Computer Networks
Jacobs University Bremen
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Course: CO20-320301
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CN Problem Sheet #5

**Problem 5.1:** *tcp retransmission timer* (3 points)

Consider a TCP connection where the current estimation of the round-trip time is $RTT = 30\,\text{ms}$ and the current estimation of the standard deviation is $D = 20\,\text{ms}$. The following acknowledgments come in after 26, 32, and 24 msec. How does the RTT estimation evolvate? How does the estimation of the standard deviation D evolve? What are the resulting retransmission timeout RTO values? Assume that $\alpha = \frac{7}{8}$.

Problem 5.2: *TCP data exchange over links with different MTUs* (1+1+2+2+1 = 7 points)

Consider the following IP network topology. IP traffic is flowing from the source S to the destination D via the two routers R1 and R2 with the link MTUs indicated below the links.

```
S ---------------- R1 ---------------- R2 ---------------- D
     MTU = 1500          MTU = 1200          MTU = 800
```
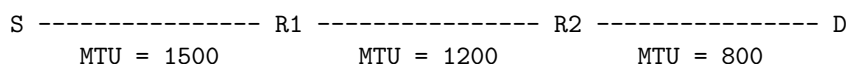
The source S sends 2000 bytes of data (payload) over a TCP connection to the destination D. There is no data (payload) flowing into the other direction. The IPv4 header size without options is 20 bytes and the TCP header size without options is 20 bytes. No packets are lost, or reordered or otherwise damaged.

You will be asked to draw TCP time sequence diagrams. The source S is actively opening the TCP connection and S will initiate the teardown of the TCP connection after sending its payload. For each TCP/IPv4 packet, indicate which ACK number it carries and indicate the IPv4 packet size in square brackets. Assume that the TCP handshakes to establish and teardown the TCP connection do not overlap with the data transfer phase (i.e., no piggybacking). Indicate any header fields that are relevant to understand your solution.

a) Draw a TCP time sequence diagram for the TCP connection establishment without using any TCP options.

b) Draw a TCP time sequence diagram for the TCP connection establishment using the Maximum Segment Size (MSS) TCP option. Indicate the MSS values announced by the TCP endpoints.

c) Draw a TCP time sequence diagram for the data transfer for a TCP connection not using the MSS TCP option.

d) Draw a TCP time sequence diagram for the data transfer for a TCP connection using the MSS TCP option.

e) Draw a TCP time sequence diagram for the TCP connection teardown (the presence of the MSS option does not play a role here).