

(1) Print the first 10 congestion window sizes

Size of the initial congestion window = 1448

The data below is estimated by RTT, and it can be seen from the data that TCP uses Additive Increase Multiplicative Decrease. cwnd increases by 1/cwnd each time until $cwnd \geq \text{slow start threshold ssthresh}$, then cwnd only increases by 1/cwnd each time. When loss or timeout occurs, $cwnd = cwnd * 2/3$, slow start threshold $ssthresh = cwnd * 2/3$.

Flow: 1 | Source Port: 43498 | Destination Port: 80

1 Congestion window sizes: 11584
2 Congestion window sizes: 14480
3 Congestion window sizes: 21720
4 Congestion window sizes: 50680
5 Congestion window sizes: 47784
6 Congestion window sizes: 83984
7 Congestion window sizes: 136112
8 Congestion window sizes: 191136
9 Congestion window sizes: 273672
10 Congestion window sizes: 160728

Flow: 2 | Source Port: 43500 | Destination Port: 80

1 Congestion window sizes: 11584
2 Congestion window sizes: 15928
3 Congestion window sizes: 21720
4 Congestion window sizes: 44888
5 Congestion window sizes: 46336
6 Congestion window sizes: 98464
7 Congestion window sizes: 143352
8 Congestion window sizes: 183896
9 Congestion window sizes: 296840
10 Congestion window sizes: 395304

Flow: 3 | Source Port: 43502 | Destination Port: 80

1 Congestion window sizes: 11584
2 Congestion window sizes: 26064
3 Congestion window sizes: 23168
4 Congestion window sizes: 34752
5 Congestion window sizes: 50680
6 Congestion window sizes: 81088
7 Congestion window sizes: 125976
8 Congestion window sizes: 191136
9 Congestion window sizes: 254848
10 Congestion window sizes: 218648

(2) Compute the number of times a retransmission occurred due to triple duplicate ack and the number of time a retransmission occurred due to timeout

When the Source Port, Destination Port, Sequence number, and Ack number of the two packets are the same, retransmission occurs. When the number of retransmissions is greater than 2, it is recorded as triple duplicate ack. Otherwise recorded is timeout.

Source Port: 43498 -> Destination Port: 80

Number of retransmission: Due to triple duplicate ack: { 0 }. Due to timeout: { 1 }.

Source Port: 43500 -> Destination Port: 80

Number of retransmission: Due to triple duplicate ack: { 0 }. Due to timeout: { 1 }.

Source Port: 43502 -> Destination Port: 80

Number of retransmission: Due to triple duplicate ack: { 0 }. Due to timeout: { 1 }.

Source Port: 80 -> Destination Port: 43498

Number of retransmission: Due to triple duplicate ack: { 680 }. Due to timeout: { 3 }.

Source Port: 80 -> Destination Port: 43500

Number of retransmission: Due to triple duplicate ack: { 1569 }. Due to timeout: { 80 }.

Source Port: 80 -> Destination Port: 43502

Number of retransmission: Due to triple duplicate ack: { 0 }. Due to timeout: { 0 }.