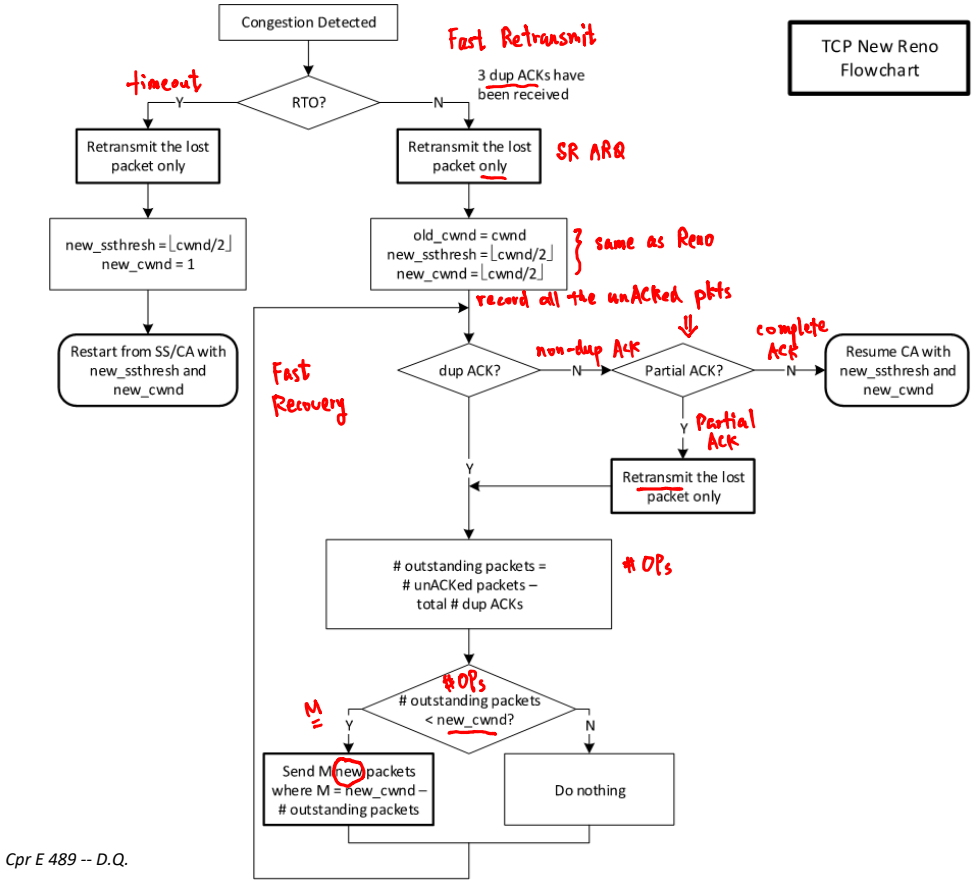
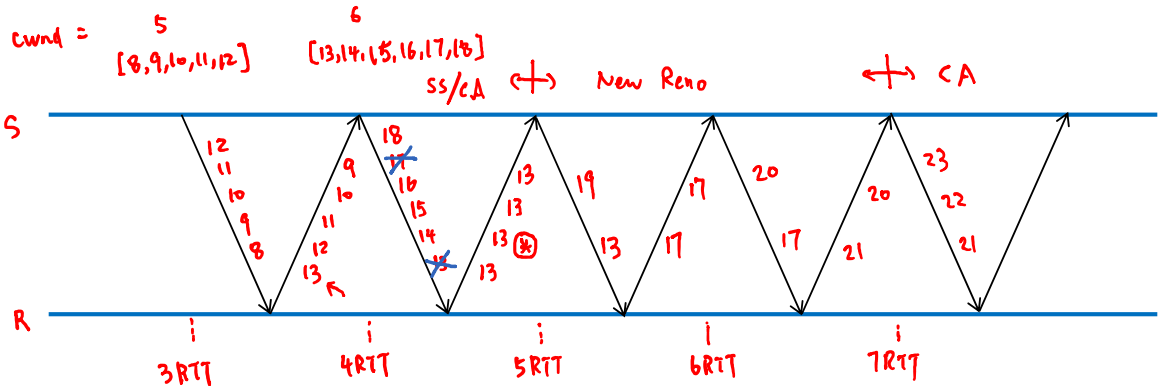




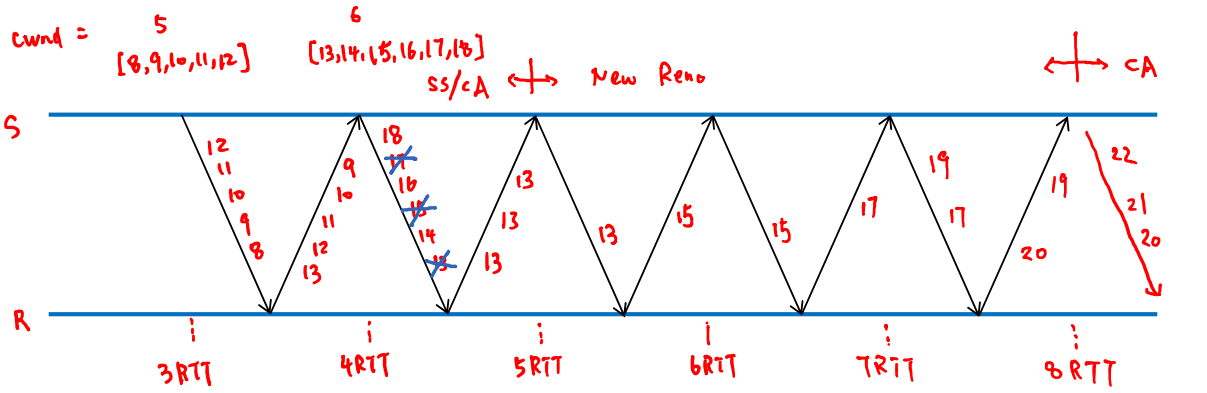
At 5RTT: 3rd dup A13: C.D.
retransmit 13
new_ssthresh = new_cwnd = 3
all unACKed pkts: [13,14,15,16,17,18]
#OPs = 6 - 3 = 3 = new_cwnd
4th dup A13:
#OPs = 6 - 4 = 2 < 3
⇒ M = 1 : xmit 19

At 6RTT:
A17: partial ACK
retransmit 17
#OPs = 3 - 0 = 3

1st dup A17:
#OPs = 3 - 1 = 2 < 3
⇒ M = 1 : xmit 20

At 7RTT:
A20: complete ACK, cwnd = $3\frac{1}{3}$
xmit 21, 22 [20,21,22]
A21: cwnd = $3\frac{2}{3}$: [21,22,23] : xmit 23

Time	Packet Received	Action Taken	List of unACKs packets	Total # dup ACKs	Estimated # outstanding packets	ssthresh value	cwnd size	cwnd range	# **new** packets to send
4 RTT	A9		9,10,11,12			4	5+1/5	9,10,11,12,13	1: ~~#13~~
	A10		10,11,12,13			4	5+2/5	10,11,12,13,14	1: #14
	A11		11,12,13,14			4	5+3/5	11,12,13,14,15	1: #15
	A12		12,13,14,15			4	5+4/5	12,13,14,15,16	1: #16
	A13		13,14,15,16			4	6	13,14,15,16,17,18	2: ~~#17~~, #18
5 RTT	1st dup A13								
	2nd A13								
	3rd A13	C.D. rexmit 13	13,14,15,16,17,18	3	6-3 = 3	3	3	13,14,15	0
	4th A13		13,14,15,16,17,18	4	6-4 = 2	3	3	13,14,15	1: 19
6 RTT	A17	partial Ack. rexmit 17	17,18,19	0	3-0 = 3	3	3	17,18,19	0
	1st dup A17		17,18,19	1	3-1 = 2	3	3	17,18,19	1: 20
7 RTT	A20	Exit F.R.	20			3	3 1/3	20,21,22	2: 21,22
	A21		21,22			3	3 2/3	21,22,23	1: 23



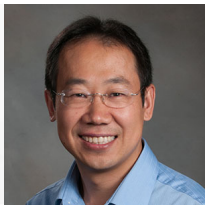
At 5RTT:
3rd dup A13
rexmit 13
new_ssthresh = new_cwnd = 3
unAcked pkts: [13, ..., 18]
#ops = 6-3 = 3

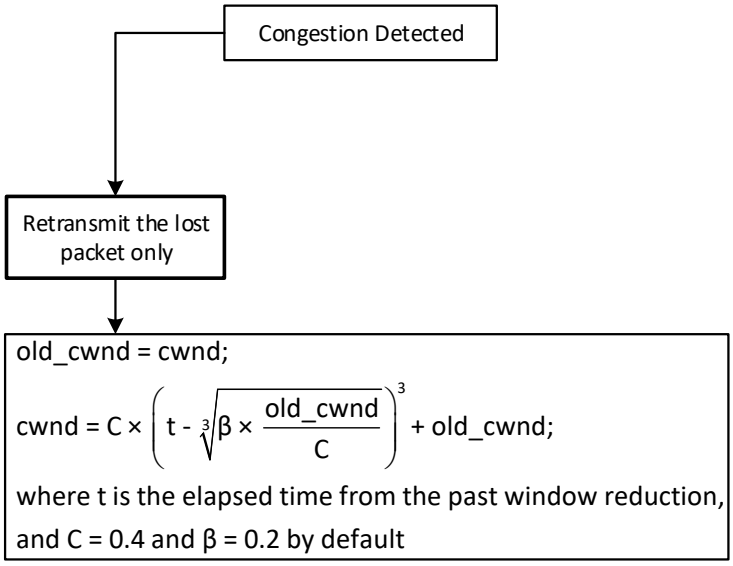
At 6RTT:
A15: partial ACK
Rexmit 15
#ops = 4-0 = 4

At 7RTT
A17: partial Ack
Rexmit 17
#ops = 2-0 = 2 < 3
M=1: xmit 19

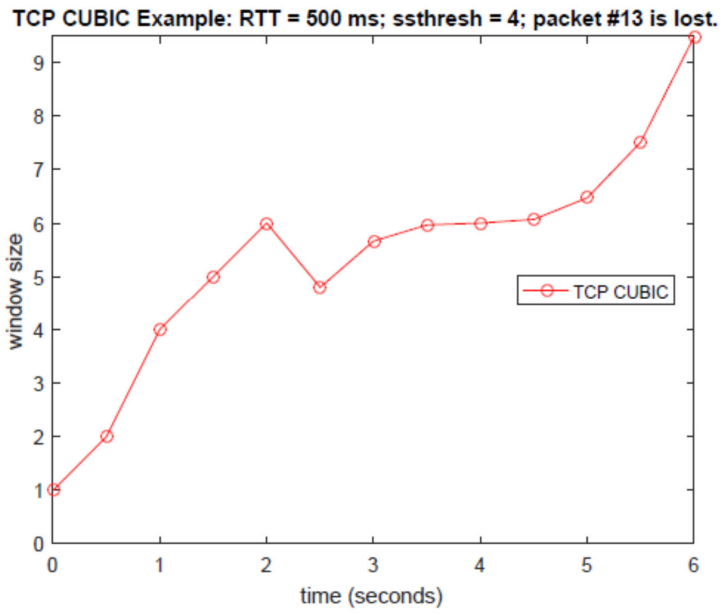
At 8RTT:
A19: complete Ack
cwnd = $3\frac{1}{3}$
[19, 20, 21]
xmit 20, 21
A20: cwnd = $3\frac{2}{3}$
[20, 21, 22]
xmit 22

TCP CUBIC



TCP CUBIC Example



TCP CUBIC Simulation Results

- TCP CUBIC window curves with competing flows
- NS simulation in network with 500 Mbps and 100 ms RTT
- C = 0.4, β = 0.2