IK1203
Networks and Communication

Recitation 2 – Transport layer

Solutions

1.

a) Because the retransmission timer can then expire and cause an unnecessary retransmission.

b) The receiver will immediately send an ACK (no more delay). This is what causes the typical "ACK every other segment" pattern in case of bulk transfers over TCP.

2. Flow control is a way for the receiver to regulate the sender's transmission pace. The purpose is to prevent the receiver from becoming overwhelmed with more data than it can process. Congestion control deals with the situation when packets are dropped by routers along the path between sender and receiver. The purpose of TCP congestion control is to regulate the sender's transmission pace based on the current network conditions.

3.

a) A window of data can be sent every 20th ms. It gives a maximum throughput of:
$(65535 * 8)/(20*10^{-3})$ bps = 26 214 000 bps (≈ 26 Mbps).

b) Channel utilization = 26 214 000/1 000 000 000 ≈ 2,6%

4. 35 ms. TCP begins in slow start by first sending 2 kB. After one RTT TCP will send 4kB; after two RTT TCP will send 8 kB; after 3 RTT TCP will send the last 1 kB of data (2+4+8+1 = 15). The last kB will reach the server application 5 ms later. So, in total: 3 * RTT + RTT/2 = 35 ms.

5.

a) Slow start: [1, 6] and [23, 26], congestion avoidance: [6, 16] and [17, 22].

b) In this case, the packet loss is detected through three duplicate ACKs. This can be concluded since TCP goes to fast recovery and reduces the congestion window to half (roughly) the current size. If the packet loss had been detected through a timeout, TCP would go to slow start and reduced the congestion window to 1 MSS.

6. The finite state machine is illustrated below. The receiver's FSM is not changed when the timer-based retransmission mechanism is introduced.