# HOMEWORK 3

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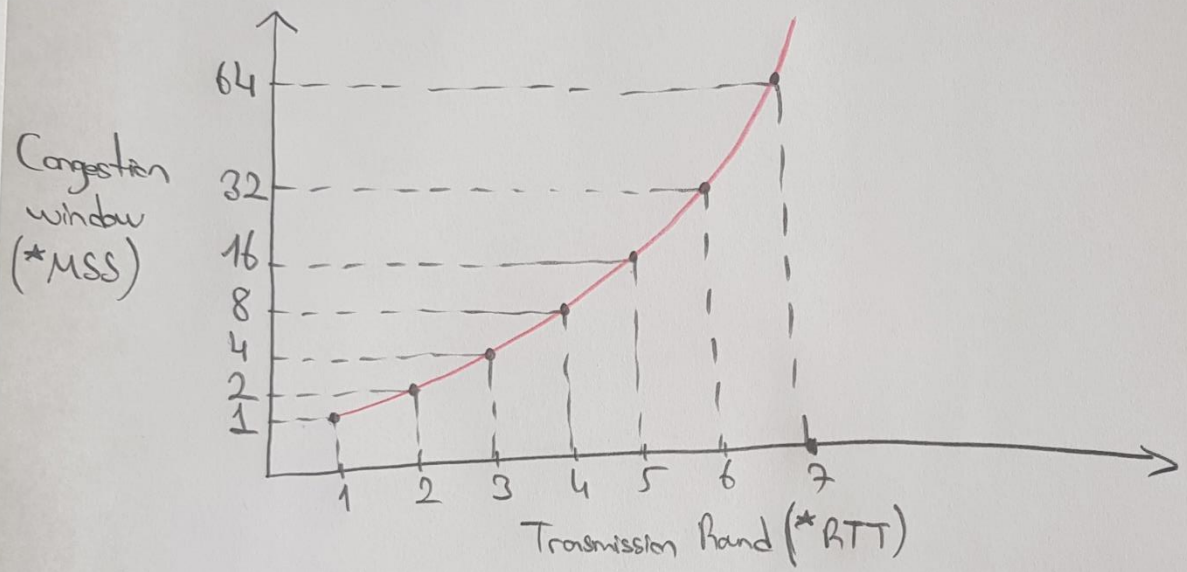
1- Propagation delay = 1 sec
Image file size = 50000 bytes = 100 MSS
MSS = 500 bytes
SSthresh = 64000 bytes = 128 MSS = 64000/500 (Slow Start threshhold)
RcvBuffer = 64000 bytes = 128 MSS (Receiver Buffer Size)

TCP connection establishment delay = 1 sec + 1 sec = 2 sec




| RTT # | Amount of Sending MSS |
|---|---|
| 1 | 1 |
| 2 | 2 |
| 3 | 4 |
| 4 | 8 |
| 5 | 16 |
| 6 | 32 |
| 7 | + 64 |

127 MSS (Total amount of possible MSS)

Image file size = 100 MSS

127 MSS > 100 MSS, image file can send with 7 RTT. Thus, amount of time required:

= 2 sec (TCP connection establishment delay) + 2x7 sec (image transfer delay) = 16 sec

2- Datagram's IP field value = 12345
Length's field value = 1200
fragflag = 0
offset = 0
$M_1$ = 1500 bytes (First Link MTU)
$M_2$ = 500 bytes (Second Link MTU)

1200 = 20 bytes (IP Header) + 1180 bytes (IP Payload)

Values of the length, ID, fragflag and offset fields in the IP datagram(s) forwarded to the first link:

1500 - 20 = 1480 bytes

1480/8 = 185

| | Length | ID | fragflag | offset |
|---|---|---|---|---|
| 1st fragment | 1200 (1180) | 12345 | 0 | 0 |

Since 1480 > 1180, there is no need for fragmentation.

Values of the length, ID, fragflag and offset fields in the IP datagram(s) forwarded to the second link:

500 - 20 = 480 bytes

480/8 = 60

| | Length | ID | fragflag | offset |
|---|---|---|---|---|
| 1st fragment of 1st fragment | 500 (480) | 12345 | 1 | 0 |
| 2nd fragment of 1st fragment | 500 (480) | 12345 | 1 | 60 |
| 3rd fragment of 1st fragment | 240 (220) | 12345 | 0 | 120 |

3-a) Intervals of time when TCP slow start is operation are [1,4] and [13,20]
Additive increase occurs in these intervals and these start with 1 MSS.

b) Intervals of time when TCP congestion avoidance is operating are [4,14], [15,18]
Linear increase occurs in those intervals.

c) • After 14th transmission round, packet loss is recognized by a triple duplicate ACK.
If there was a timeout, congestion window size would have dropped to 1.
• After 18th transmission round, segment loss is detected due to timeout, and
hence the congestion window size is set to 1.

d) Slow start threshold at the 4th transmission round is 8. After that point, congestion avoidance phase starts.

e) Slow start threshold at the 11th transmission round is 8. Before that point, congestion avoidance phase starts when window size is 8 that is threshold value.

f) Slow start threshold at the 17th transmission round is 9.
The threshold is set to half of the congestion window when packet loss is detected. When loss is detected during transmission round 14, the congestion window size is 18. Hence the threshold is 9 during the 17th transmission round.

g) In the 21st round, slow start phase is operating because MSS starts with 1 in the 19th round and no loss occurs in the 20th round. Hence, window size in the 21st round is 4 having additive increase in slow start phase.