EP2120 Internetworking Lab 2 Group Report

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5. Measuring TCP with ttcp and Wireshark (We did this part wrong with UDP, we used data from group EP-SEP-24-AM-3 for answering the questions)

(1) How many packets are transmitted in total (count both directions)?
22.

(2) What is the range of the sequence numbers used by the sender (Host A)?
0~10002.

(3) How many packets do not carry a data payload?
14.

(4) What is the total number of bytes transmitted in the recorded transfer? (Calculate the amount of user data that was transmitted!)
1448*6+312+1000+66*20+74*2=11468

(5) Compare the total amount of data transmitted in the TCP data transfer to that of a UDP data transfer. Which of the protocols is more efficient in terms of overhead? What is the efficiency in percentage for these two protocols? (Recall the UDP measurements from the previous lab. How many bytes were sent in total using UDP?)
TCP:10000/11468 = 87.2%
UDP:10000/10820 = 92.4%
UDP is more efficient.

6. TCP connection management

6.1 Connection establishment and termination

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(1) Which packets constitute the three-way handshake? Which flags are set in the headers of these packets?
The first 3 packets constitute the three-way handshake.
For packet 1: SYN.
For packet 2: ACK, SYN.
For packet 3: ACK.

(2) What are the initial sequence numbers used by the client and the server, respectively?
The first sequence numbers used by the client and server are both 0, which are followed by 1.

(3) Which packet contains the first application data?
After the third packet mentioned above.

(4) What are the initial window sizes for the client and for the server?
Client: 29200.
Server: 28960.

(5) How long does it roughly take to open the TCP connection?
1ms.

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(1) What packets are involved in closing the connection?
The last 3 TCP packets.

(2) Which flags are set in these packets?
Packet No.: -3 FIN, ACK
Packet No.: -2 FIN, ACK
Packet No.: -1 ACK

6.2 Connecting to a non-existing port

(1) How does the server host (Host B) close the connection?
Host B receives the SYN connection from host A, it returns a packet with ACK and RST.

(2) How long does the process of ending the connection take?
50 μs.

6.3 Connecting to a non-existing host

(1) How often does the client try to open a connection? Note the time interval between attempts.
7 attempts. Interval is about 1s, 2.1s, 4.1s, 8.6s, 16.6s, 32.7s

(2) Does the client stop trying to connect at some point? If so, after how many attempts?
Yes, 7 attempts.

7 Fragmentation in TCP

(1) How many packets did Host A measure and how many packets did Host B measure? Why?
A: 20 packets.
B: 22 packets.
Because of fragmentation, the number is different.

(2) Is the DF flag set in the datagrams? Why?
Yes, DF is set to 1 so that the router will send a ICMP message noting that fragmentation is needed instead of discarding the packets.

(3) Do you observe fragmentation? If so, where does it occur?
No. Packets have MF = 0, DF = 1, so it won't happen.

(4) Study the ICMP messages recorded at Host A. Which node is the source? What is the type and the code of the messages?
no ICMP message is recorded.

8. TCP data transfer

8.1 Interactive application - fast link

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(1) How many segments can be seen?
We can see 3 segments.

(2) Describe the payload of each packet.
The payload of each character is 1 byte and the payload of ACK is 0.

(3) Explain why you do not see four packets per typed character.
Because the server sends ACK and echo characters in the same packet.

(4) When the client receives the echo, it waits a certain time before sending the ACK. Why? How long is the delay?
The delay is about 100ms. Because the client needs to check if more data will arrive.

(5) In the segments that carry characters, what window size is advertised by the telnet client and by the server? Does the window size vary as the connection proceeds?
The window size advertised by the telnet client is 245 and that by the server is 227. The size does not vary as the connection proceeds.

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(1) Do you observe a difference in the transmission of segment payloads and ACKs?

Yes. There is only one ACK after we release the key.

8.2 Bulk transfer - fast link

(1) How often does the receiver send ACKs? Can you see a rule on how TCP sends ACKs?
At first, after the sender sends 10 packets, the receiver sends an ACK packet. Then, it sends an ACK packet for every two packets the sender sends. Later, it sends an ACK packet for every packet it receives.

(2) How many bytes of data does a receiver acknowledge in a typical ACK?
In a typical ACK, the receiver acknowledges 1448 bytes of data.

(3) How does the window size vary during the session?
In the beginning, the window size increases quickly. Then, due to the congestion control, the window size increases linearly and more slowly until it reaches the maximum.

(4) Select any ACK packet in the Wireshark trace and note its acknowledgement number. Find the original segment in the Wireshark output. How long did it take from the transmission until it was ACKed?
As for packet 66 with ACK=25617, which is an ACK to the segment in frame 26, it took 1.412ms from the transmission until it was ACKed.

(5) Does the TCP sender generally transmit the maximum number of bytes as allowed by the receiver?
The TCP sender does not generally transmit the maximum number of bytes.

8.3 Interactive application - slow link

(1) How many packets are transferred for each keystroke? Does the number change when you type faster>
There are 3 packets transferred for each keystroke. When we type faster, there are more packets transferred before the receiver sends an ACK.

(2) Do you observe delayed acknowledgements?
Yes, there are delayed acknowledgments when we type fast.

(3) Do you observe the effect of Nagle's algorithm? How many characters can you see in a segment?
Yes, we can observe the effect of Nagle's algorithm when we type fast. We can see four characters in a segment.

8.4 Bulk transfer - slow link

(1) Look at the pattern of segments and ACKs. Did the frequency of ACKs change compared to the bulk transfer on the fast link? How?
Yes, its frequency of ACKs is much lower than that on the fast link.

(2) Are the window sizes advertised by the receiver different from those of the previous exercise?
The increase of the window sizes is consistent, but much slower.

(3) Does the TCP sender generally transmit the maximum number of bytes as allowed by the receiver?
Yes, the TCP sender generally transmits the maximum number of bytes.

9 TCP retransmissions

(1) How many packets are transmitted at retransmission timeout?

There is 1 packet being transmitted at retransmission timeout.

(2) Do the retransmissions end at some point?
Yes, the retransmissions end after packet 240, since there will be no packet-loss.

10 TCP congestion control

(1) Try to observe periods when a TCP sender is in slow start phase and when the sender switches to congestion control. Verify if the congestion window follows the rule of the slow-start phase.
Observing the slope in TCP trace picture, we can verify that at the beginning, TCP sender follows the rule of the slow-start phase and it switches to congestion control at about sequence 20000.

(2) Can you find occurrences of fast recovery?
We can find from the TCP trace picture that sometimes the slope decreases, which means that a packet was received out of order or missed. And then, there is a fast recovery, leading to a constant increase of the slope in the picture.