جامعة الحمدانية
كلية التربية
قسم علوم الحاسوب

TCP/IP

المرحلة الرابعة
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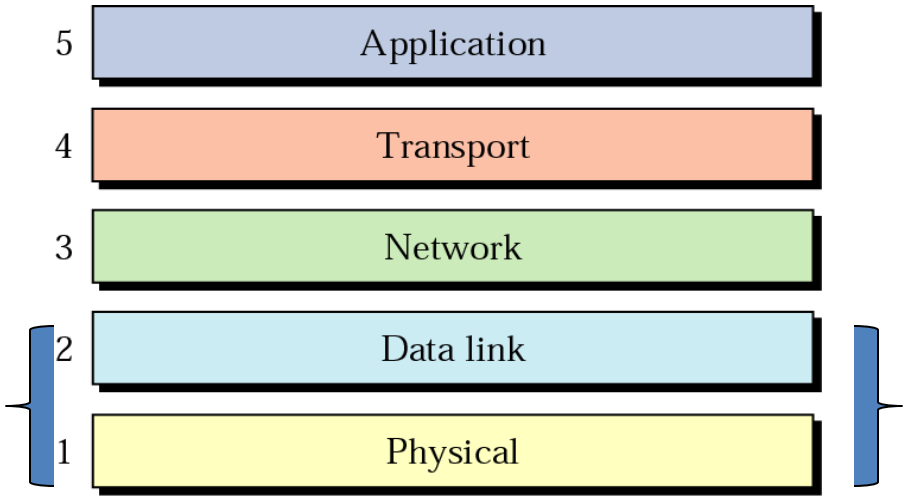
المحاضرة السابعة

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.

TCP/IP Internet Model



Brief history

- The U.S. Department of Defense (DoD) created the TCP/IP reference model, because it wanted to design a network that could survive any conditions, including a nuclear war. In a world connected by different types of communication media such as copper wires, microwaves, optical fibers and satellite links, the DoD wanted transmission of packets every time and under any conditions. This very difficult design problem brought about the creation of the TCP/IP model.

- TCP/IP was developed as an open standard. This meant that anyone was free to use TCP/IP.

The TCP/IP model has the following four layers:

- Application layer
- Transport layer
- Internet layer
- Network access layer

- The designers of TCP/IP felt that the application layer should include the OSI session and presentation layer details. They created an **application** layer that handles issues of **representation, encoding, and dialog control**

The transport

- layer deals with the quality of service issues of **reliability, flow control, and error correction**. One of its protocols, **the transmission control protocol (TCP)**, provides excellent and flexible ways to create reliable, well-flowing, low-error network communications.

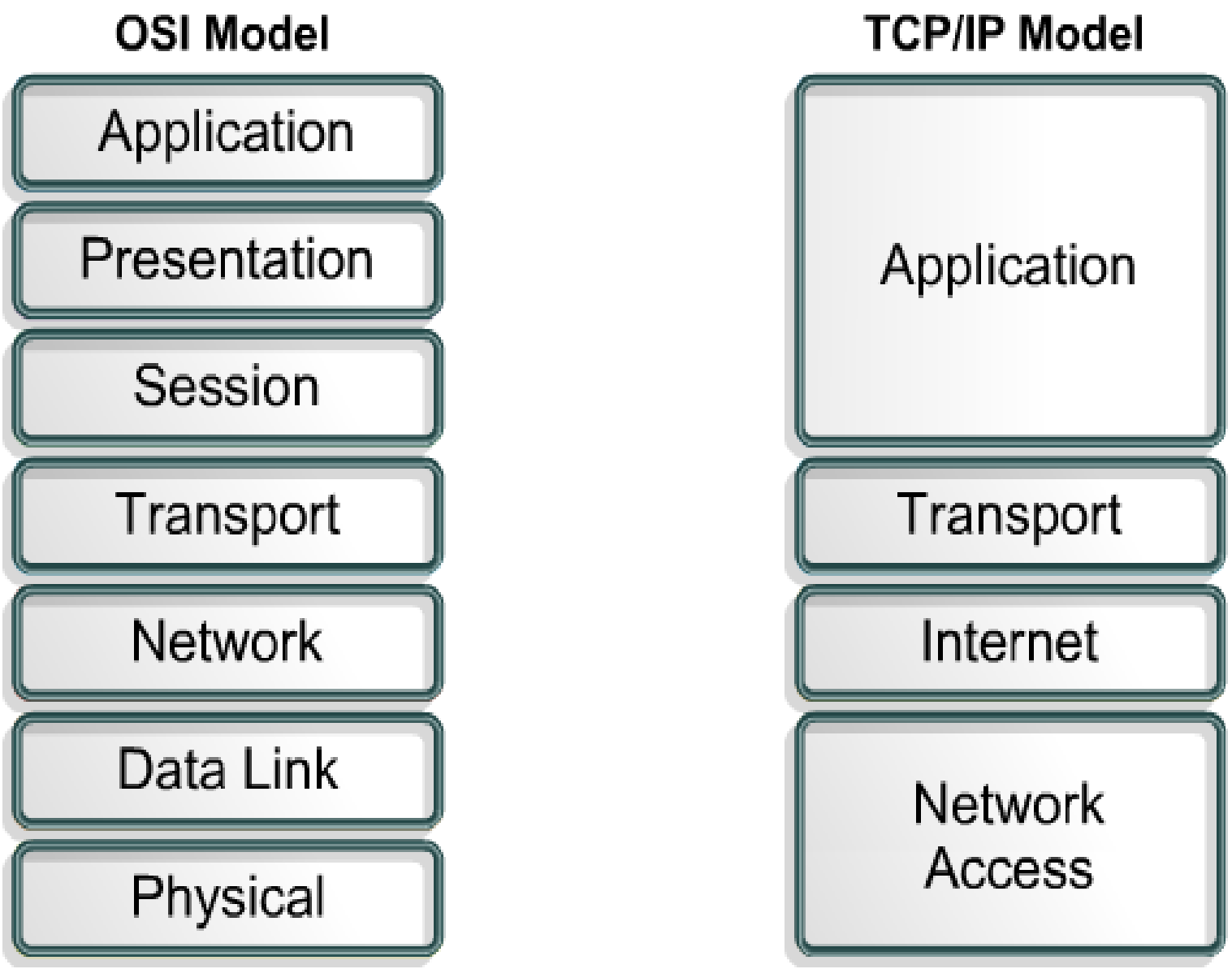
- **TCP** is a connection-oriented protocol. It maintains a dialogue between source and destination while packaging application layer information into units called segments. Connection-oriented does not mean that a circuit exists between the communicating computers. It does mean that Layer 4 segments travel back and forth between two hosts to acknowledge the connection exists logically for some period

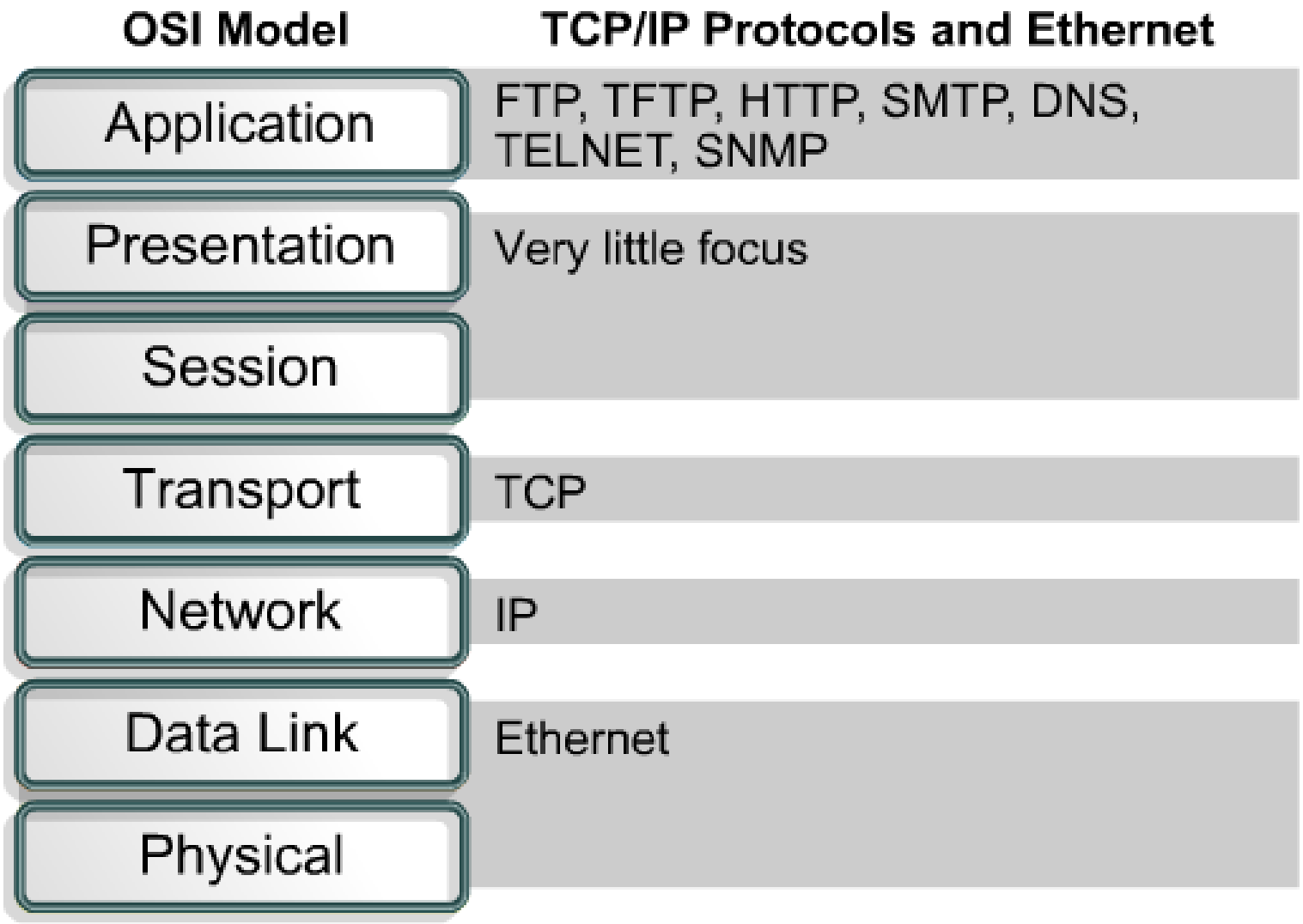
Internet layer

- The purpose of the **Internet layer** is to divide TCP segments into packets and send them from any network. The packets arrive at the destination network independent of the path they took to get there. The specific protocol that governs this layer is called the Internet Protocol (IP). Best path determination and packet switching occur at this layer.

network access layer

- The name of the network access layer is very broad and somewhat confusing. It is also known as the host-to-network layer. This layer is concerned with all of the components, both physical and logical, that are required to make a physical link. It includes the networking technology details, including all the details in the OSI physical and data link layers


OSI Model
Application
Presentation
Session
Transport
Network
Data Link
Physical
TCP/IP Model
Application
Transport
Internet
Network Access


OSI Model
TCP/IP Protocols and Ethernet
Application
FTP, TFTP, HTTP, SMTP, DNS, TELNET, SNMP
Presentation
Very little focus
Session
Transport
TCP
Network
IP
Data Link
Ethernet
Physical

some of the common protocols specified by the TCP/IP reference model layers.

- Some of the most commonly used **application** layer protocols include the following:
- File Transfer Protocol (FTP)
- Hypertext Transfer Protocol (HTTP)
- Simple Mail Transfer Protocol (SMTP)
- Domain Name System (DNS)

- The common **transport** layer protocols include:
- Transport Control Protocol (TCP)
- User Datagram Protocol (UDP)
- Stream Control Transmission Protocol (SCTP).

The primary protocol of the **Internet layer** is:

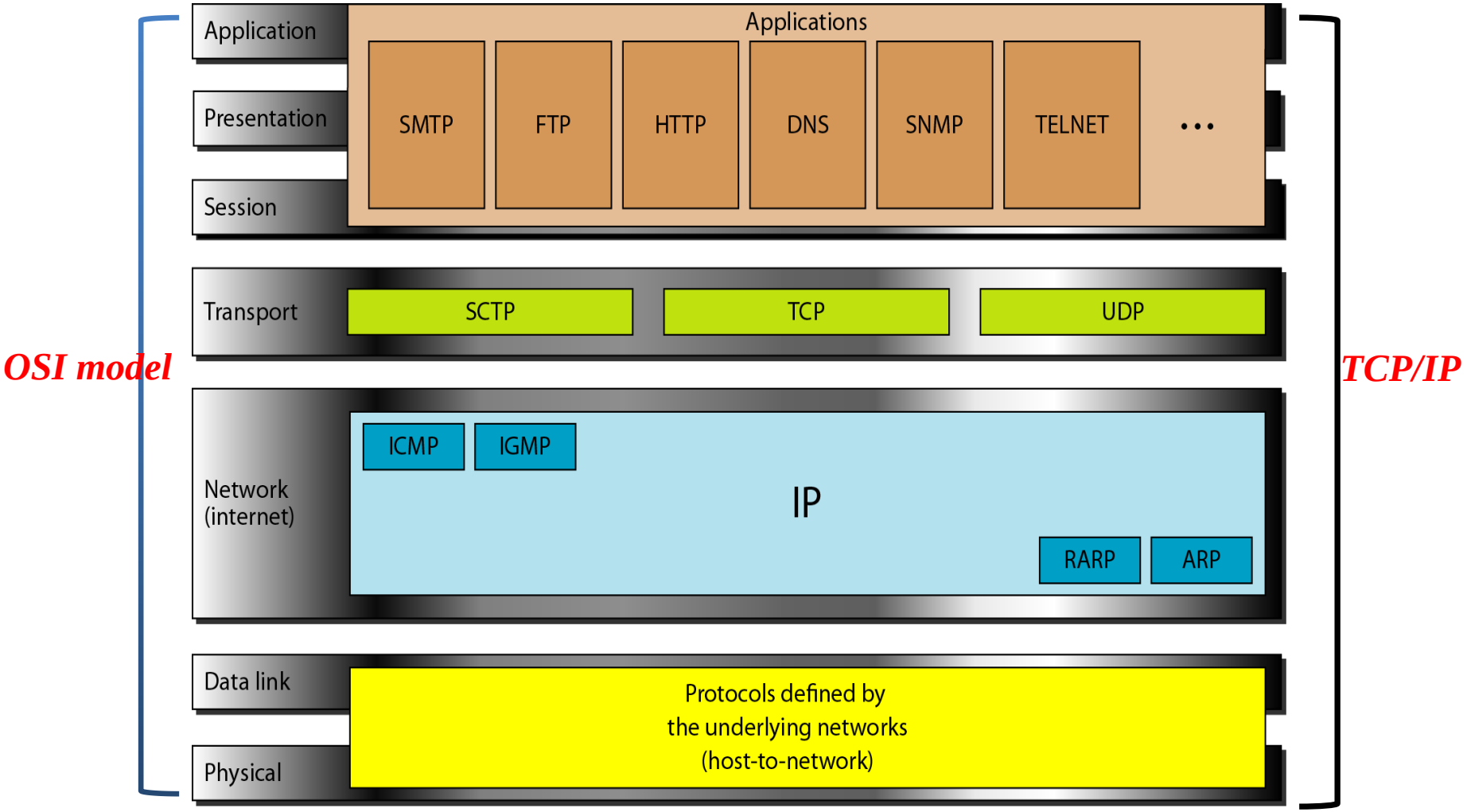
- Internet Protocol (IP)

A comparison of the OSI model and the TCP/IP model will point out some similarities and differences Similarities include:

- Both have layers.
- Both have application layers, though they include very different services.
- Both have comparable transport and network layers.
- Both assume packets are switched. This means that individual packets may take different paths to reach the same destination.

- Differences include:
- TCP/IP combines the presentation and session layer issues into its application layer.
- TCP/IP combines the OSI data link and physical layers into the network access layer.
- TCP/IP appears simpler because it has fewer layers.
- TCP/IP protocols are the standards around which the Internet developed, so the TCP/IP model gains credibility just because of its protocols.

TCP/IP and OSI model



Network Layer protocols

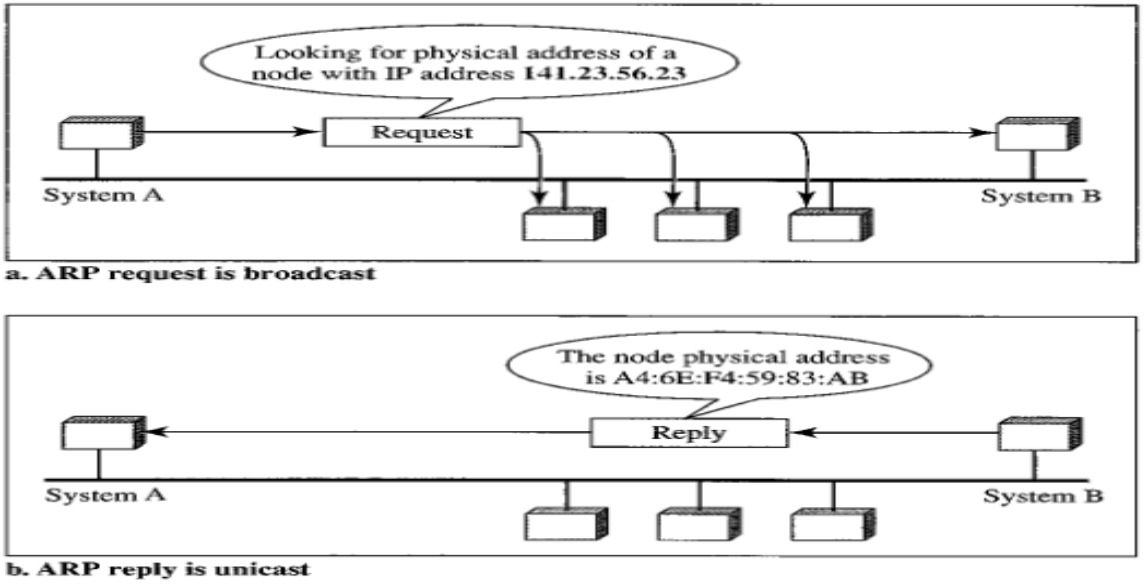
Internetworking Protocol (IP)

The Internetworking Protocol (IP) is the transmission mechanism used by the TCP/IP protocols. IP transports data in packets called *datagram*, each of which is transported separately.

Address Resolution Protocol (ARP)

Is used to associate a logical address with a physical address. ARP is used to find the physical address of the node when its Internet address is known.

ARP operation



Mapping Logical to Physical Address:

Reverse Address Resolution Protocol (RARP)

Allows a host to discover its Internet address when it knows only its physical address. It is used when a computer is connected to a network for the first time.

The machine can get its physical address (by reading its NIC, for example), which is unique locally. It can then use the physical address to get the logical address by using the RARP protocol.

Mapping physical to logical address.

Internet Control Message Protocol (ICMP)

Is a mechanism used by hosts and gateways to send notification of datagram problems back to the sender. ICMP sends query and error reporting messages.

ICMP always reports error messages to the original source.

Internet Group Message Protocol (IGMP)

Is used to facilitate the simultaneous transmission of a message to a group of recipients.

Transport Layer

UDP and TCP are transport level protocols responsible for delivery of a message from a process (running program) to another process. A new transport layer protocol, SCTP, has been devised to meet the needs of some newer applications.

*User Datagram Protocol (**UDP**)*

It is a process-to-process protocol that adds only port addresses (Service Point Addressing), checksum (to detect error in the message) error control, and length information to the data from the upper layer.

*Transmission Control Protocol (**TCP**)*

Provides full transport-layer services to applications, segmentation and reassembly and connection control.

*Stream Control Transmission Protocol (**SCTP**)*

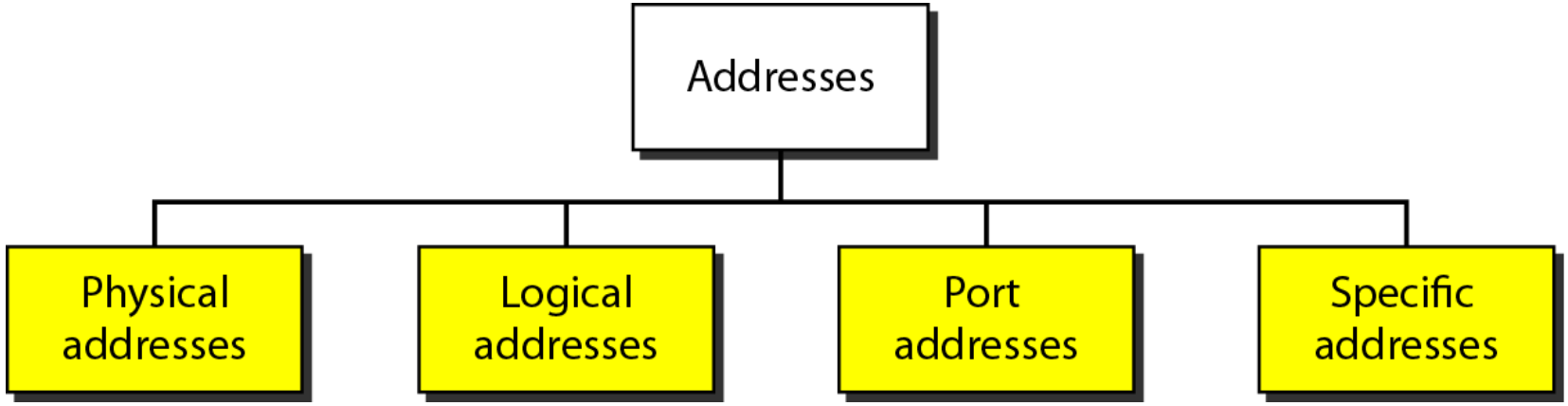
Provides support for newer applications such as voice over the Internet. It is a transport layer protocol that combines the best features of UDP and TCP.

Application Layer

The *application layer* in TCP/IP is equivalent to the combined session, presentation, and application layers in the OSI model. Many protocols are defined at this layer.

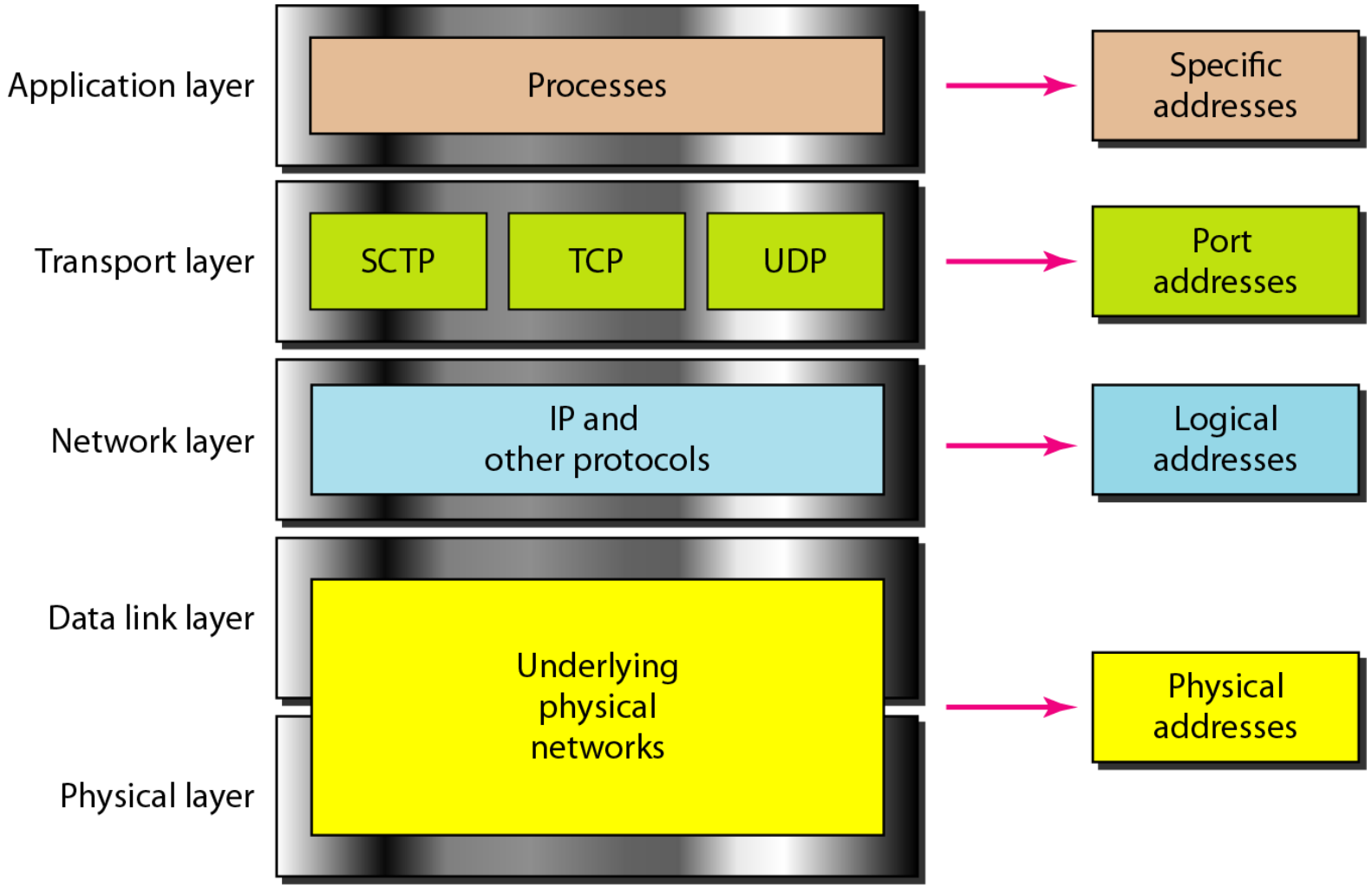
ADDRESSING

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



Addresses in TCP/IP

Relationship of layers and addresses in TCP/IP

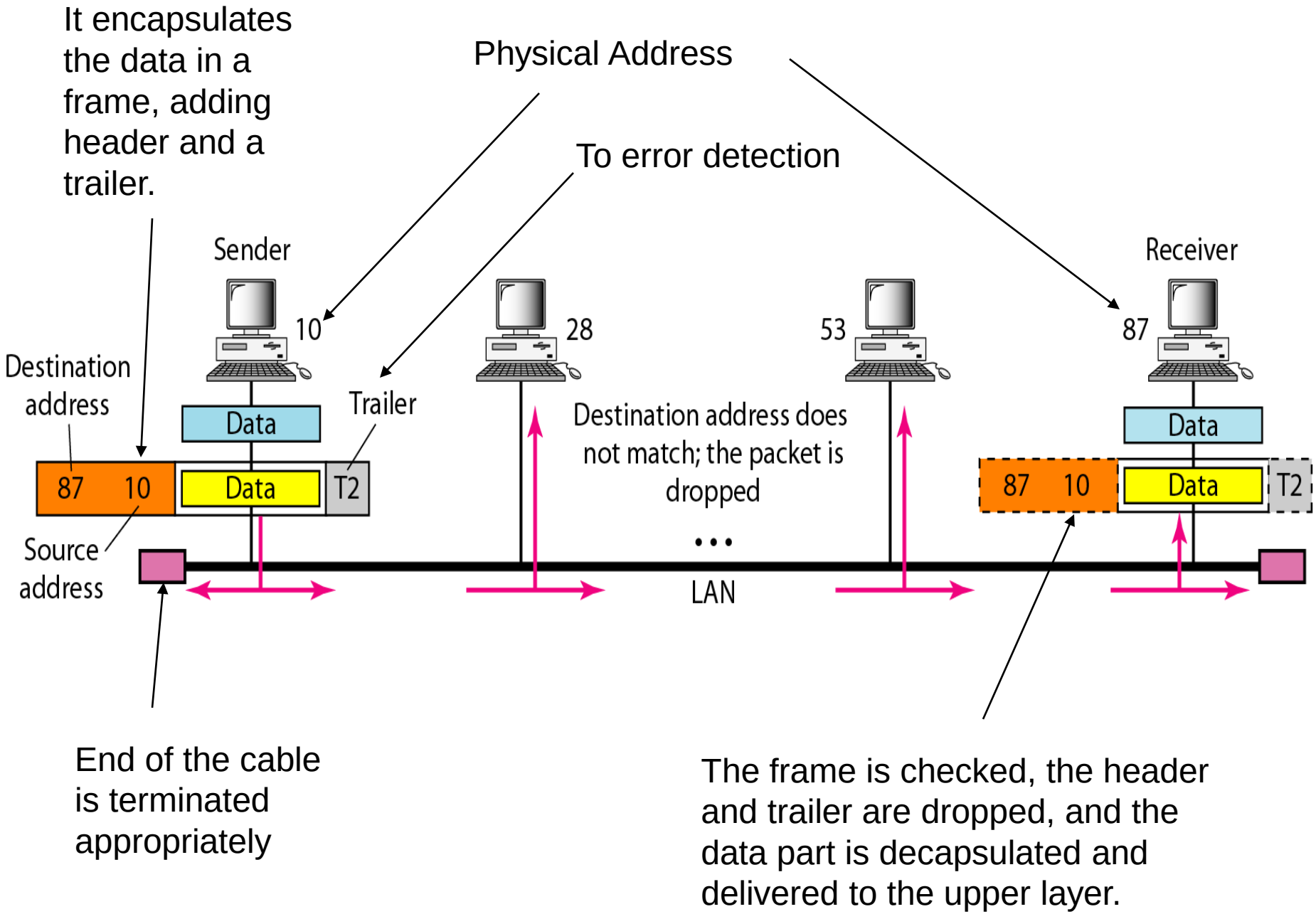


Physical Addresses (Data Link)

The physical address, also known as the link address, is the address of a node as defined by its LAN or WAN. It is included in the frame used by the data link layer.

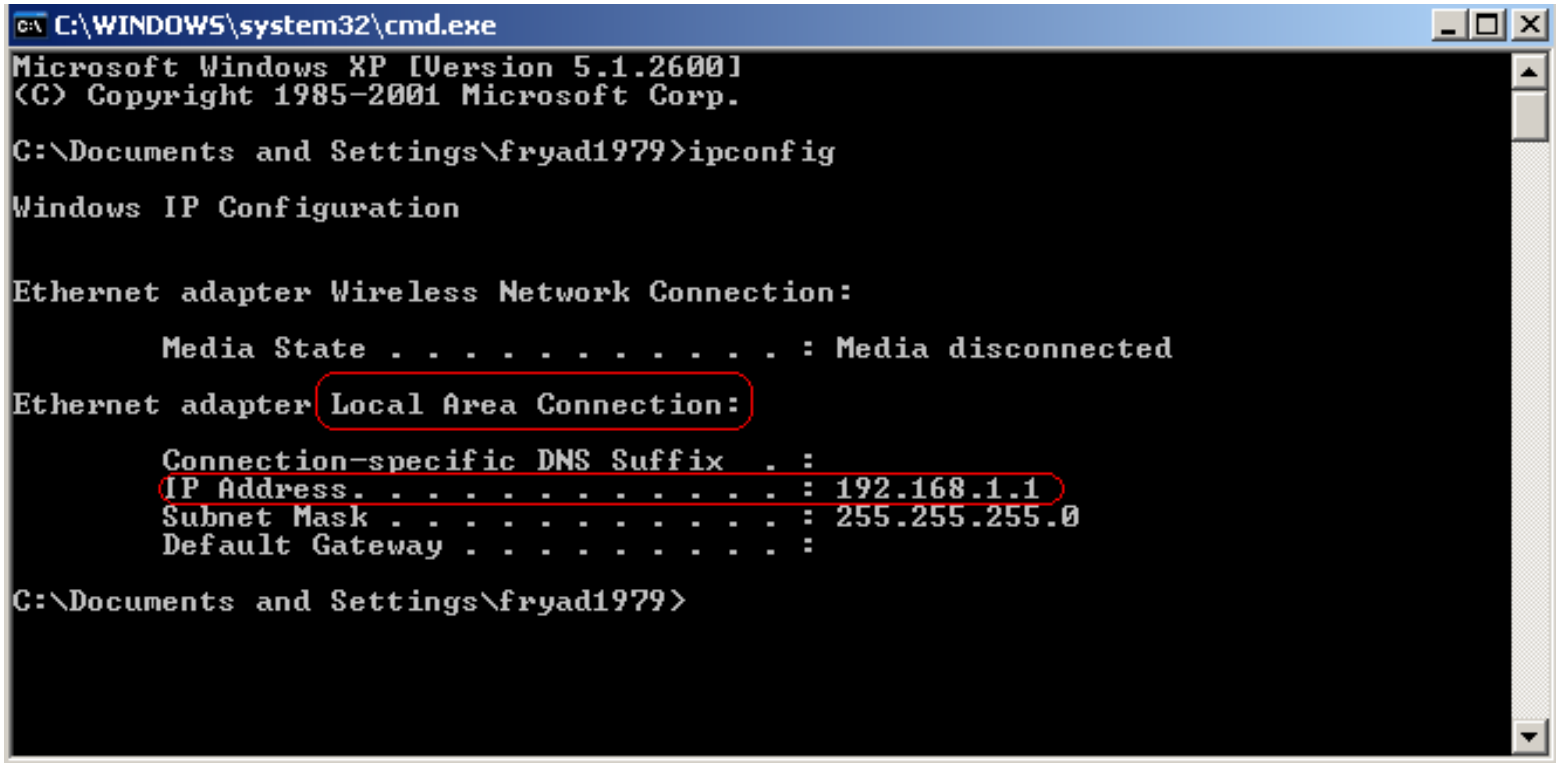
Example 1

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.

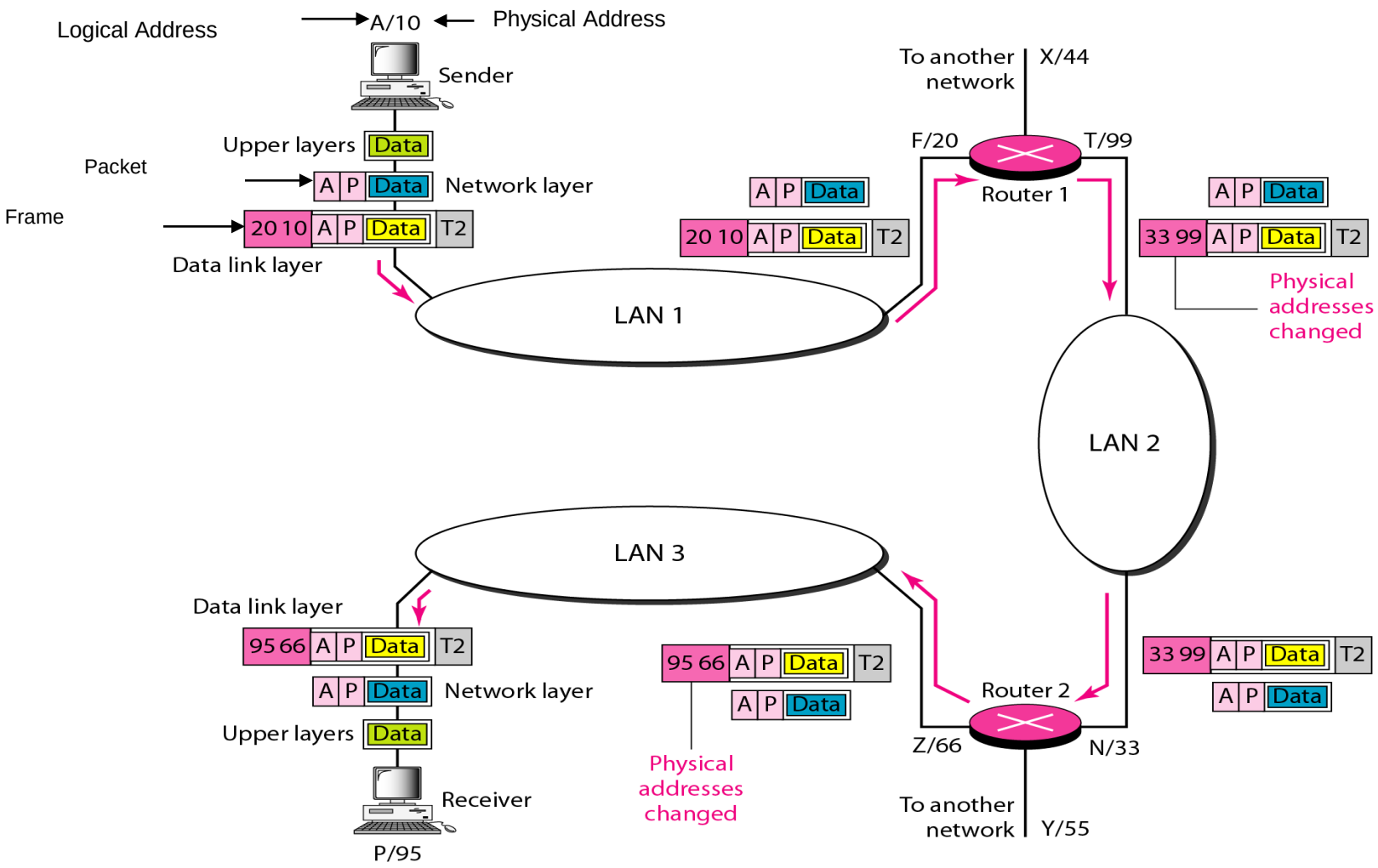

It encapsulates the data in a frame, adding header and a trailer.
Physical Address
To error detection
Sender
Receiver
10
28
53
87
Destination address
Trailer
Data
87 10
Data
T2
Source address
Destination address does not match; the packet is dropped
LAN
End of the cable is terminated appropriately
The frame is checked, the header and trailer are dropped, and the data part is decapsulated and delivered to the upper layer.

Logical Addresses (Network Layer)

A logical address in the Internet is currently a 32-bit address that can uniquely define a host connected to the Internet. No two publicly addressed and visible hosts on the Internet can have the same IP address.



Example 3



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

Port Addresses (Transport Layer)

For example, computer A can communicate with computer C by using TELNET. At the same time, computer A communicates with computer B by using the File Transfer Protocol (FTP). For these processes to receive data simultaneously, we need a method to label the different processes.
In other words, they need addresses. In the TCP/IP architecture, the label assigned to a process is called a port address. A port address in TCP/IP is 16 bits in length.

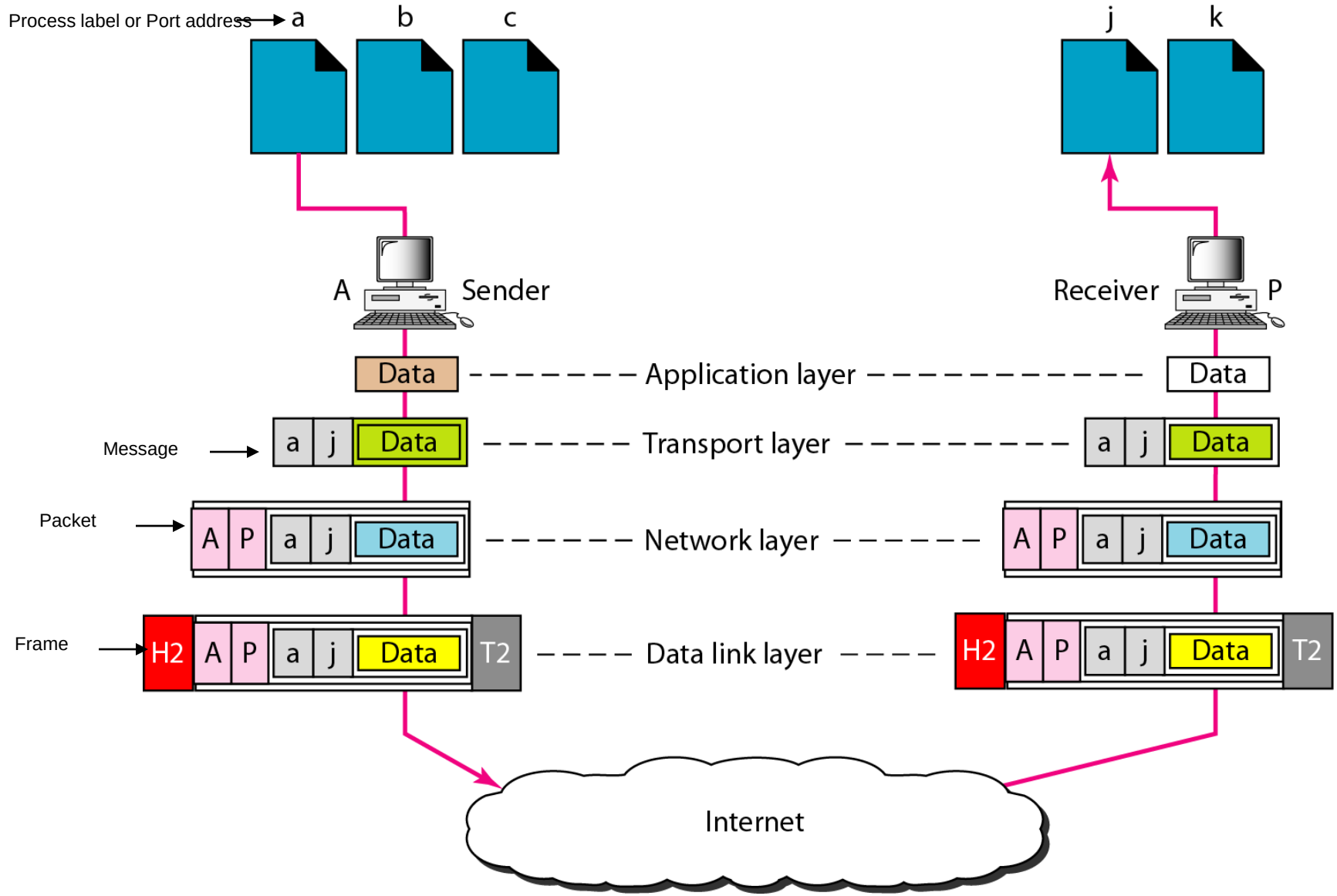
Process Label Telnet=Port Address=23

Process Label FTP=Port Address=21

Example 4

Figure 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.

Port addresses



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