TECHNISCHE UNIVERSITÄT BERLIN
Fakultät IV – Elektrotechnik und Informatik
Fachgebiet Intelligente Netze
Prof. Anja Feldmann
Thomas Krenc, Felix Poloczek, Srivatsan Ravi and Philipp Schmidt

4th Assignment: Network Protocols and Architectures, WS 14/15

Question 1: (10 points) *VoIP using TCP*

Assume a VoIP session was established over TCP. What would happen in case of a packet loss? Describe how TCP reacts to the packet loss and how the user experience is effected. Is TCP the best choice for VoIP?

Question 2: (10 + 10 = 20 points) *TCP's RTT Estimation*

Consider the TCP procedure for estimating RTT (Round-Trip-Time). Let $\texttt{SampleRTT}_1$ be the most recent sample RTT, let $\texttt{SampleRTT}_2$ be the next most recent sample RTT, and so on. Recall that the formula for RTT estimation in TCP is:

$$\texttt{EstimatedRTT}_{\texttt{new}} = (1-\alpha) \cdot \texttt{EstimatedRTT}_{\texttt{old}} + \alpha \cdot \texttt{SampleRTT} \tag{1}$$

Given n sample round-trip times the formula can be generalized to:

$$\texttt{EstimatedRTT}_{\texttt{new}} = \alpha \cdot \sum_{i=1}^{n-1} (1-\alpha)^{i-1} \cdot \texttt{SampleRTT}_i + (1-\alpha)^{n-1} \cdot \texttt{SampleRTT}_n \tag{2}$$

(a) For the formula (2) let n approach infinity. Comment on why this averaging procedure is called an exponential moving average and why no simple average is used.

(b) Why do you think TCP avoids measuring the `SampleRTT` for retransmitted segments? Explain!

Question 3: (10 + 10 = 20 points) *TCP sequence number space*

Consider transferring an enormous file of L bytes from Host A to Host B. Assume a MSS (Maximum Segment Size) of 1434 bytes.

(a) Assume that the file is transferred in a single TCP connection. What is the maximum value of L such that TCP sequence numbers do not need to wrap around? Recall that the TCP sequence number field is four bytes.

(b) For the L you obtained in (a), find out how long it takes to transmit the file. Assume that a total of 66 bytes of transport, network, and data-link header are added to each segment before the resulting frame is sent out over a 100 Mbit/s link. Ignore flow control and congestion control so A can pump out the segments back to back and continuously.

Please turn!

Question 4: $(5 + 5 = 10$ points) *TCP Sequence Numbers*

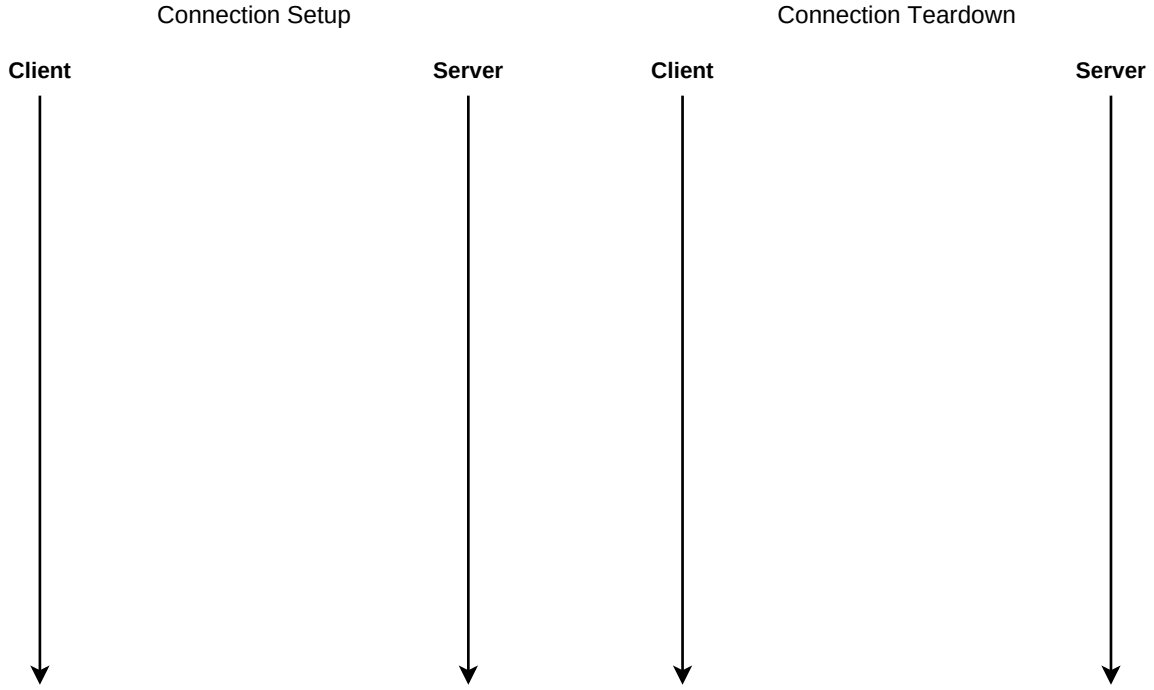
Suppose, Host A sends two TCP segments back-to-back to Host B over a TCP connection. The first segment has sequence number 1346; the second has sequence number 2016.

(a) How much data (in bytes) is in the first segment?

(b) Suppose, the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?

Question 5: $(20 + 20 = 40$ points) *TCP Handshake and Teardown*

TCP is the number one example for connection-oriented services. In this problem we will have a closer look at TCP's connection management.



(a) Enter a successful connection setup into a diagram (see above on the left). Label the arrows with the relevant parts of the TCP header (flags, sequence number, acknowledgment number). The initial (randomly chosen) sequence numbers of client and server are: 6400 (Client) and 15620 (Server).

(b) Enter the successful connection teardown into another diagram (see above on the right). Again label the arrows with the relevant parts of the TCP header (flags, sequence number, acknowledgement number). Assume that after the connection setup from part (a) some data was transferred: 490 bytes from client to server, and 12300 bytes from server to client. Consider these values when determining sequence and acknowledgment numbers.

Due Date: Wednesday, November, 19th 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.