TCP Protocol

Exercise 1 :

We consider a TCP connection between two hosts H1 and H2. H1 has data to transmit. We assume that a receiver immediately acknowledges all received segments. The version of TCP used is the Tahoe version. We will also suppose that H2 has a reception window of size W. We will note RTT the round trip delay between H1 and H2

- After the initialization of the connection, H1 starts to transmit TCP segments following the slow-start phase. During this phase, how does the size of the transmission window of H1 evolve ? What is the impact on the throughput ?
- Calculate the time taken by H1 to transmit the first 15 segments based on the RTT.
- Suppose that at time t1 a loss occurs. Following the detection of this loss, detail the behavior of H1 (retransmission, window size, throughput, etc.).

- The transmission window of H1 increases exponentially during the slow-start phase. Therefore the flow rate also increases exponentially.

- H1 is in the slow-start phase. Therefore :

o the 1st segment will have been transmitted after 1 RTT
o the 3d segments will have been transmitted after 2 RTT
o the 7th segments will have been transmitted after 3 RTT
o the 15th segments will have been transmitted after 4 RTT
The formula is: nb segments = 2 n - 1 where n is the number of RTT

Exercise 2 :

We want to back up the data of the UFAZ (10 TBytes of data) in Hövsan city in case of a flood of the local server.

Two solutions are considered:

- The first one is to take a hard disk by car from Baku (40 min drive).

- The second one is to transfer the data via the Internet (2 Gbit/s of the throughput is assumed).

Which is the faster solution ?

Troughput is expressed on G/s and the estimated time by car is in min, me must convert all units in Gbit and min

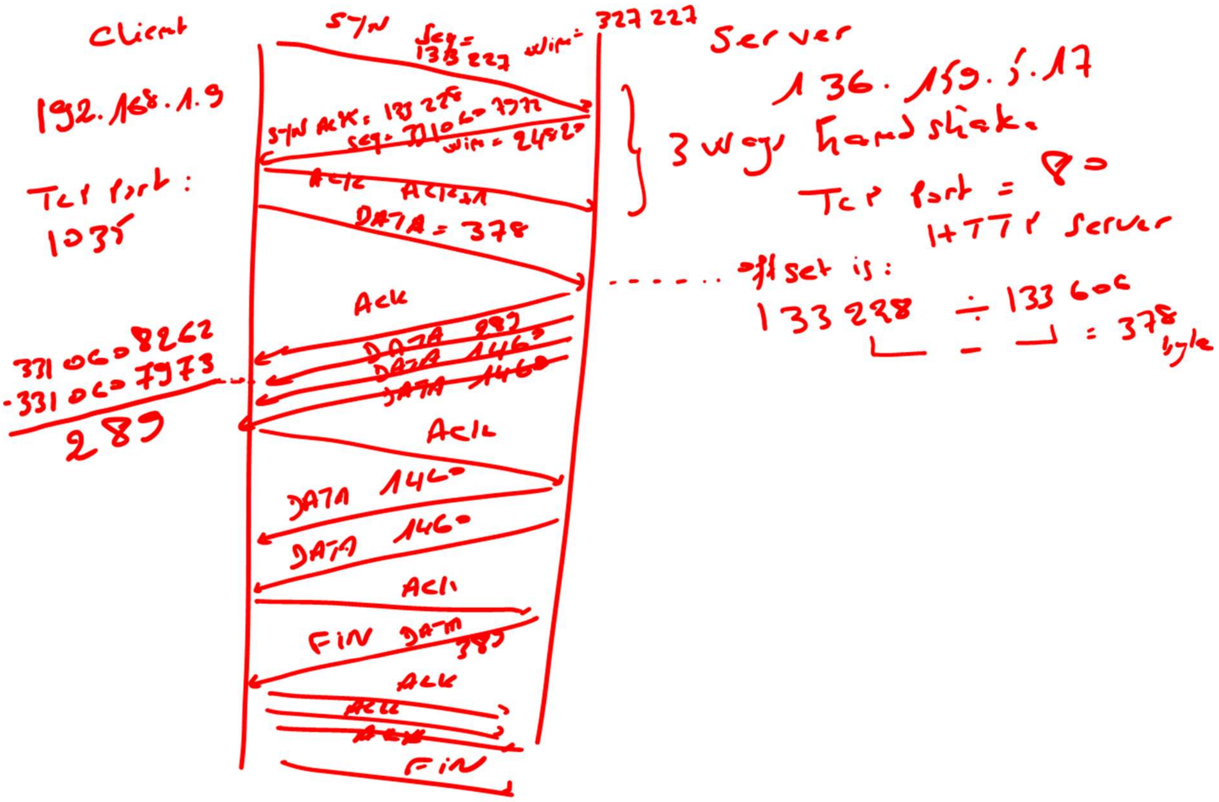
10TBytes = 1024 x 10GByte = 10240 x 8bit = 81920Gbits

$T_{(\text{transfer time})}$ = Data/troughput => T(min) = 81920/2*60Gbits/min = 682,66 min = 11H25min

2Gbit/s => 2*1/1/60 min => 2*60 Gbits/min

Exercise 3 :

Describe on a diagram the data exchanges resulting from the above traffic analysis

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1629.884415 192.168.1.9 -> 136.159.5.17 44 TCP 1035 80 133227 : 133227 0 win: 32768 S
1629.886713 136.159.5.17 -> 192.168.1.9 44 TCP 80 1035 3310607972 : 3310607972 133228 win: 24820 SA
1629.888507 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133228 : 133228 3310607973 win: 32768 A
1629.948462 192.168.1.9 -> 136.159.5.17 418 TCP 1035 80 133228 : 133606 3310607973 win: 32768 PA
1629.952320 136.159.5.17 -> 192.168.1.9 40 TCP 80 1035 3310607973 : 3310607973 133606 win: 24820 A
1629.955295 136.159.5.17 -> 192.168.1.9 329 TCP 80 1035 3310607973 : 3310608262 133606 win: 24820 PA
1629.959145 136.159.5.17 -> 192.168.1.9 1500 TCP 80 1035 3310608262 : 3310609722 133606 win: 24820 A
1629.960963 136.159.5.17 -> 192.168.1.9 1500 TCP 80 1035 3310609722 : 3310611182 133606 win: 24820 PA
1629.962090 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310609722 win: 31019 A
1629.970264 136.159.5.17 -> 192.168.1.9 1500 TCP 80 1035 3310611182 : 3310612642 133606 win: 24820 A
1629.972489 136.159.5.17 -> 192.168.1.9 1500 TCP 80 1035 3310612642 : 3310614102 133606 win: 24820 A
1629.972713 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310612642 win: 28099 A
1629.973373 136.159.5.17 -> 192.168.1.9 429 TCP 80 1035 3310614102 : 3310614491 133606 win: 24820 FA
1629.974735 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310614492 win: 26250 A
1630.072101 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310614492 win: 26250 A
1630.136767 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310614492 win: 31370 A
1630.141369 192.168.1.9 -> 136.159.5.17 40 TCP 1035 80 133606 : 133606 3310614492 win: 0 F
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Exercise 4 :

In TCP reno, the Fast-recovery protocol is used.This algorithm works as follows. When 3 dupACKs are received, the algorithm sets the sstresh value to half of the congestion window. Then the lost segment is retransmitted and the congestion window is equal to sstresh + 3 MSS because of 3 ACKs received (window swelling). For each unduplicated ACK the congestion window increases by 1. When an unduplicated ACK arrives then the congestion window is equal to sstresh and we go back to congestion avoidance. Consider the figure below, which illustrates the evolution of the size of the congestion window. Briefly describe the following events:

- what happens in A and B?

At A we use the slow start algorithm, and you see that it’s increasing exponentially. At B a congestion problem occurs

- What happens in B is it useful to drop packets? why?

At B level, the sstresh est decrased to half of cwnd

- what happens at C and D?

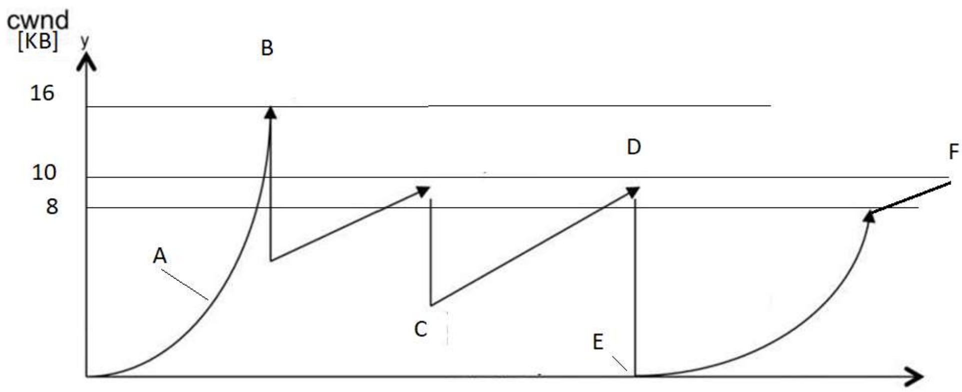
AT C level the FAST recovery is applied due to 3dupACK, we apply the congestion avidance to retransmit the packet one by one until D.

- When singing what happens in D, is it useful to delete the packets?

AT D level a congestion occurs because of Timeout. So we apply the definition : decrease the ssthresh to half of cwnid and start the slow start algorithm until the ssthresh and transmit the packet one by one until a congestion occurs

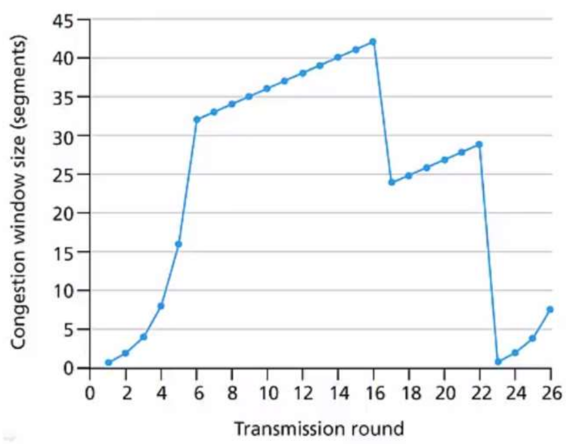
-How many times does the algorithm go through Slow-start and at what level of the figure ?

Two time AT A and E levels



Exercise 5 :

Consider the figure below which dipslays the congestion windows size at each transmission round.



1- Identify the intervals when TCP slow- start is operating

   TCP slow start operates when its starts exponentially : rounds [1-6] and rounds 23 through 26

2- What is the value of *sstresh* at the first transmission round ?

   The sstresh equal 32

3- During what transmission round is the 7th segment sent ?

   Packet 1 is sent int 1st round, packet 2-3 in the 2sd round, packet 4-7 sent int the 3rd round

4- Suppose Tahoe Algorithm is used, Assume 3 duplicate ACK are received at the 12th round, At the 14th round, what is sstresh value ? what is congestion windows size ?

   In the 12th sstresh = 19, cwind = 1 at the 14th 4