Transport layer

For AIMD:

ACK's: increase cwnd by 1 Mss per RTT (additive increase) [3]

loss: cut cwnd in half (multiplicative decrease)

eg 500 Packets, RTT = 100ms, pkt size = 1KB.

Lost Packets = 10, 25, 34, 45. (Initial start with 1.

$$\frac{\text{no. of pkts} \times \overset{1\times}{(1024)} \times (8 \text{ bits})}{\underset{RTT}{100} + 19}$$

pkt size in bits

RTT	Seq no.
1	1
2	2 3
3	4 5 6
4	7 8 9 ~~10~~
5	10 11 ~~3~~ ~~4~~ ~~5~~
6	12 13 14 ~~14~~ ~~5~~
7	15 16 17 18
8	19 20 21 22 23
9	24 ~~25~~ 26 27 28 29
10	25 26 27 ~~28~~ ~~29~~
11	28 29 30 31
12	~~31~~ 32 33 ~~34~~ 35 36
13	34 35
14	36 37 38
15	39 40 41 42
16	43 44 ~~45~~ 46 47
17	45 46
18	47 48 49

$\boxed{4/2 = 2}$

$6/2 = 3$

$5/2 = 2.5 \approx \boxed{2}$

$5/2 = 2$

19	50

For Slow Start:

Initial W = 1

On successful ACK =

increase exponentially until first loss event
or when threshold reached.
   ↳ double cwnd every RTT
   ↳ done by incrementing cwnd by 1 for every ACK
      received

When cwnd ≥ ssthresh, transition from
slow start to congestion avoidance phase.
using AIMD.

When triple duplicate ACK occurs,
ssthresh set to cwnd/2.

When timeout occurs, ssthresh set to
cwnd/2.

50 packets, RTT = 100ms, 1kB pkt size
pkt loss = 10, 25, 34, 45

RTT	Seq #
1	1
2	2 3
3	4 5 6 7
4	8 9 ~~10~~ 11 12 13 14 15
5	10
6	11 12

cwnd = 8, con. threshold = 4 = $\frac{8}{2}$

7	13	14	15	16	$cwnd = 4 \geqslant 4$
8	17	18	19	20	21
9	22	23	24	~~25~~	26 27
10	25				
11	26	27			
12	28	29	30	~~8~~	
13	31	32	33	~~34~~	
14	34	~~36 37 38 39~~			
15	35	36			
16	37	38	39		
17	40	41	42	43	
18	44	~~45~~	46	47	48
19	45				
20	46	47			
21	48	49	50		

Annotations:
- Row 9: $cwnd = 6$, con. threshold $= \dfrac{6}{2} = 3$
- Row 13: $cwnd = 4$, con. threshold $= \dfrac{4}{2} = 2$
- Row 17/18: $cwnd = 5$, threshold $= 2.5$

$$\frac{no.\ of\ pkts \times pkt\ size}{RTT \times sampleRTT}$$

$$= \frac{50 \times (1 \times 1024 \times 8)}{21 \times \frac{100}{1000}}$$

0	1
1	1 2
2	3 4 5 6
3	7 8 9 10 11 12 13 14
4	15 16 17 18 19 20 21 22
	23 24 25 26 27 28 29 30
5	.

threshold = 16/2 = 8

Additive increase

16

Slow start

1 2 3   8

Token Bucket:
Bursty Traffic at regulated traffic
→ Remove one token and discard for each packet transmitted. const. flow of data.

BGP: Interdomain routing protocol that uses path vector routing.

Types
i). Stub AS : has only one connection [AS1] ⇄ [AS2]

2). Multihomed AS: More than one conn. to other AS.
(No transient traffic) [AS1] → [AS2], [AS3], [AS4]

3). Transit AS: Allows transient traffic (Source)

Sessions:

external comm b/w speaker

i). External BGP   and 2). Internal BGP: b/w routers of same AS.

Leaky Bucket: convert bursty traffic into fixed rate traffic by averaging data rate.

hole

Fixed flow of water

Arrival → Queue → Processor → Departure

Discard   3mbps

fetches packets at const. rate.

0   10