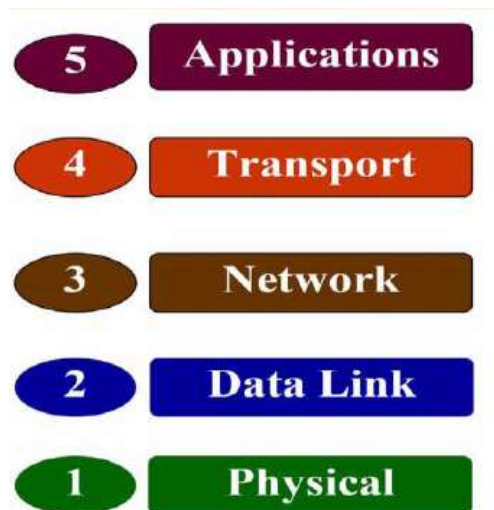


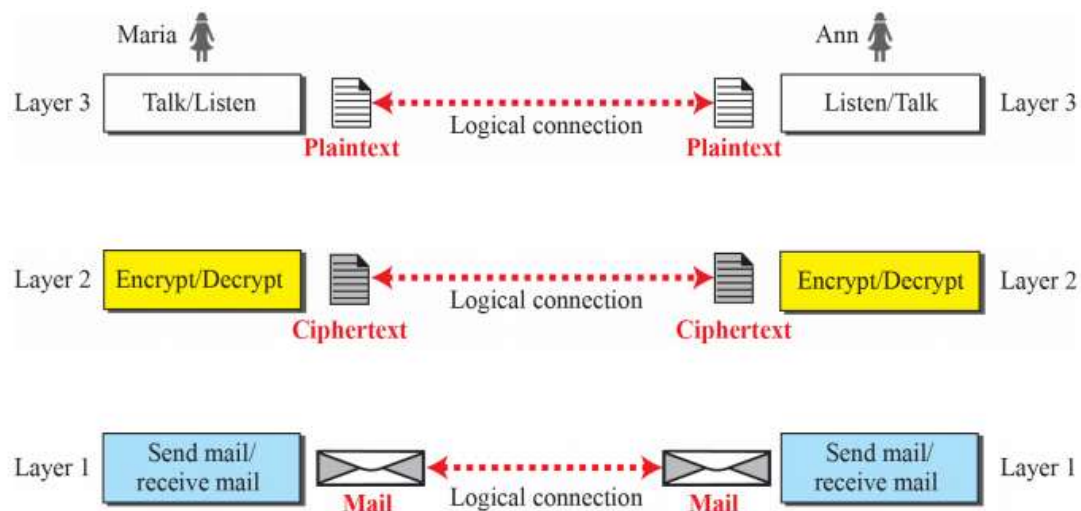


Discussion Chapter#2

TCP/IP Protocol Suite (Internet Model)



Layer-to-layer communication: logical connection between each layer



The Physical Layer

- Physical layer is the lowest level in the TCP/IP protocol suite.
- It is responsible for carrying individual bits between two nodes across the link.

The Data Link Layer

- The data link layer is responsible for ensuring that a packet of data is successfully transmitted between two adjacent nodes in the network.
- The data-link layer takes a datagram and encapsulates it in a packet called a frame.
- Some link-layer protocols provide complete error detection and correction, some provide only error correction.

Network Layer

- The network layer is responsible for creating a connection between the source computer and the destination computer.
- The communication at the network layer is host-to-host.
- The network layer in the Internet includes the main protocol, Internet Protocol (IP), that defines the format of the packet, called a datagram at the network layer

Transport Layer

- The transport layer is end-to-end communication.
- The transport layer at the source host gets the message from the application layer, encapsulates it in a transport layer packet (called a segment or a user datagram in different protocols) and sends it, through the logical (imaginary) connection, to the transport layer at the destination host

Transport-layer protocols:

- TCP (Transmission Connection Protocol):

Connection-oriented protocol that first establishes a logical connection between transport layers at two hosts before transferring data.

It creates a logical pipe between two TCPs for transferring a stream of bytes.

TCP provides flow control, error control, and congestion control to reduce the loss of segments due to congestion in the network.

Flow control: matching the sending data rate of the source host with the receiving data rate of the destination host to prevent overwhelming the destination.

Error control: to guarantee that the segments arrive at the destination without error and resending the corrupted ones.

- **UDP (User Datagram Protocol):**

It is a connectionless protocol that transmits user datagrams without first creating a logical connection.

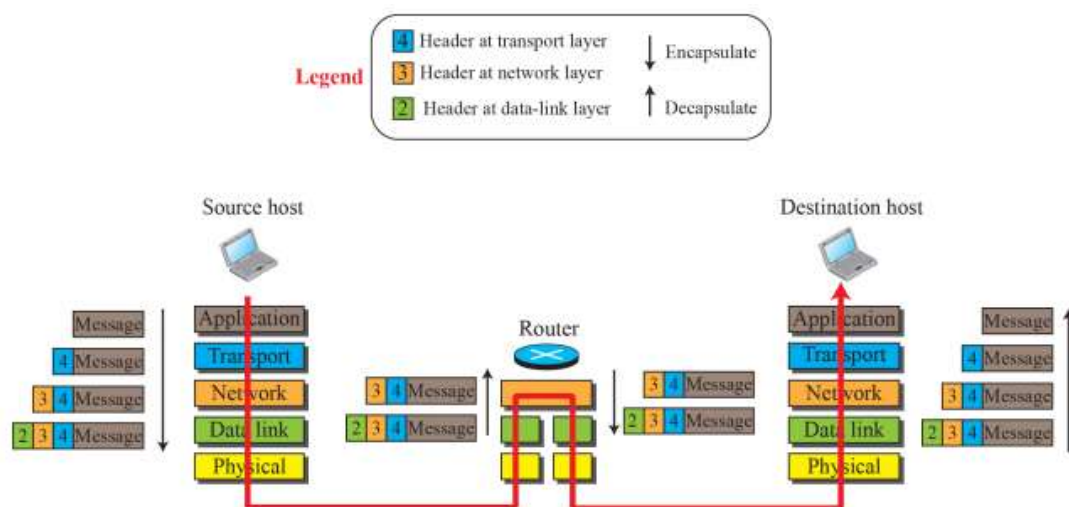
In UDP, each user datagram is an independent entity without being related to the previous or the next one (the meaning of the term connectionless).

UDP is a simple protocol that does not provide flow, error, or congestion control. Its simplicity, which means small overhead, is attractive to an application program that needs to send short messages and cannot afford the retransmission of the packets involved in TCP, when a packet is corrupted or lost.

Application Layer:

- The application layers is Process-to-process communication. To communicate, a process sends a request to the other process and receives a response.

Encapsulation and Decapsulation:



Chapter's Questions:

Q2-1. What is the first principle we discussed in this chapter for protocol layering that needs to be followed to make the communication bidirectional?

We need to make each layer so that it is able to perform two opposite tasks, one in each direction.

Q2-2. Which layers of the TCP/IP protocol suite are involved in a link-layer switch?

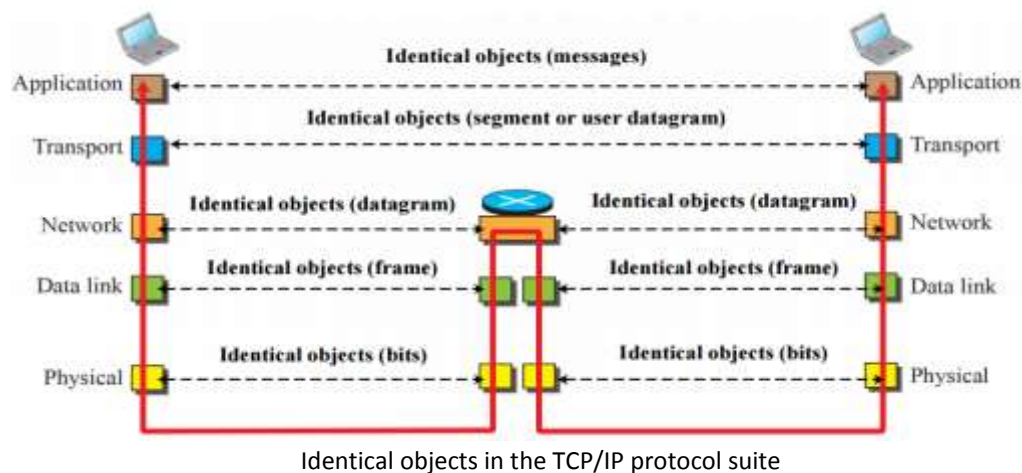
A link-layer switch in a link is involved only in two layers, data-link and physical.

Q2-3. A router connects three links (networks). How many of each of the following layers can the router be involved with?

- a. physical layer: 3
- b. data-link layer: 3
- c. network layer: 1

Q2-4. In the TCP/IP protocol suite, what are the identical objects at the sender and the receiver sites when we think about the logical connection at the application layer?

Identical objects are (messages).



Q2-5. A host communicates with another host using the TCP/IP protocol suite. What is the unit of data sent or received at each of the following layers?

- a. application layer : messages
- b. network layer: datagrams or packets
- c. data-link layer: frames

Q2-6. Which of the following data units is encapsulated in a frame?

- a. a user datagram
- b. a datagram
- c. a segment

All of them.

Q2-7. Which of the following data units is decapsulated from a user datagram?

- a. a datagram

- b. a segment
- c. a message

A message.

Q2-8. Which of the following data units has an application-layer message plus the header from layer 4?

- a. a frame
- b. a user datagram
- c. a bit

A user datagram.

Q2-9. List some application-layer protocols mentioned in this chapter.

- Hypertext Transfer Protocol (HTTP)
- Simple Mail Transfer Protocol (SMTP)
- File Transfer Protocol (FTP)
- Terminal Network (TELNET)
- Domain Name System (DNS)

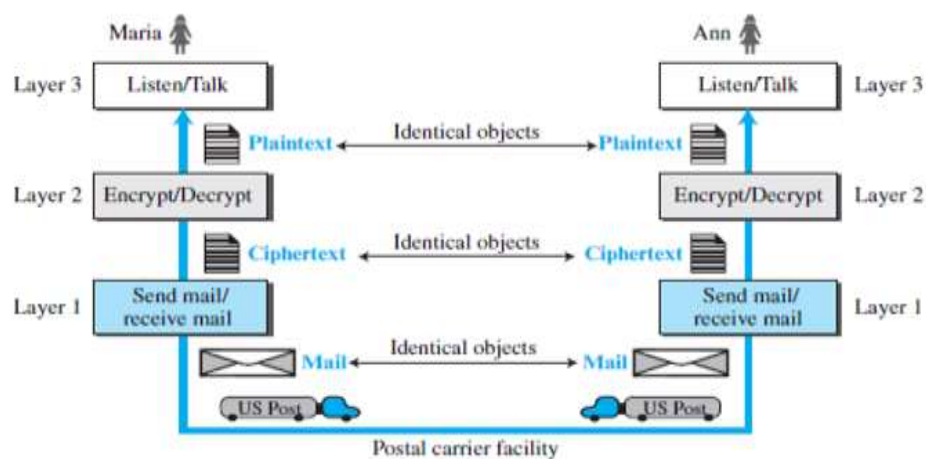
Q2-10. If a port number is 16 bits (2 bytes), what is the minimum header size at the transport layer of the TCP/IP protocol suite?

The minimum header size will be (2*16 bits) 32 bits to contain the sending and receiving port address.

Q2-11. What are the types of addresses (identifiers) used in each of the following layers?

- a. Application layer: site name or email (specific address).
- b. Network layer: logical address (IP address).
- c. Data-link layer: link-layer address.

P2-1. Answer the following questions about Figure 2.2 when the communication is from Maria to Ann:



- a. What is the service provided by layer 1 to layer 2 at Maria's site?

Layer 1 takes the ciphertext from layer 2, inserts (encapsulates) it in an envelope and sends it.

- b. What is the service provided by layer 1 to layer 2 at Ann's site?

Layer 1 receives the mail, removes (decapsulates) the ciphertext from envelope and delivers it to layer 2.

P2-2. Answer the following questions about Figure 2.2 when the communication is from Maria to Ann:

- a. What is the service provided by layer 2 to layer 3 at Maria's site?

Layer 2 takes the plaintext from layer 3, encrypts it into ciphertext and delivers it to layer 1.

- b. What is the service provided by layer 2 to layer 3 at Ann's site?

Layer 2 receives the ciphertext from layer 1, decrypts it and delivers the plaintext to layer 3.

P2-5. Assume we have created a packet-switched internet. Using the TCP/IP protocol suite, we need to transfer a huge file. What are the advantages and disadvantage of sending large packets?

The advantage is that the packet is routed along the fastest available route by routers that read the destination address and forwards each IP packet independently.

The disadvantage is that larger packets take longer to transmit as they contain more data.

P2-6. Match the following to one or more layers of the TCP/IP protocol suite:

- a. Route determination: data-link, network.
- b. Connection to transmission media: physical.
- c. Providing services for the end user: Application.

P2-7. Match the following to one or more layers of the TCP/IP protocol suite:

- a. Creating user datagrams: Transport, and Network.
- b. Responsibility for handling frames between adjacent nodes: Datalink.
- c. Transforming bits to electromagnetic signals: physical.

P2-8. In Figure 2.10, when the IP protocol decapsulates the transport-layer packet, how does it know to which upper-layer protocol (UDP or TCP) the packet should be delivered?

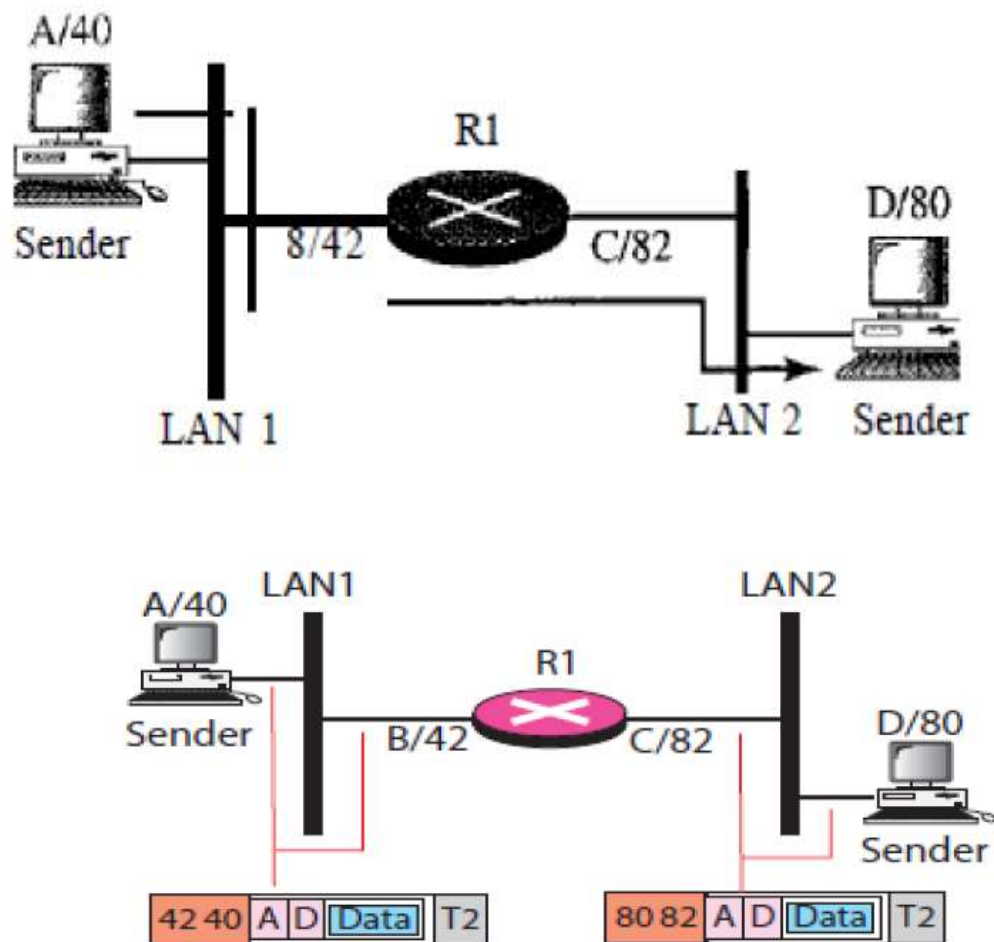
A protocol needs to have a field in its header to identify to which protocol the encapsulated packets belong.

P2-10. Assume that a private internet requires that the messages at the application layer be encrypted and decrypted for security purposes. If we need to add some information about the encryption/decryption process (such as the algorithms used in the process), does it mean that we are adding one layer to the TCP/IP protocol suite? Redraw the TCP/IP layers (Figure 2.4 part b) if you think so.

No it does not mean that we are adding another layer to the protocol suite, it just means that the transport layer has taken another function and now contains the encryption/decryption process. This process could be contained and handled within the transport layer to be able to encrypt and decrypt data.

Other Questions:

In Figure below, computer A sends a message to computer D via LAN 1, router R1, and LAN2. Show the contents of the packets and frames at the network and data link layer for each hop interface.



In the previous figure, assume that the communication is between a process running at computer A with port address i and a process running at computer D with port address j . Show the contents of packets and frames at the network, data link, and transport layer for each hop.

