

## Output Trace (SR with Cumulative ACK)

### Case 1: no loss no corruption

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000

Enter packet loss probability (0.0 for no loss): [0.0] 0.0

Enter packet corruption probability (0.0 for no corruption): [0.0] 0.0

Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200

Enter window size (> 0): [8] 8

Enter retransmission timeout (>0.0) [15.0] 30

Enter trace level (>= 0): [0] 3

Enter random seed: [0] 1234

generateNextArrival(): called

generateNextArrival(): time is 0.0

generateNextArrival(): future time for event 1 at entity 0 will be 43.4339426862392

EVENT time: 43.4339426862392 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 43.4339426862392

generateNextArrival(): future time for event 1 at entity 0 will be 67.36045411542099

toLayer3: seqnum: 0 acknum: -1 checksum: 1939 payload: aaaaaaaaaaaaaaaaaaaaaa

toLayer3: scheduling arrival on other side

startTimer: starting timer at 43.4339426862392

EVENT time: 45.66060365611743 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 1 checksum: 1 payload:

toLayer3: scheduling arrival on other side

EVENT time: 47.569475386822106 type: 2 entity: 0

stopTimer: stopping timer at 47.569475386822106

EVENT time: 67.36045411542099 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 67.36045411542099

generateNextArrival(): future time for event 1 at entity 0 will be 83.31553086947233

toLayer3: seqnum: 1 acknum: -1 checksum: 1960 payload: bbbbbbbbbbbbbbbbbbbbbb

toLayer3: scheduling arrival on other side

startTimer: starting timer at 67.36045411542099

EVENT time: 68.78865932187871 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 2 checksum: 2 payload:

toLayer3: scheduling arrival on other side

EVENT time: 70.75603503524887 type: 2 entity: 0

stopTimer: stopping timer at 70.75603503524887

EVENT time: 83.31553086947233 type: 1 entity: 0  
generateNextArrival(): called  
generateNextArrival(): time is 83.31553086947233  
generateNextArrival(): future time for event 1 at entity 0 will be 238.65474410229803  
toLayer3: seqnum: 2 acknum: -1 checksum: 1981 payload: ccccccccccccccccccc  
toLayer3: scheduling arrival on other side  
startTimer: starting timer at 83.31553086947233

EVENT time: 87.99688711203343 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 3 checksum: 3 payload:  
toLayer3: scheduling arrival on other side

EVENT time: 91.66637165440838 type: 2 entity: 0  
stopTimer: stopping timer at 91.66637165440838

EVENT time: 238.65474410229803 type: 1 entity: 0  
generateNextArrival(): called  
generateNextArrival(): time is 238.65474410229803  
generateNextArrival(): future time for event 1 at entity 0 will be 529.581591235084  
toLayer3: seqnum: 3 acknum: -1 checksum: 2002 payload: ddddddddddddddddddd  
toLayer3: scheduling arrival on other side  
startTimer: starting timer at 238.65474410229803

EVENT time: 241.6328928495132 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 4 checksum: 4 payload:  
toLayer3: scheduling arrival on other side

EVENT time: 249.96951200903345 type: 2 entity: 0  
stopTimer: stopping timer at 249.96951200903345

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=====STATISTICS=====

Number of original packets transmitted by A:1000  
Number of retransmissions by A:0  
Number of data packets delivered to layer 5 at B:1000  
Number of ACK packets sent by B:1000  
Number of corrupted packets:0  
Ratio of lost packets:0.0  
Ratio of corrupted packets:0.0  
Average RTT:10.76163435773795  
Average communication time:10.76163435773795

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## Case 2: ack lost, a later accumulative ack moves the sender window by more than 1

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000

Enter packet loss probability (0.0 for no loss): [0.0] 0.3

Enter packet corruption probability (0.0 for no corruption): [0.0] 0.0

Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200

Enter window size (> 0): [8] 8

Enter retransmission timeout (>0.0) [15.0] 30

Enter trace level (>= 0): [0] 3

Enter random seed: [0] 1234

generateNextArrival(): called

generateNextArrival(): time is 0.0

generateNextArrival(): future time for event 1 at entity 0 will be 43.4339426862392

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EVENT time: 1627.3689992980742 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 1627.3689992980742

generateNextArrival(): future time for event 1 at entity 0 will be 1801.1291848506119

toLayer3: seqnum: 8 acknum: -1 checksum: 2107 payload: iiiiiiiiiiiiiiiiii

toLayer3: scheduling arrival on other side

startTimer: starting timer at 1627.3689992980742

EVENT time: 1631.3911557359538 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 9 checksum: 9 payload:

toLayer3: scheduling arrival on other side

Next expected Packet is one with  
sequence number 9

EVENT time: 1639.8258308664203 type: 2 entity: 0

stopTimer: stopping timer at 1639.8258308664203

EVENT time: 1801.1291848506119 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 1801.1291848506119

generateNextArrival(): future time for event 1 at entity 0 will be 1866.9148838770714

toLayer3: seqnum: 9 acknum: -1 checksum: 2128 payload: jjjjjjjjjjjjjjjjjjjj

toLayer3: packet being lost

startTimer: starting timer at 1801.1291848506119

EVENT time: 1831.1291848506119 type: 0 entity: 0

toLayer3: seqnum: 9 acknum: -1 checksum: 2128 payload: jjjjjjjjjjjjjjjjjjjj

toLayer3: packet being lost

stopTimer: stopping timer at 1831.1291848506119

stopTimer: Warning: Unable to cancel your timer

startTimer: starting timer at 1831.1291848506119

EVENT time: 1861.1291848506119 type: 0 entity: 0

toLayer3: seqnum: 9 acknum: -1 checksum: 2128 payload: jjjjjjjjjjjjjjjjjjjj

toLayer3: scheduling arrival on other side

stopTimer: stopping timer at 1861.1291848506119

stopTimer: Warning: Unable to cancel your timer

startTimer: starting timer at 1861.1291848506119

EVENT time: 1866.9148838770714 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 1866.9148838770714

generateNextArrival(): future time for event 1 at entity 0 will be 2218.2317575609604

toLayer3: seqnum: 10 acknum: -1 checksum: 2149 payload: kkkkkkkkkkkkkkkkkkkk

toLayer3: scheduling arrival on other side

startTimer: starting timer at 1866.9148838770714

startTimer: Warning: Attempting to start a timer that is already running

EVENT time: 1868.514908291879 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 10 checksum: 10 payload:

toLayer3: packet being lost

Receiver received Packet with sequence number 9 and sent ACK Packet which told sender the next expected Packet is one with sequence number 10. But this packet is lost

EVENT time: 1875.67210913419 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 11 checksum: 11 payload:

toLayer3: scheduling arrival on other side

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=====STATISTICS=====

Number of original packets transmitted by A:1000

Number of retransmissions by A:954

Number of data packets delivered to layer 5 at B:1000

Number of ACK packets sent by B:1354

Number of corrupted packets:0

Ratio of lost packets:0.2883917775090689

Ratio of corrupted packets:0.0

Average RTT:16.469906417455793

Average communication time:43.76293848558422

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ack corrupted, a later accumulative ack moves the sender window by more than 1

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000

Enter packet loss probability (0.0 for no loss): [0.0] 0.0

Enter packet corruption probability (0.0 for no corruption): [0.0] 0.3

Receiver received Packet with sequence number 10 and sent ACK Packet which told sender the next expected Packet is one with sequence number 11. So when the sender accept this ACK packet will move window forward by 2

Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200

Enter window size (> 0): [8] 8

Enter retransmission timeout (>0.0) [15.0] 30

Enter trace level (>= 0): [0] 3

Enter random seed: [0] 1234

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EVENT time: 8191.9804071169165 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 10 checksum: 10 payload:

toLayer3: scheduling arrival on other side

Next expected Packet is one with  
sequence number 10

EVENT time: 8197.87002166814 type: 2 entity: 0

stopTimer: stopping timer at 8197.87002166814

EVENT time: 8342.442091128269 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 8342.442091128269

generateNextArrival(): future time for event 1 at entity 0 will be 8360.093997009186

toLayer3: seqnum: 10 acknum: -1 checksum: 2269 payload: qqqqqqqqqqqqqqqqqqqqq

toLayer3: packet being corrupted

toLayer3: scheduling arrival on other side

startTimer: starting timer at 8342.442091128269

EVENT time: 8351.139622180852 type: 2 entity: 1

EVENT time: 8360.093997009186 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 8360.093997009186

generateNextArrival(): future time for event 1 at entity 0 will be 8524.21033356731

toLayer3: seqnum: 11 acknum: -1 checksum: 2290 payload: rrrrrrrrrrrrrrrrrrr

toLayer3: scheduling arrival on other side

startTimer: starting timer at 8360.093997009186

startTimer: Warning: Attempting to start a timer that is already running

EVENT time: 8368.97665334025 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 10 checksum: 10 payload:

toLayer3: packet being corrupted

toLayer3: scheduling arrival on other side

Receiver received Packet with sequence  
number 9 and sent ACK Packet which told  
sender the next expected Packet is one  
with sequence number 10. But this packet  
is corrupted

EVENT time: 8371.956999420148 type: 2 entity: 0

EVENT time: 8372.442091128269 type: 0 entity: 0

toLayer3: seqnum: 10 acknum: -1 checksum: 2269 payload: qqqqqqqqqqqqqqqqqqqqq

toLayer3: scheduling arrival on other side

stopTimer: stopping timer at 8372.442091128269

stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 8372.442091128269

EVENT time: 8378.243812372202 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 12 checksum: 12 payload:  
toLayer3: packet being corrupted  
toLayer3: scheduling arrival on other side

EVENT time: 8380.824243903926 type: 2 entity: 0

EVENT time: 8402.442091128269 type: 0 entity: 0  
toLayer3: seqnum: 10 acknum: -1 checksum: 2269 payload: qqqqqqqqqqqqqqqqqqqqq  
toLayer3: scheduling arrival on other side  
stopTimer: stopping timer at 8402.442091128269  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 8402.442091128269

EVENT time: 8405.838831751456 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 12 checksum: 12 payload:  
toLayer3: scheduling arrival on other side

Receiver received Packet with sequence number 11 and sent ACK Packet which told sender the next expected Packet is one with sequence number 12. So when the sender accept this ACK packet will move window forward by 2

EVENT time: 8412.359080782493 type: 2 entity: 0  
stopTimer: stopping timer at 8412.359080782493

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=====STATISTICS=====

Number of original packets transmitted by A:1000  
Number of retransmissions by A:975  
Number of data packets delivered to layer 5 at B:1000  
Number of ACK packets sent by B:1368  
Number of corrupted packets:1019  
Ratio of lost packets:-0.013161830690996112  
Ratio of corrupted packets:0.30085621493947445  
Average RTT:15.126216195774944  
Average communication time:42.68302154603352

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### Case 3: data packet corrupted, sender retransmit data after RTO

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000

Enter packet loss probability (0.0 for no loss): [0.0] 0.0

Enter packet corruption probability (0.0 for no corruption): [0.0] 0.3

Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200

Enter window size (> 0): [8] 8

Enter retransmission timeout (>0.0) [15.0] 30

Enter trace level (>= 0): [0] 3

Enter random seed: [0] 1234

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EVENT time: 58440.33326212347 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 58440.33326212347

generateNextArrival(): future time for event 1 at entity 0 will be 58546.18366039002

Sequence 13 first send time: 58440.33326212347

toLayer3: seqnum: 13 acknum: -1 checksum: 2252 payload: ppppppppppppppppppppppp

toLayer3: packet being corrupted

toLayer3: scheduling arrival on other side

startTimer: starting timer at 58440.33326212347

Packet with sequence number 13 is corrupted

EVENT time: 58445.877346110414 type: 2 entity: 1

B received packet

seqnum: 13 acknum: -1 checksum: 2252 payload: ?pppppppppppppppppppppp

Receiver received a corrupted packet and dropped it

EVENT time: 58470.33326212347 type: 0 entity: 0

A timeout, retransmit

toLayer3: seqnum: 13 acknum: -1 checksum: 2252 payload: ppppppppppppppppppppppp

toLayer3: scheduling arrival on other side

startTimer: starting timer at 58470.33326212347

Sender didn't receive ACK for Packet with sequence number 13, timeout resend it

EVENT time: 58474.00659199804 type: 2 entity: 1

B received packet

seqnum: 13 acknum: -1 checksum: 2252 payload: ppppppppppppppppppppppp

toLayer3: seqnum: 0 acknum: 14 checksum: 14 payload:

toLayer3: packet being corrupted

toLayer3: scheduling arrival on other side

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=====STATISTICS=====

Number of original packets transmitted by A:1000

Number of retransmissions by A:975

Number of data packets delivered to layer 5 at B:1000

Number of ACK packets sent by B:1368

Number of corrupted packets:1019

Ratio of lost packets:-0.013161830690996112

Ratio of corrupted packets:0.30085621493947445

Average RTT:15.126216195774944

Average communication time:42.68302154603352

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Case 4: ack lost, sender retransmitted after receiving duplicate ack

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000  
Enter packet loss probability (0.0 for no loss): [0.0] 0.3  
Enter packet corruption probability (0.0 for no corruption): [0.0] 0.0  
Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200  
Enter window size (> 0): [8] 8  
Enter retransmission timeout (>0.0) [15.0] 30  
Enter trace level (>= 0): [0] 3  
Enter random seed: [0] 1234  
.....

EVENT time: 11350.759056367686 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 13 checksum: 13 payload:  
toLayer3: packet being lost

Receiver sent a ACK Packet with  
sequence number 13, packet is lost

EVENT time: 11371.789605395672 type: 0 entity: 0  
toLayer3: seqnum: 12 acknum: -1 checksum: 2111 payload: iiii  
toLayer3: scheduling arrival on other side  
stopTimer: stopping timer at 11371.789605395672  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 11371.789605395672

EVENT time: 11377.732230597858 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 13 checksum: 13 payload:  
toLayer3: packet being lost

EVENT time: 11401.789605395672 type: 0 entity: 0  
toLayer3: seqnum: 12 acknum: -1 checksum: 2111 payload: iiii  
toLayer3: scheduling arrival on other side  
stopTimer: stopping timer at 11401.789605395672  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 11401.789605395672

EVENT time: 11408.814142277291 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 13 checksum: 13 payload:  
toLayer3: scheduling arrival on other side

Receiver received a Packet with sequence  
number 12 which is duplicate, receiver  
send a ACK packet for packet with  
sequence number 13. This is a duplicate  
ACK

EVENT time: 11410.338480788598 type: 2 entity: 0  
stopTimer: stopping timer at 11410.338480788598

EVENT time: 11524.05774101993 type: 1 entity: 0  
generateNextArrival(): called  
generateNextArrival(): time is 11524.05774101993  
generateNextArrival(): future time for event 1 at entity 0 will be 11846.516312143316  
toLayer3: seqnum: 14 acknum: -1 checksum: 2153 payload: kkkkkkkkkkkkkkkkkkk



toLayer3: packet being lost  
startTimer: starting timer at 11524.05774101993

EVENT time: 11554.05774101993 type: 0 entity: 0  
toLayer3: seqnum: 13 acknum: -1 checksum: 2132 payload: jjjjjjjjjjjjjjjjjjjj  
toLayer3: packet being lost  
stopTimer: stopping timer at 11554.05774101993  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 11554.05774101993

EVENT time: 11584.05774101993 type: 0 entity: 0  
toLayer3: seqnum: 13 acknum: -1 checksum: 2132 payload: jjjjjjjjjjjjjjjjjjjj  
toLayer3: packet being lost  
stopTimer: stopping timer at 11584.05774101993  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 11584.05774101993

Sender received duplicate ACK packet  
and retransmit

EVENT time: 11614.05774101993 type: 0 entity: 0  
toLayer3: seqnum: 13 acknum: -1 checksum: 2132 payload: jjjjjjjjjjjjjjjjjjjj  
toLayer3: scheduling arrival on other side  
stopTimer: stopping timer at 11614.05774101993  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 11614.05774101993

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=====STATISTICS=====

Number of original packets transmitted by A:1000  
Number of retransmissions by A:954  
Number of data packets delivered to layer 5 at B:1000  
Number of ACK packets sent by B:1354  
Number of corrupted packets:0  
Ratio of lost packets:0.2883917775090689  
Ratio of corrupted packets:0.0  
Average RTT:16.469906417455793  
Average communication time:43.76293848558422

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Case 5: data packet lost, a later delivered and cumulative ack moves the sender window by more than 1

-- \* Network Simulator v1.0 \* --

Enter number of messages to simulate (> 0): [10] 1000

Enter packet loss probability (0.0 for no loss): [0.0] 0.3

Enter packet corruption probability (0.0 for no corruption): [0.0] 0.0

Enter average time between messages from sender's layer 5 (> 0.0): [1000] 200

Enter window size (> 0): [8] 8

Enter retransmission timeout (>0.0) [15.0] 30

Enter trace level (>= 0): [0] 3

Enter random seed: [0] 1234

.....

EVENT time: 238.65474410229803 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 238.65474410229803

generateNextArrival(): future time for event 1 at entity 0 will be 529.581591235084

toLayer3: seqnum: 3 acknum: -1 checksum: 2002 payload: ddddddddddddddddddd

toLayer3: packet being lost

startTimer: starting timer at 238.65474410229803

data packet with sequence number 3 is  
lost

EVENT time: 268.654744102298 type: 0 entity: 0

toLayer3: seqnum: 2 acknum: -1 checksum: 1981 payload: ccccccccccccccccccc

toLayer3: packet being lost

stopTimer: stopping timer at 268.654744102298

stopTimer: Warning: Unable to cancel your timer

startTimer: starting timer at 268.654744102298

EVENT time: 298.654744102298 type: 0 entity: 0

toLayer3: seqnum: 2 acknum: -1 checksum: 1981 payload: ccccccccccccccccccc

toLayer3: scheduling arrival on other side

stopTimer: stopping timer at 298.654744102298

stopTimer: Warning: Unable to cancel your timer

startTimer: starting timer at 298.654744102298

EVENT time: 303.3361003448591 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 3 checksum: 3 payload:

toLayer3: scheduling arrival on other side

Receiver received a data packet with  
sequence number 2 which is duplicate,  
and send a ACK packet for packet with  
sequence number 3, this is a duplicate  
ACK

EVENT time: 307.0055848872341 type: 2 entity: 0

stopTimer: stopping timer at 307.0055848872341

EVENT time: 529.581591235084 type: 1 entity: 0

generateNextArrival(): called

generateNextArrival(): time is 529.581591235084

generateNextArrival(): future time for event 1 at entity 0 will be 924.1126743369853

toLayer3: seqnum: 4 acknum: -1 checksum: 2023 payload: eeeeeeeeeeeeeeeeeee

toLayer3: scheduling arrival on other side

startTimer: starting timer at 529.581591235084

EVENT time: 532.5597399822992 type: 2 entity: 1

toLayer3: seqnum: 0 acknum: 3 checksum: 3 payload:

toLayer3: scheduling arrival on other side

EVENT time: 540.8963591418195 type: 2 entity: 0  
stopTimer: stopping timer at 540.8963591418195  
toLayer3: seqnum: 3 acknum: -1 checksum: 2002 payload: ddddddddddddddddddd  
toLayer3: packet being lost  
startTimer: starting timer at 540.8963591418195

EVENT time: 570.8963591418195 type: 0 entity: 0  
toLayer3: seqnum: 3 acknum: -1 checksum: 2002 payload: ddddddddddddddddddd  
toLayer3: packet being lost  
stopTimer: stopping timer at 570.8963591418195  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 570.8963591418195

EVENT time: 600.8963591418195 type: 0 entity: 0  
toLayer3: seqnum: 3 acknum: -1 checksum: 2002 payload: ddddddddddddddddddd  
toLayer3: scheduling arrival on other side  
stopTimer: stopping timer at 600.8963591418195  
stopTimer: Warning: Unable to cancel your timer  
startTimer: starting timer at 600.8963591418195

EVENT time: 607.7091280861843 type: 2 entity: 1  
toLayer3: seqnum: 0 acknum: 5 checksum: 5 payload:  
toLayer3: scheduling arrival on other side

EVENT time: 610.2434156315805 type: 2 entity: 0  
stopTimer: stopping timer at 610.2434156315805

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=====STATISTICS=====

Number of original packets transmitted by A:1000  
Number of retransmissions by A:954  
Number of data packets delivered to layer 5 at B:1000  
Number of ACK packets sent by B:1354  
Number of corrupted packets:0  
Ratio of lost packets:0.2883917775090689  
Ratio of corrupted packets:0.0  
Average RTT:16.469906417455793  
Average communication time:43.76293848558422

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Receiver received a data packet with sequence number 4 but still request for packet with sequence number 3, and sender send a later packet with sequence number 3. And the receiver send a ACK for this packet and request for packet with sequence number 5, which will move sender's window by 2