Computer Networks
Jacobs University Bremen
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Course: CO20-320301
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Due: 2018-04-18

CN 2018 Problem Sheet #4

**Problem 4.1:** *tcp selective acknowledgements* (2+2 = 4 points)

a) A TCP extension defined in RFC 2018 introduced selective acknowledgments (SACK) that are carried in TCP header options. Explain *in your own words* how selective acknowledgments work and why they are useful. What exactly do the two numbers carried in the SACK option for each block indicate?

b) Two TCP endpoints establish a connection and negotiate the starting sequence numbers X and Y. The endpoint performing the active open and negotiating the starting sequence numbers X sends TCP segments carrying 500, 300, 200, and 100 octets of data before closing the TCP connection. The TCP segment carrying the 200 octets of data is lost on first attempt. Which numbers do the ACK messages from the other endpoint contain? Draw a time sequence diagram (including any necessary retransmissions and the initial connection establishment and final connection teardown exchange).

Which numbers do the ACK messages and the SACK options contain if both endpoints support selective acknowledgments? Draw another time sequence diagram (including any necessary retransmissions and the initial connection establishment and final connection teardown exchange).

**Problem 4.2:** *tcp trace analysis* (2+2+1+1 = 6 points)

A file has been copied to a remote server and the following 'tcptrace diagram' has been produced using wireshark. The following plots show the overall diagram and selected zoomed in areas.
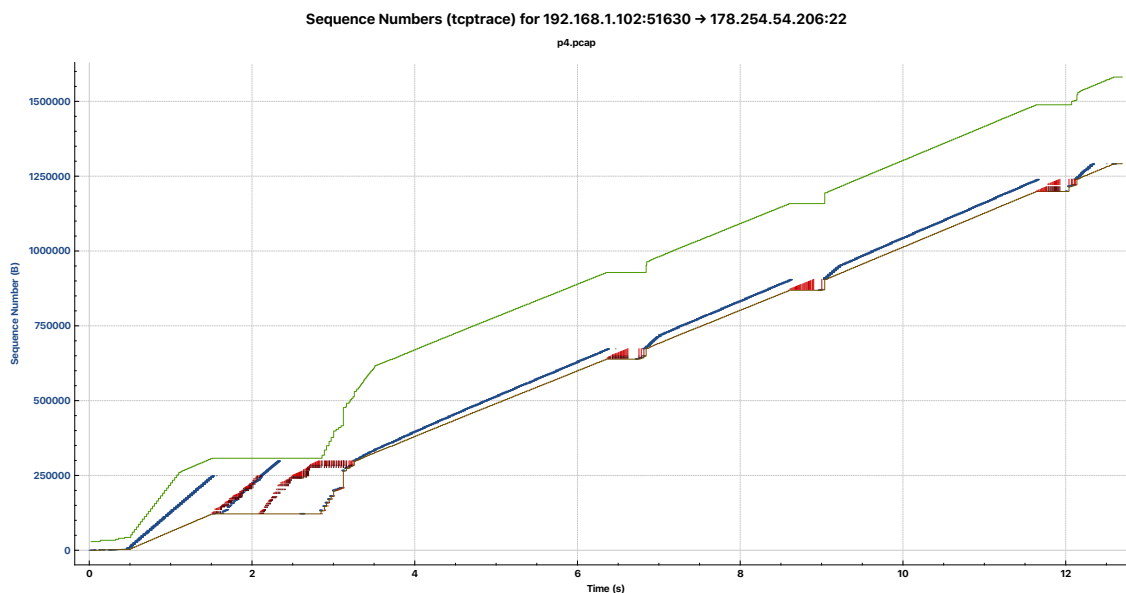
Sequence Numbers (tcptrace) for 192.168.1.102:51630 → 178.254.54.206:22
p4.pcap

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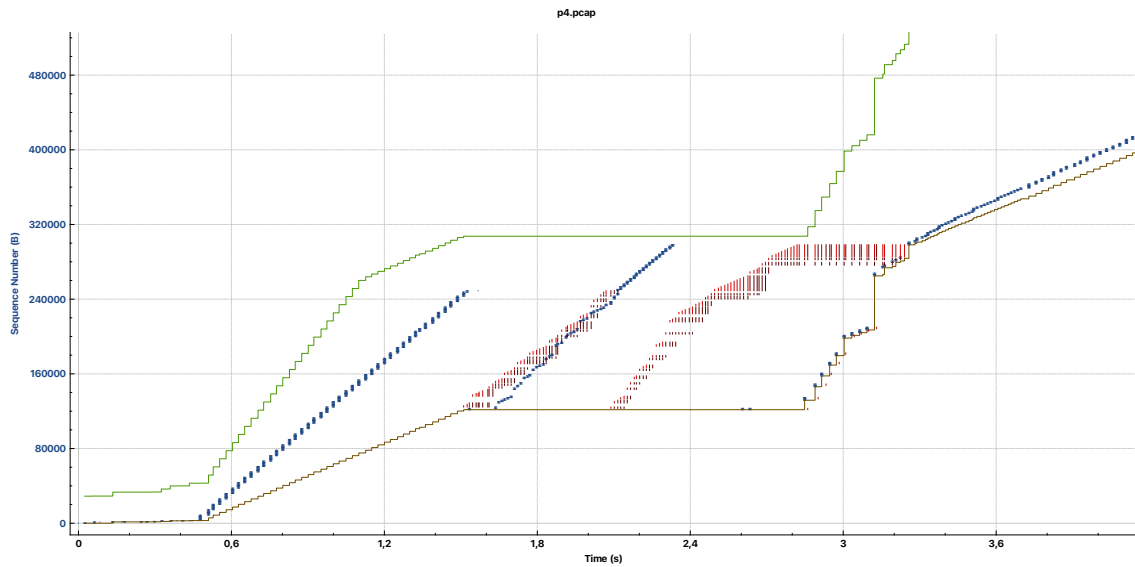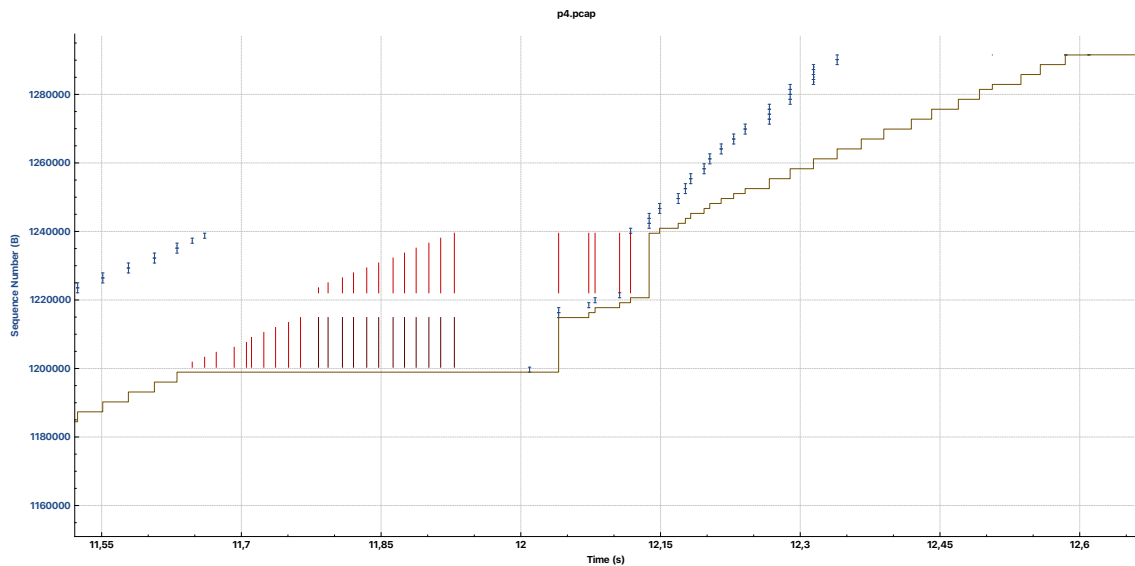
Note that the plots are zoomable vector graphics (as it should be). Answer the following questions:

a) How much data has been transferred? What was the average data rate during the entire data transfer (time interval $[0.5 : 12.5]$)?

b) What was the sending data rate during the time interval $[0.5 : 1.5]$? When was all data sent during this time interval finally received by the receiver?

c) How many segments have been lost and were not yet successfully retransmitted at $t = 12$?

d) What is the (estimated) receive window size at $t = 2.0$?