2 Data Communication

Week 2 Communication Protocol

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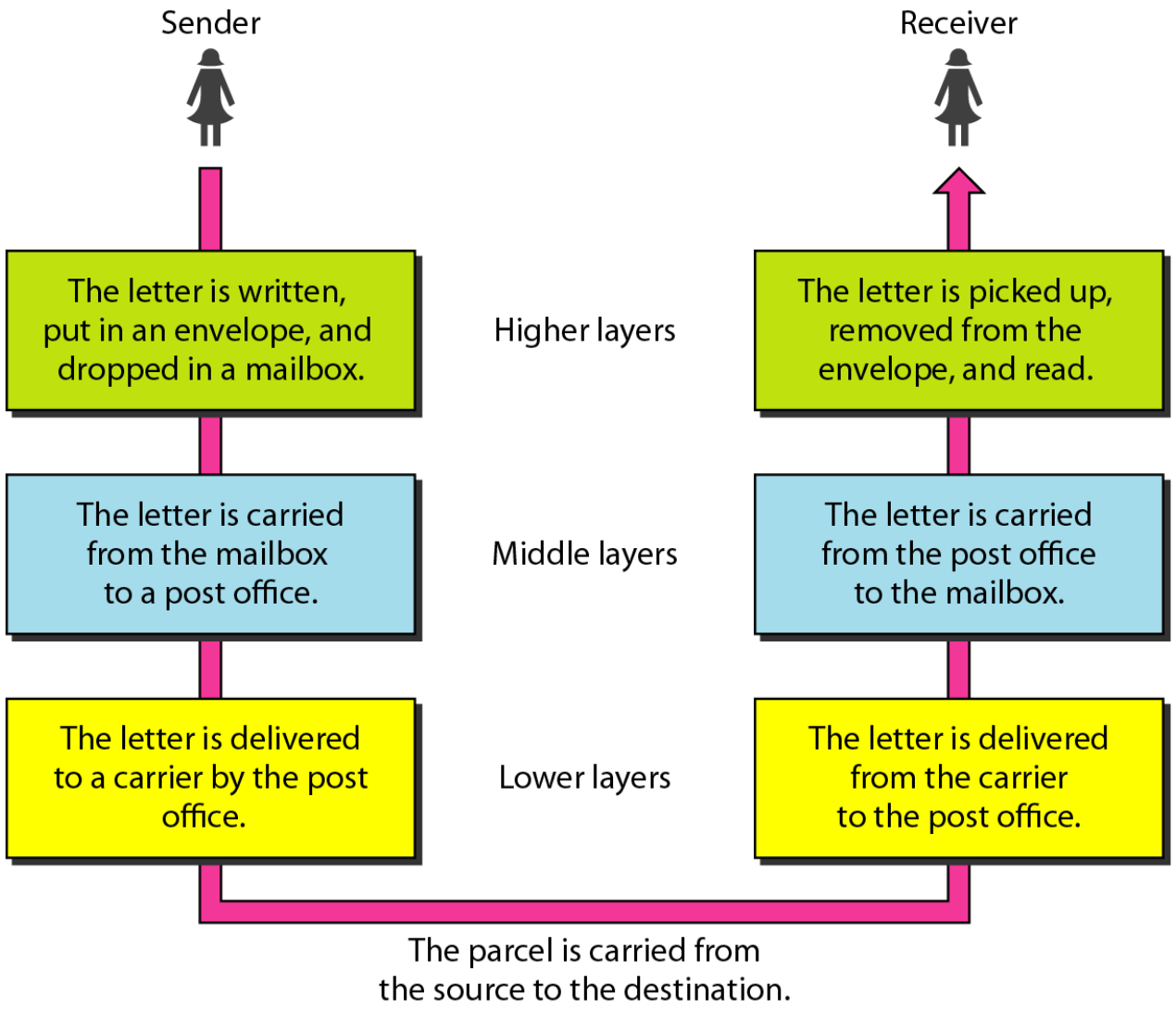
Layered Task

- A network is a combination of hardware and software that sends data from one location to another. The hardware consists of the physical equipment that carries signals from one point of the network to another. The software consists of instruction sets that make possible the services that we expect from a network.
- We can compare the task of networking to the task of solving a mathematics problem with a computer. The fundamental job of solving the problem with a computer is done by computer hardware. However, this is a very tedious task if only hardware is involved. We would need switches for every memory location to store and manipulate data. The task is much easier if software is available. At the highest level, a program can direct the problem-solving process; the details of how this is done by the actual hardware can be left to the layers of software that are called by the higher levels.
- Compare this to a service provided by a computer network. For example, the task of sending an e-mail from one point in the world to another can be broken into several tasks, each performed by a separate software package. Each software package uses the services of another software package. At the lowest layer, a signal, or a set of signals, is sent from the source computer to the destination computer.
- In this chapter, we give a general idea of the layers of a network and discuss the functions of each. Detailed descriptions of these layers follow in later chapters.

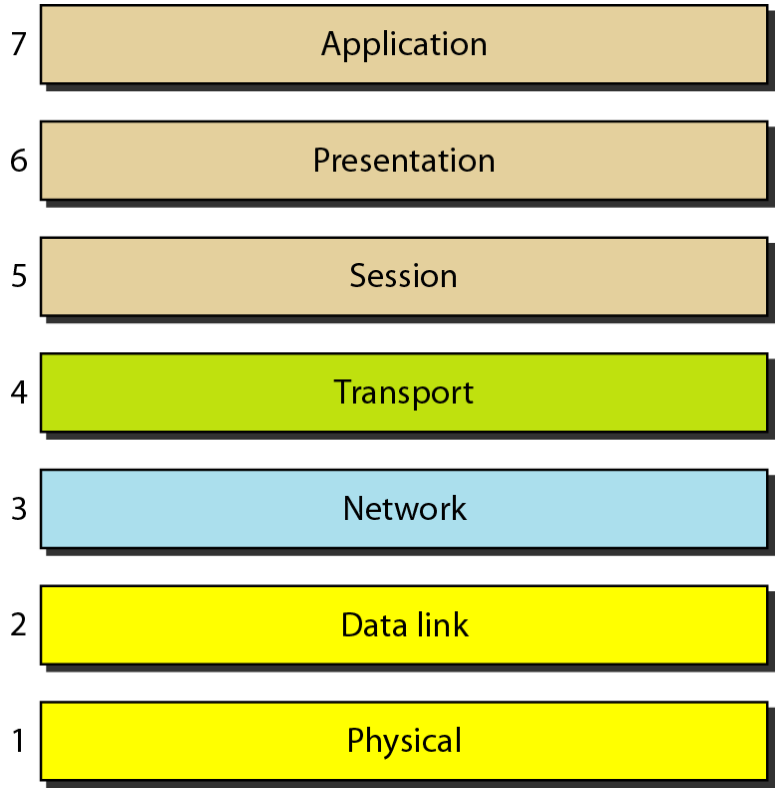
Tasks involved in sending a letter



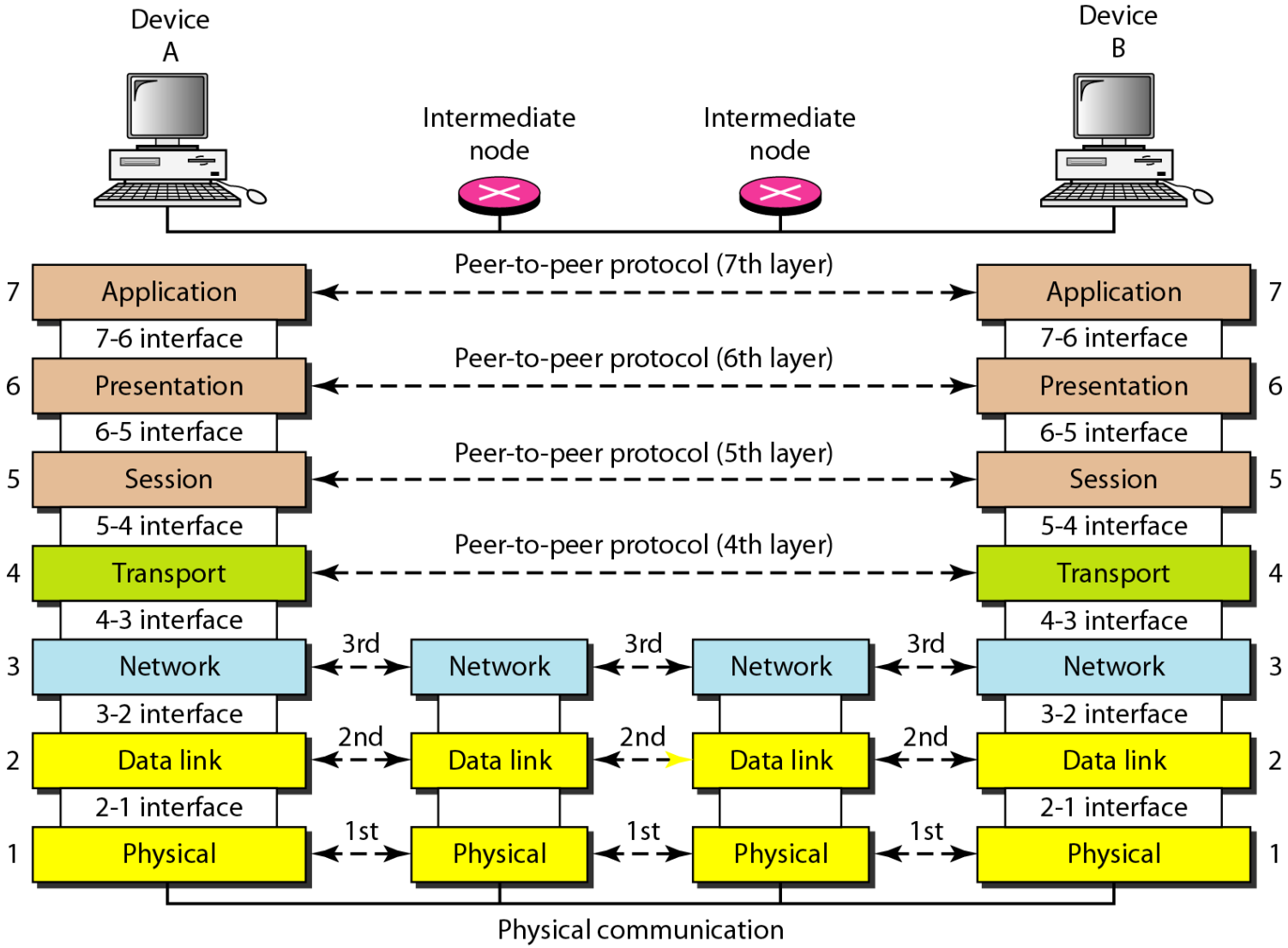
- The layered model that dominated data communications and networking literature before 1990 was the Open Systems Interconnection (OSI) model. Everyone believed that the OSI model would become the ultimate standard for data communications, but this did not happen. The TCP/IP protocol suite became the dominant commercial architecture because it was used and tested extensively in the Internet; the OSI model was never fully implemented.

The OSI Model

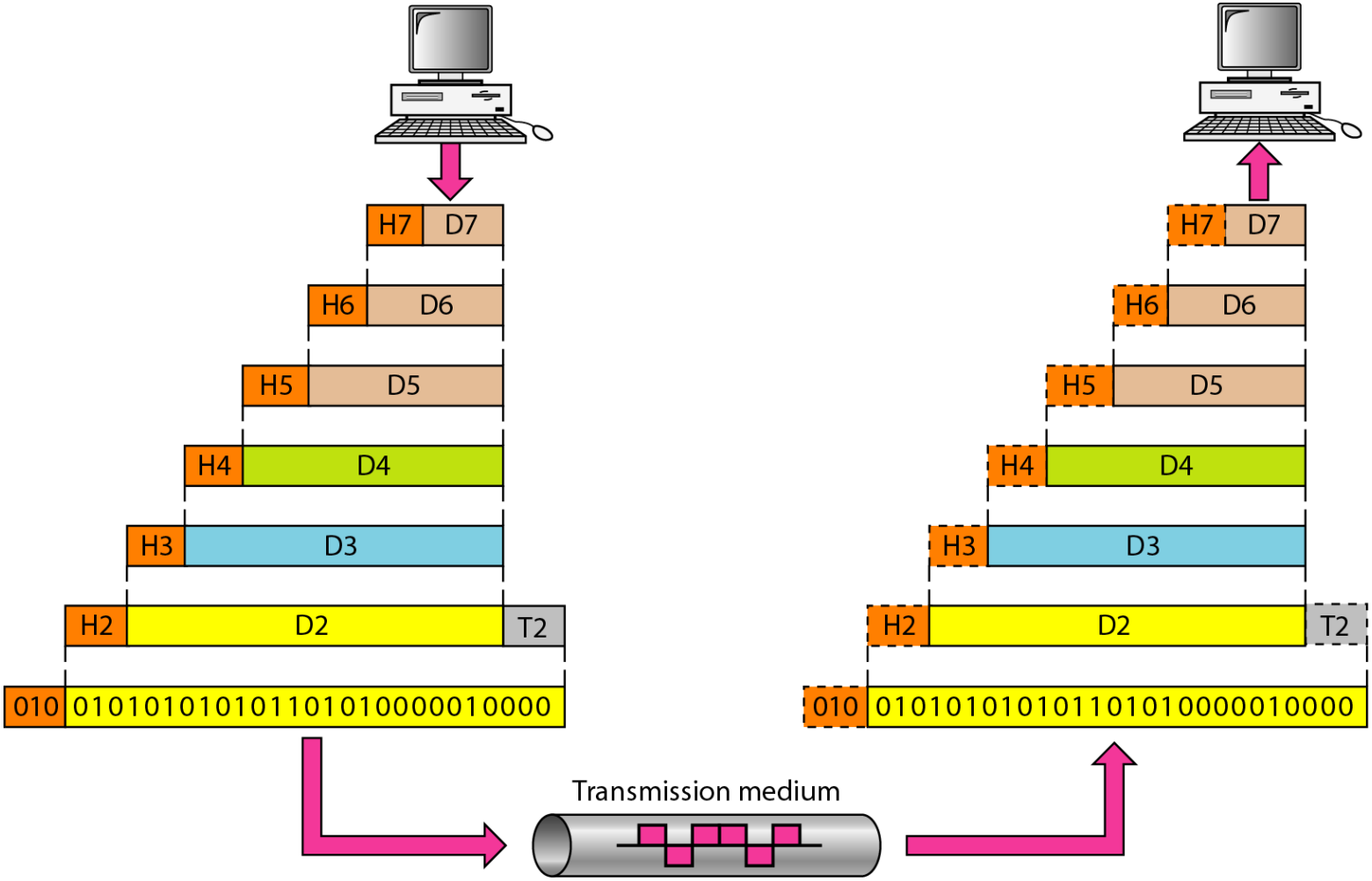
- Established in 1947, the International Standards Organization (ISO) is a multinational body dedicated to worldwide agreement on international standards. An ISO standard that covers all aspects of network communications is the Open Systems Interconnection (OSI) model. It was first introduced in the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



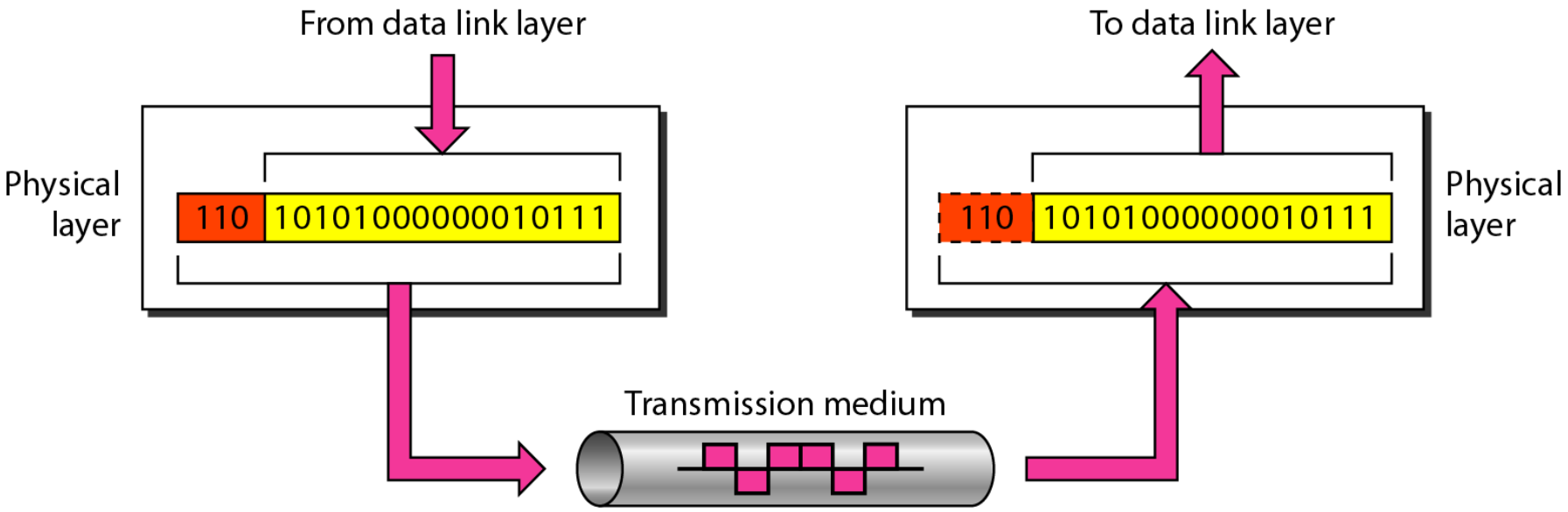
The interaction between layers in the OSI model



An exchange using the OSI model

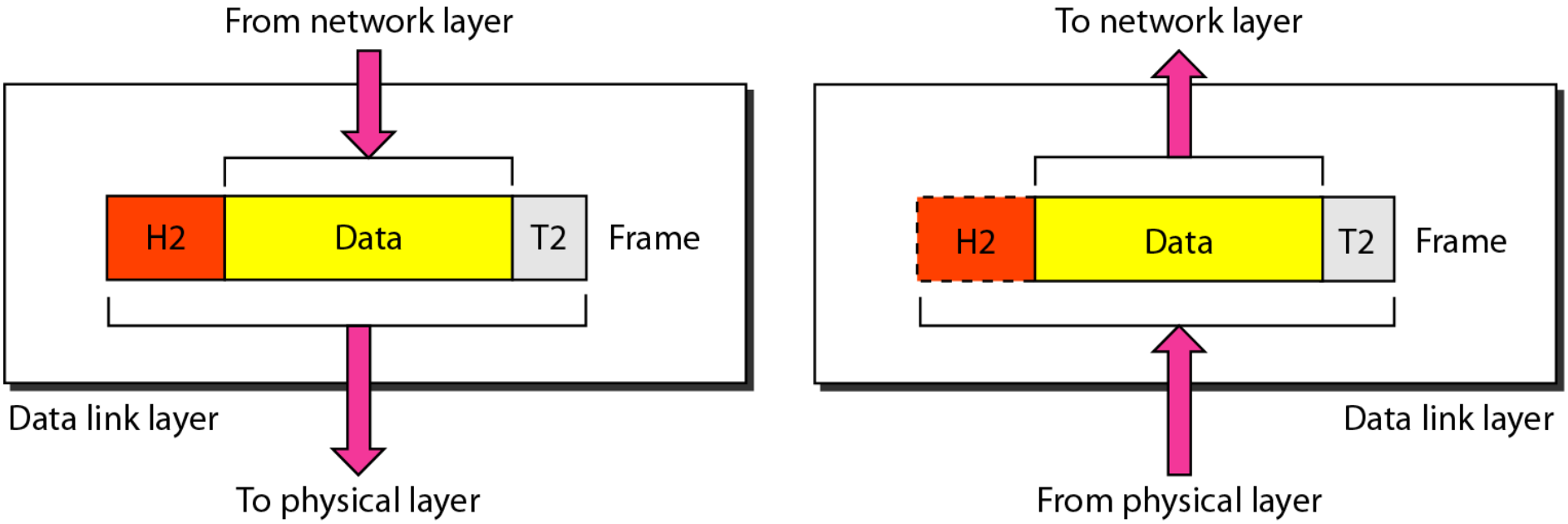


Physical Layer



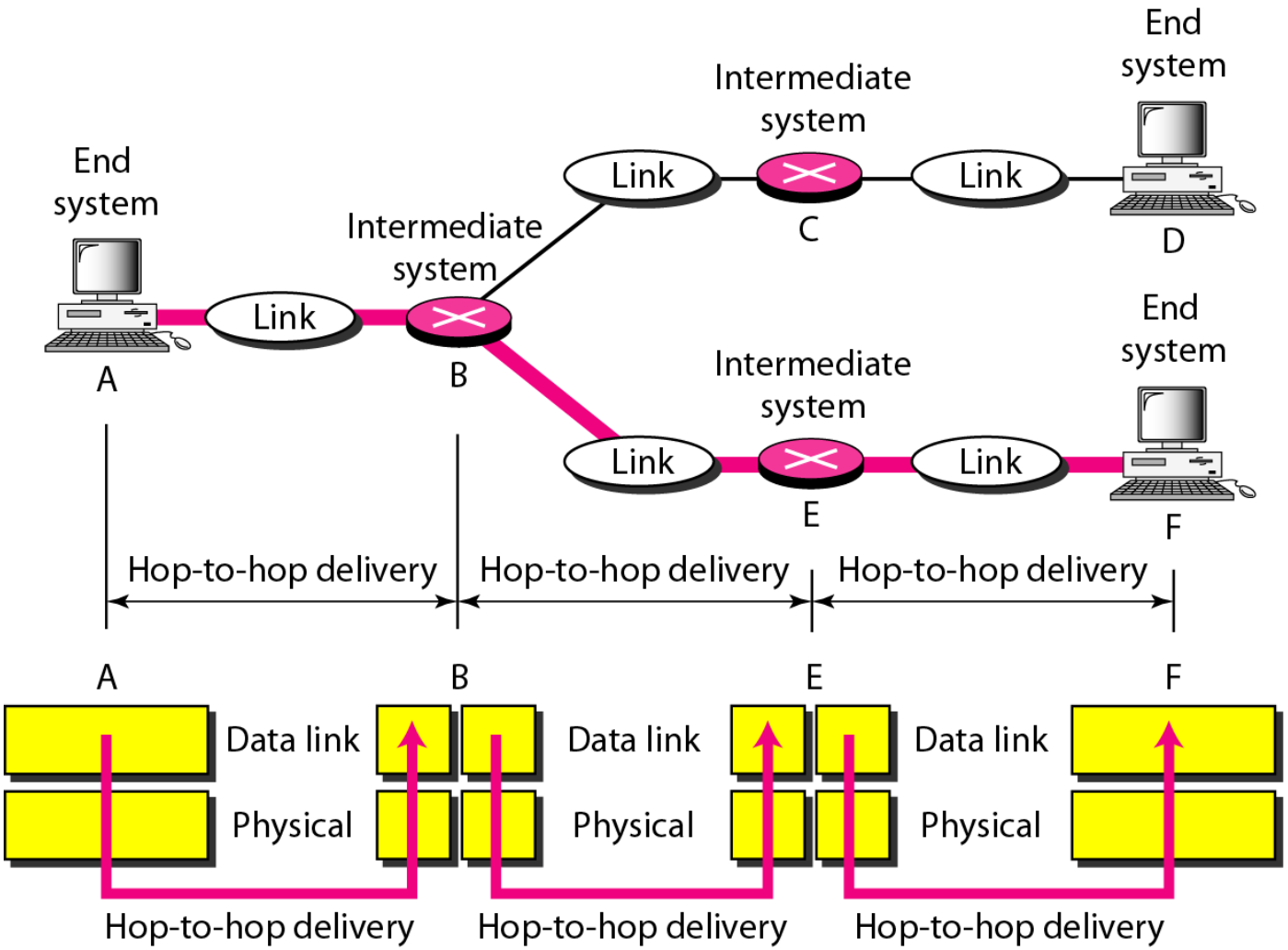
- The physical layer is responsible for movements of individual bits from one hop (node) to the next.

Data Link Layer

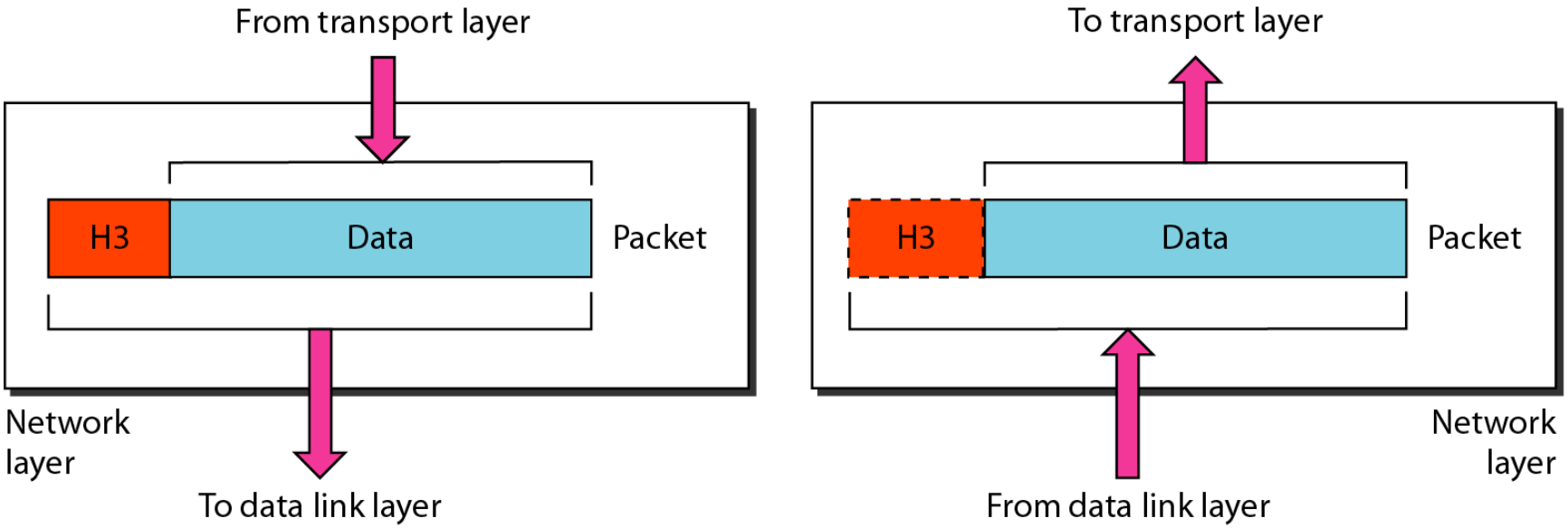


- The data link layer is responsible for moving frames from one hop (node) to the next.

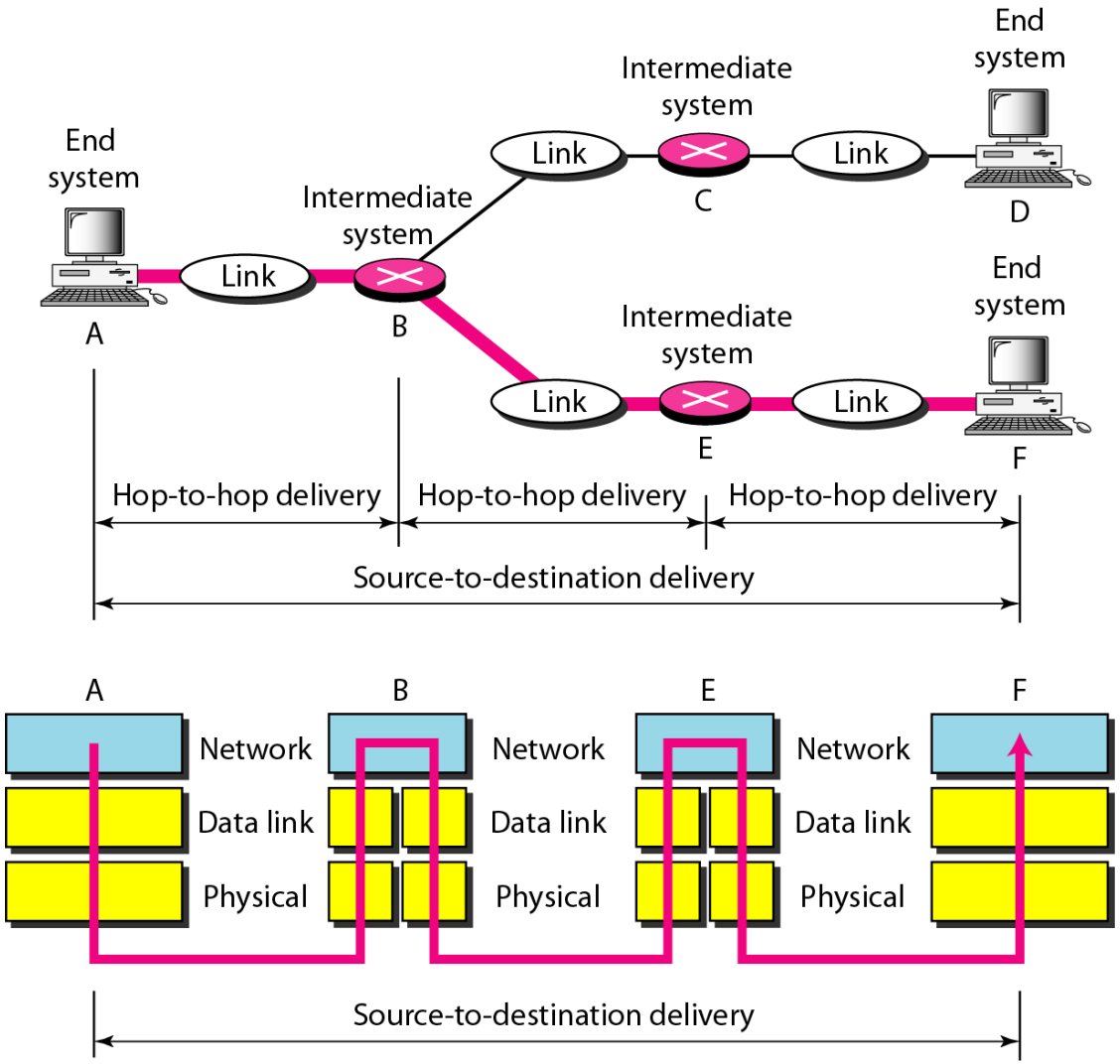
Hop to Hop Delivery



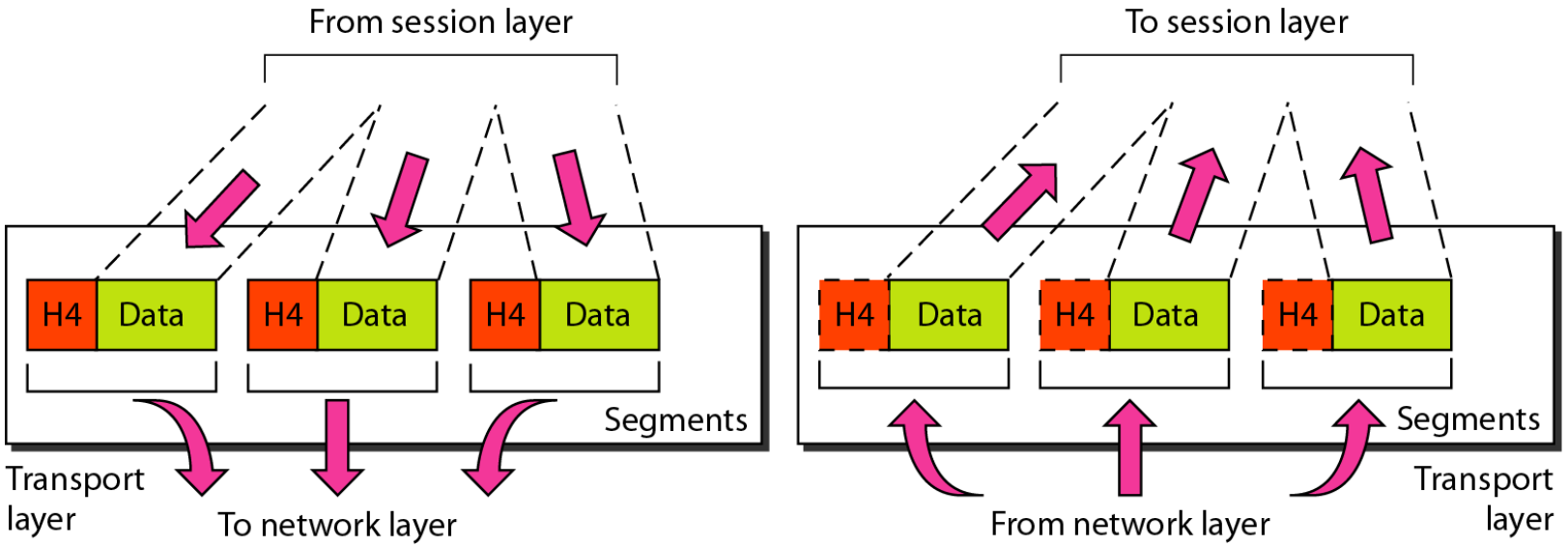
Network Layer



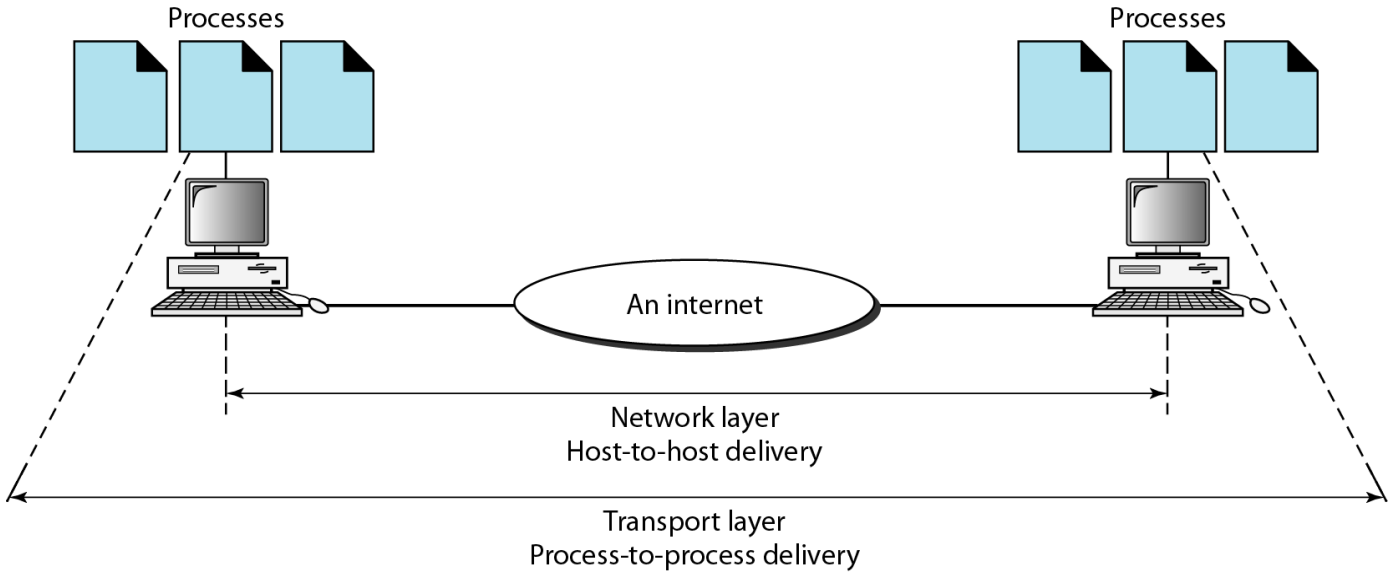
- The network layer is responsible for the delivery of individual packets from the source host to the destination host.


End system
Intermediate system
End system
Link
Link
Intermediate system
C
D
End system
Link
A
B
Intermediate system
Link
Link
E
F
Hop-to-hop delivery
Hop-to-hop delivery
Hop-to-hop delivery
Source-to-destination delivery
A
B
E
F
Network
Network
Network
Data link
Data link
Data link
Physical
Physical
Physical
Source-to-destination delivery

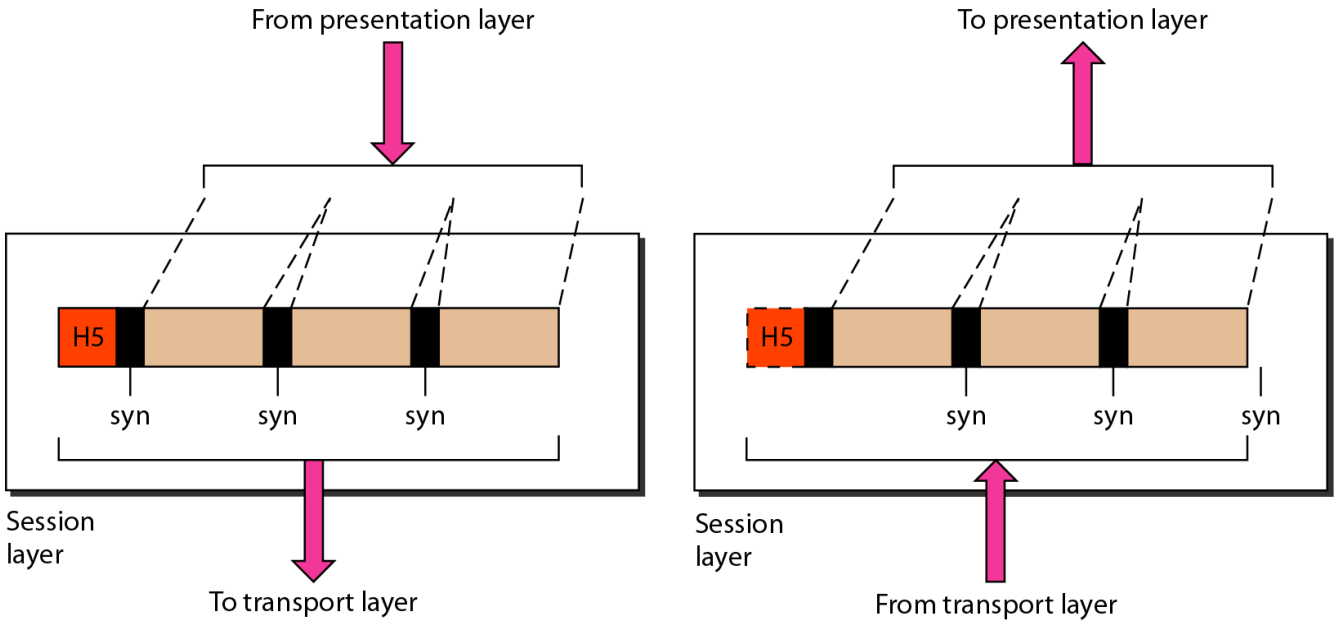
Transport Layer



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

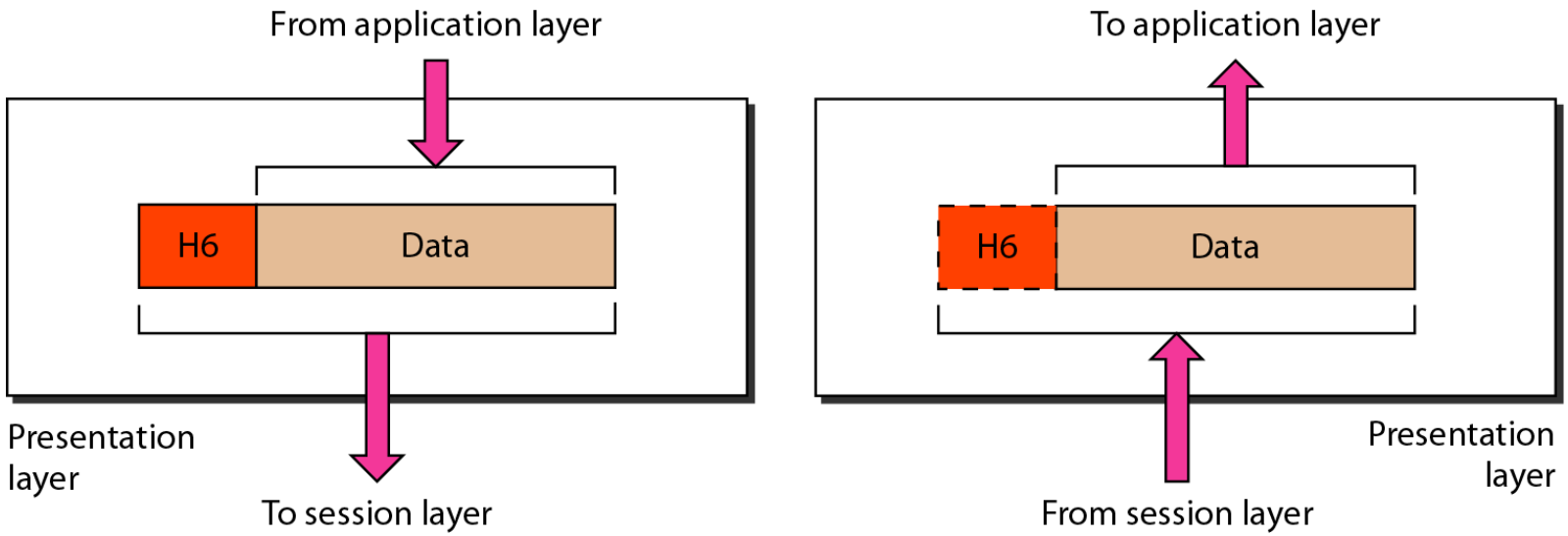

Processes
Processes
An internet
Network layer
Host-to-host delivery
Transport layer
Process-to-process delivery

Session Layer



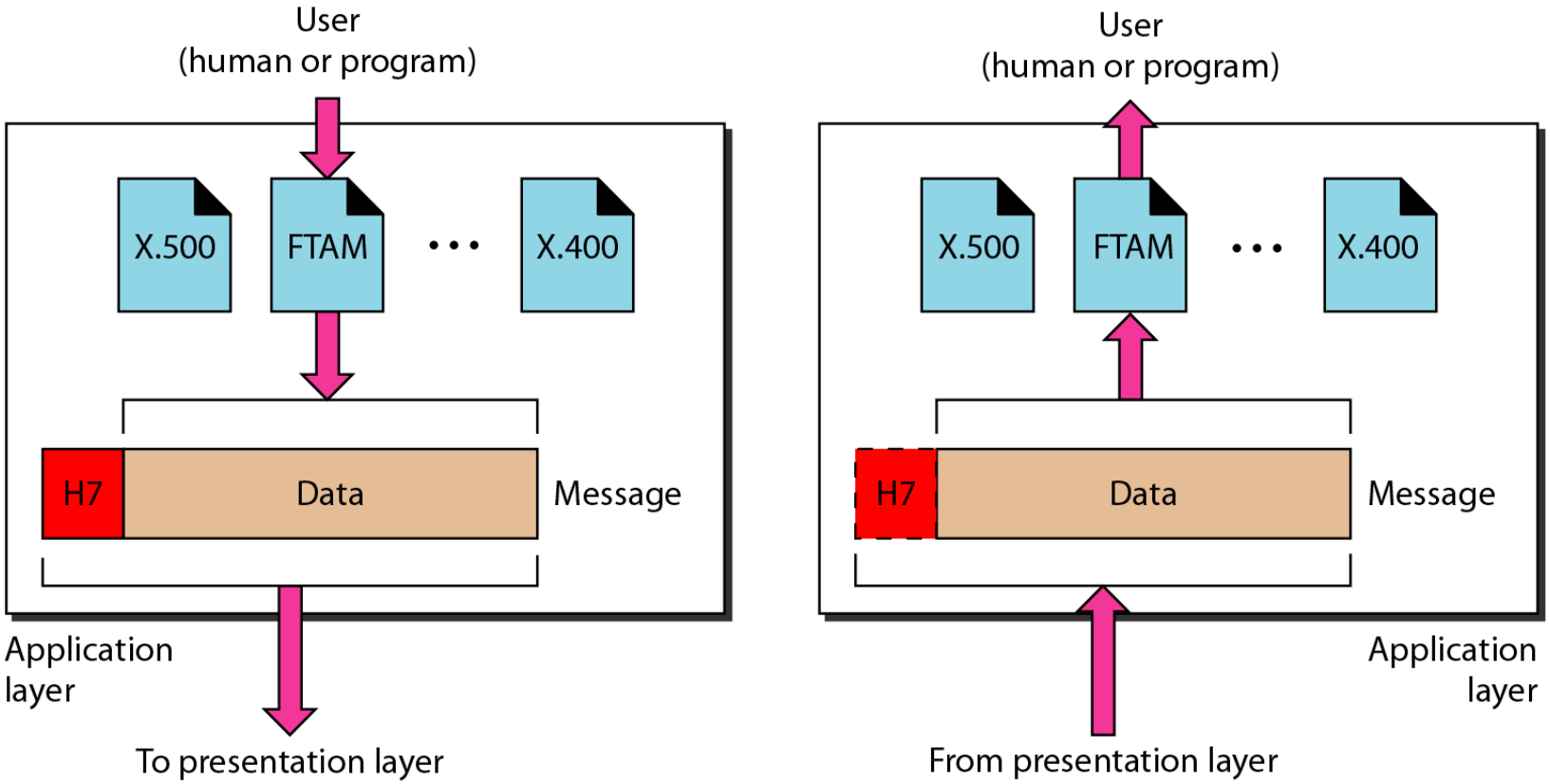
- The session layer is responsible for dialog control and synchronization.

Presentation Layer

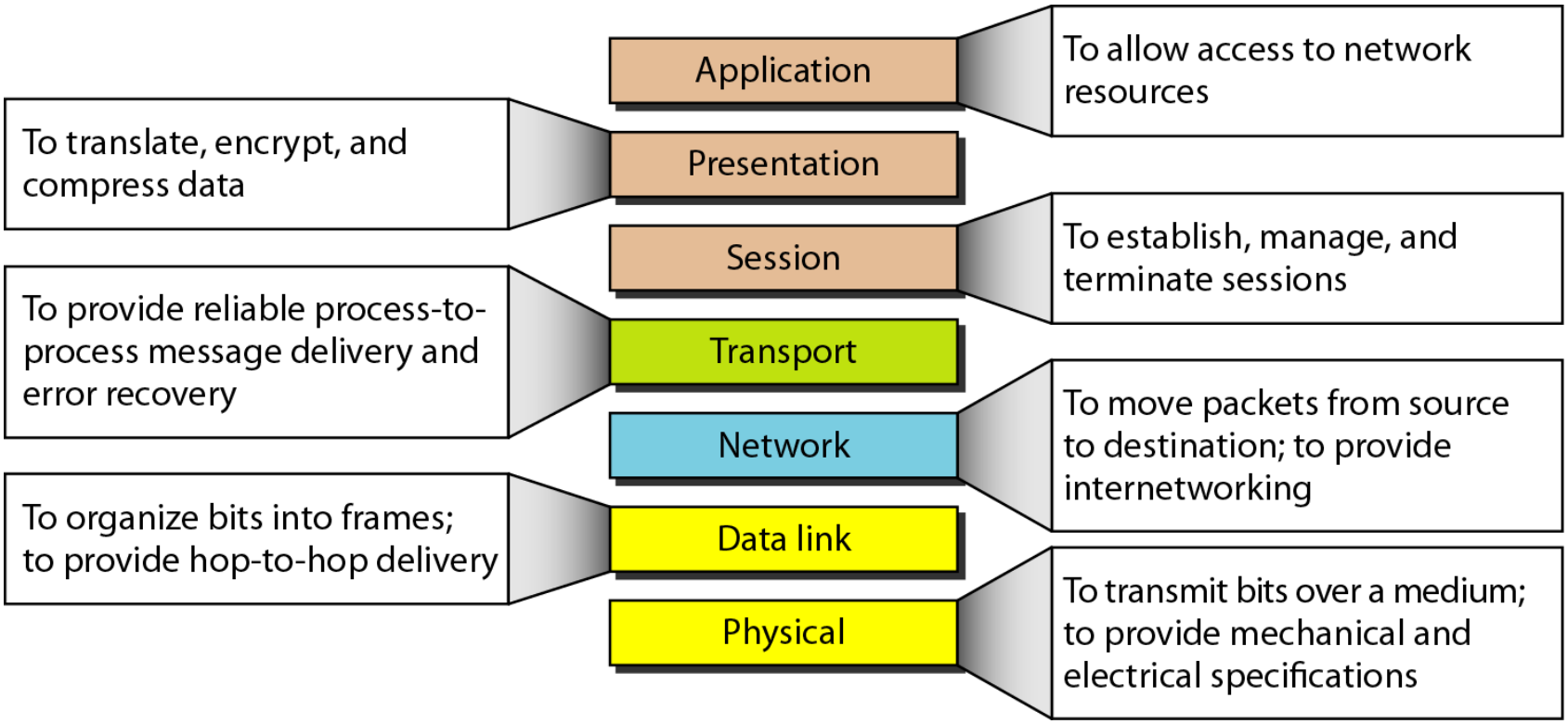


- The presentation layer is responsible for translation, compression, and encryption.

Application Layer

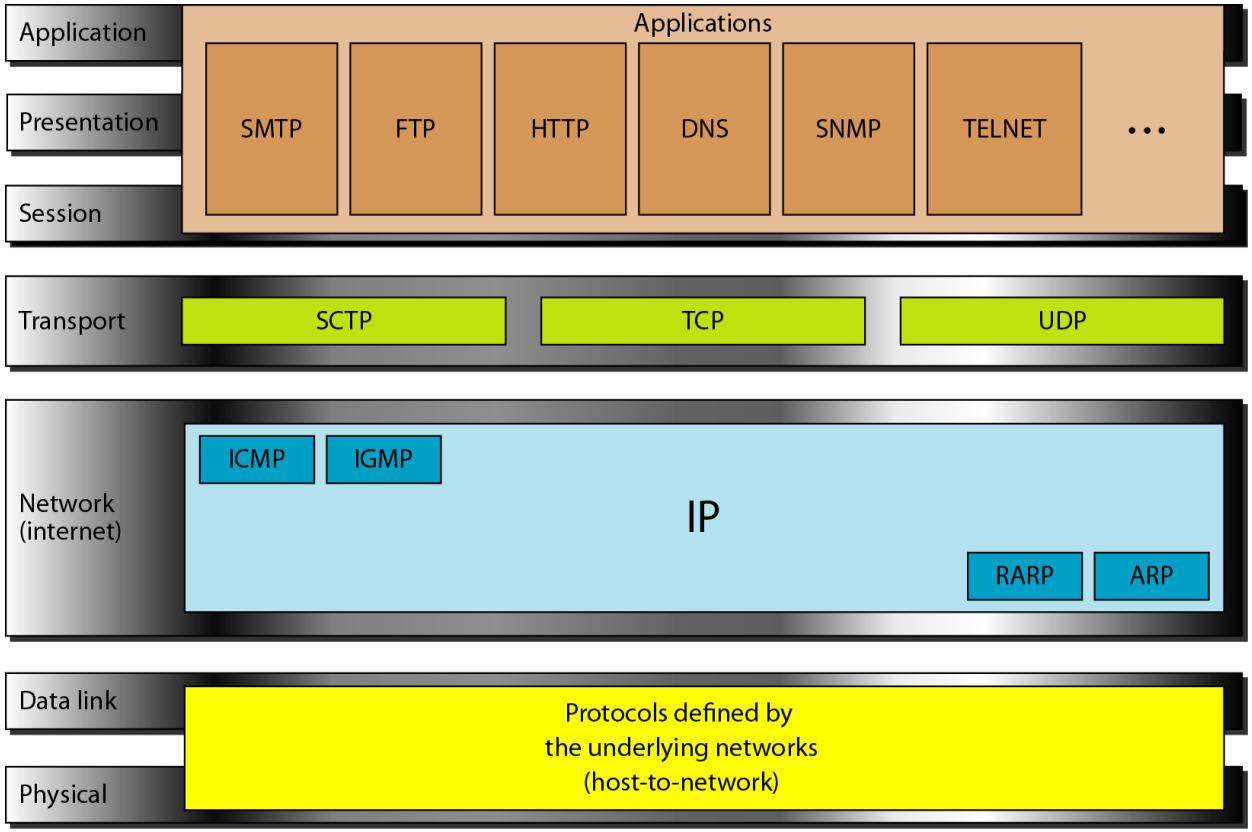


- The application layer is responsible for providing services to the user.

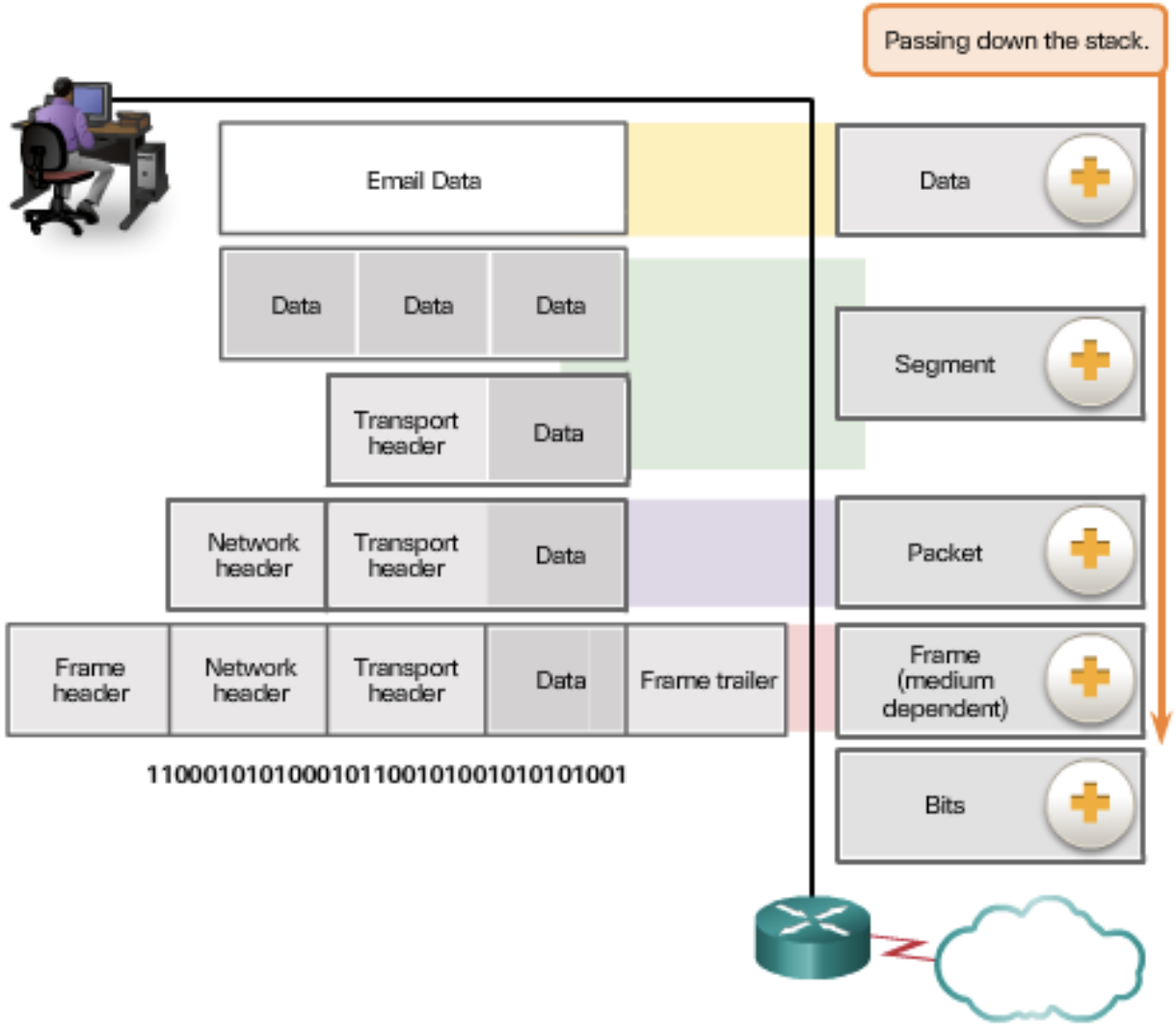

Application
To allow access to network resources
To translate, encrypt, and compress data
Presentation
Session
To establish, manage, and terminate sessions
To provide reliable process-to-process message delivery and error recovery
Transport
Network
To move packets from source to destination; to provide internetworking
To organize bits into frames; to provide hop-to-hop delivery
Data link
Physical
To transmit bits over a medium; to provide mechanical and electrical specifications

TCP/IP Protocol Suite

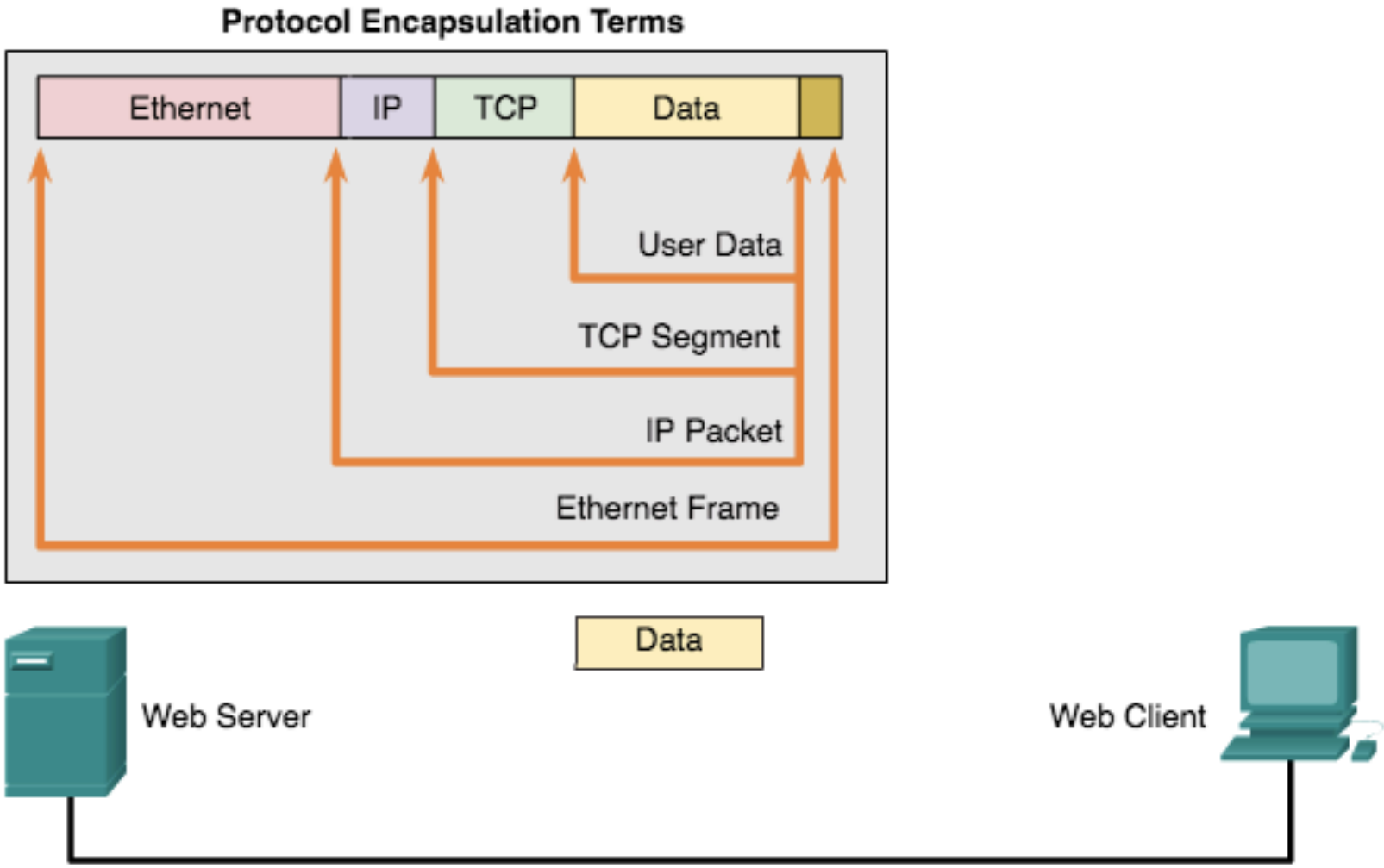
- The layers in the TCP/IP protocol suite do not exactly match those in the OSI model. The original TCP/IP protocol suite was defined as having four layers: host-to-network, internet, transport, and application. However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made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



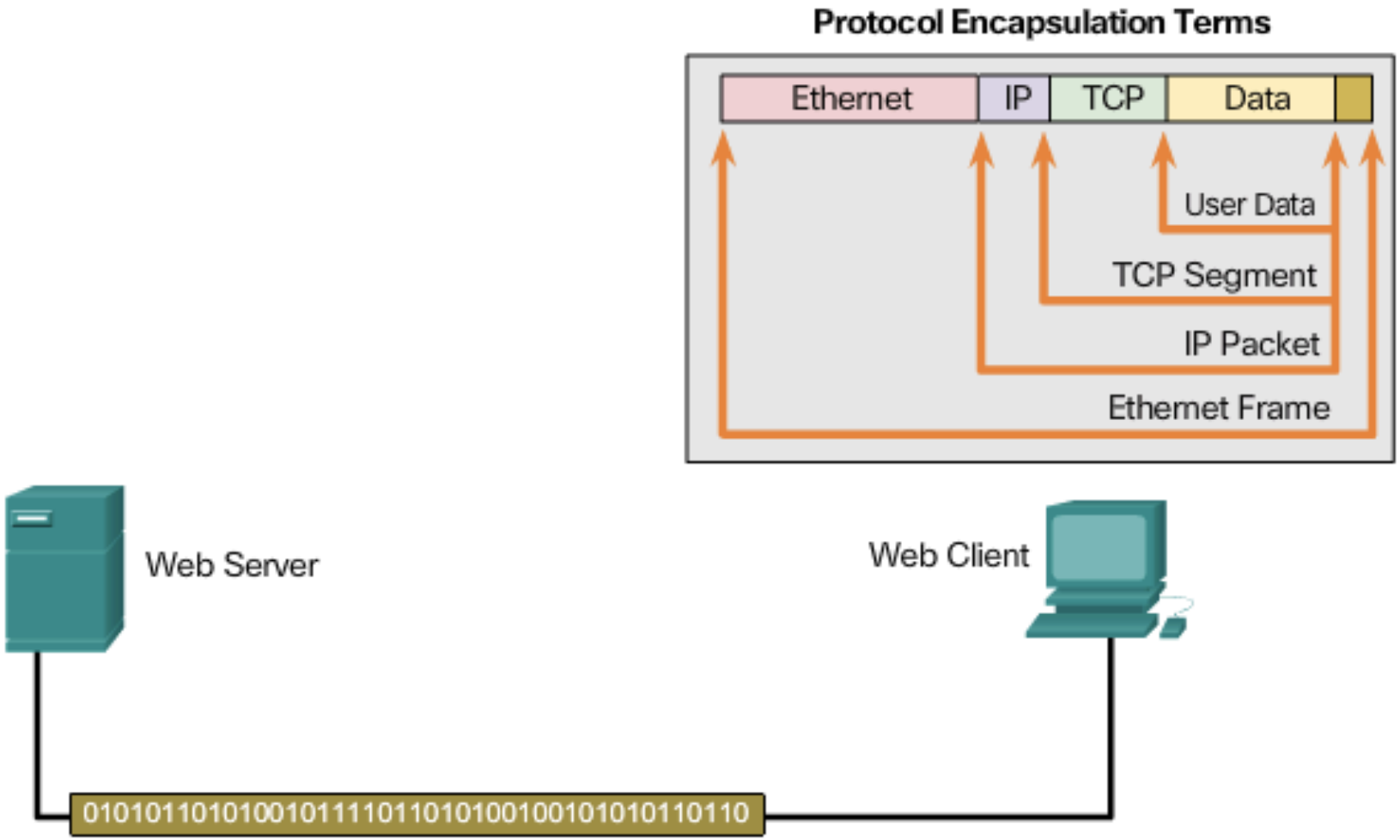
Protocol Data Unit (PDU)



Encapsulation

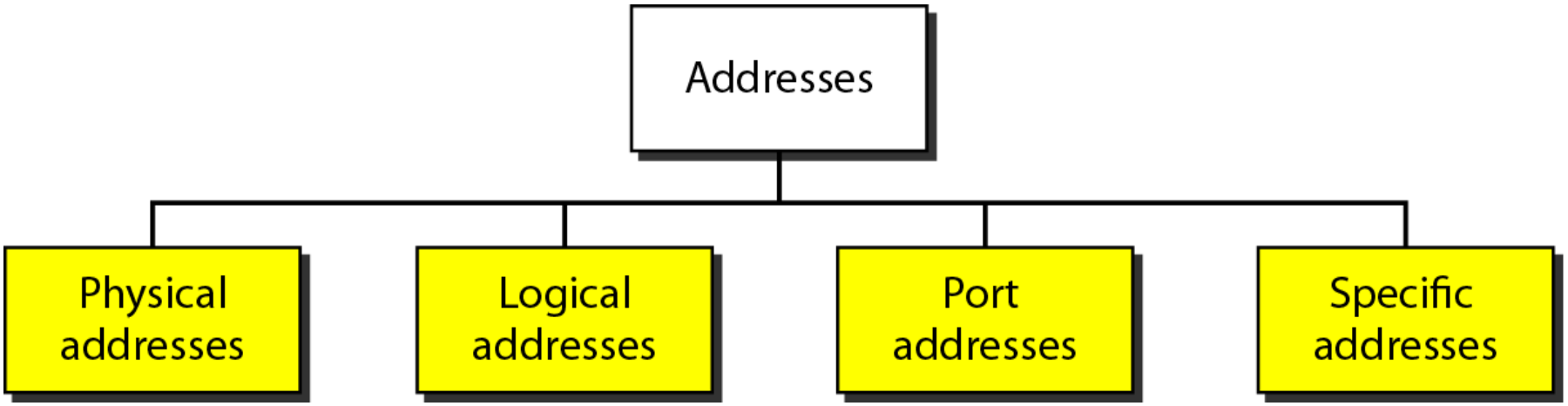


De-encapsulation

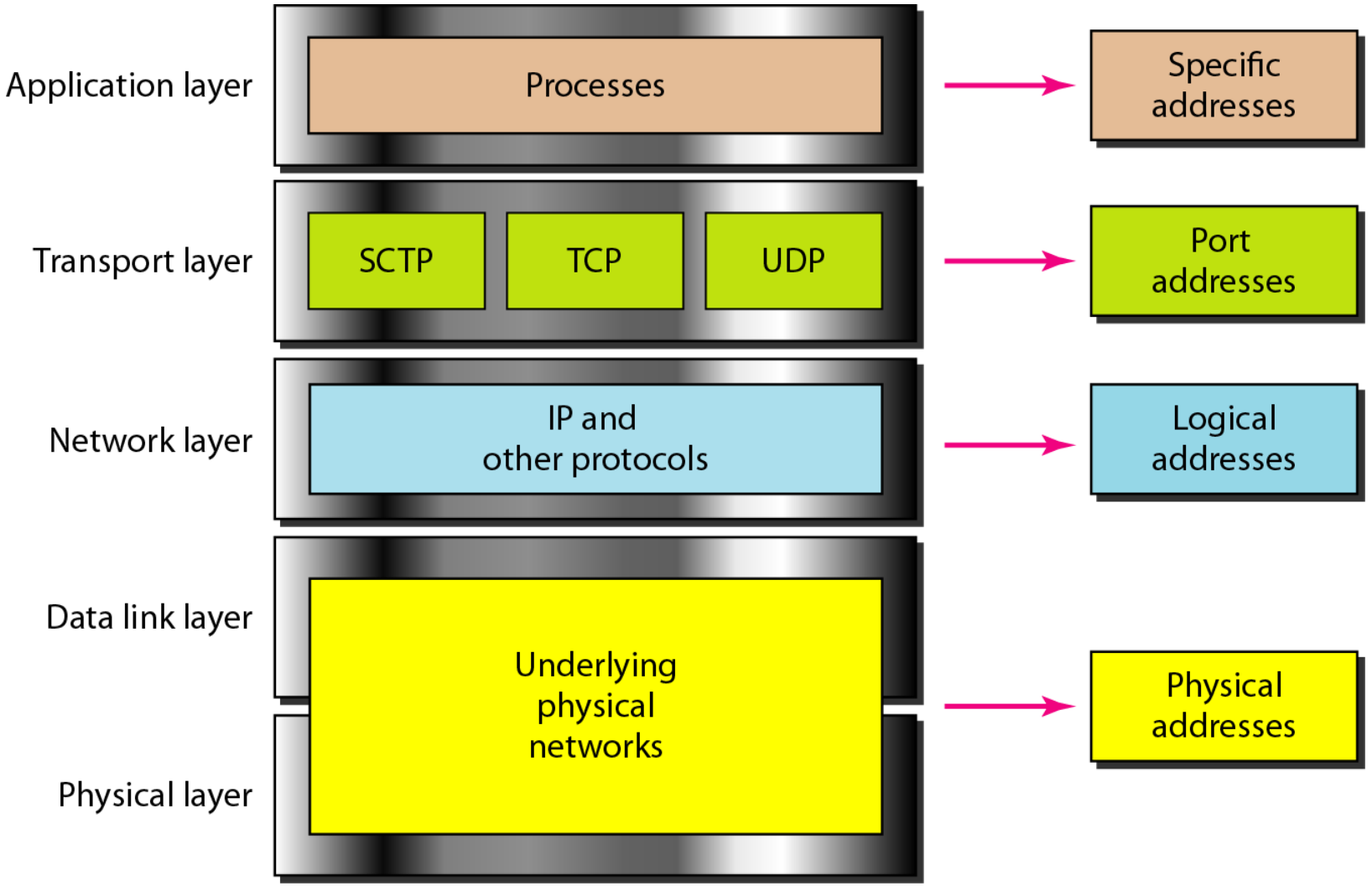


Addressing

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

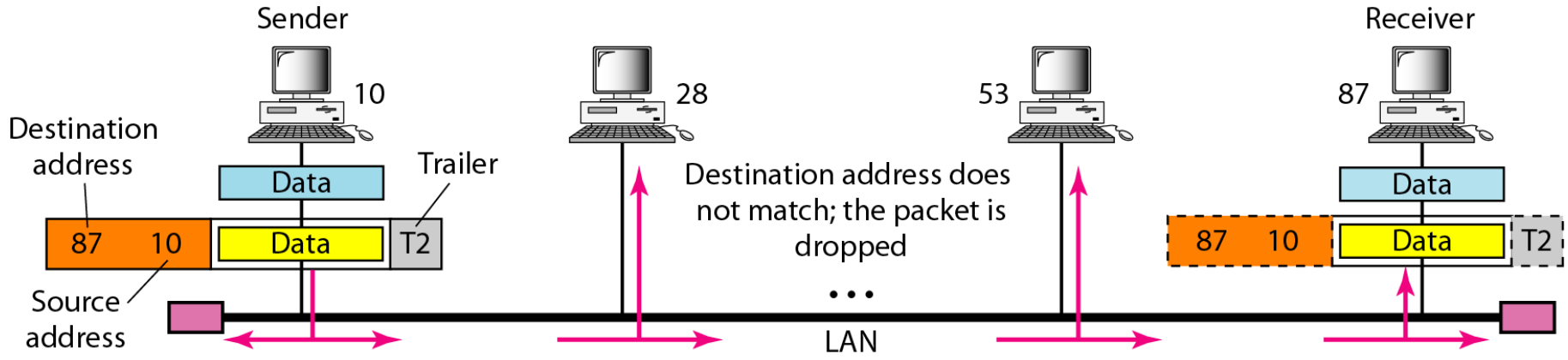


Relationship of Layers and Addresses in TCP/IP



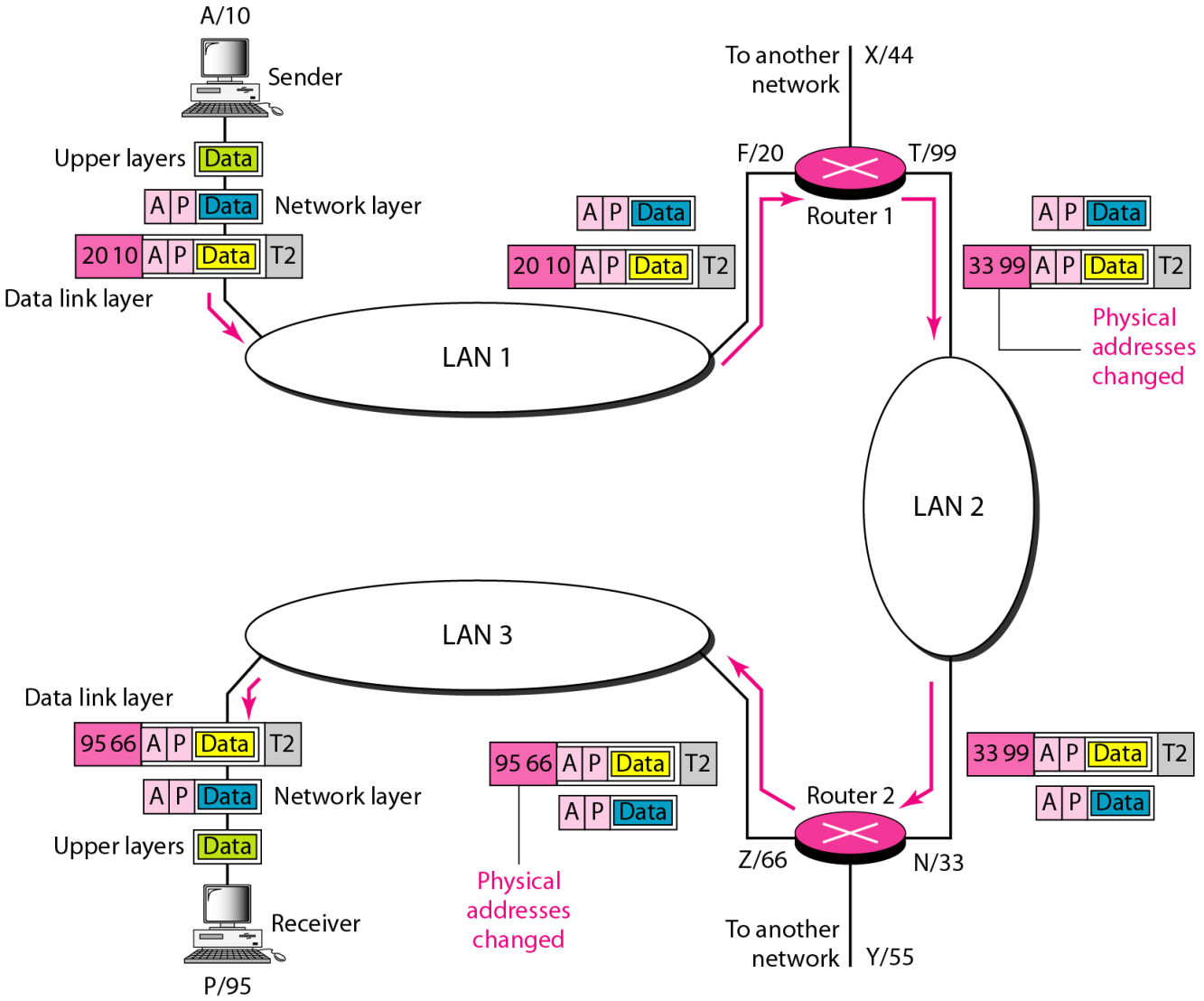
Physical Address

- In Figure, 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.

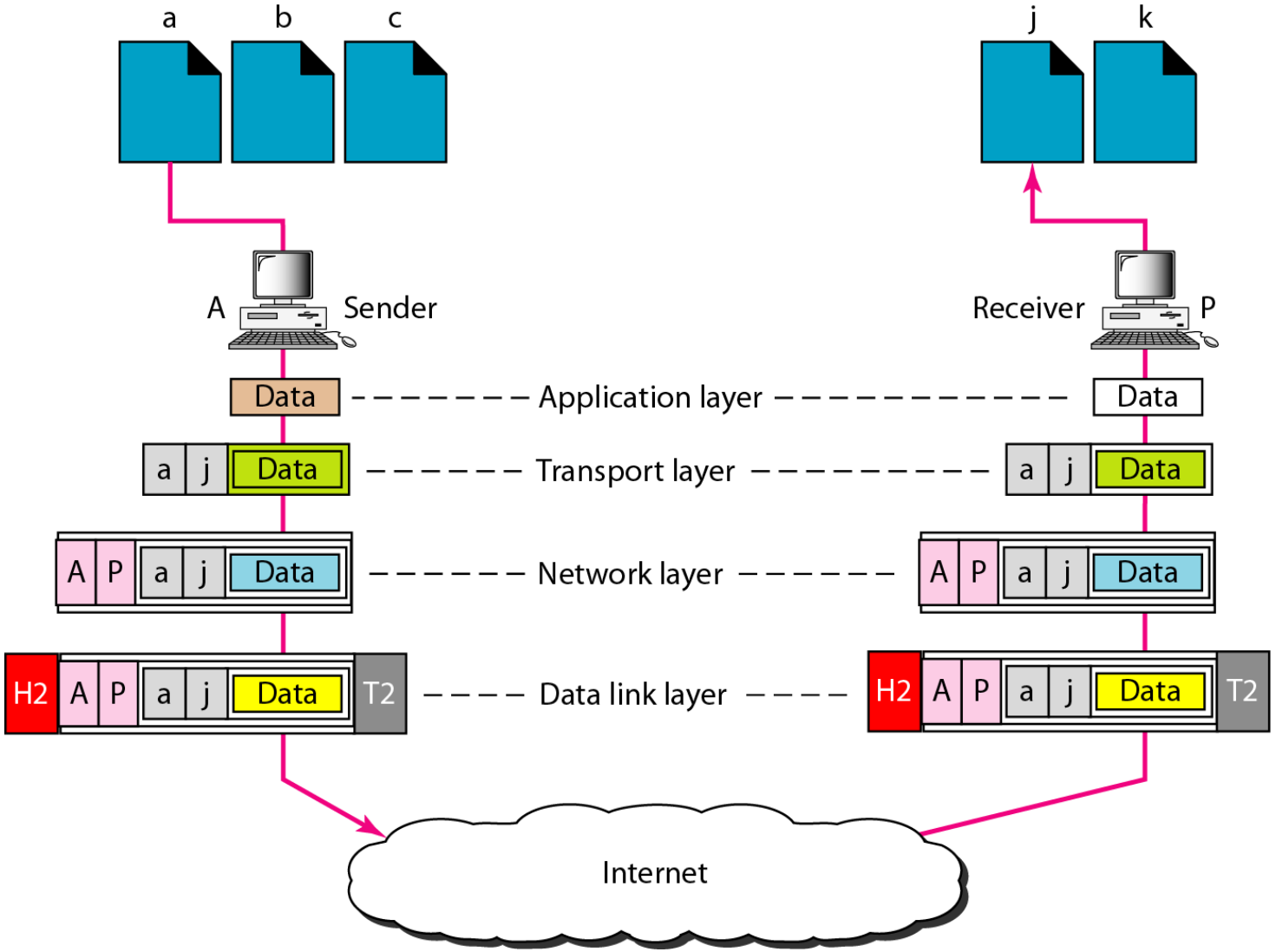


MAC Address
07:01:02:01:2C:4B
A 6-byte (12 hexadecimal digits) physical address.

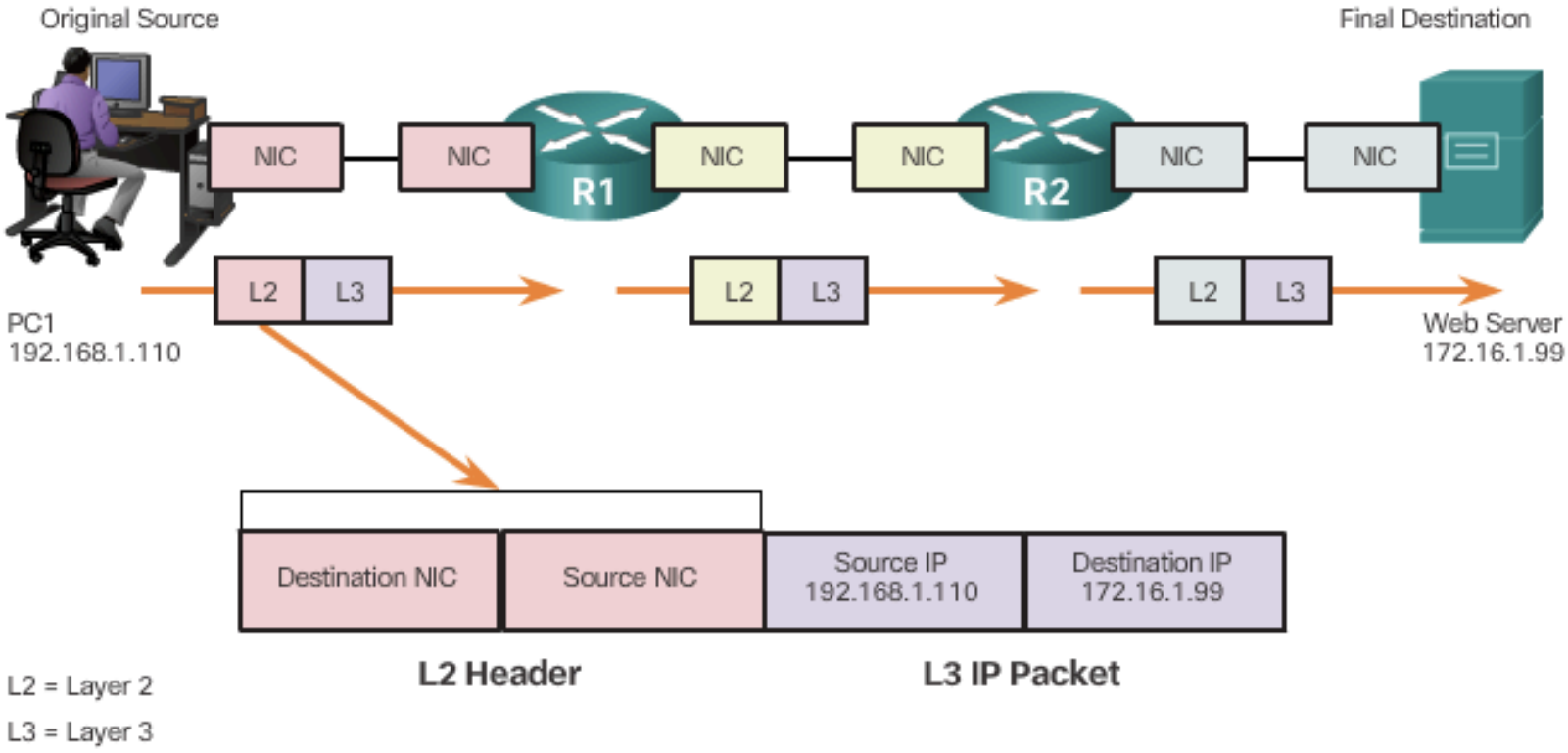
Logical Addresses



Port Addresses



Header L2 and L3



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