

Exponential Weighed Moving Average Report

Experiments

Each picture is consisted of six graphes with different alphas: 0.5, 0.25, 0.125, 0.0625, 0.03125, and 0. Each graph is a round trip time (RTT) record for sending 50 packages. The y-axis is the time for each RTT and the x-axis is the timestamp for each sample RTT and estimated round trip time (EstRTT).

Here we consider two network environments. One has a loss rate of 0.1 and a corruption rate of 0.1. Another has a loss rate of 0.3 and a corruption rate of 0.3. In each environment, we consider three different sending intervals (i.e. s/pkt).

Observations

Relationship between EstRTT and Alpha

The EstRTT will change more rapidly under a larger alpha.

By comparing six graphs in each picture, we can see that the red line (EstRTT) becomes much smoother as the alpha changes large to a small value. It is reasonable because larger alpha will favor the current sample RTT and update the EstRTT much aggressively.

Relationship between Sending Interval and Average RTT

The average RTT will increase as traffic intensity becomes larger (i.e. the time interval between packages is smaller).

By comparing each picture in the same environment, we can observe that the Average RTT is significantly lower when the sending interval is larger. When sending interval is large enough, the Average RTT can reduce to $2E[1+9*rand(0,1)] = 11$.

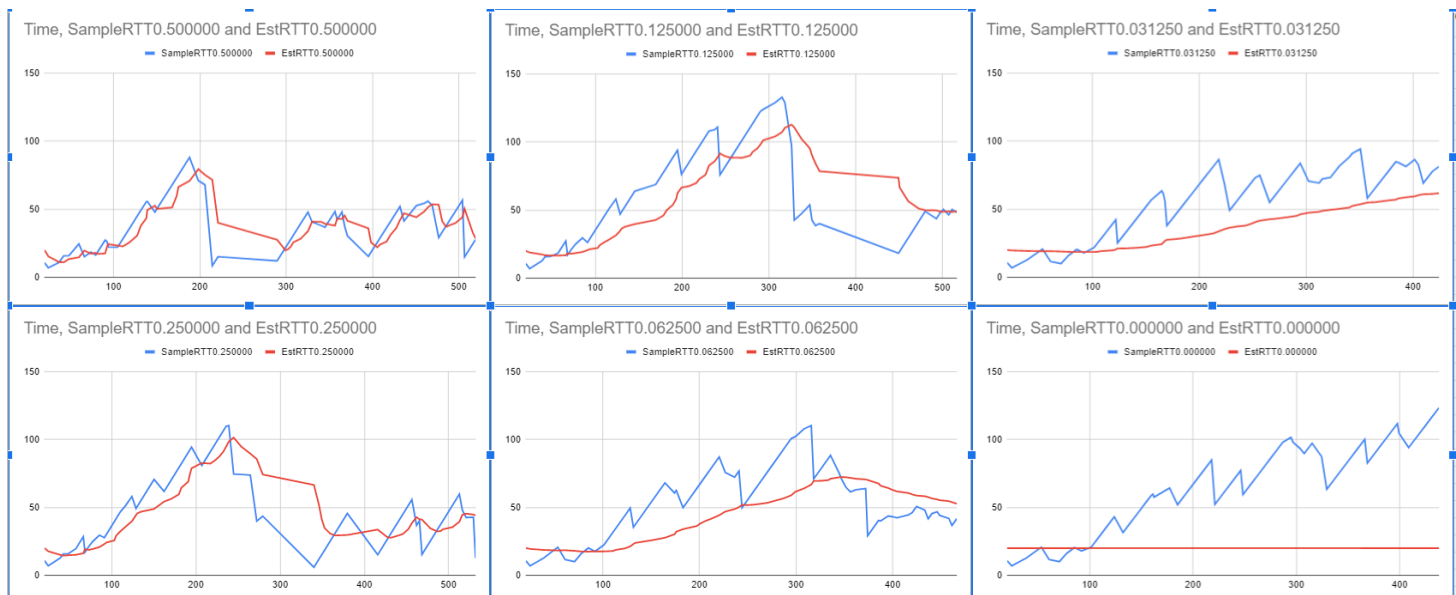
Relationship between the network environment and Average RTT

When the loss rate and corruption rate are bigger, the sender may need to reduce the sending speed to avoid overloading the network.

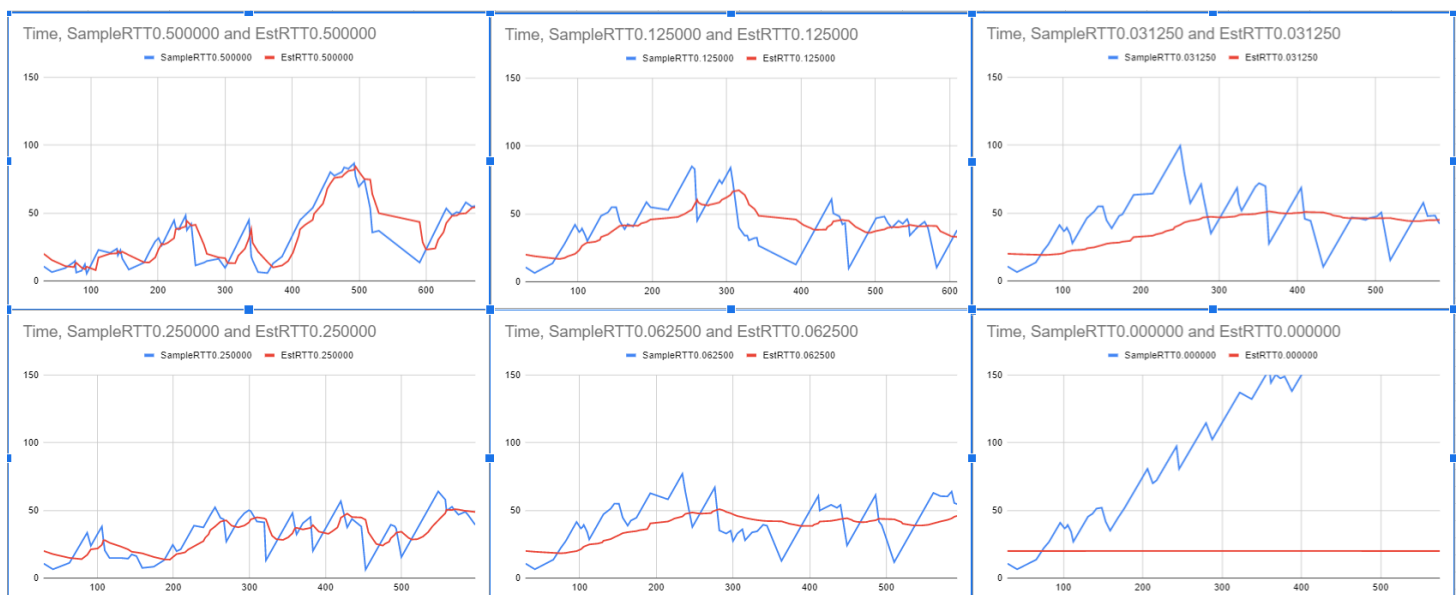
By comparing pictures with the same sending interval between two network environments under, it is clear that the EstRTT is much worse in a noisy environment. It is caused by constant package losses and interruptions. Therefore, the sender keeps sending the same package many more times. As a result, the network is congested by many duplicated packages. A remedy to this is to further reduce the sending interval.

0.1 Loss 0.1 Corruption

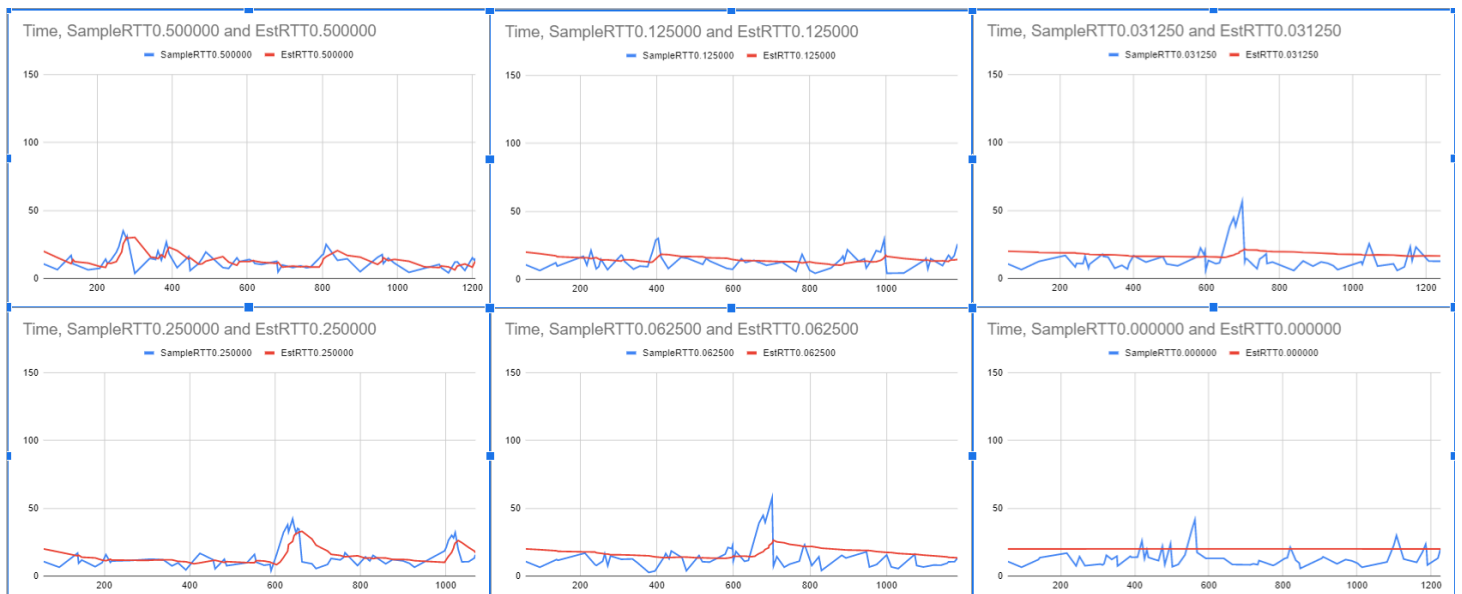
Traffic intensigy (5 s/pkt)



Traffic intensigy (10 s/pkt)

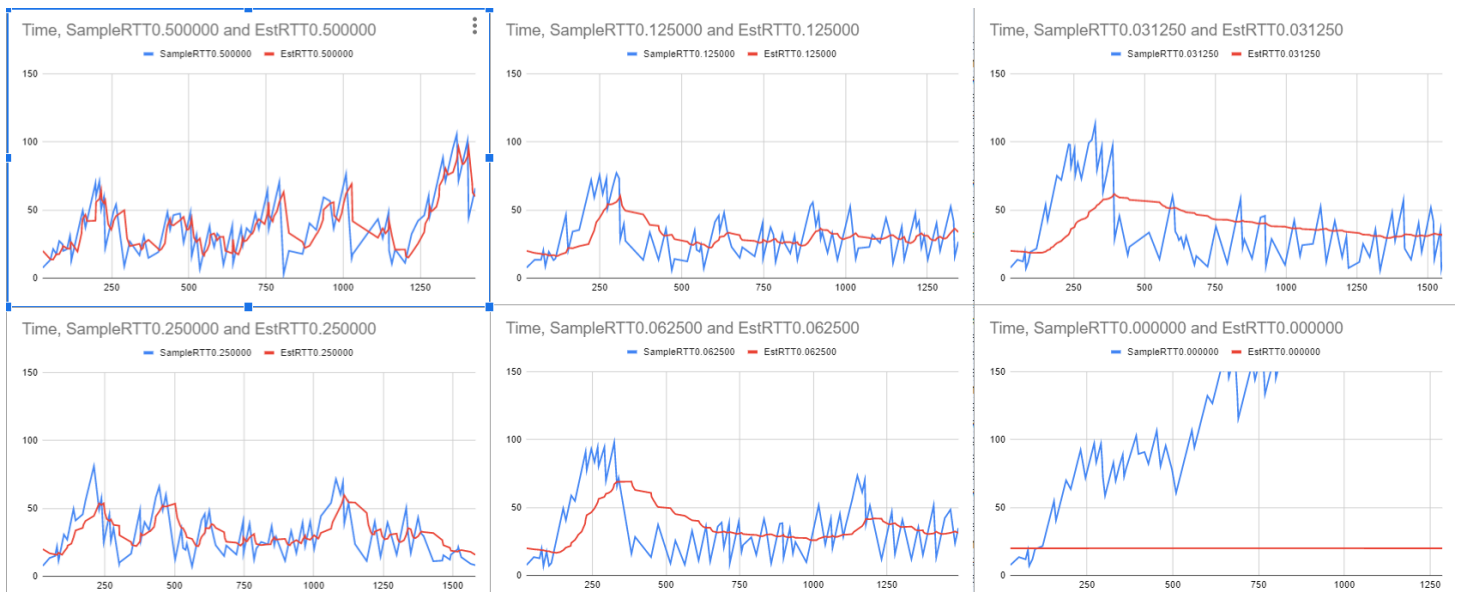


Traffic intensigy (25 s/pkt)

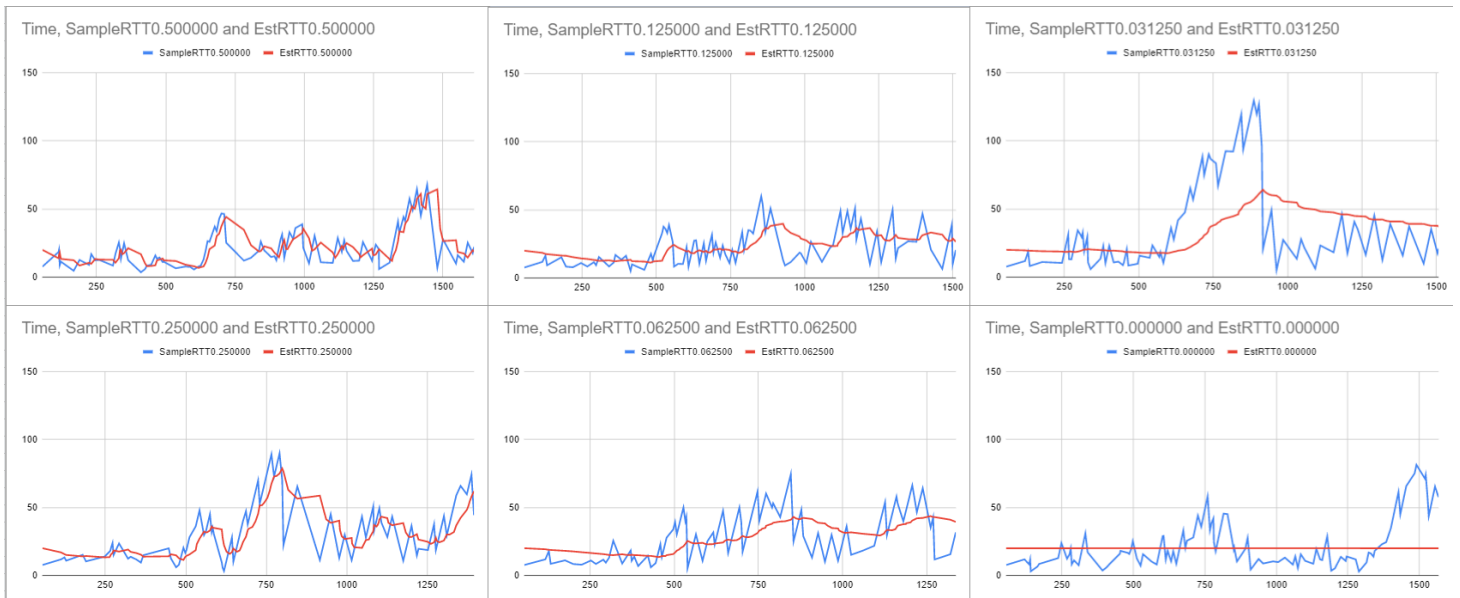


0.3 Loss 0.3 Corruption

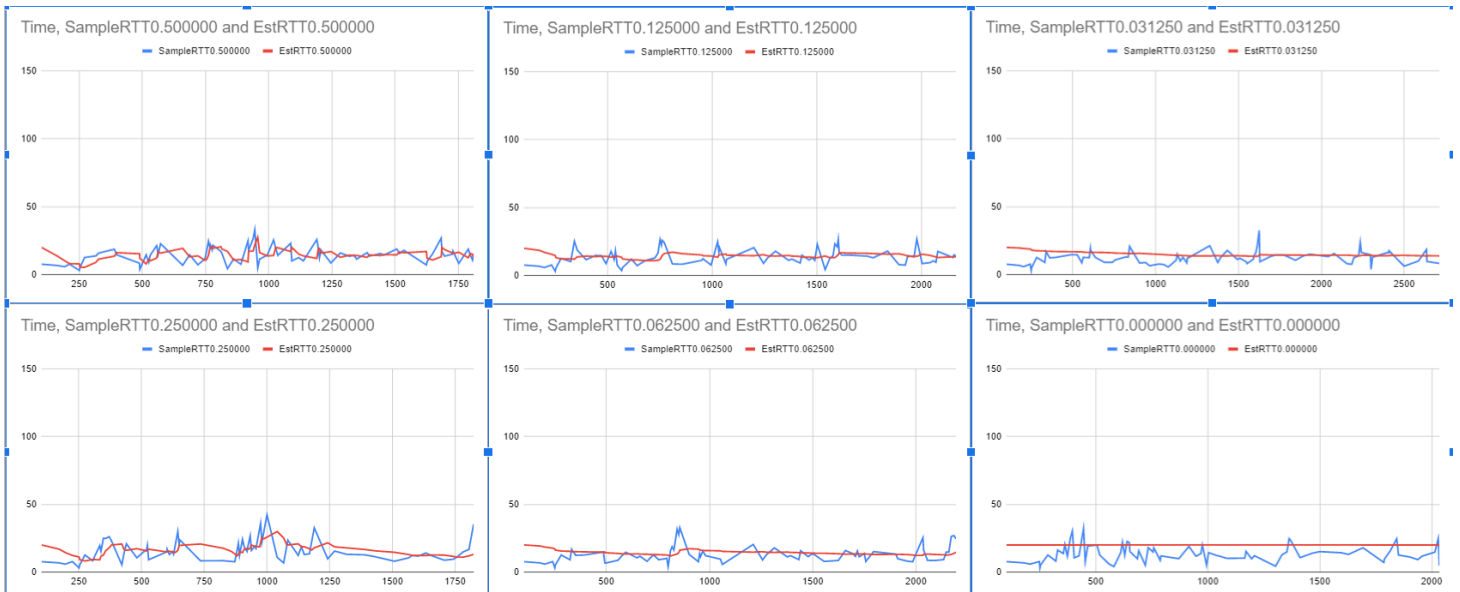
Traffic intensity (10 s/pkt)



Traffic intensity (25 s/pkt)



▷ Traffic intensigy (50 s/pkt)



————— Correct package

----- Stop and Wait Network Simulator Version 1.1 -----

————— Corrupted package

————— X Missed package

the number of messages to simulate: 20

packet loss probability: 0.100000

packet corruption probability: 0.100000

average time between messages from sender's layer5: 10.000000

TRACE: 2

EVENT time: 18.705740, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 0, ack 0

Start timer

EVENT time: 24.170835, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 0, ack 0

Checksum PASS

Accept pkt 0

SEND ack: seq 0, ack 0

EVENT time: 29.402449, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 0

Checksum PASS

Update base from 0 to 1

Stop timer

EVENT time: 35.124840, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 1, ack 0

Start timer

EVENT time: 37.145336, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 1, ack 0

Checksum PASS

Accept pkt 1

SEND ack: seq 0, ack 1

TOLAYER3: packet being corrupted

EVENT time: 41.612602, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 1

Checksum not PASS

EVENT time: 52.094032, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 2, ack 0

EVENT time: 53.157188, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 3, ack 0

EVENT time: 61.522457, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 2, ack 0

Checksum PASS

Correct package
Corrupted package
Missed package

Accept pkt 2
SEND ack: seq 0, ack 2

EVENT time: 64.252701, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 2

Checksum PASS

Update base from 1 to 3

Stop timer

Start timer

EVENT time: 64.931442, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 4, ack 0

EVENT time: 65.725098, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 3, ack 0

Checksum PASS

Accept pkt 3

SEND ack: seq 0, ack 3

TOLAYER3: packet being lost

EVENT time: 69.138000, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 4, ack 0

Checksum PASS

Accept pkt 4

SEND ack: seq 0, ack 4

TOLAYER3: packet being lost

EVENT time: 71.739449, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 5, ack 0

EVENT time: 75.898033, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 5, ack 0

Checksum PASS

Accept pkt 5

SEND ack: seq 0, ack 5

TOLAYER3: packet being lost

EVENT time: 91.376518, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 6, ack 0

EVENT time: 94.007172, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 6, ack 0

Checksum PASS

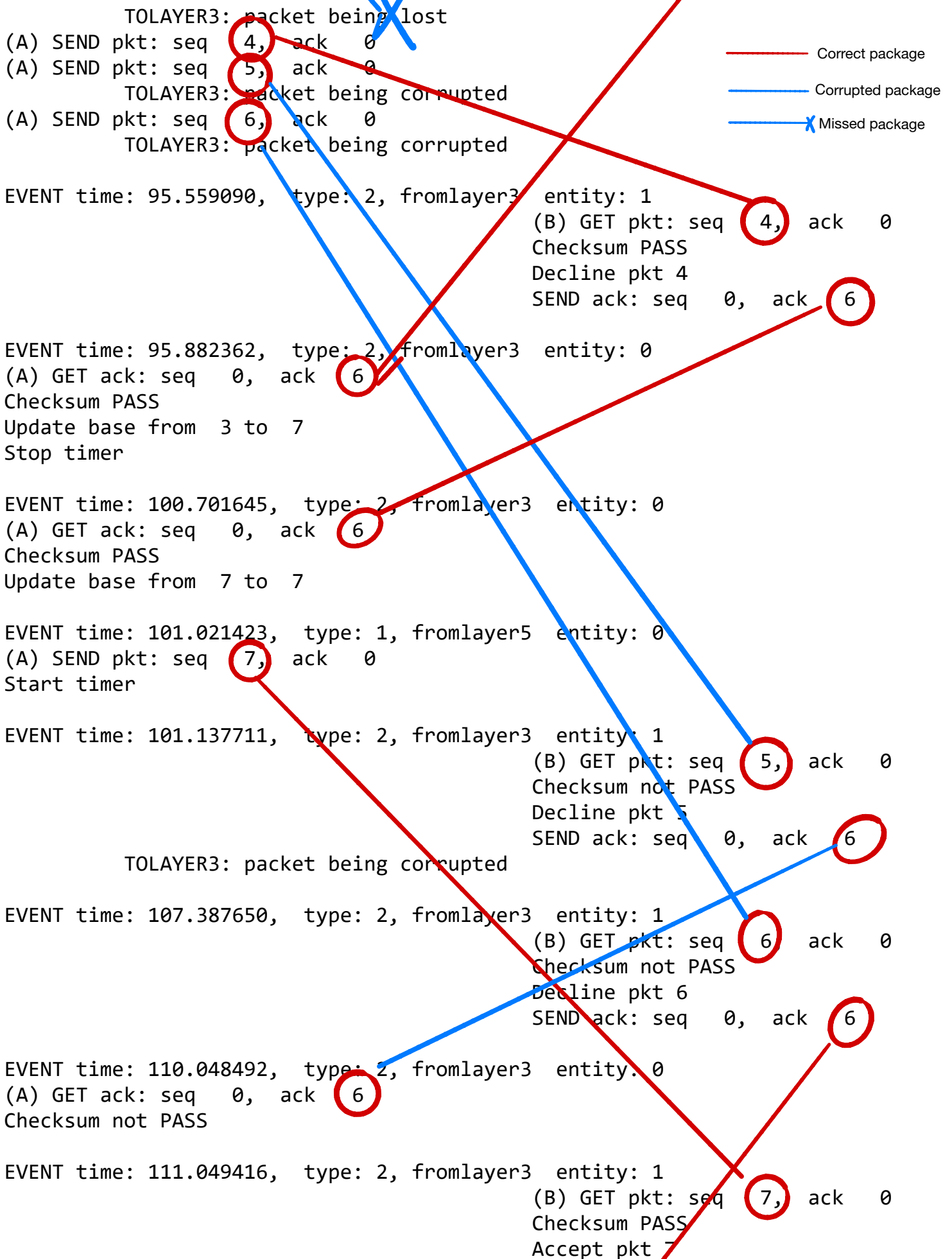
Accept pkt 6

SEND ack: seq 0, ack 6

EVENT time: 94.252701, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 3, ack 0



SEND ack: seq 0, ack 7

EVENT time: 112.837830, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 8, ack 0

TOLAYER3: packet being lost

EVENT time: 115.666161, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 6

Checksum PASS

Update base from 7 to 7

EVENT time: 117.053978, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 9, ack 0

EVENT time: 117.644531, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 7

Checksum PASS

Update base from 7 to 8

Stop timer

Start timer

EVENT time: 119.166702, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 9, ack 0

Checksum PASS

Decline pkt 9

SEND ack: seq 0, ack 7

EVENT time: 119.476890, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 10, ack 0

EVENT time: 121.959206, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 10, ack 0

Checksum PASS

Decline pkt 10

SEND ack: seq 0, ack 7

EVENT time: 125.858047, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 7

Checksum PASS

Update base from 8 to 8

EVENT time: 127.819176, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 11, ack 0

TOLAYER3: packet being lost

EVENT time: 131.244904, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 7

Checksum PASS

Update base from 8 to 8

— Correct package
— Corrupted package
X Missed package

EVENT time: 143.067922, type: 1, fromlayer5 entity: 0
(A) SEND pkt: seq 12 ack 0
TOLAYER3: packet being lost

Correct package
Corrupted package
Missed package

EVENT time: 147.644531, type: 0, timerinterrupt entity: 0
Start timer

(A) SEND pkt: seq 8, ack 0
(A) SEND pkt: seq 9, ack 0
(A) SEND pkt: seq 10, ack 0
(A) SEND pkt: seq 11, ack 0
(A) SEND pkt: seq 12, ack 0

EVENT time: 155.602386, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 8, ack 0
Checksum PASS
Accept pkt 8
SEND ack: seq 0, ack 8

EVENT time: 159.401672, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack 8
Checksum PASS
Update base from 8 to 9
Stop timer
Start timer

EVENT time: 159.994843, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 9, ack 0
Checksum PASS
Accept pkt 9
SEND ack: seq 0, ack 9

EVENT time: 160.234818, type: 1, fromlayer5 entity: 0
(A) SEND pkt: seq 13, ack 0
TOLAYER3: packet being lost

EVENT time: 165.659866, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 10, ack 0
Checksum PASS
Accept pkt 10
SEND ack: seq 0, ack 10

TOLAYER3: packet being lost

EVENT time: 169.026566, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack 9
Checksum PASS
Update base from 9 to 10
Stop timer
Start timer

EVENT time: 172.356720, type: 2, fromlayer3 entity: 1

Correct package

Corrupted package

Missed package

(B) GET pkt: seq 11, ack 0
Checksum PASS
Accept pkt 11
SEND ack: seq 0, ack 11

TOLAYER3: packet being corrupted

EVENT time: 175.300659, type: 1, fromlayer5 entity: 0
(A) SEND pkt: seq 14, ack 0

EVENT time: 178.257675, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack 11
Checksum not PASS

EVENT time: 180.143845, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 12, ack 0
Checksum PASS
Accept pkt 12
SEND ack: seq 0, ack 12

EVENT time: 181.727707, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack 12
Checksum PASS
Update base from 10 to 13
Stop timer
Start timer

EVENT time: 182.293228, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 14, ack 0
Checksum PASS
Decline pkt 14
SEND ack: seq 0, ack 12

TOLAYER3: packet being lost

EVENT time: 187.756638, type: 1, fromlayer5 entity: 0
(A) SEND pkt: seq 15, ack 0

EVENT time: 193.595108, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 15, ack 0
Checksum PASS
Decline pkt 15
SEND ack: seq 0, ack 12

EVENT time: 196.130432, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack 12
Checksum PASS
Update base from 13 to 13

EVENT time: 206.445023, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 16, ack 0

TOLAYER3: packet being corrupted

Correct package

Corrupted package

Missed package

EVENT time: 207.936188, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 16, ack 0

Checksum not PASS

Decline pkt 16

SEND ack: seq 0, ack 12

EVENT time: 211.305588, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 12

Checksum PASS

Update base from 13 to 13

EVENT time: 211.727707, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 13, ack 0

(A) SEND pkt: seq 14, ack 0

(A) SEND pkt: seq 15, ack 0

(A) SEND pkt: seq 16, ack 0

EVENT time: 212.876740, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 13, ack 0

Checksum PASS

Accept pkt 13

SEND ack: seq 0, ack 13

EVENT time: 214.104340, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 17, ack 0

EVENT time: 216.789505, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 14, ack 0

Checksum PASS

Accept pkt 14

SEND ack: seq 0, ack 14

EVENT time: 219.148422, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 13

Checksum PASS

Update base from 13 to 14

Stop timer

Start timer

EVENT time: 221.327942, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 15, ack 0

Checksum PASS

Accept pkt 15

SEND ack: seq 0, ack 15

TOLAYER3: packet being corrupted

EVENT time: 222.470184, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 14

Checksum PASS

Update base from 14 to 15

Stop timer

Start timer

— Correct package

— Corrupted package

✗ Missed package

EVENT time: 222.771545, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 18, ack 0

EVENT time: 227.015762, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 16, ack 0

Checksum PASS

Accept pkt 16

SEND ack: seq 0, ack 16

EVENT time: 229.238647, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 15

Checksum not PASS

EVENT time: 231.393784, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 17, ack 0

Checksum PASS

Accept pkt 17

SEND ack: seq 0, ack 17

EVENT time: 235.728958, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 19, ack 0

EVENT time: 235.924057, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 16

Checksum PASS

Update base from 15 to 17

Stop timer

Start timer

EVENT time: 239.823532, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 18, ack 0

Checksum PASS

Accept pkt 18

SEND ack: seq 0, ack 18

EVENT time: 241.634125, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 17

Checksum PASS

Update base from 17 to 18

Stop timer

Start timer

EVENT time: 244.412704, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 18

Checksum PASS

Update base from 18 to 19

Stop timer

Start timer

EVENT time: 244.656296, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 19 ack 0

Checksum PASS

Accept pkt 19

SEND ack: seq 0, ack 19

EVENT time: 251.161682, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 19

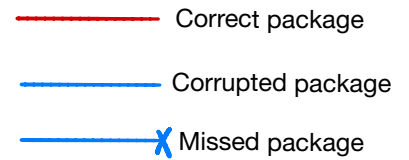
Checksum PASS

Update base from 19 to 20

Stop timer

Simulator terminated at time 251.161682

after sending 20 msgs from layer5



----- Stop and Wait Network Simulator Version 1.1 -----

the number of messages to simulate: 50
packet loss probability: 0.300000
packet corruption probability: 0.300000
average time between messages from sender's layer5: 10.000000
TRACE: 2

Corrupt case at pkt 0

EVENT time: 18.705740, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 0, ack 0

TOLAYER3: packet being corrupted

Start timer

1. B will decline all out of order pkt.
2. Only accept pkt with seq = 0.
3. A will call interrupt and resend.

EVENT time: 24.170835, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 0, ack 0

Checksum not PASS

Decline pkt 0

SEND ack: seq 0, ack -1

EVENT time: 26.352459, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack -1

Checksum PASS

Update base from 0 to 0

EVENT time: 28.705740, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 0, ack 0

TOLAYER3: packet being lost

Loss case at pkt 0

EVENT time: 35.124840, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 1, ack 0

EVENT time: 37.392609, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 2, ack 0

EVENT time: 38.057533, type: 1, fromlayer5 entity: 0

(A) SEND pkt: seq 3, ack 0

EVENT time: 38.705742, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 0, ack 0

(A) SEND pkt: seq 1, ack 0

TOLAYER3: packet being lost

(A) SEND pkt: seq 2, ack 0

TOLAYER3: packet being corrupted

(A) SEND pkt: seq 3, ack 0

TOLAYER3: packet being corrupted

1. B will decline all out of order pkt.
2. Only accept pkt with seq = 0.
3. A will call interrupt and resend.

EVENT time: 44.369377, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 1, ack 0
Checksum PASS
Decline pkt 1
SEND ack: seq 0, ack -1

EVENT time: 45.847797, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 2, ack 0
Checksum PASS
Decline pkt 2
SEND ack: seq 0, ack -1

TOLAYER3: packet being lost

EVENT time: 48.527962, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack -1
Checksum PASS
Update base from 0 to 0

EVENT time: 48.705742, type: 0, timerinterrupt entity: 0
Start timer

(A) SEND pkt: seq 0, ack 0
TOLAYER3: packet being corrupted
(A) SEND pkt: seq 1, ack 0
(A) SEND pkt: seq 2, ack 0
TOLAYER3: packet being lost
(A) SEND pkt: seq 3, ack 0

EVENT time: 52.146210, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 3, ack 0
Checksum PASS
Decline pkt 3
SEND ack: seq 0, ack -1

TOLAYER3: packet being corrupted

EVENT time: 56.787369, type: 1, fromlayer5 entity: 0
(A) SEND pkt: seq 4, ack 0
TOLAYER3: packet being corrupted

EVENT time: 57.724827, type: 2, fromlayer3 entity: 0
(A) GET ack: seq 0, ack -1
Checksum not PASS

EVENT time: 58.175858, type: 2, fromlayer3 entity: 1
(B) GET pkt: seq 0, ack 0
Checksum PASS
Accept pkt 0
SEND ack: seq 0, ack 0

EVENT time: 58.705742, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 0, ack 0

(A) SEND pkt: seq 1, ack 0

TOLAYER3: packet being corrupted

(A) SEND pkt: seq 2, ack 0

TOLAYER3: packet being corrupted

(A) SEND pkt: seq 3, ack 0

TOLAYER3: packet being lost

(A) SEND pkt: seq 4, ack 0

TOLAYER3: packet being lost

EVENT time: 61.053696, type: 2, fromlayer3 entity: 0

(A) GET ack: seq 0, ack 0

Checksum PASS

Update base from 0 to 1

Stop timer

Start timer

(A) Output 0 package(s) from buffer

(A) Buffer size: 0

EVENT time: 62.239460, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 2, ack 0

Checksum not PASS

Decline pkt 2

SEND ack: seq 0, ack 0

TOLAYER3: packet being lost

EVENT time: 64.023384, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 3, ack 999999

Checksum not PASS

Decline pkt 3

SEND ack: seq 0, ack 0

TOLAYER3: packet being lost

EVENT time: 69.861351, type: 2, fromlayer3 entity: 1

(B) GET pkt: seq 0, ack 0

Checksum not PASS

Decline pkt 0

SEND ack: seq 0, ack 0

TOLAYER3: packet being lost

EVENT time: 71.053696, type: 0, timerinterrupt entity: 0

Start timer

(A) SEND pkt: seq 1, ack 0

(A) SEND pkt: seq 2, ack 0

TOLAYER3: packet being lost

(A) SEND pkt: seq 3, ack 0

(A) SEND pkt: seq 4, ack 0

EVENT time: 71.736542, type: 2, fromlayer3 entity: 1