Winter 2010 CSE3213 Communication Networks
Assignment # 1: Solutions
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Question 1: Suppose transmission channels become virtually error-free. Is the data link layer still needed?

The data link layer is still needed 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.

Question 2: Give two reasons for using layered protocols.

Layered protocols / architecture allow:
1) modularity, i.e. the breaking up of the design problem into smaller and more manageable peaces
2) simplicity / ease in designing new applications, independent from the underlying technology
3) efficient upgrade / replacement of components as new technology emerges

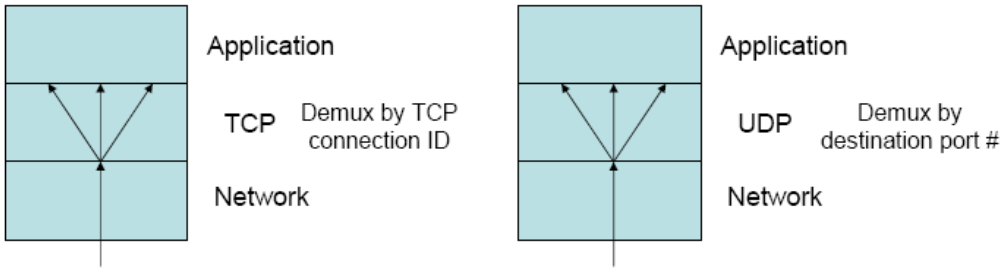
Question 3: Match the following to one (or more) of the five Internet layers:

a) Route determination - Network Layer
b) Flow control - Transport and Data-Link Layer
c) Mechanical and electrical interface - Physical Layer
d) Reliable process-to-process data transportation - Transport Layer
e) Reassembly of data packets - Transport Layer
f) Error correction and retransmission - Data-Link and Transport Layer

Question 4: Explain how the notion of multiplexing can be applied at the data link, network, and transport layers. Draw a figure that shows the flow of PDUs in each multiplexing scheme.

Transport Layer: Multiple application layers processes can share the service provided by UDP. When a UDP PDU arrives from the network layer, the destination port number in the PDU is used to deliver the SDU to the appropriate application layer process. Multiple application layer processes also share the service provided by TCP. In this case, when a TCP segment arrives, the TCP connection ID, consisting of (source port #, source IP address, destination port #, destination IP address), is used to determine which application process to deliver the SDU to.

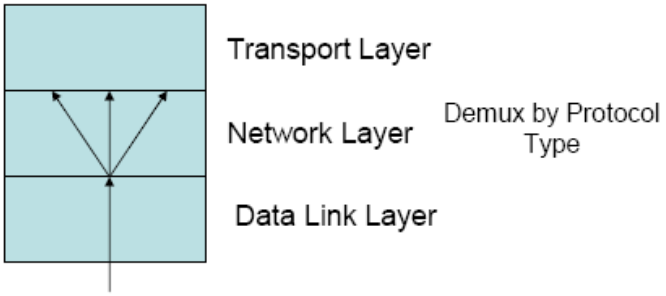
Transport Layer De-multiplexing



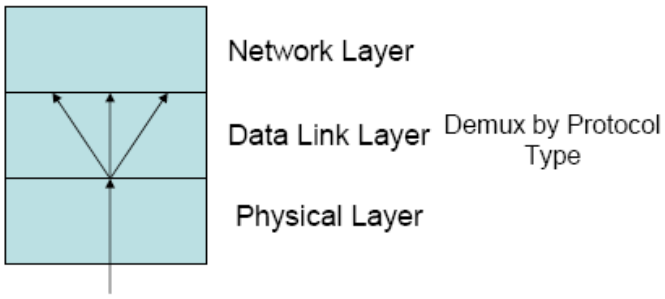
Network Layer: The packet transfer service provided by IP can be used by all transport layers operating in a machine. Each transfer layer passes SDUs to the IP layer which prepares IP packets with appropriate source and destination IP addresses for transfer across the Internet. Upon receiving an IP packet, a machine examines the protocol type field to determine which transport layer service to deliver the SDU to. We can also view all transport layer PDUs as sharing the IP packet transfer service between a source machine and a destination machine.

Data Link Layer: Network layer packets from different protocols (IP, etc) can share a data link (such as PPP or Ethernet). We can also view packet flows that traverse a data link between two routers as sharing the link.

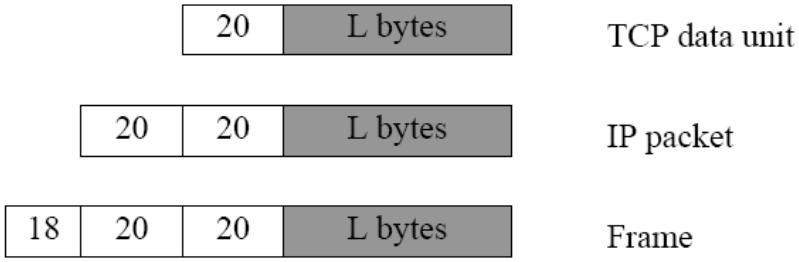
Network Layer De-multiplexing



Data Link Layer De-multiplexing



Question 5: 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 corresponds to the message information if L = 100bytes? 500 bytes? 1000 bytes?



$$\text{percentage of message} = \frac{L}{L+58} * 100\,[\%]$$

L	% of message information
100 bytes	$\frac{100}{158} * 100 = 63\%$ - 37% overhead !!!
500 bytes	$\frac{500}{558} * 100 = 90\%$
1000 bytes	$\frac{1000}{1058} * 100 = 95\%$

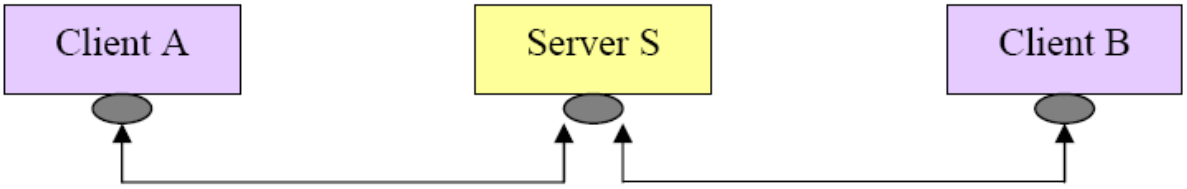
Question 6: Suppose a user has two browser applications active at the same time, and suppose that the two applications are accessing the same server to retrieve HTTP documents at the same time. How does the server tell the difference between the two applications?

A client application generates an ephemeral port number for every TCP connection it sets up. An HTTP request connection is uniquely specified by the five parameters: (TCP, client IP address, ephemeral port #, server IP address, 80). The two applications in the above situations will have different ephemeral port #s and will thus be distinguishable to the server.

Question 7: For each of the following services, discuss which of the following type of services:
Reliable vs unreliable
Connectionless vs connection-oriented would you prefer.

(a) Internet radio is live, so we would like to prevent delays as much as possible. Also, we do not have time for error-detection. Hence Internet radio is **unreliable and connectionless**.
(b) File transfer has to **reliable and connection-oriented**, to ensure that data is received correctly and in-order.
(c) Ping is **unreliable and connectionless**. Unreliable since we are only interested in knowing if the destination host is active. Connectionless since 1 packet needs to be transmitted during each attempt – sequencing is not required.
(d) Telnet is **reliable and connection-oriented**.
(e) Email is **reliable and connection-oriented**.

Question 8: Suppose client A initiates a Telnet session with server S. At about the same time, client B also initiates a Telnet session with server S. Provide possible but consistent source and destination port numbers for:



(a) segment sent from A to S:
• Source port number = 1024
• Destination port number = 23

(b) segment sent from B to S:
• Source port number = 1025
• Destination port number = 23

(c) segment sent from S to A:
• Source port number = 23
• Destination port number = 1024

(d) segment sent from S to B:
• Source port number = 23
• Destination port number = 1025

(e) Source port number form (A to S) and from (B to S) can be the same. The destination (server) will use a combination of source port number and source IP address to determine the actual source.

(f) If A and B are client programs on the same machine, they must have different source port numbers.

Question 9: Suppose we need a communication service to transmit real-time voice over the Internet. What features of TCP and what features of UDP are appropriate?

TCP is desirable in that it provides a connection for the transfer of a stream of information, which characterizes a digital voice stream. However, to provide reliable service TCP uses acknowledgments and retransmissions that result in packet delay and jitter that can not be tolerated by real-time traffic.
UDP provides connectionless service and delivers packets quickly. In case of packet loss, UDP does not provide retransmission, but some degree of packet loss can be tolerated by voice.