Solutions to Assignment #4

3. What difference does it make to the network layer if the underlying data link layer provides a connection-oriented service versus a connectionless service? **[4 marks]**

Solution:

If the data link layer provides a connection-oriented service to the network layer, then the network layer must precede all transfer of information with a connection setup procedure (2). If the connection-oriented service includes assurances that frames of information are transferred correctly and in sequence by the data link layer, the network layer can then assume that the packets it sends to its neighbor traverse an error-free pipe.

On the other hand, if the data link layer is connectionless, then each frame is sent independently through the data link, probably in unconfirmed manner (without acknowledgments or retransmissions). In this case the network layer cannot make assumptions about the sequencing or correctness of the packets it exchanges with its neighbors (2).

The Ethernet local area network provides an example of connectionless transfer of data link frames. The transfer of frames using "Type 2" service in Logical Link Control (discussed in Chapter 6) provides a connection-oriented data link control example.

4. Suppose transmission channels become virtually error-free. Is the data link layer still needed?

[2 marks – 1 for the answer and 1 for explanation]

Solution:

The data link layer is still needed(1) for framing the data and for flow control over the transmission channel. In a multiple access medium such as a LAN, the data link layer is required to coordinate access to the shared medium among the multiple users (1).

6. Which OSI layer is responsible for the following?

(a) Determining the best path to route packets. **[1 mark]**

The network layer is concerned with the selection of paths across the network.

(b) Providing end-to-end communications with reliable service. **[1 mark]**

The transport layer is concerned with providing reliable service on an end-to-end basis across the network.

(c) Providing node-to-node communications with reliable service. **[1 mark]**

The data link layer provides for the reliable transfer of information between adjacent nodes in

a network.

13. Does Ethernet provide connection-oriented or connectionless service? **[2 marks]**

Solution:

Ethernet provides connectionless transfer(2) service of information frames.

16. Suppose two Ethernet LANs are interconnected by a box that operates as follows. The box has a table that tells it the physical addresses of the machines in each LAN. The box listens to frame transmissions on each LAN. If a frame is destined to a station at the other LAN, the box retransmits the frame onto the other LAN, otherwise the box does nothing.

Solutions follow questions:

a. Is the resulting network still a LAN? Does it belong in the data link layer or the network layer? **[2 marks]**

The resulting network is a local area network(1) that has been extended. The extended LAN transfers frames, and so it still belongs in the data link layer(1).

b. Can the approach be extended to connect more than two LANs? If so, what problems arise as the number of LANs becomes large? **[2 marks]**

Yes, more than two LANs can be connected(1) using the above approach to form an extended LAN. As the number of LANs becomes large, the number of physical addresses stored in the bridge grows and becomes unmanageable(1). Each time a machine is added the addresses in all the boxes need to be updated. Serious problems arise if boxes are connected so that loops can occur.

17. Suppose all laptops in a large city are to communicate using radio transmissions from a high antenna tower. Is the data link layer or network layer more appropriate for this situation? **[2 marks]**

Solution:

The data link layer is concerned with the transfer of frames of information across a single hop . The network layer involves the transfer of information across a network using multiple hops per path in general. The connection from a radio antenna to the laptops is direct, and thus a data link layer protocol is more suitable for this situation (2).

Now suppose the city is covered by a large number of small antennas covering smaller areas. Which layer is more appropriate? **[2 marks]**

A number of areas each covered by small antennas can be interconnected using the "bridging" approach of problem 16, which remains in the data link layer. However, the network layer may be more appropriate(2) because it provides for the transfer of data in the form of packets across the communication network. A key aspect of this transfer is the routing of the packets from the source machine to the destination machine, typically traversing a number of transmission link and network nodes where routing is carried out.

19. Suppose an application layer entity wants to send an *L*-byte message to its peer process, using an existing TCP connection. The TCP segment consists of the message plus 20 bytes of header. The segment is encapsulated into an IP packet that has an additional 20 bytes of header. The IP packet in turn goes inside an Ethernet frame that has 18 bytes of header and trailer. What percentage of the transmitted bits in the physical layer correspond to message information, if *L* = 100 bytes, 500 bytes, 1000 bytes? **[3 marks – 1 mark each]**

> **Solution:**
>
> TCP/IP over Ethernet allows data frames with a payload size up to 1460 bytes. Therefore, *L* = 100, 500 and 1000 bytes are within this limit.
>
> The message overhead includes:
>
> - TCP: 20 bytes of header
> - IP: 20 bytes of header
> - Ethernet: total 18 bytes of header and trailer.
>
> Therefore
>
> *L* = 100 bytes, 100/158 = 63% efficiency (1).
>
> *L* = 500 bytes, 500/558 = 90% efficiency (1).
>
> *L* = 1000 bytes, 1000/1058 = 95% efficiency (1).

33. Suppose a computer is moved from one department to another. Does the physical address need to change? Does the IP address need to change? Does it make a difference if the computer is a laptop? **[3 marks – 1 for each question]**

> **Solution:**
>
> The physical address does not change (1). It is globally unique to the computer's NIC card.
>
> The IP address may need to be changed (1) to reflect a new subnetwork id and host id.
>
> The situation is the same for laptops.(1)

40. Explain why it is useful for application layer programs to have a "well-known" TCP port number? **[2 marks]**

> **Solution:**
>
> The TCP layer entity uses the port number to determine which application program the packets belong to. In the TCP connection setup process it is very convenient to have a unique well-known port number, otherwise some protocol or procedure would be required to find the desired number.(2)