Number:	12. Assignment
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Note: The referenced websites and publications do not have to be read from begin to the end. You are only required to read enough to answer the questions and to get a general understanding of the topics.

Exercise 1, Self-Clocking:

Explain the self-clocking property of TCP and how the self-clocking can be disturbed.

Exercise 2, Initial Sequence Numbers:

Read and discuss the publication *Strange Attractors and TCP/IP Sequence Number Analysis* by Michal Zalewski that is available on this website. Have a look at his second study published one year later and discuss what has changed.

Exercise 3, TCP + Scapy:

Please try the following only in your private network!
Create a TCP header with *Scapy*. Set the SYN flag and choose a random initial *sequence number* and *source port*. Append an IP header with *destination address* set to some host's address. Set the *destination port* to a port number the host is listening on. Send the packet with the `send()` function. Wrap everything in a loop that never finishes.

1. What will the program realize?
2. Your program will probably not work as desired. Why is the program not working as you might have expected and what do you have to add or modify?

Exercise 4, Selective Acknowledgements:

Read RFC 2018 that specifies the *Selective Acknowledgement* (SACK) option for TCP.

1. What problem is addressed by SACKs and how are they used in a TCP connection?
2. Give an example for a TCP connection using the SACK option where some segments are lost and explain which values are contained in the SACK options in the TCP headers.

Exercise 5, Forward Acknowledgements:

Have a look at the publication Forward acknowledgement: refining TCP congestion control and discuss the *Forward Acknowledgment* (FACK) congestion control algorithm. What problem is addressed by FACK and how is it used in a TCP connection?

Exercise 6, Proactive Congestion Control:

TCP congestion control algorithms as implemented in TCP Vegas or TCP-LP are considered to be proactive in contrast to the common reactive algorithms. Discuss the difference of the approaches and what the term *TCP fairness* means.

Exercise 7, Explicit Congestion Control:

RFC 3168 defines an *Explicit Congestion Control* (ECN) approach for IP and transport layer protocols. Explain how ECN works and why the principle of a layered network architecture is violated.

Exercise 8, TCP - A Retrospective:

The TCP protocol and a selection of extensions have been discussed in the Telematics lecture and tutorial sessions. In retrospective, do you think TCP performs equally well in all kinds of networks? Are there extensions (options, congestion control algorithms, etc) that are best suited for particular application scenarios?

Exercise 9, Alternative Transport Layer Protocols:

Although TCP and UDP are the dominating transport layer protocols, there are alternatives. Give examples and name the basic features that differentiate these alternative protocols from TCP and UDP. Discuss which problems they try to solve. Can applications be easily adapted to use these alternatives?