Homework 6

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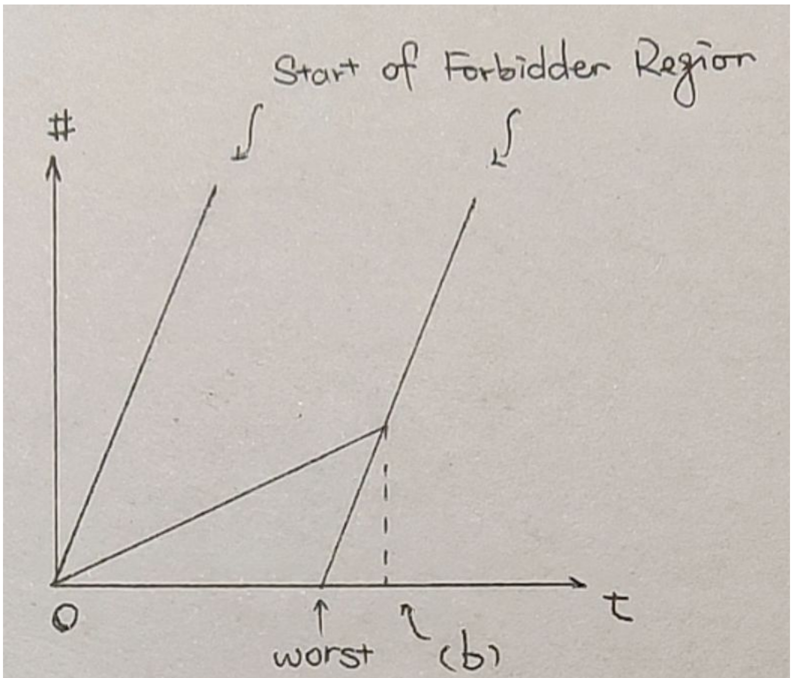
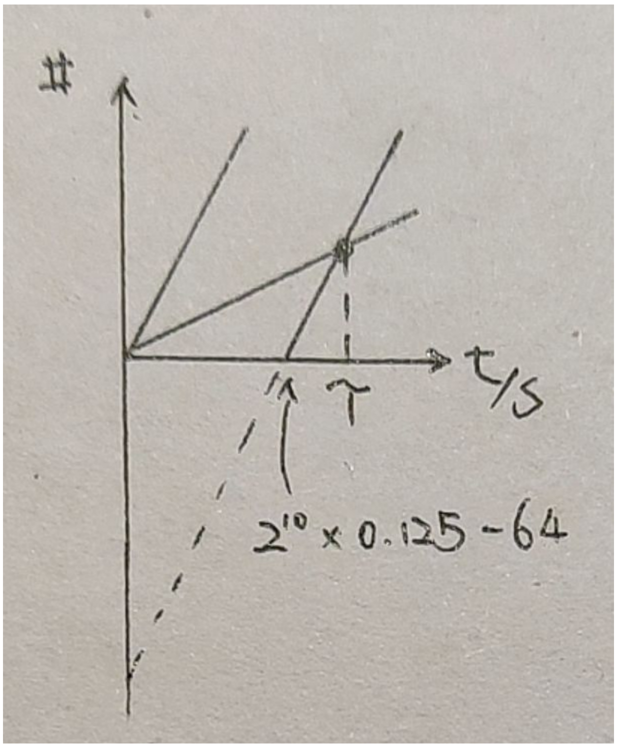
1. No.
   Actually, as LISTEN is a blocking call, we usually use a new thread to perform the LISTEN operation. But we can also design primitive LISTEN as an enable for interrupt. When a connect request arrives, it triggers an interrupt, and the progress can handle it by answering the query.
   The advantage is that, we can save the resource for the LISTENing thread.
2. As is shown in the following figure:



   (a) $T = 2^{15} \times 100\text{ms} - 60\text{s} = 3216.8\text{s}$

   (b) $4T = 10T - 32168 \Rightarrow T = 5361.33\text{s}$

3. If we simply ensure that, after T, only the packets have vanished, while its ACK may still be somewhere alive, then after T a new packet whose Seq. may be rounded-back and the ACK of the former packet which has the same Seq. will be misunderstood as the ACK of this packet, which will cause the protocol fail.
4. $4T = 8(T - 64 + 2^{10} \times 0.125) \Rightarrow T = 128$ (s)



5. Sorry, but I'm not sure what credit means :(

6. * As UDP cares nothing about congestions, it will simply send all its data which uses $100 \times 8\text{b}/\text{ms} \times \frac{1\text{s}}{1\text{ms}} = 800\text{kbps}$ bandwidth. As TCP will look at the network status, it will only use the 200kbps left. So Host A which uses UDP will get a higher throughput.

7. We say transport layer is the *real* end-to-end layer as it uses port to identify each process. With IP, we can only send a packet to a host, but UDP introduces port which can send this packet to the destination process.

8. (The refractive index of optical fiber is 2/3, so the propagation speed of optical signal on it is 2/3 speed of light.)

   Transmission delay: $\dfrac{128 \times 8}{2^{30}}\text{s} = 10^{-6}\text{s}$

   Propagation delay: $\dfrac{100 \times 10^3}{2 \times 10^8}\text{s} = 5 \times 10^{-4}\text{s}$

   Efficiency: $\dfrac{10^{-6}}{5 \times 10^{-4}} = 0.2\%$

9. For 1 Mbps line, transmission delay is $\dfrac{128 \times 8}{2^{20}}\text{s} = 10^{-3}\text{s}$. So the total time cost is 0.5ms for 1Gbps line and 1.5ms for 1Mbps line. That is, when the line is long enough, the expansion of bandwidth can not improve the total performance significantly.

10. No. Datagram fragmentation is used when the packet size is larger than the path MTU, but IP may carry the data from the sender's transport layer in different datagrams, which might arrive in wrong order, when the data is to large to be carried by a single one.

11. Yes. The ACK bit shows that the Ack number field is used. For example, in the first hand shake of TCP, ACK = 0.

12. `1->2->4->8->16->32->64->65->66`

13. My original answer was $\dfrac{128 \times 8 \text{ bits} \times 2^8}{30 \text{ sec}} = 8.74\text{kbps}$

    But answer is $\dfrac{128 \times 8 \text{ bits} \times (2^8 - 1)}{30 \text{ sec}} = 8.704\text{kbps}$. (Like GBN)

    Why not $\dfrac{128 \times 8 \text{ bits} \times 2^{8-1}}{30 \text{ sec}} = 4.369\text{kbps}$? (Like SR)

14. $\dfrac{2^{64} \times 8}{75 \times 10^{12}} = 1.7 \times 10^6\text{s}$.

15. a. $1.5 \times 10^6 \times 0.1 = 1.5 \times 10^5\text{b} = 1.875 \times 10^4\text{Bytes} = 18.75\text{kB}$

    b. $10 \times 10^6 \times 0.1 = 10^6\text{b} = 1.25 \times 10^5\text{Bytes} = 125\text{kB}$

    c. $45 \times 10^6 \times 0.1 = 4.5 \times 10^6\text{b} = 5.625 \times 10^5\text{Bytes} = 562.5\text{kB}$

    d. $155 \times 10^6 \times 0.1 = 1.55 \times 10^7\text{b} = 1.94 \times 10^6\text{Bytes} = 1.94\text{MB}$

    (Refered to the answer) According to Problem 13, the TCP window size is about 64KB or 32KB, so this window size is kind of small for make full use of Ethernet, T3 and STS-3.