TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
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5th Assignment: Network Protocols and Architectures, WS 14/15

Question 1: $(5 + 15 + 10 = 30$ points) *Relationship of bandwidth and window-size*

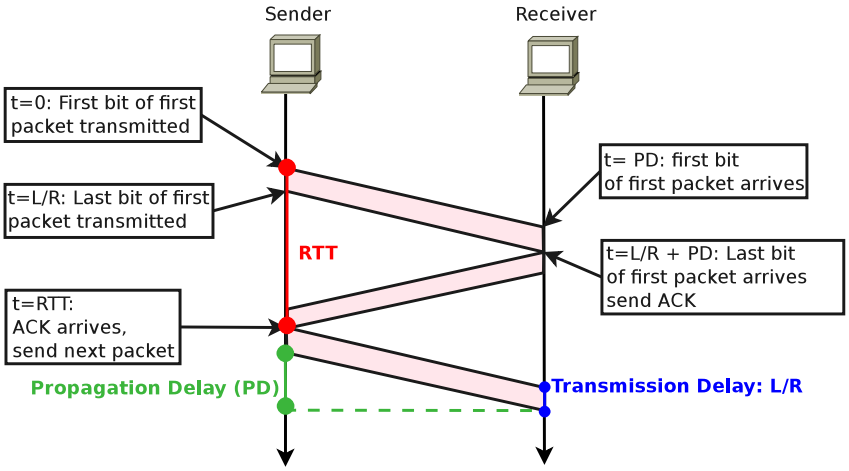

Figure 1: Types of Delay and Sequence plots: L is the length of the packet to transmit and R is the available bandwidth.

Assume an unidirectional data-stream. Let $S = 536$ Byte be the maximum segment size (MSS), and a round-trip-time of $RTT = 60$ msec for 40 Byte packets without payload. Remember that the RTT is defined as the time it takes from sending the first bit until receiving the last bit. The transport protocol uses a static window of size W.

Please note that calculations need to be comprehensible in order to be accepted.

(a) What is the average propagation delay between sender and receiver by assuming a bandwidth of $R = 32$ Kbit/s?

(b) What is the smallest window size that allows a maximum utilization of the available bandwidth of $R = 32$ Kbit/s?

(c) Do you need another window size for a maximum utilization if the bandwidths changes to (i) $R = 100$ Kbit/s, (ii) $R = 1$ Mbit/s, (iii) $R = 10$ Mbit/s? Discuss how the results change with the different bandwidths.

Question 2: $(10 \cdot 4 = 40$ points) *TCP congestion window size*

Assuming TCP Reno is the protocol experiencing the behaviour shown in Figure 2. Answer the following questions. In all cases, you should provide a short discussion justifying your answer. Stating a simple number is not sufficient, as it should be clear where that number stems from. Remember that `Threshold` is the limit after which TCP switches from slow start to congestion avoidance.

Please turn!

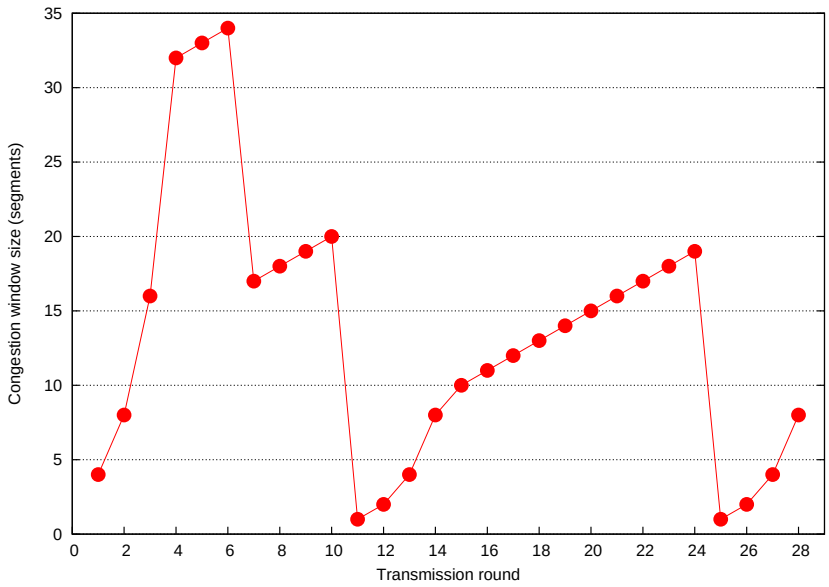

Figure 2: TCP window size as a function of time.

(a) What is the size of the inital window?
(b) Identify the intervals of time when TCP slow start is operating.
(c) Identify the intervals of time when TCP congestion avoidance is used.
(d) After the 6th transmission round, is the segment loss detected by a triple duplicate acknowledgment or by a timeout?
(e) After the 10th transmission round, is the segment loss detected by a triple duplicate acknowledgment or by a timeout?
(f) What is the initial value of `Threshold` at the first transmission round?
(g) What is the value of `Threshold` at the 8th transmission round?
(h) What is the value of `Threshold` at the 12th transmission round?
(i) During which transmission round is the 30th segment sent?
(j) Assuming a packet loss is detected after the 28th round by the receipt of a triple duplicate acknowledgement, what will be the values of the congestion window size and of `Threshold`?

Question 3: (30 points) *TCP Traffic Analysis*

This exercise will introduce you to traffic analysis techniques by examining TCP using a real connection. In order to complete the exercise, download a copy of Wireshark for your operating system from `http://www.wireshark.org/` and familiarize yourself with the tool. Read about display filters and how to set them.

Let us come to the experiment itself. Start the traffic capturing in Wireshark and download a web page using your browser, then stop the capturing. You will probably have captured packets that do not belong to the transfer of the website itself, so configure a display filter to display only packets that belong to the HTTP connection you have just requested. An easy way to accomplish this is to filter by the IP address of the remote web server and the HTTP protocol.

Analyse the obtained data by marking packets belonging to i) the TCP connection setup, ii) the transmission of the HTTP request, iii) the transmission of the HTTP response and iv) tear-down of the connection. Include a marked screenshot of Wireshark in your solution. Also include the host name of the remote web server, its IP address and the used display filter.

Due Date: Wednesday, November, 26th 2014 only until 14:00 h s. t.

- **As PDF files (no MS Office or OpenOffice files):** Uploaded via ISIS (`https://www.isis.tu-berlin.de/2.0/course/view.php?id=2560`)
- Put your name, StudentID number (Matrikelnummer) **and** the name of your tutor on your solution.