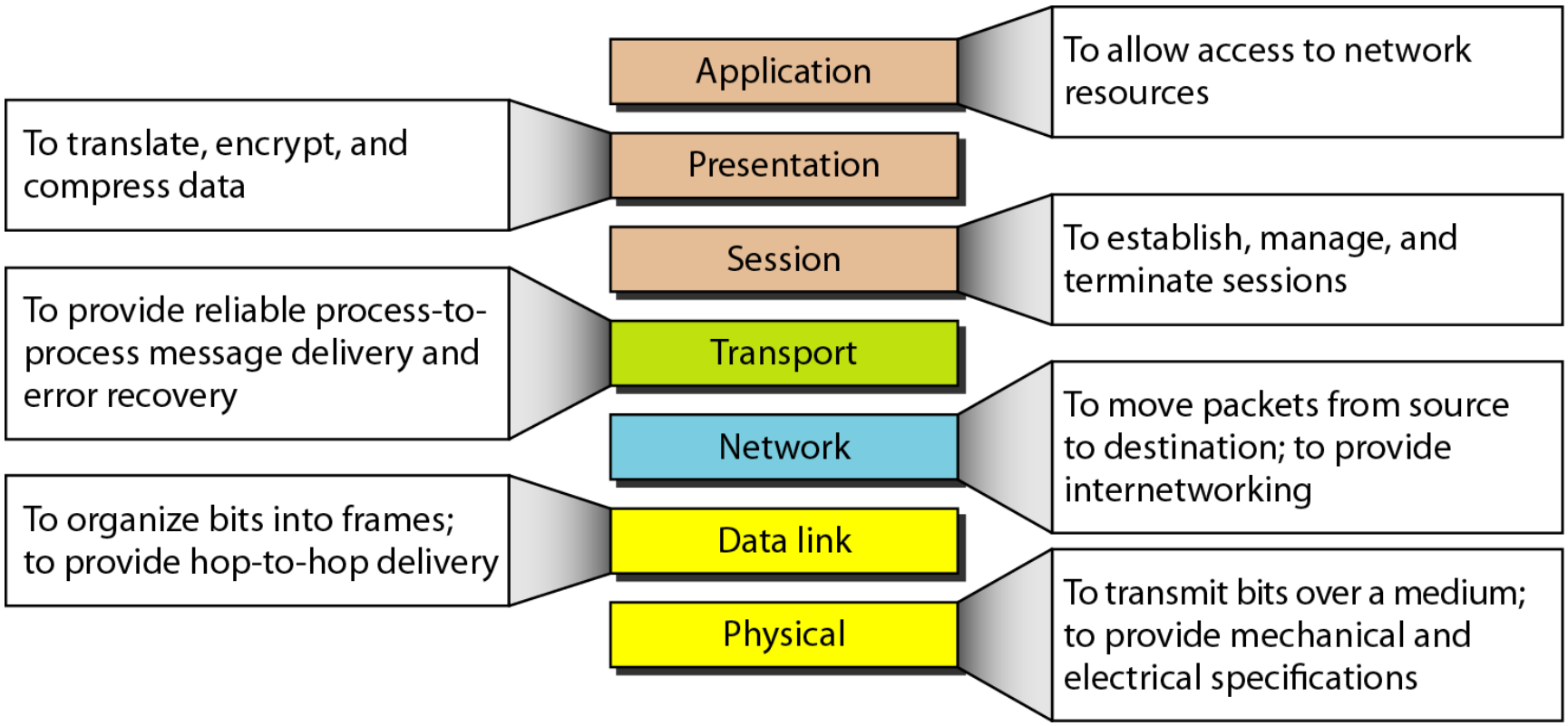
Figure 2.14 *Application layer*



Note

The application layer is responsible for providing services to the user.

Figure 2.15 *Summary of layers*



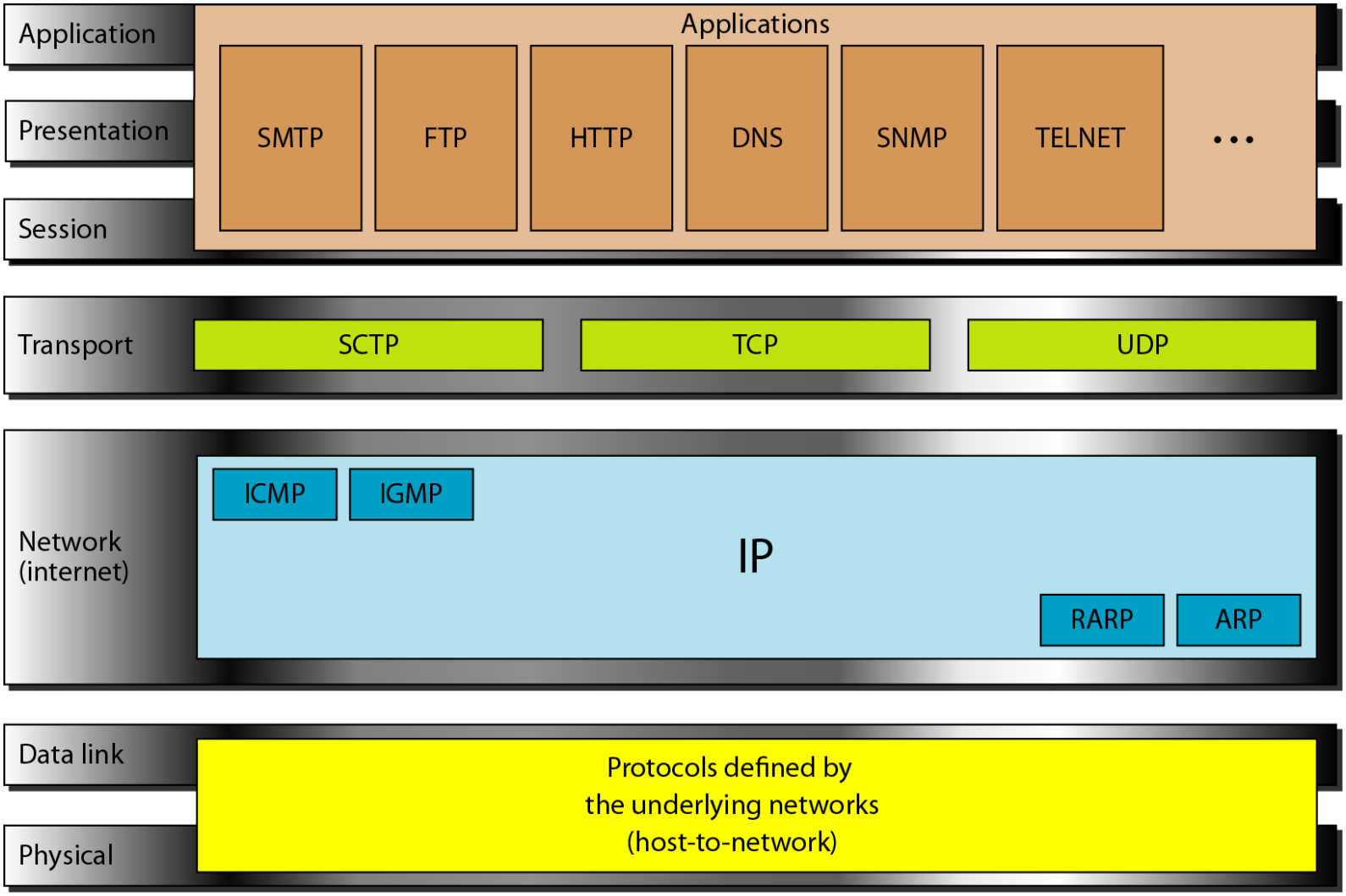
2-4 TCP/IP PROTOCOL SUITE

The layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: physical, data link, network, transport, and application.

Topics discussed in this section:

Physical and Data Link Layers
Network Layer
Transport Layer
Application Layer

Figure 2.16 *TCP/IP and OSI model*



2-5 ADDRESSING

Four levels of addresses are used in an internet employing the TCP/IP protocols: physical, logical, port, and specific.

Topics discussed in this section:

Physical Addresses
Logical Addresses
Port Addresses
Specific Addresses

Figure 2.17 *Addresses in TCP/IP*

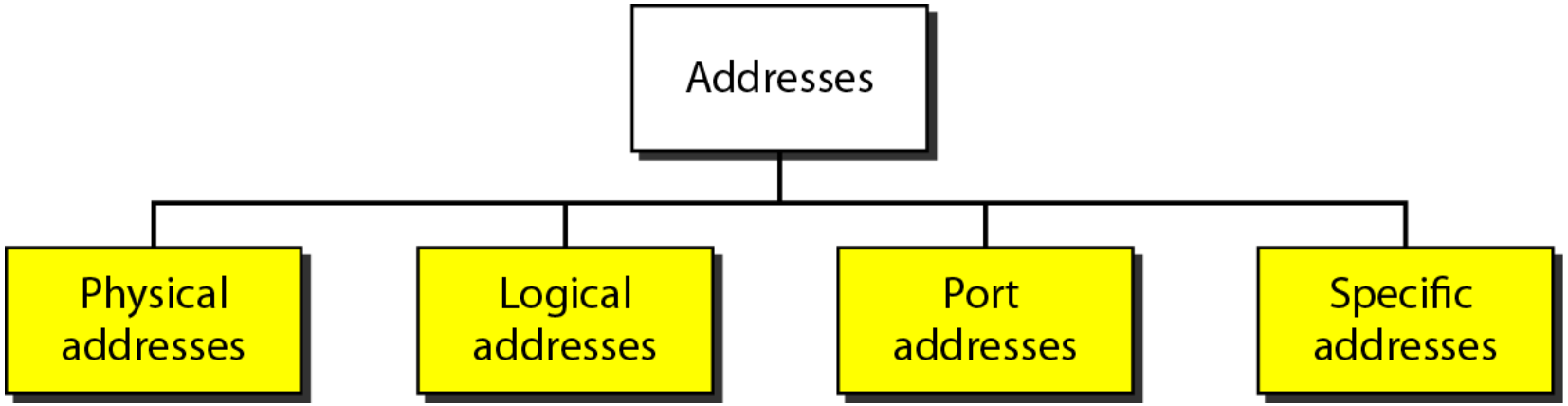
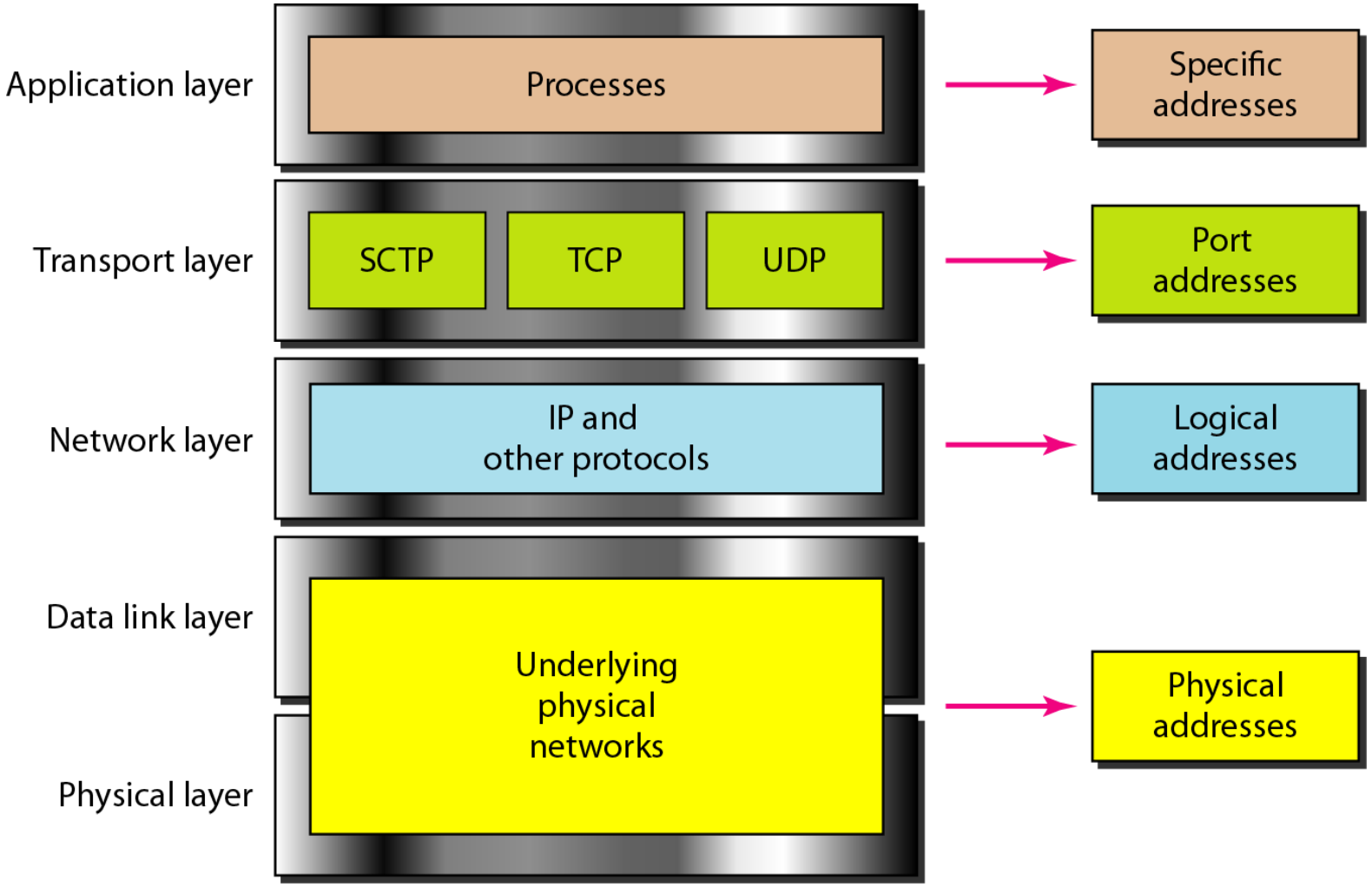


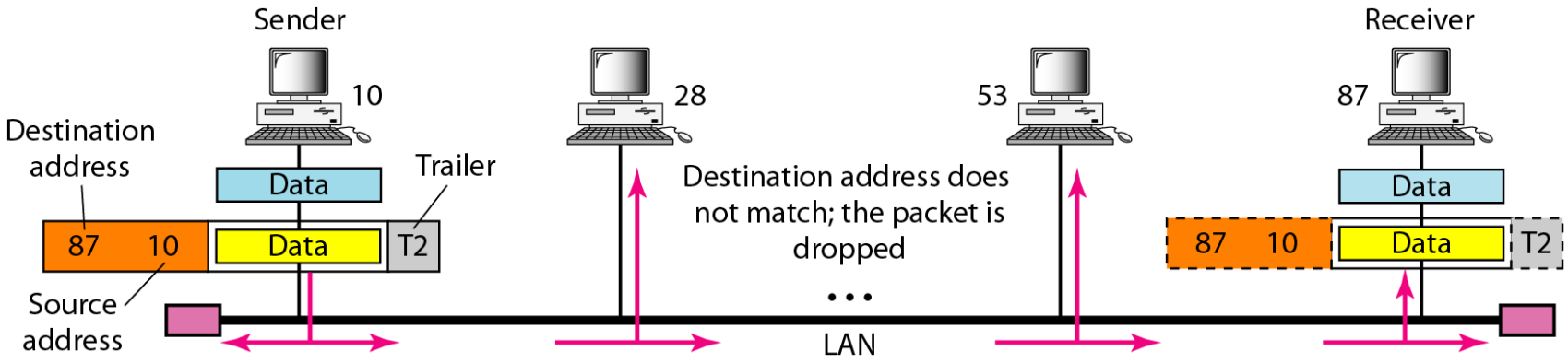
Figure 2.18 *Relationship of layers and addresses in TCP/IP*



Example 2.1

In Figure 2.19 a node with physical address 10 sends a frame to a node with physical address 87. The two nodes are connected by a link (bus topology LAN). As the figure shows, the computer with physical address 10 is the sender, and the computer with physical address 87 is the receiver.

Figure 2.19 *Physical addresses*



Example 2.2

Most local-area networks use a 48-bit (6-byte) physical address written as 12 hexadecimal digits; every byte (2 hexadecimal digits) is separated by a colon, as shown below:

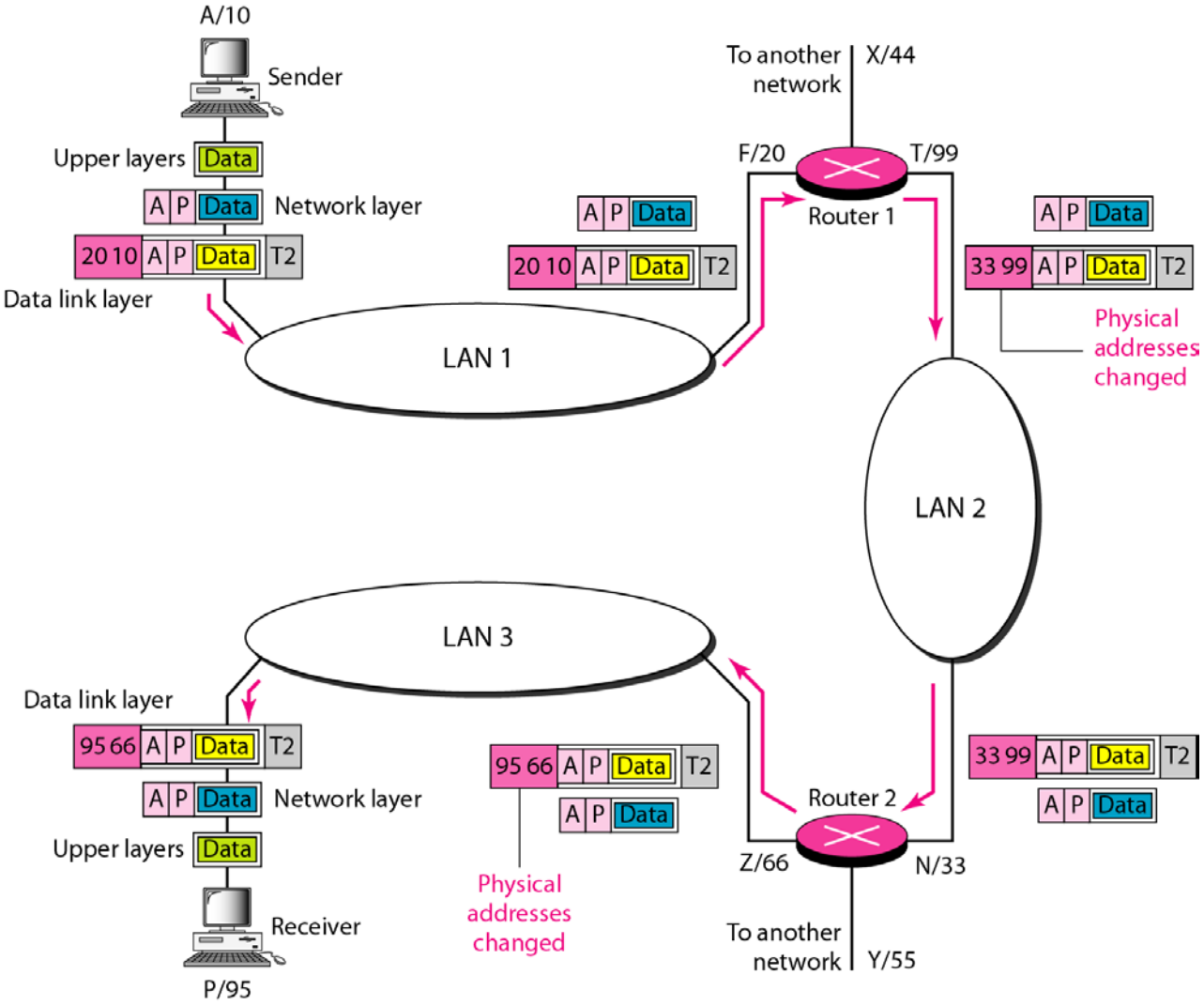
07:01:02:01:2C:4B

A 6-byte (12 hexadecimal digits) physical address.

Example 2.3

Figure 2.20 shows a part of an internet with two routers connecting three LANs. Each device (computer or router) has a pair of addresses (logical and physical) for each connection. In this case, each computer is connected to only one link and therefore has only one pair of addresses. Each router, however, is connected to three networks (only two are shown in the figure). So each router has three pairs of addresses, one for each connection.

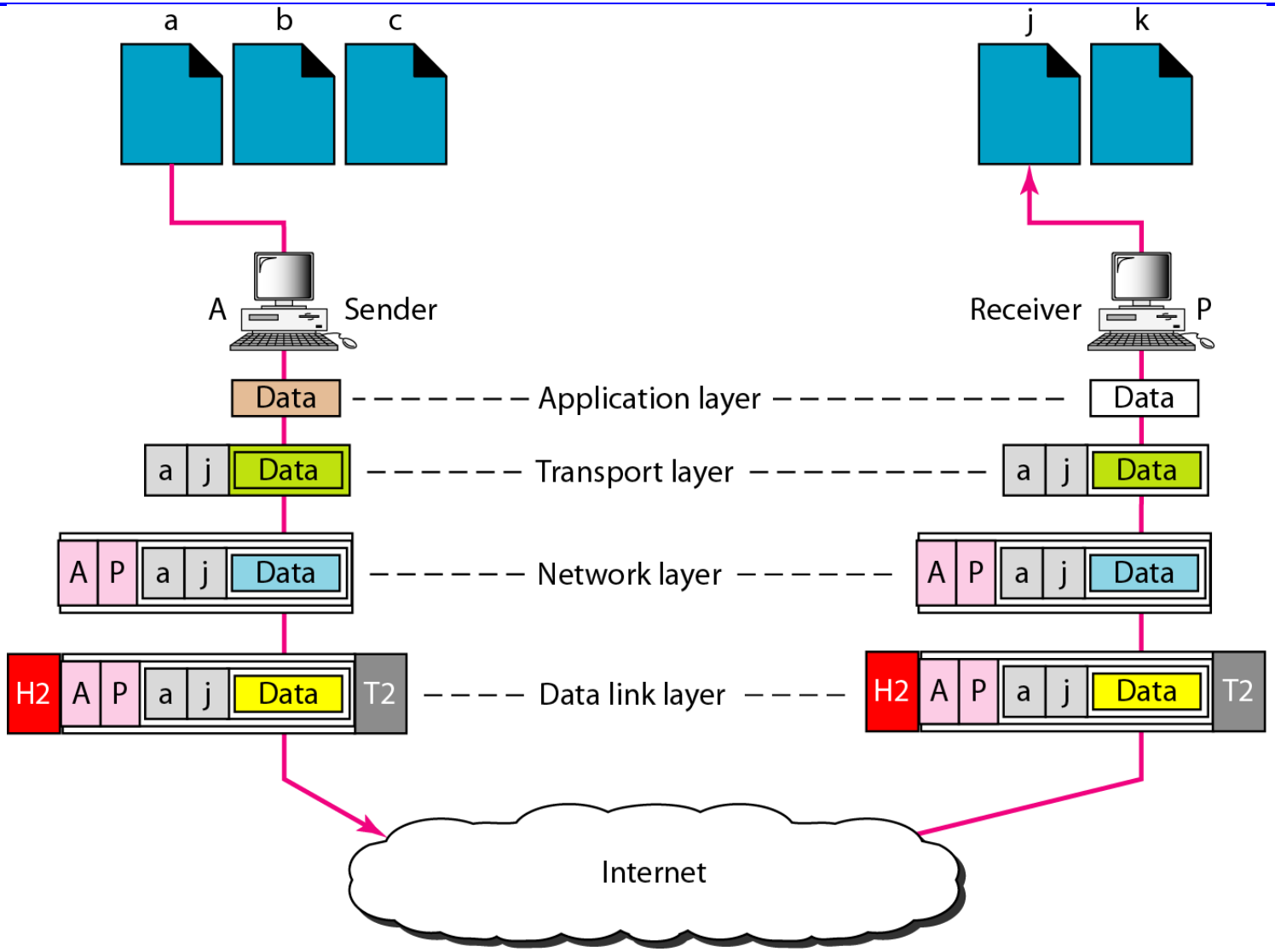
Figure 2.20 *IP addresses*



Example 2.4

Figure 2.21 shows two computers communicating via the Internet. The sending computer is running three processes at this time with port addresses a, b, and c. The receiving computer is running two processes at this time with port addresses j and k. Process a in the sending computer needs to communicate with process j in the receiving computer. Note that although physical addresses change from hop to hop, logical and port addresses remain the same from the source to destination.

Figure 2.21 *Port addresses*



Note

The physical addresses will change from hop to hop, but the logical addresses usually remain the same.

Example 2.5

A port address is a 16-bit address represented by one decimal number as shown.

753

A 16-bit port address represented as one single number.