

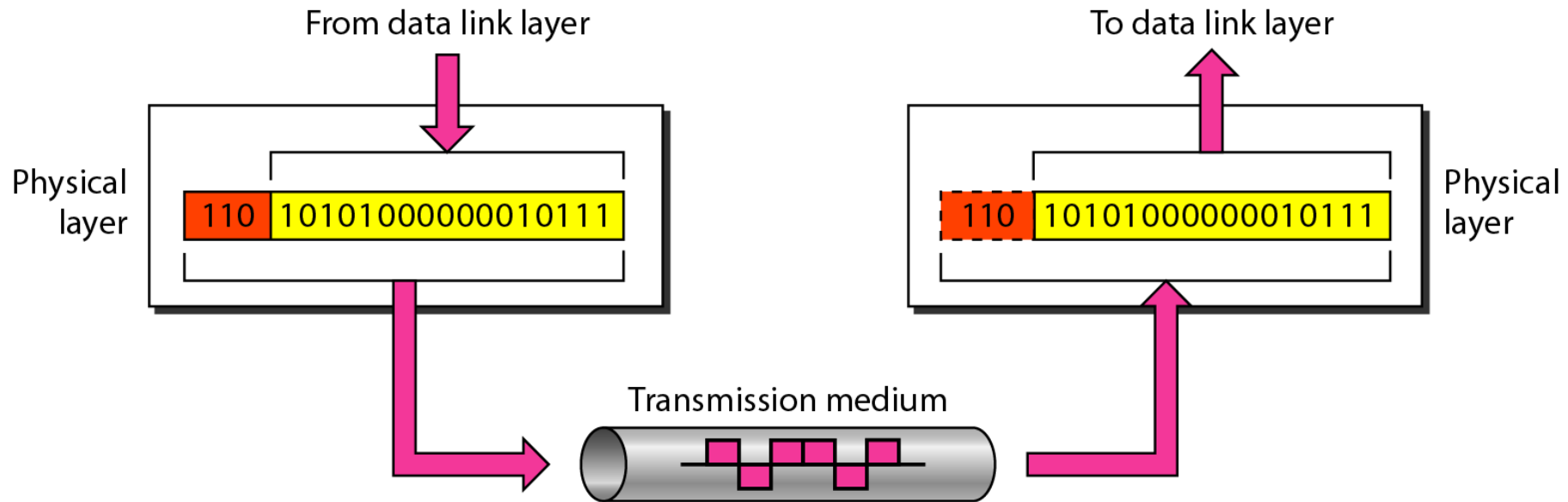
جامعة الحمدانية  
كلية التربية  
قسم علوم الحاسوب

# Network Layers II

المرحلة الرابعة  
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المحاضرة الخامسة

# Physical Layer

coordinates the functions required to carry a bit stream over a physical medium, It deals with the mechanical and electrical specifications of the **interface** and **transmission medium**.



*Physical layer*

## Main Function:

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

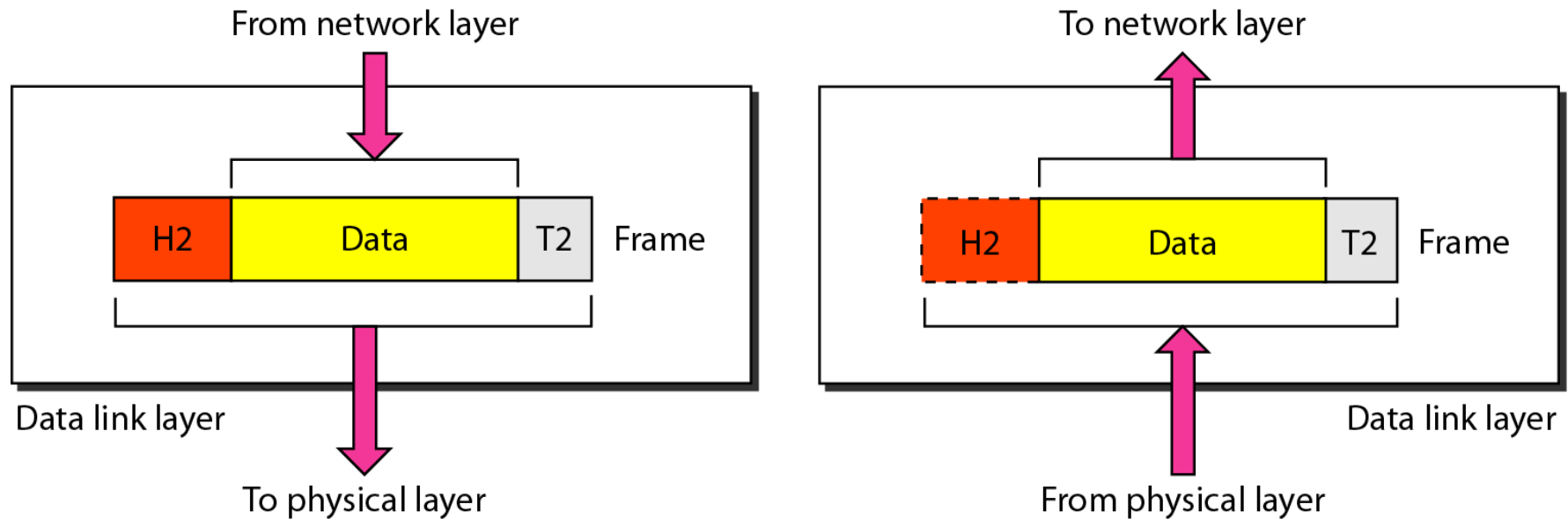
The physical layer is also concerned with the following:

- **Physical characteristics of interfaces and medium.** The physical layer defines the characteristics of the interface between the devices and the transmission medium. It also defines the type of transmission medium.
- **Representation of bits.** The physical layer data consists of a stream of bits (sequence of 0s or 1s) with no interpretation. To be transmitted, bits must be encoded into signals-- electrical or optical. The physical layer defines the type of encoding (how 0s and 1s are changed to signals).
- **Data rate.** The transmission rate-the number of bits sent each second-is also defined by the physical layer. In other words, the physical layer defines the duration of a bit, which is how long it lasts.
- **Synchronization of bits.** The sender and receiver not only must use the same bit rate but also must be synchronized at the bit level. In other words, the sender and the receiver clocks must be synchronized.

- **Line configuration.** The physical layer is concerned with the connection of devices to the media. In a point-to-point configuration, two devices are connected through a dedicated link. In a multipoint configuration, a link is shared among several devices.
- **Physical topology.** The physical topology defines how devices are connected to make a network. Devices can be connected by using a mesh topology (every device is connected to every other device), a star topology (devices are connected through a central device), a ring topology (each device is connected to the next, forming a ring), a bus topology (every device is on a common link), or a hybrid topology (this is a combination of two or more topologies).
- **Transmission mode.** The physical layer also defines the direction of transmission between two devices: simplex, half-duplex, or full-duplex. In simplex mode, only one device can send; the other can only receive. The simplex mode is a one-way communication. In the half-duplex mode, two devices can send and receive, but not at the same time. In a full-duplex (or simply duplex) mode, two devices can send and receive at the same time.

# Data Link Layer

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



*Data link layer*

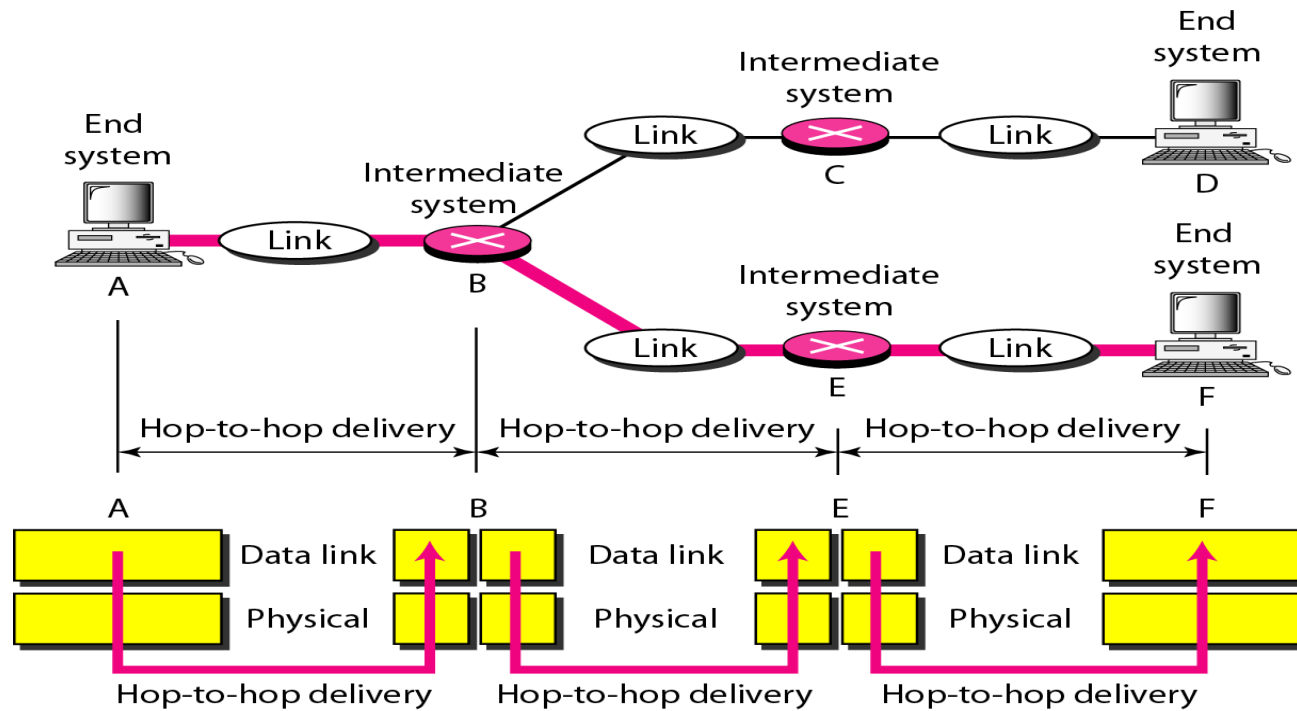
**Framing:** The data link layer divides the stream of bits received from the network layer into manageable data units called frames.

**Physical addressing:** The data link layer adds a header to the frame to define the sender and/or receiver of the frame. Such as NIC

**Flow control:** If the rate at which the data are absorbed by the receiver is less than the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.

**Error control:** adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames.

**Access control:** When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time.

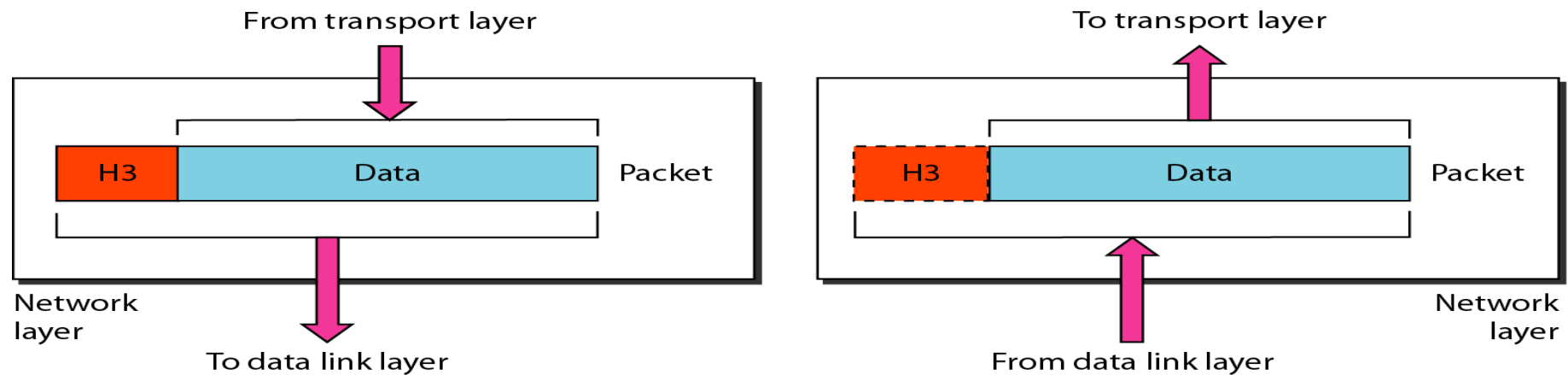


**This Figure illustrates hop-to-hop (node-to-node) delivery by the data link layer**

To send data from **A** to **F**, three partial deliveries are made. First, the data link layer at A sends a frame to the data link layer at B (a router). Second, the data link layer at B sends a new frame to the data link layer at E. Finally, the data link layer at E sends a new frame to the data link layer at F. Note that the frames that are exchanged between the three nodes have different values in the headers. The frame from A to B has B as the destination address and A as the source address. The frame from B to E has E as the destination address and B as the source address. The frame from E to F has F as the destination address and E as the source address. The values of the trailers can also be different if error checking includes the header of the frame.

# Network Layer

The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination. If two systems are connected to the same link, there is usually no need for a network layer. However, if the two systems are attached to different networks (links) with connecting devices between the networks (links), there is often a need for the network layer to accomplish source-to-destination delivery.



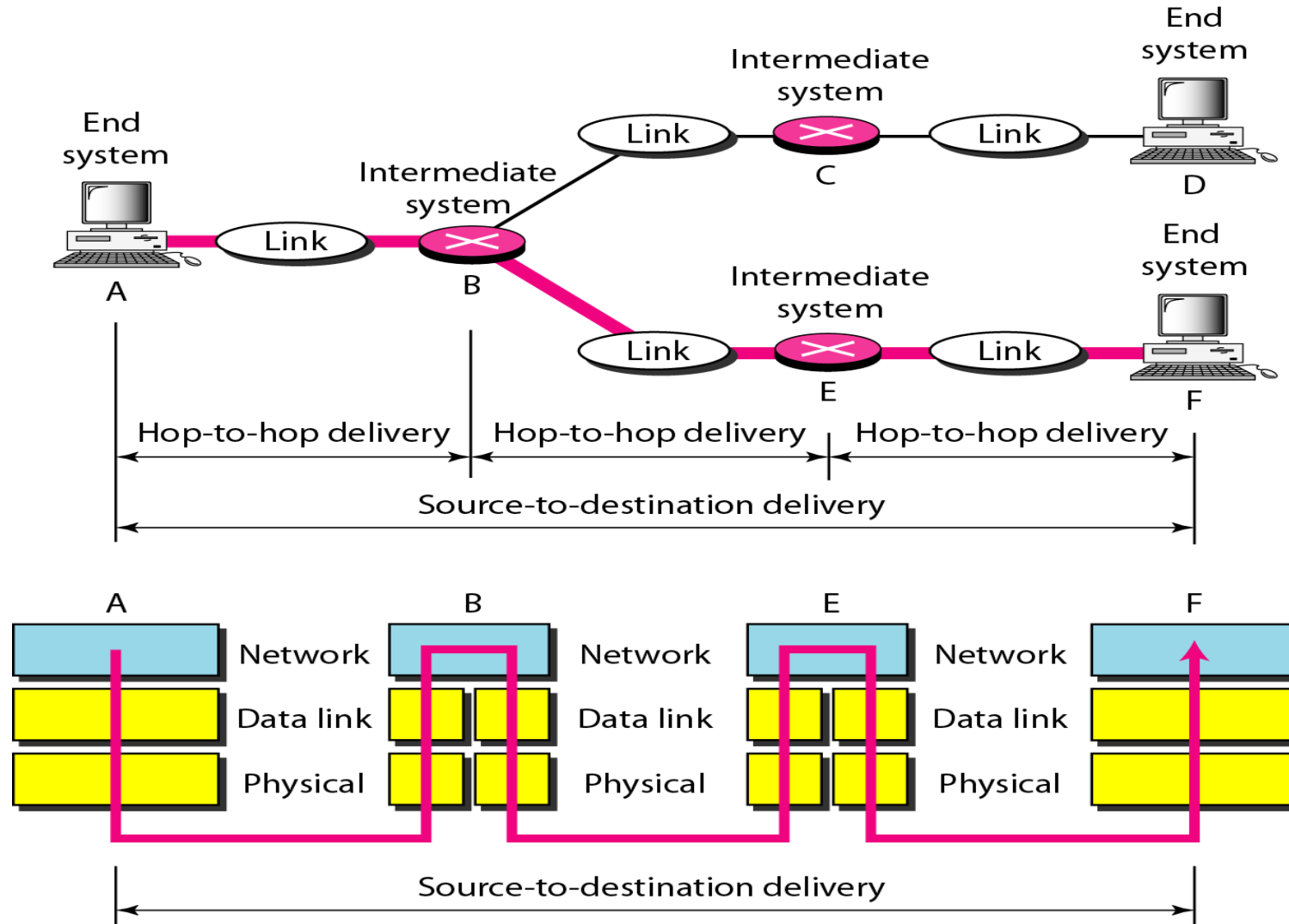
**The Figure shows the relationship of the network layer to the data link and transport layers**



**Logical addressing:** The network layer adds a header to the packet coming from the upper layer that, among other things, includes the logical addresses of the sender and receiver. Such as IP.

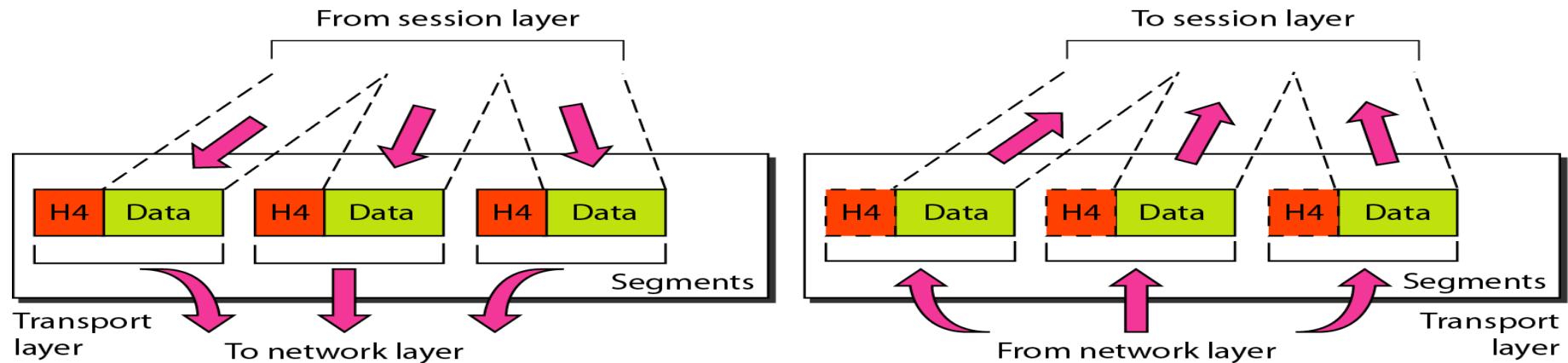
**Routing:** When independent networks or links are connected to create *internetworks* (network of networks) or a large network, the connecting devices (called *routers* or *switches*) route or switch the **packets to their final destination.**

# Source-to-destination delivery



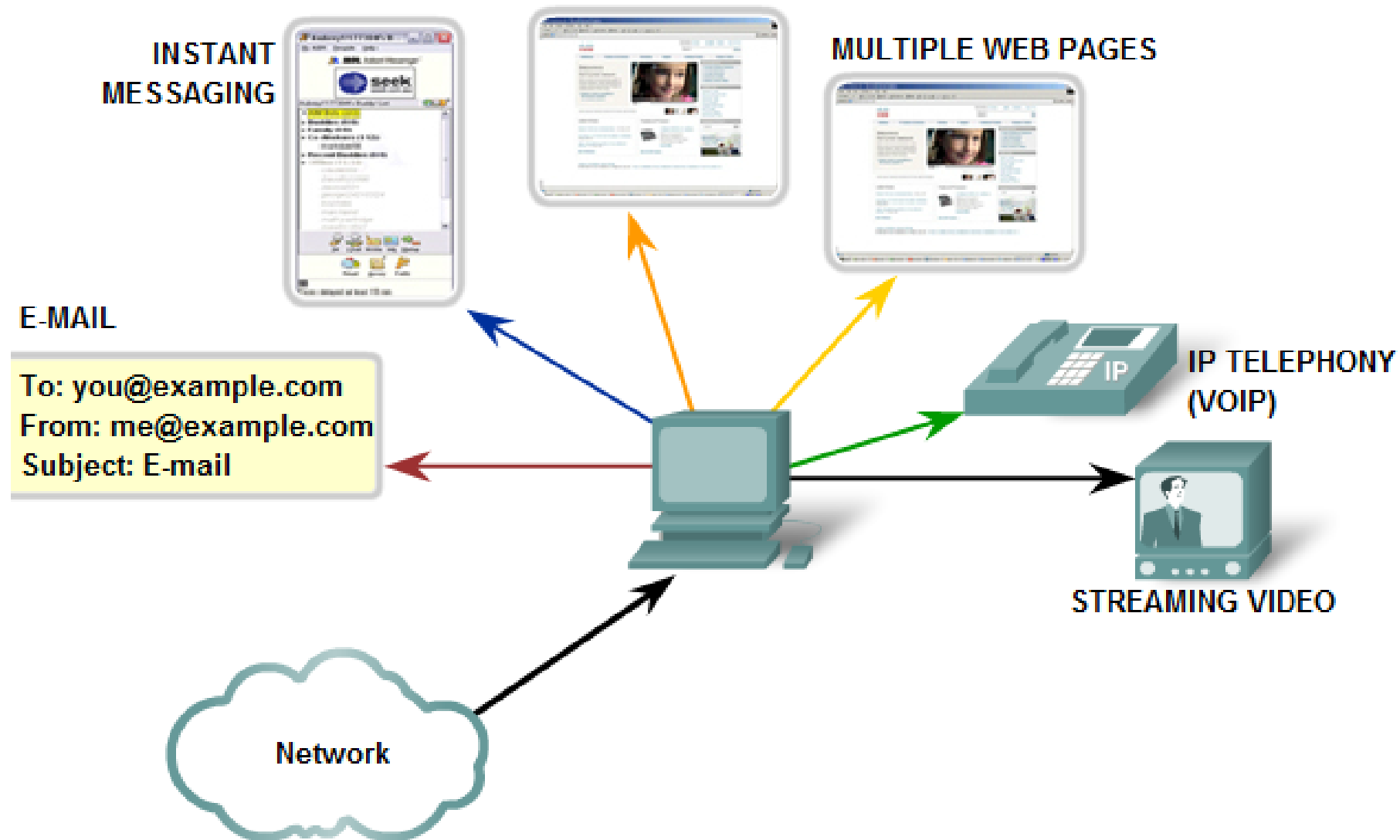
# Transport Layer

The transport layer is responsible for process-to-process delivery of the entire message. A **process** is an application program running on a host. Whereas the network layer oversees source-to-destination delivery of individual packets, it does not recognize any relationship between those packets. It treats each one independently, as though each piece belonged to a separate message, whether or not it does. The transport layer, on the other hand, ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to-destination level.



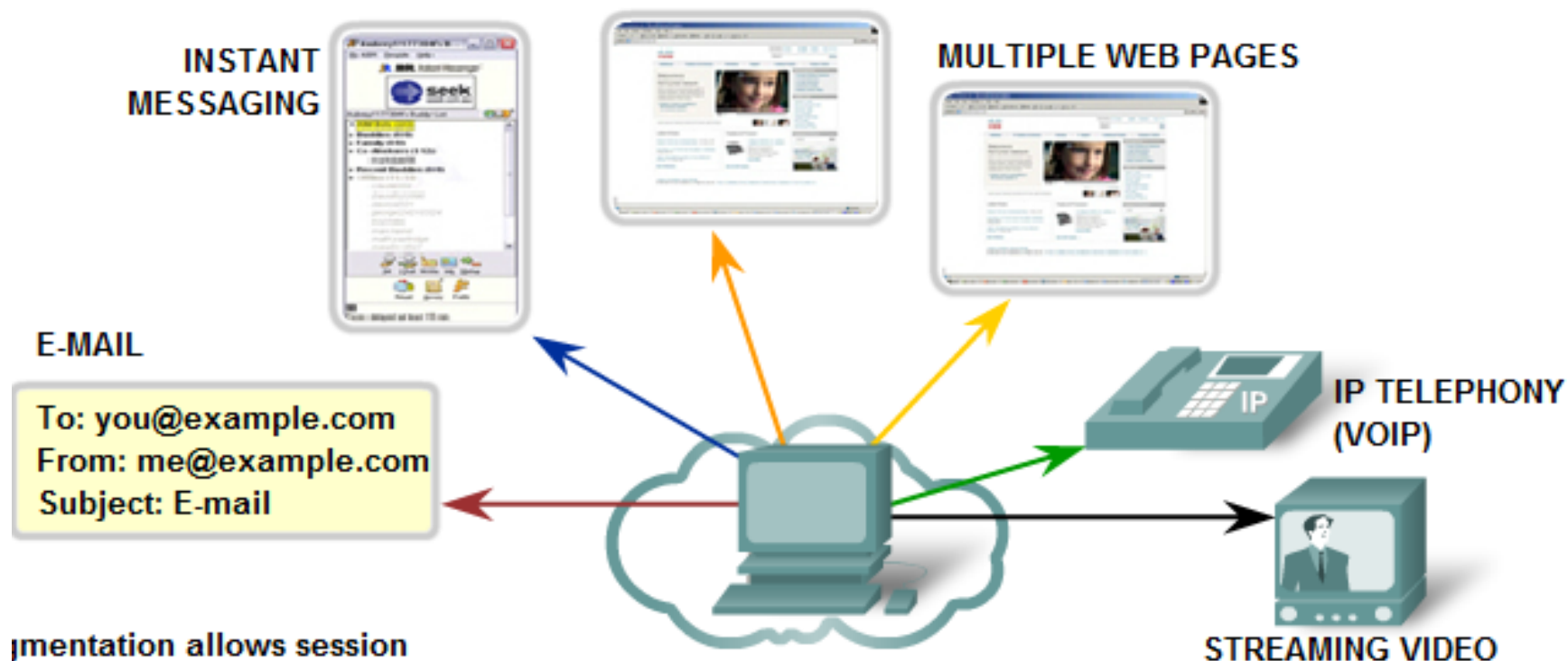
The Figure shows the relationship of the transport layer to the network and session layers

## Tracking the Conversations

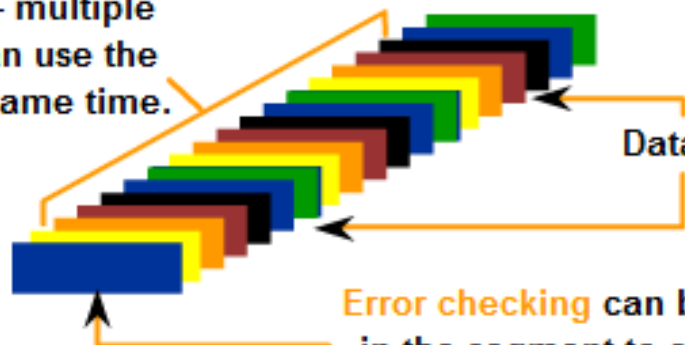


The Transport layer segments the data and manages the separation of data for different applications. Multiple applications running on a device receive the correct data.

## Transport Layer Services



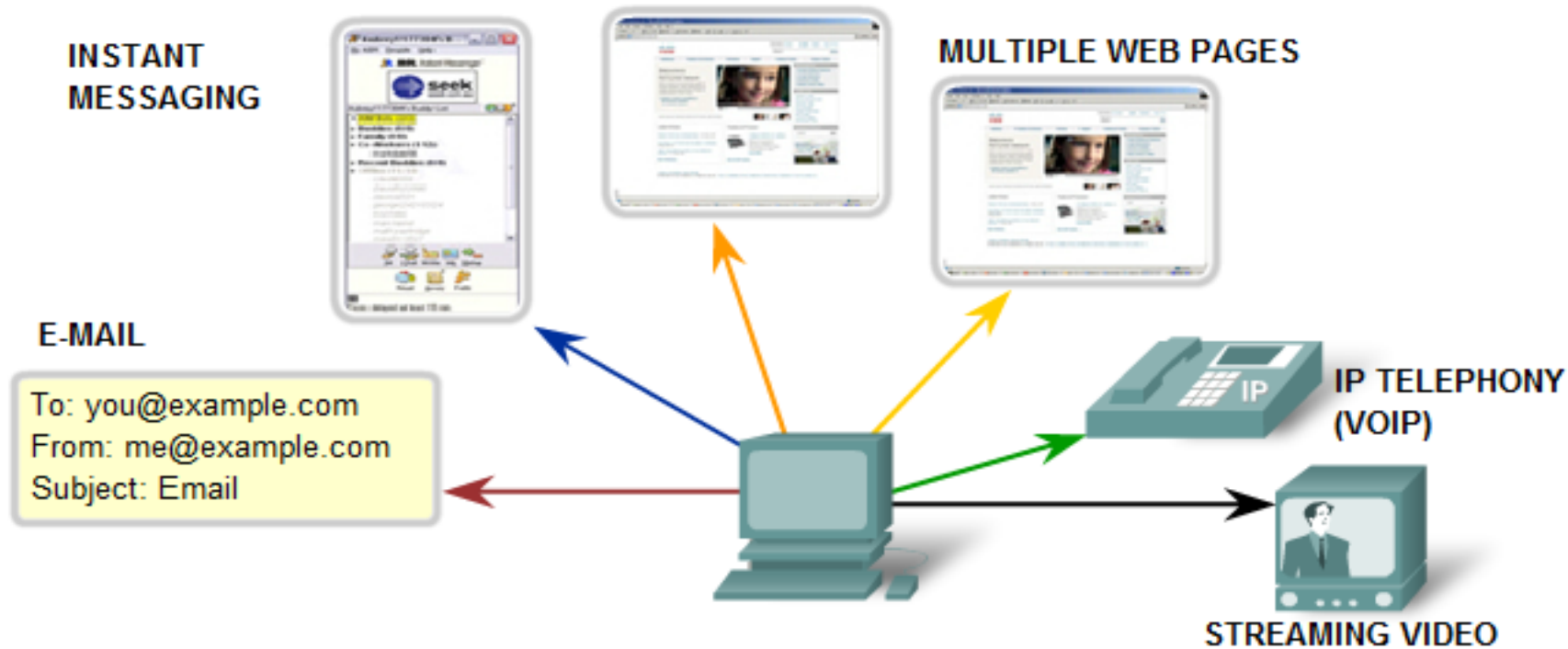
Segmentation allows session multiplexing — multiple applications can use the network at the same time.



Data segmentation facilitates data carriage by the lower network layers.

Error checking can be performed on the data in the segment to check if the segment was changed during transmission.

## Transport Layer Services



**Establishing a Session**  
ensures the application is ready to receive the data.

**Reliable delivery** means lost segments are resent so the data is received complete.

**Same order delivery**  
ensures data is delivered sequentially as it was sent.

**Flow Control** manages data delivery if there is congestion on the host.

**Service-point addressing(Port Address):** Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other. The transport layer header must therefore include a type of address called a *service-point address* (or port address). The network layer gets each packet to the correct computer; the transport layer gets the entire message to the correct process on that computer

**Segmentation and reassembly:** A message is divided into transmittable segments, with each segment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission

**Connection control:** The transport layer can be either connectionless or connection oriented. A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine. A connection oriented transport layer makes a connection with the transport layer at the destination machine first before delivering the packets. After all the data are transferred, the connection is terminated

Described in data link layer

**Error control:**

# Flow control

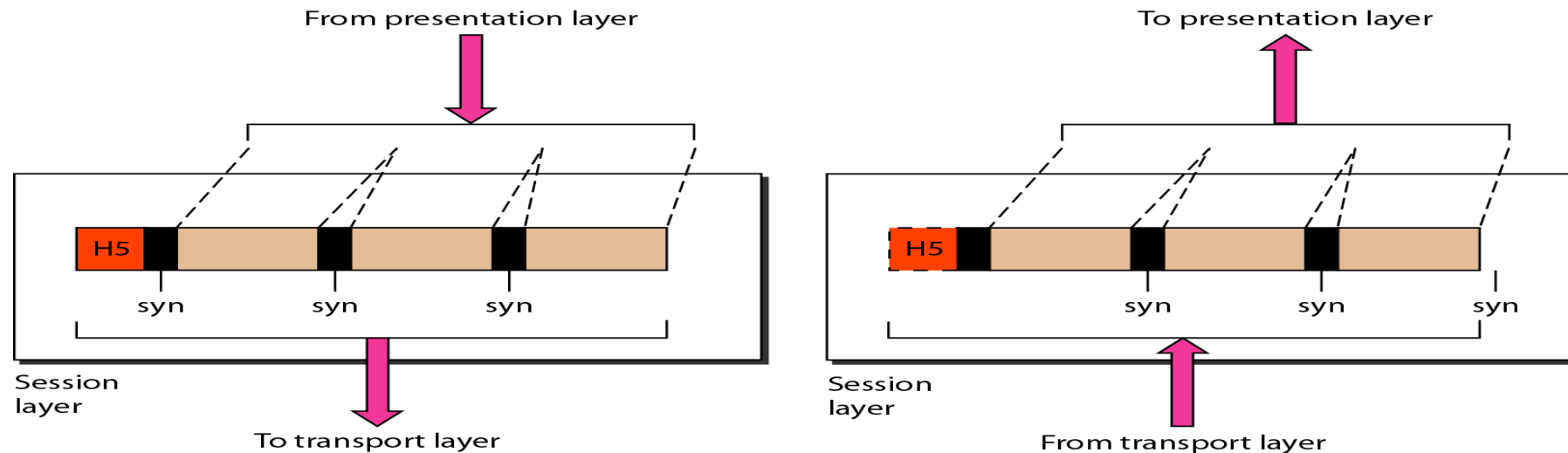
- Network hosts have limited resources, such as memory or bandwidth. When Transport layer is aware that these resources are overtaxed, some protocols can request that the sending application reduce the rate of data flow. This is done at the Transport layer by regulating the amount of data the source transmits as a group. Flow control can prevent the loss of segments on the network and avoid the need for retransmission.



# Session Layer

is the network *dialog controller*. It establishes, maintains, and synchronizes the interaction among communicating systems.

The session layer is responsible for dialog control and synchronization.



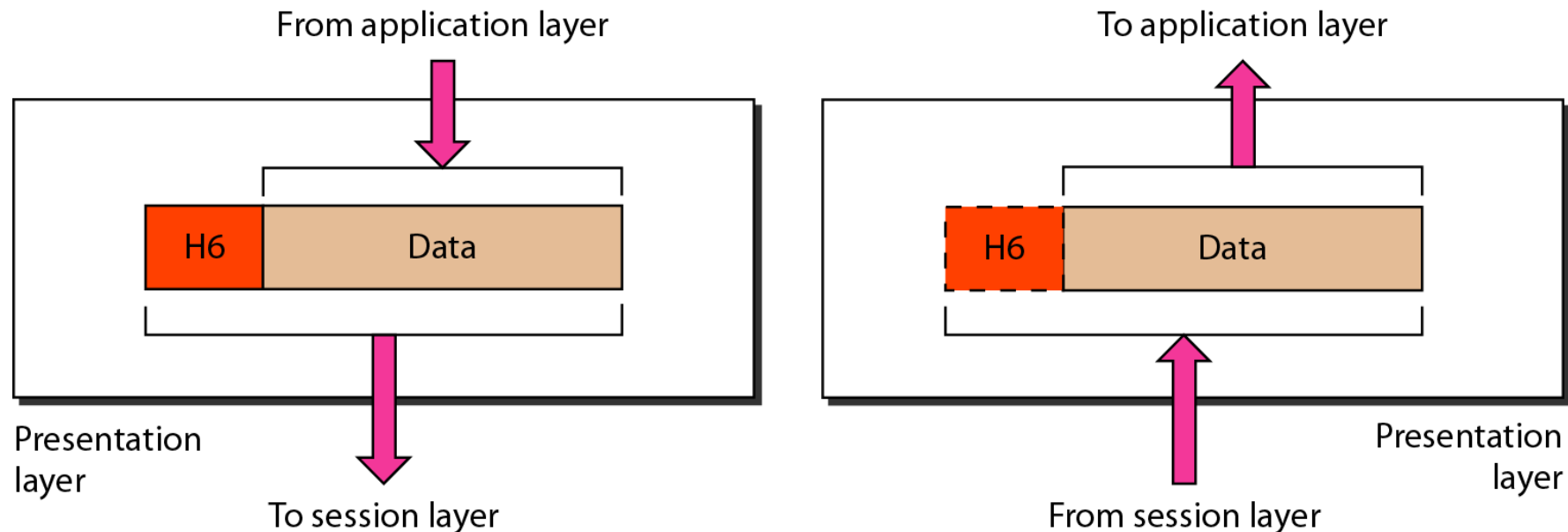
**Dialog control:** It allows the communication between two processes to take place in either half-duplex (one way at a time) or full-duplex (two ways at a time) mode.

**Synchronization:** The session layer allows a process to **add checkpoints, or synchronization points**, to a stream of data.

# Presentation Layer

The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.

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



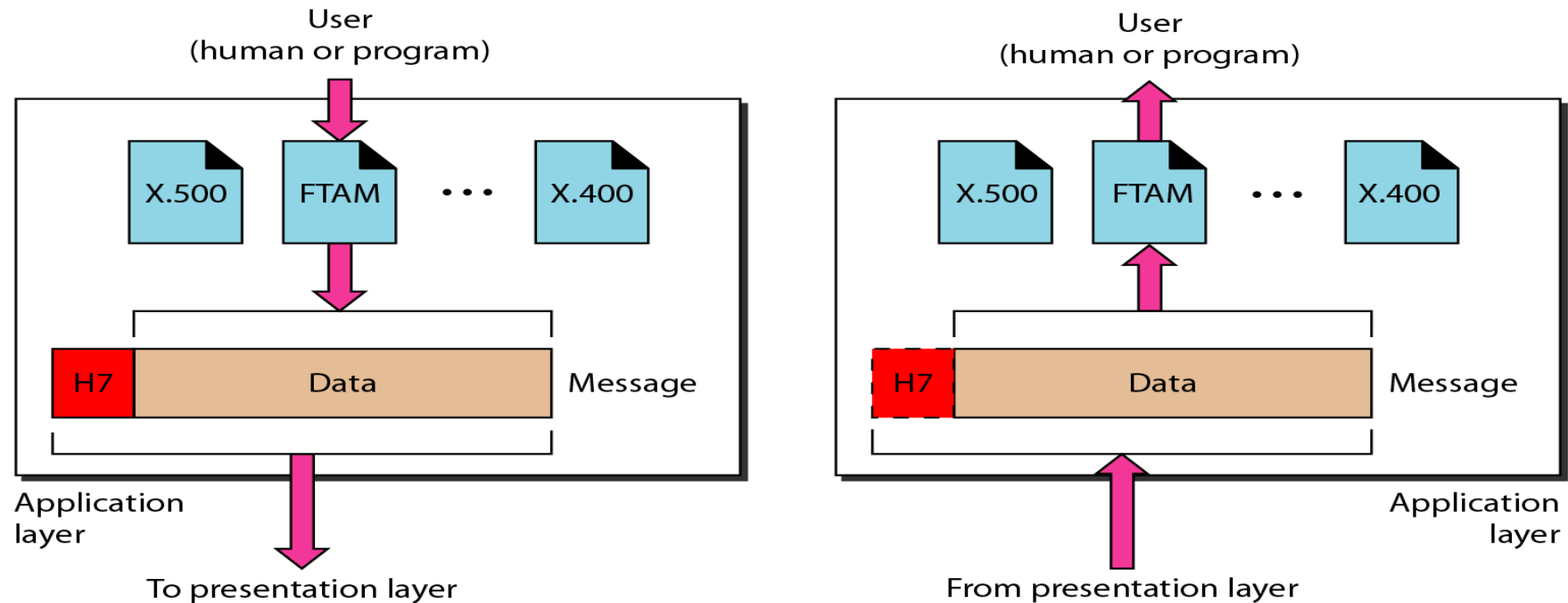
**Translation:** The information (in the form of character strings, numbers, and so on) must be changed to bit streams before being transmitted. But in the Physical Layer the Bits should be converted to signal.

**Encryption:** it means that the sender transforms the original information to another form and sends the resulting message out over the network. Decryption reverses the original process to transform the message back to its original form.

**Compression:** Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such as audio, and video.

# Application Layer

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



This Figure shows the relationship of the application layer to the user and the presentation layer

## *Summary of layers*

