ISO - OSI LAYERS

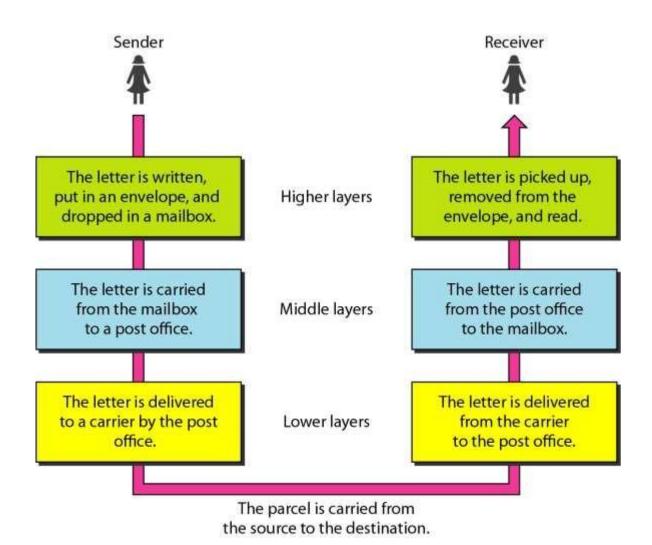
2-1 LAYERED TASKS

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

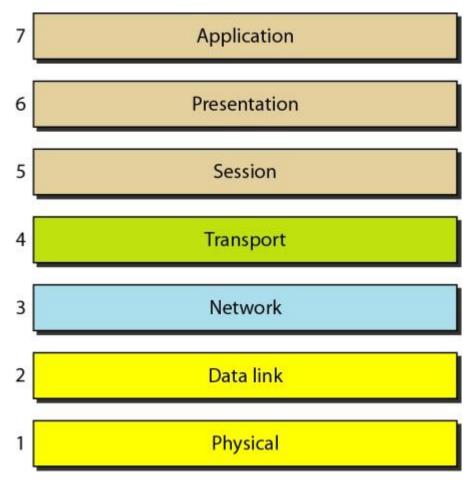


Figure 2.3 The interaction between layers in the OSI model

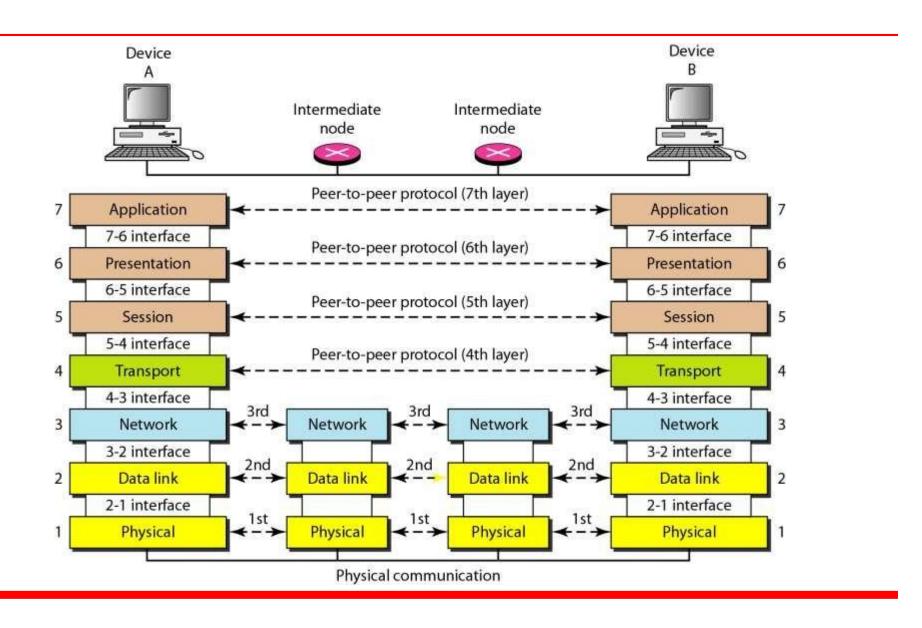
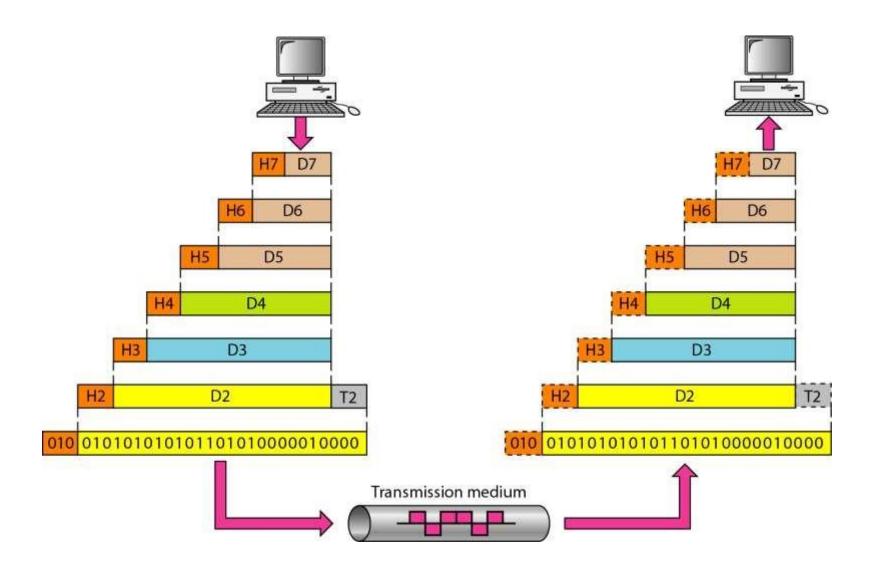


Figure 2.4 An exchange using the OSI model

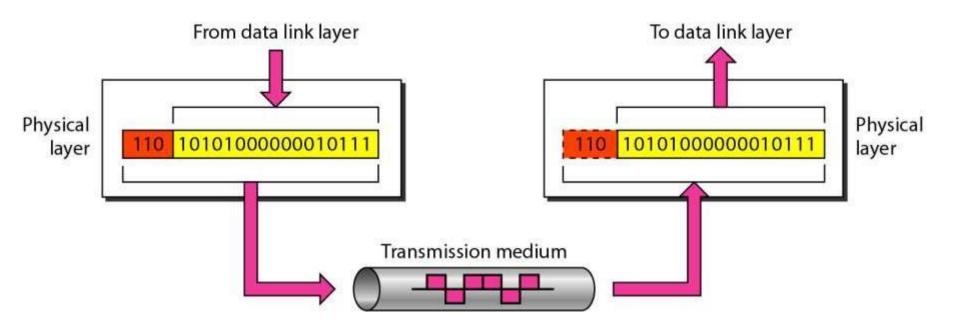


2-3 LAYERS IN THE OSI MODEL

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 2.5 *Physical layer*





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

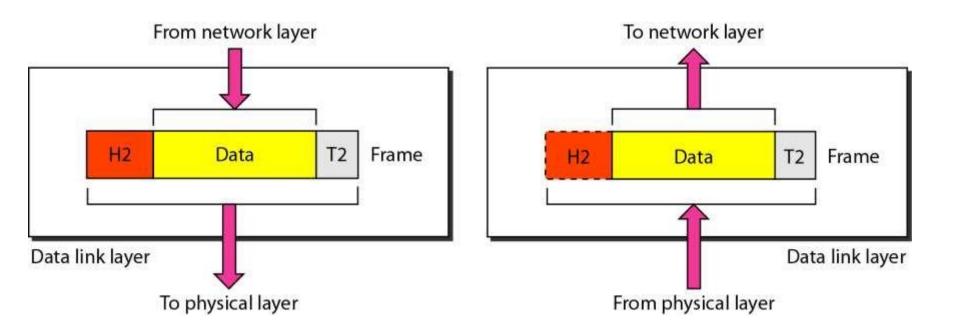
- <u>Physical characteristics of interfaces and medium</u>. The physical layer defines the characteristics of the interface between the devices and the transmission medium. It also defines the type of transmission medium.
- •Representation of bits. The physical layer data consists of a stream of bits (sequence of Os 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 Os and I s are changed to signals).

- •<u>Data rate.</u> 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.
- •<u>Line configuration.</u> 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).
- <u>Transmission mode.</u> The physical layer also defines the direction of transmission between two devices: simplex, halfduplex, 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.

Figure 2.6 Data link layer

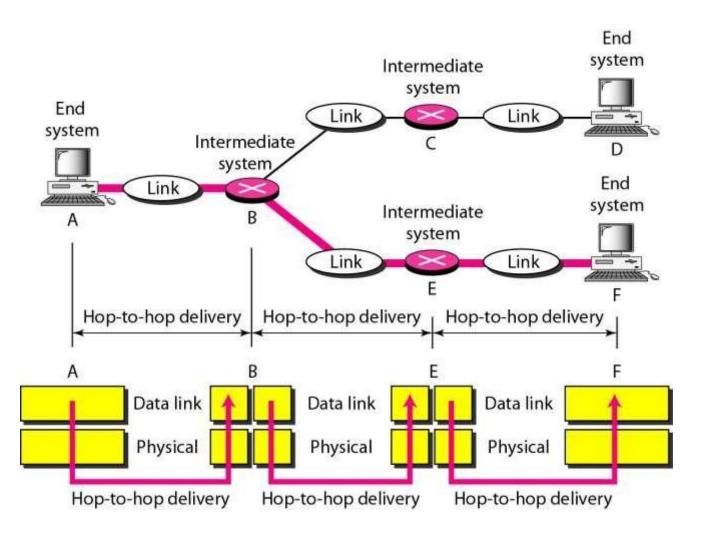


Note

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

2.16

Figure 2.7 Hop-to-hop delivery



Other responsibilities of the data link layer

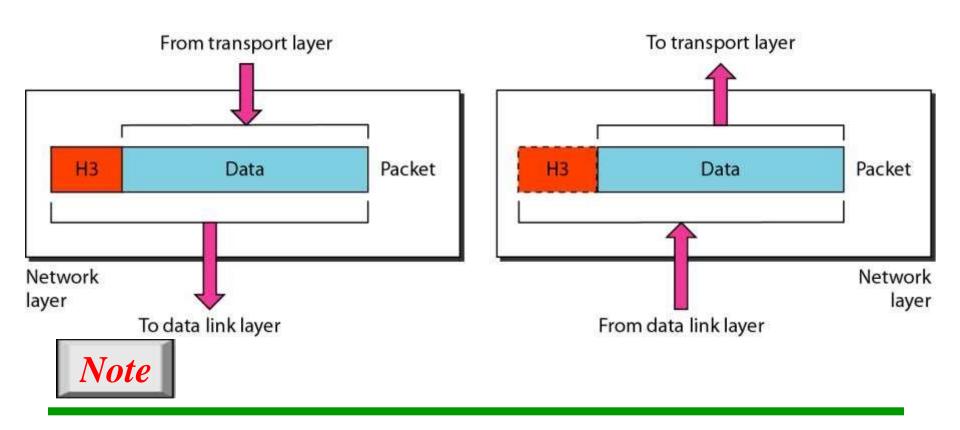
- <u>Framing</u>. The data link layer divides the stream of bits received from the network layer into manageable data units called frames.
- <u>Physical addressing</u>. If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the sender and/or receiver of the frame. If the frame is intended for a system outside the sender's network, the receiver address is the address of the device that connects the network to the next one.
- <u>Flow control</u>. 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.

Other responsibilities of the data link layer

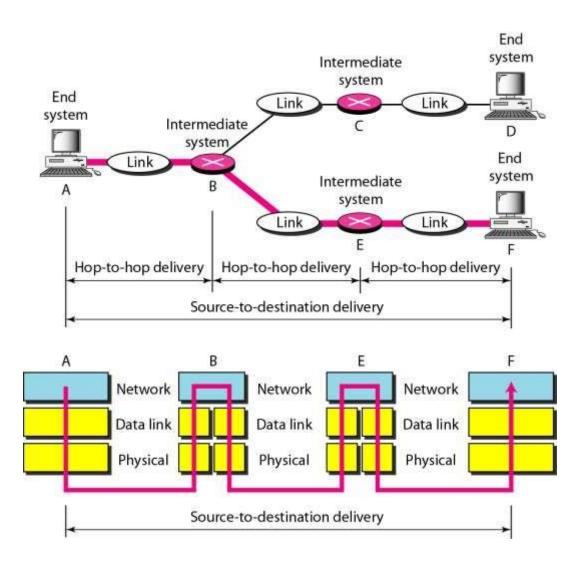
- <u>Error control</u>. The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames. Error control is normally achieved through a trailer added to the end of the frame.
- <u>Access control</u>. 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.

Figure 2.8 Network layer



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

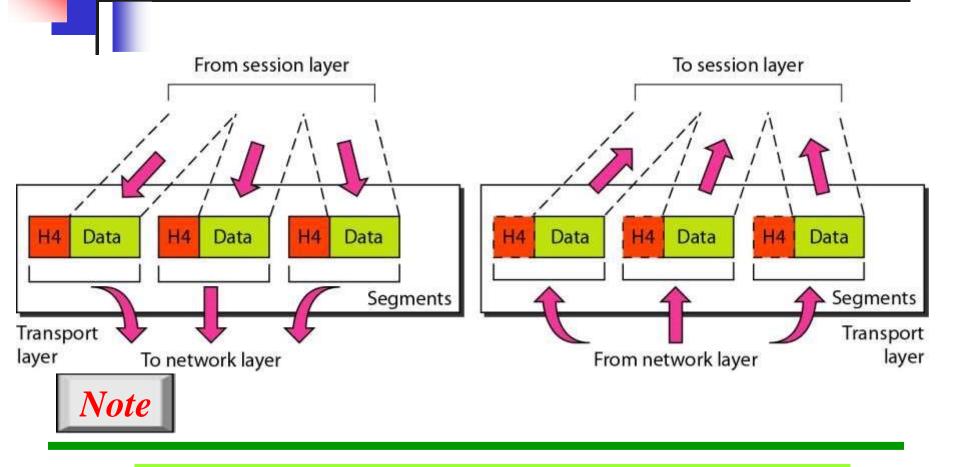


Other responsibilities of the network layer

- •<u>Logical addressing</u>. The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems. 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.
- •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*)

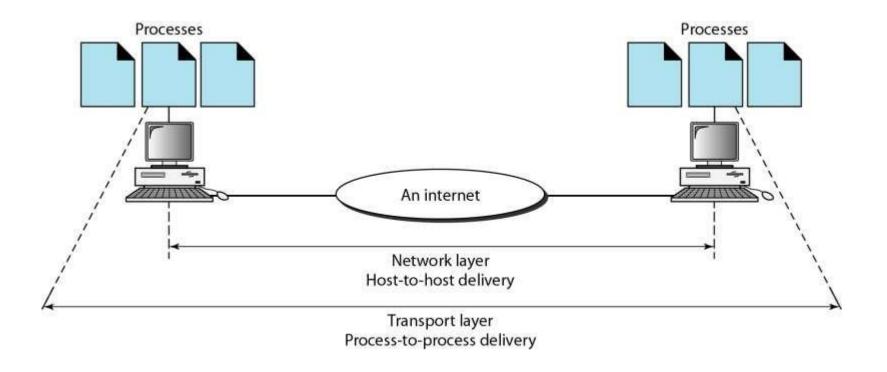
route or switch the packets to their final destination. One of the functions of the network layer is to provide this mechanism.

Figure 2.10 Transport layer



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



Other responsibilities of the transport layer

- Service-point addressing. 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.
- <u>Segmentation and reassembly</u>. A message is divided into transmittable segments, with each segment containing a sequence number. These numbers enable the transport layer to reassemble

Other responsibilities of the transport layer

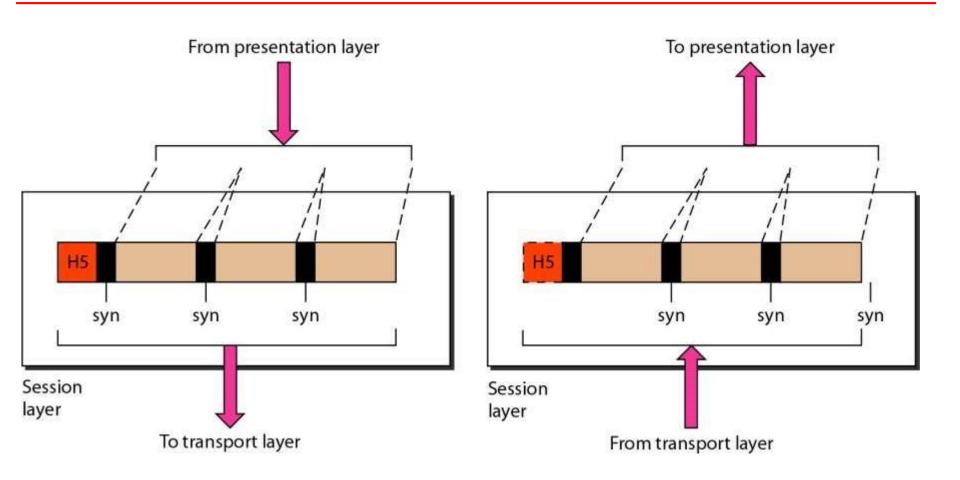
the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission.

- •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.
- <u>Flow control</u>. Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end to end rather than across a single link.

Other responsibilities of the transport layer

• <u>Error control</u>. Like the data link layer, the transport layer is responsible for error control. However, error control at this layer is performed process-to process rather than across a single link. The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss, or duplication). Error correction is usually achieved through retransmission.

Figure 2.12 Session layer



2.30



The session layer is responsible for dialog control and synchronization.

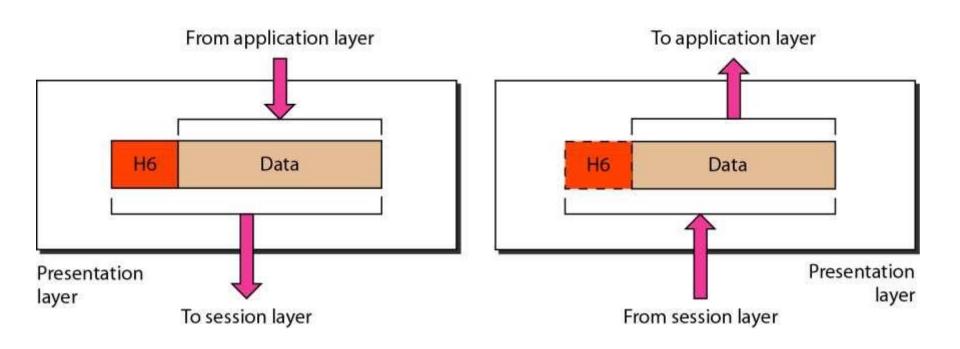
2.31

Specific responsibilities of the session layer

- <u>Dialog control</u>. The session layer allows two systems to enter into a dialog. 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. For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoints after every 100 pages to ensure that each 100-page unit is received and acknowledged independently. In this case, if a crash happens during the transmission of page 523, the only pages that need to be resent

after system recovery are pages 501 to 523. Pages previous to 501 need not be resent.

Figure 2.13 Presentation layer



2.33



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

2.34

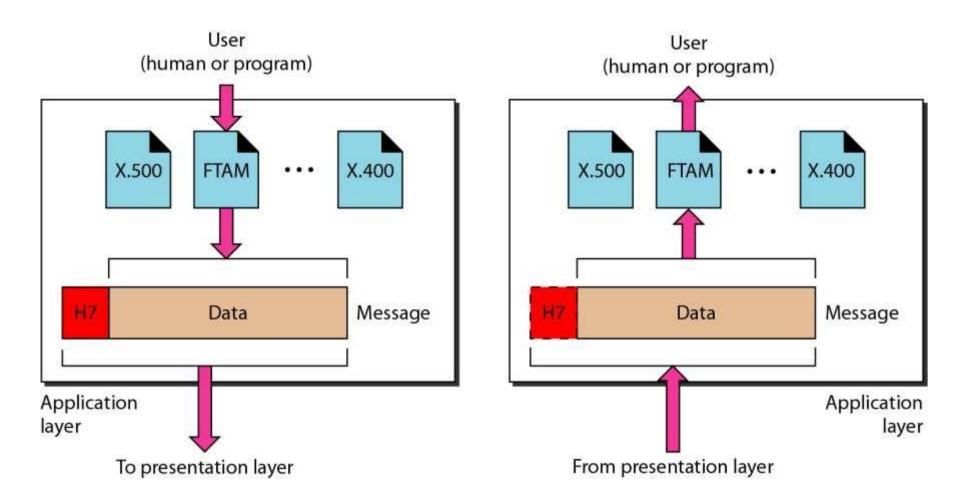
Specific responsibilities of the presentation layer

• <u>Translation</u>. The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information must be changed to bit streams before being transmitted. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding methods. The presentation layer at the sender changes the information from its sender-dependent format into a common format. The presentation layer at the receiving machine changes the common format into its receiver-dependent format.

Specific responsibilities of the presentation layer

- Encryption. To carry sensitive information, a system must be able to ensure privacy. Encryption 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.
- <u>Compression</u>. Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such as text, audio, and video.

Figure 2.14 Application layer



2.37



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

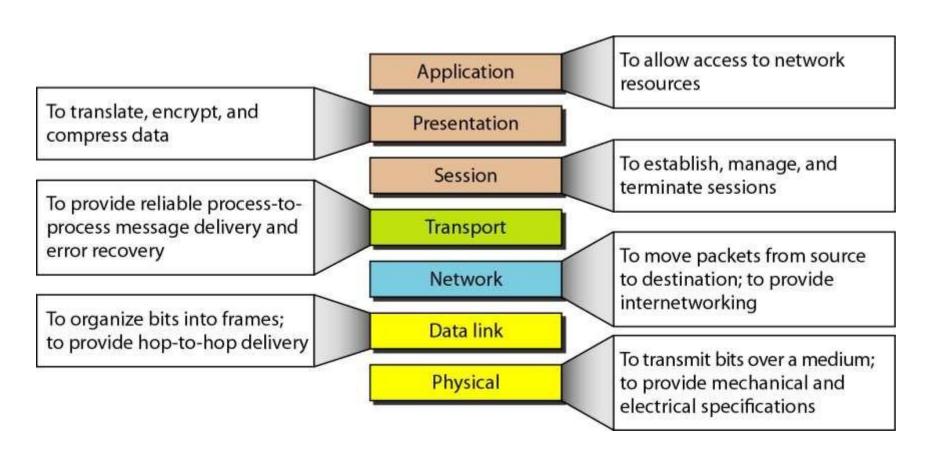
Specific services provided by the application layer

Network virtual terminal. A network virtual terminal is a software version of a physical terminal, and it allows a user to log on to a remote host. To do so, the application creates a software emulation of a terminal at the remote host. The user's computer talks to the software terminal which, in turn, talks to the host, and vice versa. The remote host believes it is communicating with one of its own terminals and allows the user to log on. File transfer, access, and management. This application allows a user to access files in a remote host (to make changes or read data), to retrieve files from a remote computer for use in the local computer, and to manage or control files in a remote computer locally.

Specific services provided by the application layer

- <u>Mail services</u>. This application provides the basis for e-mail forwarding and storage.
- <u>Directory services</u>. This application provides distributed database sources and access for global information about various objects and services.

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-tonetwork, 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

