

Question 1

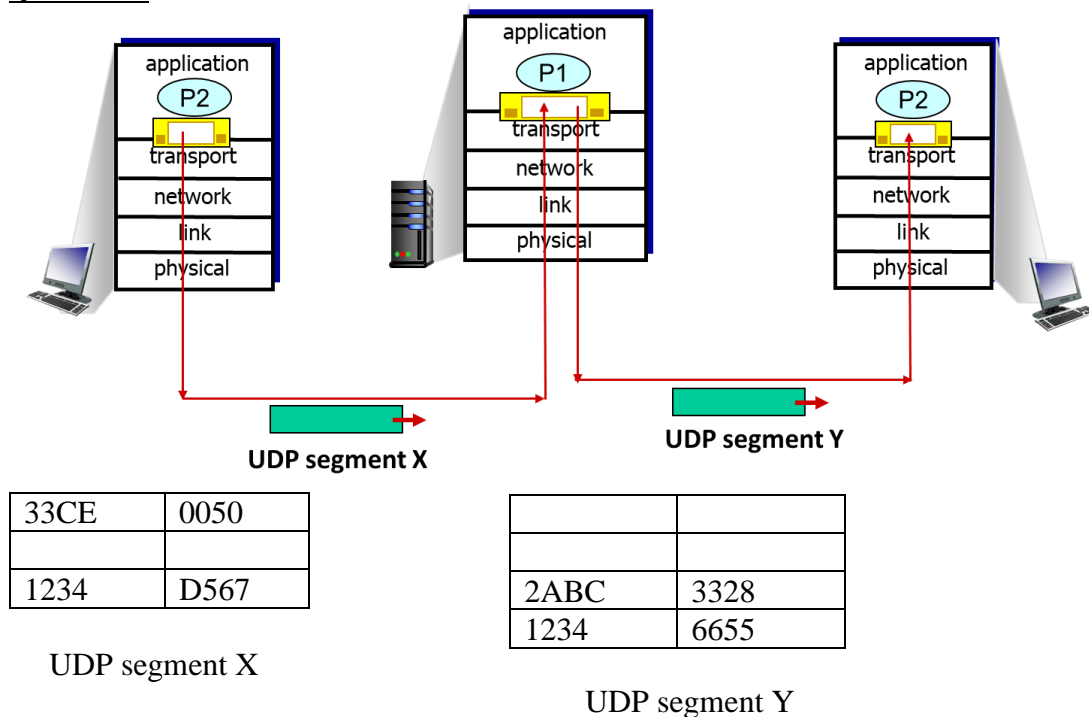
Host A sends a packet of 72 bytes to host B via two routers. The distance between host A and the first router is 20 m. The distance between host B and the second router is 25 m. The distance between the two routers is 500 m. The propagation speed is 2×10^8 m/sec. The recommended transmission rates are: 10 Mbps between host A and the first router, and 100 Mbps between the second router and host B. Each router spends 1.2 msec to perform error detection. If there is no congestion in the network, the recommended end-to-end delay for host A to send the packet to host B should not be longer than 3 msec.

- At what time the last bit of the packet leaves host A?
- At what time the last bit of the packet reaches the first router?
- At what time the first bit of the packet reaches the second router?
- Show your analysis and suggest the physical medium for the link between the two routers.

Question 2

Consider an application that transmits data at a steady rate of L bps. When the application starts, it will run for a long period of time. Would a packet-switched network or circuit-switched network be more appropriate for this application? Why?

Question 3



- Determine all the unknown fields of UDP segment X. All numbers are in hexadecimal.
- Similarly, determine all the unknown fields of UDP segment Y.

Question 4

How to make an application to transmit data reliably over UDP?

Question 5

Host A sends a file of 32,120 bytes to Host B over a TCP connection. Assume the maximum segment size (MSS) is 164 bytes. The segment has no options field. The transport layer, network layer, and data-link layer add headers of a total size of 66 bytes to each segment before the resulting packet is sent out over a 1 Gbps link.

- (a) What is the size of the last packet?
- (b) What is the sequence number of the 102nd segment?
- (c) If the 101st segment is lost but the 102nd segment arrives at Host B, what is the acknowledgment number in the segment that Host B sends to Host A?
- (d) Assume no congestion, calculate the time (in msec, up to 3 decimal places) required to transmit the file.

Question 6

Suggest two methods that can be used to avoid packet loss at input ports of the router.

Question 7

Suppose a router has 4 links, and packets are to be forwarded as follows:

Destination address range	Link interface
00000000 00000000 00000000 00000000 through 00001111 11111111 11111111 11111111	0
00110000 01000000 00000000 00000000 through 00110000 01000111 11111111 11111111	1
01000011 01000000 00000000 00000000 through 01000011 01111111 11111111 11111111	2
otherwise	3

- (a) Provide a forwarding table that has 4 entries.
- (b) Find the link interface for datagrams with the following destination addresses.

00110000 01001001 01010001 01010101
00110000 01000100 11000011 00111100

Question 8

Consider a host sends a 3300-byte datagram into a link that has an MTU of 500 bytes.

- (a) How many fragments are generated?
- (b) What is the length of the last fragment?

Question 9

A network contains 2 routers and a number of hosts. Router 1 links with a number of hosts and forms a subnet A, and also links with router 2 and forms a subnet B. Router 2 links with a number of hosts and forms a subnet C, and also links with router 1 and forms a subnet D.

- (a) Assign network addresses to each of these 4 subnets with the following constraints:
- all addresses must be allocated from 214.9.25/24
 - subnet A should have enough addresses to support 60 interfaces
 - subnet B should have enough addresses to support 14 interfaces
 - subnet C should have enough addresses to support 28 interfaces
 - subnet D should have enough addresses to support 6 interfaces
- (b) Using your answer in part (a), provide the forwarding tables for the routers.

Question 10

Let $g_1(x) = x + 1$ and $g_2(x) = x^3 + x + 1$. Consider the information bits (1, 1, 0, 1, 1, 0).

- (a) Find the codeword if $g_1(x)$ is used as the generating polynomial.
- (b) Suppose that the codeword in part (a) has a transmission error in the third bit. What does the receiver obtain when it does its error checking?
- (c) Find the codeword if $g_2(x)$ is used as the generating polynomial.
- (d) Can $g_2(x)$ detect single errors? Why?
- (e) Find the codeword if $g(x) = g_1(x)g_2(x)$ is used as the generating polynomial.

Question 11

Consider a Go-Back-N ARQ system with a window size of 1. Station A sends information frames to station B. Both A and B have timeout.

- (a) Sketch the sequence of frame exchanges when there is loss of an information frame.
- (b) Sketch the sequence of frame exchanges when there is loss of an acknowledgment frame.

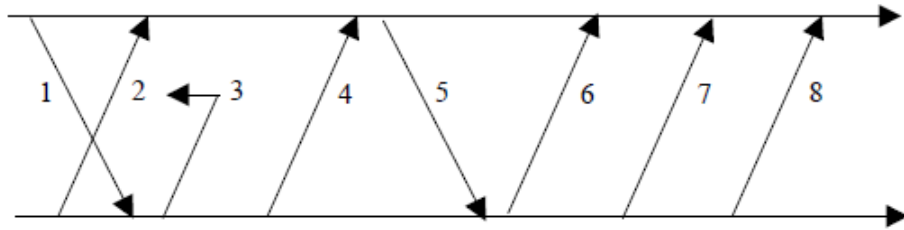
Question 12

Two computers are connected by an intercontinental link. The frame size is 256 bytes. Frame overhead is 25 bytes. Assume a bit error rate of 10^{-4} . Find the efficiency for SR ARQ (round to 4 decimal places).

Question 13

The following corresponds to an HDLC ABM frame exchange.

Station A



Station B

- | | | | |
|----------|---------|---------|---------|
| 1. BI00 | 2. AI00 | 3. xIxx | 4. xIxx |
| 5. xREJx | 6. xIyx | 7. xyxx | 8. xyxx |

- (a) Complete the diagram by completing the labeling of the frame exchanges.
- (b) Write the sequence of state variables at the two stations as each event takes place.