Computer Networks

TCP, AIMD, slow start and fast retransmit

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- ## Introduction :-

1. Transmission Control Protocol (TCP) :-

TCP connection is more reliable. It does not have very strict boundaries. On the server side it includes socket creation, bind and accept. On the client side it includes socket creation and connect. It is used for organizing data in a way that ensures the secure transmission between the server and client. It guarantees the integrity of data sent over the network, regardless of the amount. It is flexible and highly scalable.

2. Additive Increase, Multiplicative Decrease (AIMD) :-

Additive Increase Multiplicative Decrease is the algorithm for congestion avoidance. When the congestion window increases and reaches the threshold it starts incrementing linearly (i.e additive increase). But when there congestion detection threshold drops down to half of the current window size and congestion window is set to 1 again (i.e Multiplicative decrease).

3. Slow Start :-

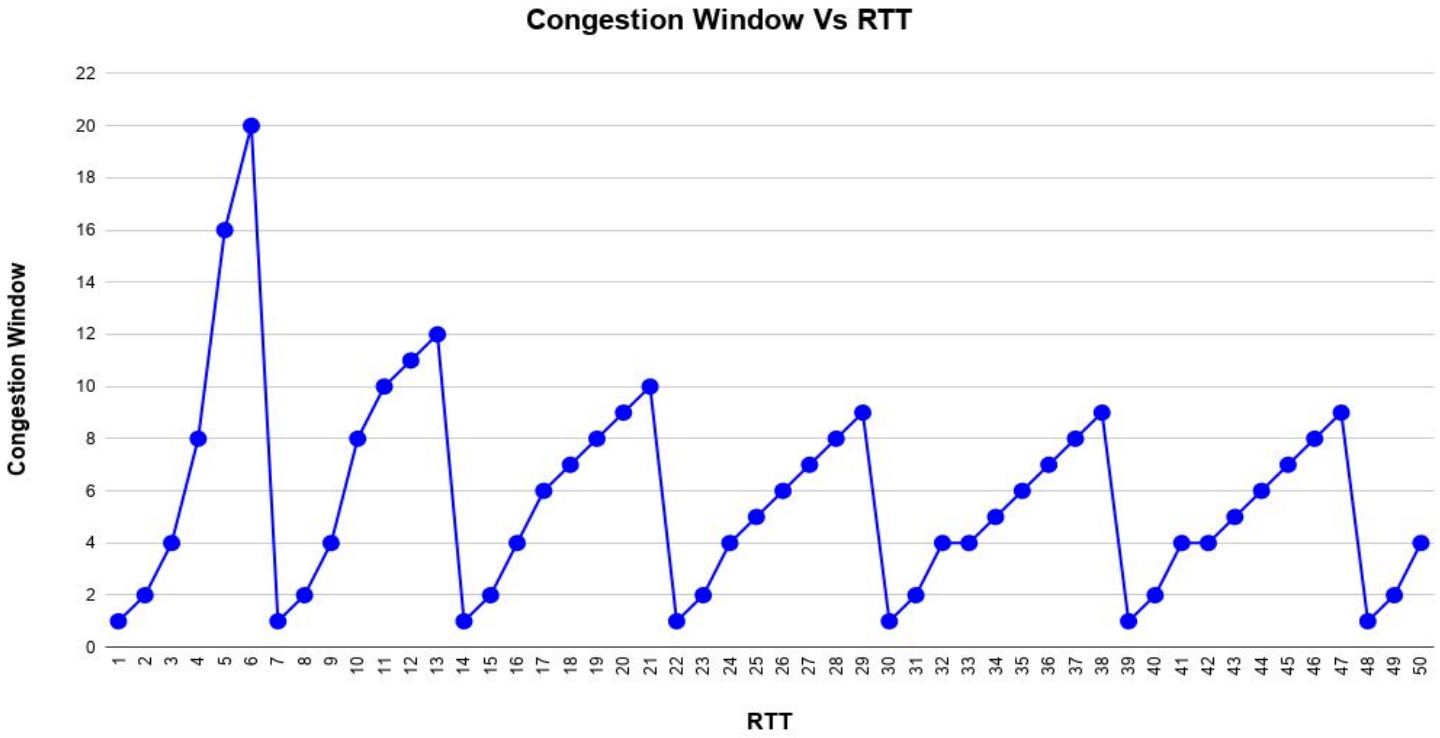
TCP slow start is one of the first steps in the congestion control process. In the beginning when the congestion window is set to 1, it increases exponentially until it reaches threshold. If the threshold is 20 then it will follow 1,2,4,8,16,20 accordingly. This exponential increase of congestion window is known as slow start.

4. **Fast Retransmit :-**

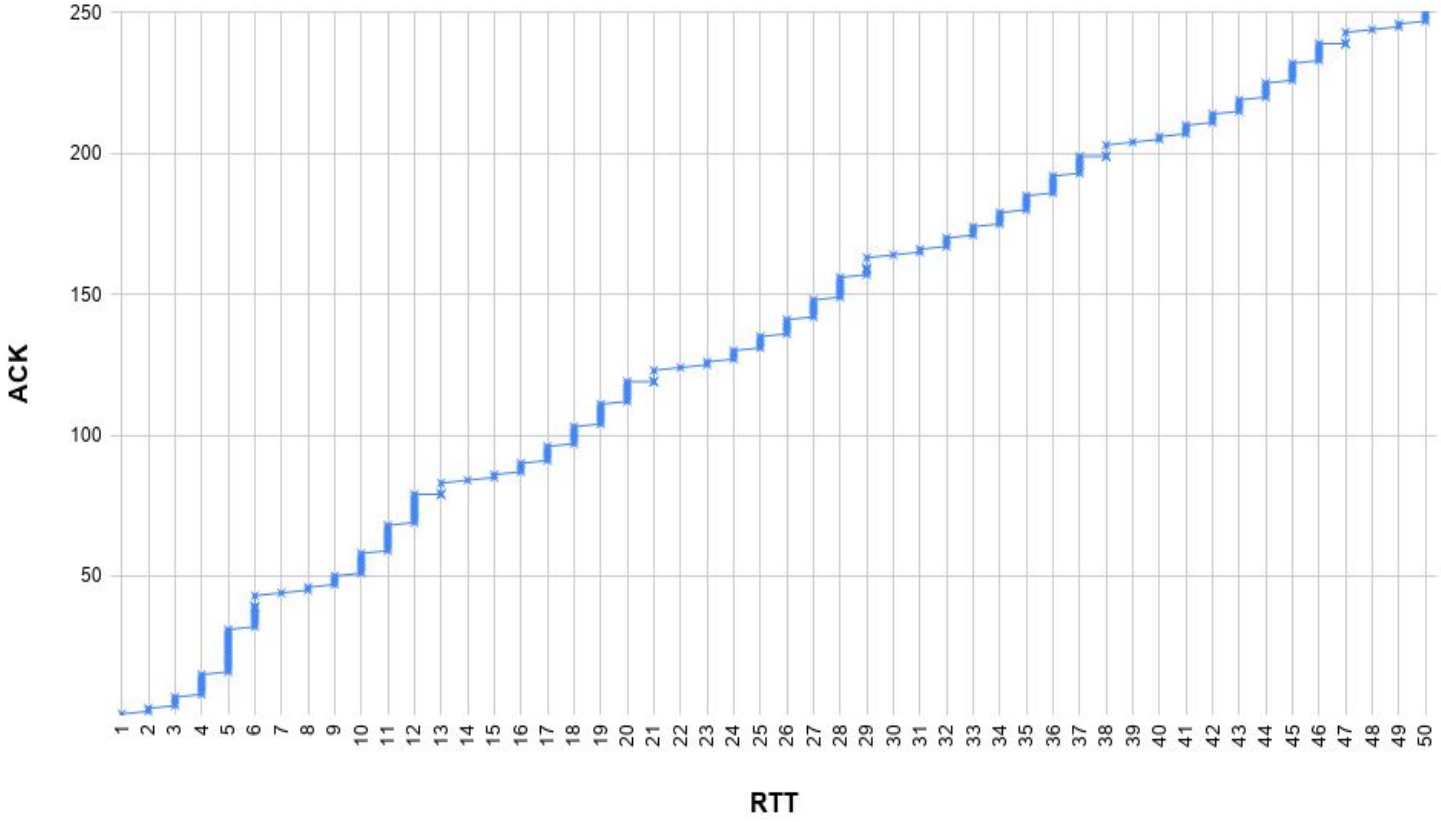
   As in Jacobson's fast retransmit algorithm, when the sender receives 3rd duplicate ACK, it assumes that the packet is lost and retransmit that packet. After retransmission, the sender continues normal data transmission.

- **Features :-**
  1. This code simulates the behaviour of congestion detection.
  2. First it follows the slow start period until the congestion window size crosses the threshold.
  3. Once it seems to cross the threshold it sets window size equal to threshold and starts incrementing congestion window size by 1. i.e the congestion avoidance phase.
  4. During congestion avoidance phase there is a packet loss which is detected by 3 duplicate acks.
  5. After the congestion is detected the threshold is set to half and congestion window is set to 1 and the system again enters into a slow start phase.

- **Major Outcomes :-**



ACK Vs RTT


250
200
150
100
50
ACK
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50
RTT

- **Screen-shots :-**

```
jaydeep@JD:~/Desktop/ABCD/client$ ./a.out 0.0.0.0
Client's remote host: 0.0.0.0
Client created socket.
Client connected.
----------Frame sent : 1
-------ACK recveived : 1

------------------------RTT NO: 1
------------Current Window Size: 1
----------Frame sent : 2
-------ACK recveived : 2

----------Frame sent : 3
-------ACK recveived : 3

------------------------RTT NO: 2
------------Current Window Size: 2
----------Frame sent : 4
-------ACK recveived : 4

----------Frame sent : 5
-------ACK recveived : 5

----------Frame sent : 6
-------ACK recveived : 6

----------Frame sent : 7
-------ACK recveived : 7

------------------------RTT NO: 3
------------Current Window Size: 4
----------Frame sent : 8
-------ACK recveived : 8

----------Frame sent : 9
-------ACK recveived : 9

----------Frame sent : 10
-------ACK recveived : 10

----------Frame sent : 11
-------ACK recveived : 11

----------Frame sent : 12
-------ACK recveived : 12

----------Frame sent : 13
-------ACK recveived : 13

----------Frame sent : 14
-------ACK recveived : 14

----------Frame sent : 15
-------ACK recveived : 15

------------------------RTT NO: 4
```

```
jaydeep@JD:~/Desktop/ABCD/server$ ./a.out
Server is using address 0.0.0.0 and port 5432.
Server bind done.
Server Listening.
-----Frame Received  1
-----ACK SENT 1

-----Frame Received  2
-----ACK SENT 2

-----Frame Received  3
-----ACK SENT 3

-----Frame Received  4
-----ACK SENT 4

-----Frame Received  5
-----ACK SENT 5

-----Frame Received  6
-----ACK SENT 6

-----Frame Received  7
-----ACK SENT 7

-----Frame Received  8
-----ACK SENT 8

-----Frame Received  9
-----ACK SENT 9

-----Frame Received  10
-----ACK SENT 10

-----Frame Received  11
-----ACK SENT 11

-----Frame Received  12
-----ACK SENT 12

-----Frame Received  13
-----ACK SENT 13

-----Frame Received  14
-----ACK SENT 14

-----Frame Received  15
-----ACK SENT 15

-----Frame Received  16
-----ACK SENT 16

-----Frame Received  17
-----ACK SENT 17

-----Frame Received  18
```

```
----------Frame sent : 34
-------ACK recveived : 34

----------Frame sent : 35
-------ACK recveived : 35

----------Frame sent : 36
-------ACK recveived : 36

----------Frame sent : 37
-------ACK recveived : 37

----------Frame sent : 38
-------ACK recveived : 38

----------Frame sent : 39
-------ACK recveived : 39

----------Frame sent : 40
------------------------RTT NO: 6
------------Current Window Size: 20
-------ACK not recveived --------->>>>>>>>
----------Frame sent : 41
-------ACK recveived : 39

----------Frame sent : 42
-------ACK recveived : 39

----------Frame sent : 43
-------ACK recveived : 39

3 duplicate ACK received
------------------>>>>>>>>>>>>>>CONGESTION DETECTED<<<<<<<<<<<<<<------------------
------------------------RTT NO: 6
------------Current Window Size: 20
------------------New Threshold: 10
-------Frame sent after Congestion : 40
----ACK recveived after Congestion : 43
----------Frame sent : 44
-------ACK recveived : 44

------------------------RTT NO: 7
------------Current Window Size: 1
----------Frame sent : 45
-------ACK recveived : 45

----------Frame sent : 46
-------ACK recveived : 46

------------------------RTT NO: 8
------------Current Window Size: 2
----------Frame sent : 47
-------ACK recveived : 47

----------Frame sent : 48
-------ACK recveived : 48
```

```
-----Frame Received  34
-----ACK SENT 34

-----Frame Received  35
-----ACK SENT 35

-----Frame Received  36
-----ACK SENT 36

-----Frame Received  37
-----ACK SENT 37

-----Frame Received  38
-----ACK SENT 38

-----Frame Received  39
-----ACK SENT 39

-----Frame not Received ------------>>>>>>>>>
-----Frame Received  41
-----ACK SENT 39

-----Frame Received  42
-----ACK SENT 39

-----Frame Received  43
-----ACK SENT 39

-----CHECK ---------Frame Received  40
-----CHECK--------- ACK SENT 43
-----Frame Received  44
-----ACK SENT 44

-----Frame Received  45
-----ACK SENT 45

-----Frame Received  46
-----ACK SENT 46

-----Frame Received  47
-----ACK SENT 47

-----Frame Received  48
-----ACK SENT 48

-----Frame Received  49
-----ACK SENT 49

-----Frame Received  50
-----ACK SENT 50

-----Frame Received  51
-----ACK SENT 51

-----Frame Received  52
```

- # References :-

[1] **Peterson, L. (2012).** ***Computer Networks a systems approach*** **(5th ed.). Burlington: Morgan Kaufmann.**