

① Essay

- 1) Yes, if the developer puts a reliable data transfer in the application layer.
- 2) For each connection there is a separate socket, each with source IP, source port, destination port, destination IP, which are analyzed to know which socket to use.
- 3) They are required for a receiver to determine whether an arriving packet contains new data or a retransmission, to support reordering and provide some information about dropped packets.

④ False② Problems

$$\begin{array}{r}
 1 \quad 1111 \\
 1) \ a) \ 01011100 \\
 \quad \quad 01100101 \\
 \quad \quad \underline{11000001}
 \end{array}
 \rightarrow \text{1st Complement: } 00111110$$

$$\begin{array}{r}
 1 \\
 b) \ 11011010 \\
 \quad \quad 01100101 \\
 \quad \quad \underline{10011111}
 \end{array}
 \rightarrow \text{1st Complement: } 01100000$$

$$\begin{array}{r}
 c) \ 01011100 \rightarrow 01011101 \\
 \quad \quad 01100101 \rightarrow 01100100
 \end{array}$$

2) The sequence number shouldn't be smaller than X or else it will be refused

3) Receiver Window of 18 KB

a) ~~slow start = $18/2 = 9$~~

a) 1st = 1

2nd = 2

3rd = 4

4th = 8

→ Threshold

b) $18/2 = 9$

→ new Threshold

4) a) 4 bytes → $4 \times 8 = 32$ bits

$2^{32} = 4,294,967,296$ possible sequences

~~so max of~~

max of $L \approx 4.29$ Gbps

b) ~~$(2^{32}/536) \approx 8,012,999$~~ segments
 ~~$\approx 1,001,625$ bytes~~

66 with each segment → ~~8,288~~

628,857,943 bytes

Total Transferred = 4.824×10^9 bytes

= 3.8592×10^{10} bits

Time = $\frac{3.8592 \times 10^{10}}{155 \times 10^6} \approx 249$ seconds

⑤ 106 ms, 120 ms, 140 ms, 90 ms, and 115 ms

$$\alpha = 0.125$$

$$\beta = 0.25$$

$$\text{first Estimated} = 100 \text{ ms, DevRTT} = 5 \text{ ms}$$

$$\text{Estimated RTT} = (1 - \alpha) \cdot \text{Estimated RTT} + \alpha (\text{Sample RTT})$$

$$\text{RTT}_{106} = 100.75$$

$$\text{RTT}_{120} = 103.15625 \approx 103.16$$

$$\text{RTT}_{140} = 107.76$$

$$\text{RTT}_{90} = 105.54$$

$$\text{RTT}_{115} = 106.72$$

$$\text{DevRTT} = (1 - \beta) \cdot \text{DevRTT} + \beta |\text{Sample RTT} - \text{Estimated RTT}|$$

$$\text{DevRTT}_{106} = 5.0625$$

$$\text{DevRTT}_{120} = 8.007$$

$$\text{DevRTT}_{140} = 14.065$$

$$\text{DevRTT}_{90} = 14.43$$

$$\text{DevRTT}_{115} = 12.89$$

⑥ - Sender sends packet & wait

- Receiver in wait for 0 and receives corrupt so doesn't send anything back