Problema 1

```
1   2.100850 200.1.10.5.3287 > 147.83.39.20.2043: . 11025:12473(1448)
2   2.201934 147.83.39.20.2043 > 200.1.10.5.3287: . ack 11025
3   2.202032 200.1.10.5.3287 > 147.83.39.20.2043: . 12473:13921(1448)
4   2.202074 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)
5   2.303513 147.83.39.20.2043 > 200.1.10.5.3287: . ack 11025
6   2.692975 200.1.10.5.3287 > 147.83.39.20.2043: . 11025: 12473(1448)
7   2.794419 147.83.39.20.2043 > 200.1.10.5.3287: . ack 13921
8   2.794503 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)
9   2.795749 200.1.10.5.3287 > 147.83.39.20.2043: P 15369:16145(776)
10  2.896720 147.83.39.20.2043 > 200.1.10.5.3287: . ack 13921
11  3.252974 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)
12  3.354419 147.83.39.20.2043 > 200.1.10.5.3287: . ack 16145
13  3.354519 200.1.10.5.3287 > 147.83.39.20.2043: . 16145:17593(1448)
14  3.354561 200.1.10.5.3287 > 147.83.39.20.2043: . 17593:19041(1448)
15  3.454561 147.83.39.20.2043 > 200.1.10.5.3287: . ack 17593
16  3.454835 200.1.10.5.3287 > 147.83.39.20.2043: FP 19041:20241(1200)
17  4.044446 147.83.39.20.2043 > 200.1.10.5.3287: . ack 19041
18  4.044555 200.1.10.5.3287 > 147.83.39.20.2043: FP 19041:20241(1200)
19  4.145837 147.83.39.20.2043 > 200.1.10.5.3287: F 1:1(0) ack 20242
20  4.145940 200.1.10.5.3287 > 147.83.39.20.2043: . ack 2
```

Slow Start and Congestion Avoidance

INIT

    cwnd = MSS

    ssthres = infinite

INIT (normalized to MSS)

    cwnd = 1

    ssthres = infinite

SS

Algorithm

If ack confirms new data (1 or more segments)

    If (cwnd < ssthres)

    then cwnd = cwnd + MSS

    else cwnd = cwnd + MSS*(MSS/cwnd)

    Stop RTO

    If unack'd segments restart RTO

Algorithm

If ack confirms new data (1 or more segments)

    If (cwnd < ssthres)

    then cwnd = cwnd + 1

    else cwnd = cwnd + (1/cwnd)

    Stop RTO

    If unack'd segments restart RTO

SS

CA

If RTO timeout then

    retransmit oldest unack'd segment

    ssthres = max(min(awnd,cwnd)/2; 2MSS)

    cwnd = MSS

If RTO timeout then

    retransmit oldest unack'd segment

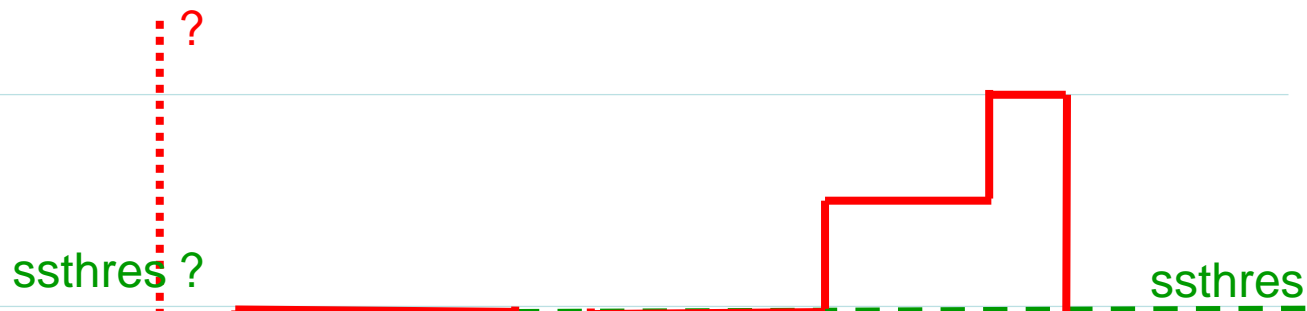   ssthres = max(min(awnd,cwnd)/2;2)

    cwnd = 1

SS

```
1   2.100850 200.1.10.5.3287 > 147.83.39.20.2043: . 11025:12473(1448)    t1
2   2.201934 147.83.39.20.2043 > 200.1.10.5.3287: . ack 11025
3   2.202032 200.1.10.5.3287 > 147.83.39.20.2043: . 12473:13921(1448)    t2
4   2.202074 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)    t3
5   2.303513 147.83.39.20.2043 > 200.1.10.5.3287: . ack 11025
6   2.692975 200.1.10.5.3287 > 147.83.39.20.2043: . 11025: 12473(1448)   r1
7   2.794419 147.83.39.20.2043 > 200.1.10.5.3287: . ack 13921            ack 1,2
8   2.794503 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)    r3
9   2.795749 200.1.10.5.3287 > 147.83.39.20.2043: P 15369:16145(776)     t4
10  2.896720 147.83.39.20.2043 > 200.1.10.5.3287: . ack 13921
11  3.252974 200.1.10.5.3287 > 147.83.39.20.2043: . 13921:15369(1448)    r3
12  3.354419 147.83.39.20.2043 > 200.1.10.5.3287: . ack 16145            ack 3,4
13  3.354519 200.1.10.5.3287 > 147.83.39.20.2043: . 16145:17593(1448)    t5
14  3.354561 200.1.10.5.3287 > 147.83.39.20.2043: . 17593:19041(1448)    t6
15  3.454561 147.83.39.20.2043 > 200.1.10.5.3287: . ack 17593            ack 5
16  3.454835 200.1.10.5.3287 > 147.83.39.20.2043: FP 19041:20241(1200)   t7
17  4.044446 147.83.39.20.2043 > 200.1.10.5.3287: . ack 19041            ack 6
18  4.044555 200.1.10.5.3287 > 147.83.39.20.2043: FP 19041:20241(1200)   r7
19  4.145837 147.83.39.20.2043 > 200.1.10.5.3287: F 1:1(0) ack 20242     ack 7
20  4.145940 200.1.10.5.3287 > 147.83.39.20.2043: . ack 2
```

cwnd/MSS

4

3

?

ssthres ?

ssthres

2

1

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20   t

t1   t2 t3   r1 a2 r3 t4   r3 a4 t5 t6 a5 t7 a6 r7 a7
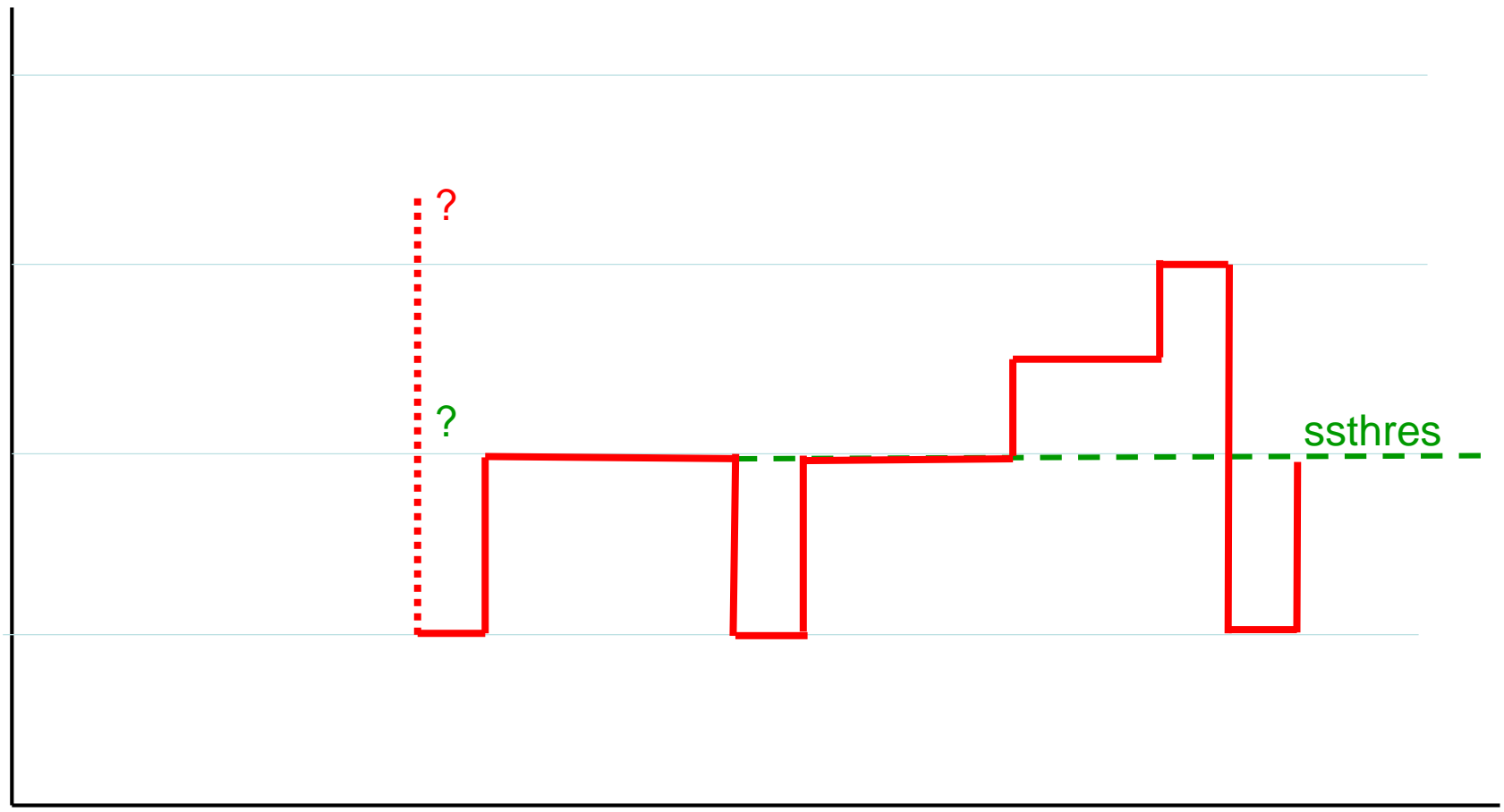
cwnd/MSS

4

3

? (red)

2

? (green)

ssthres

1

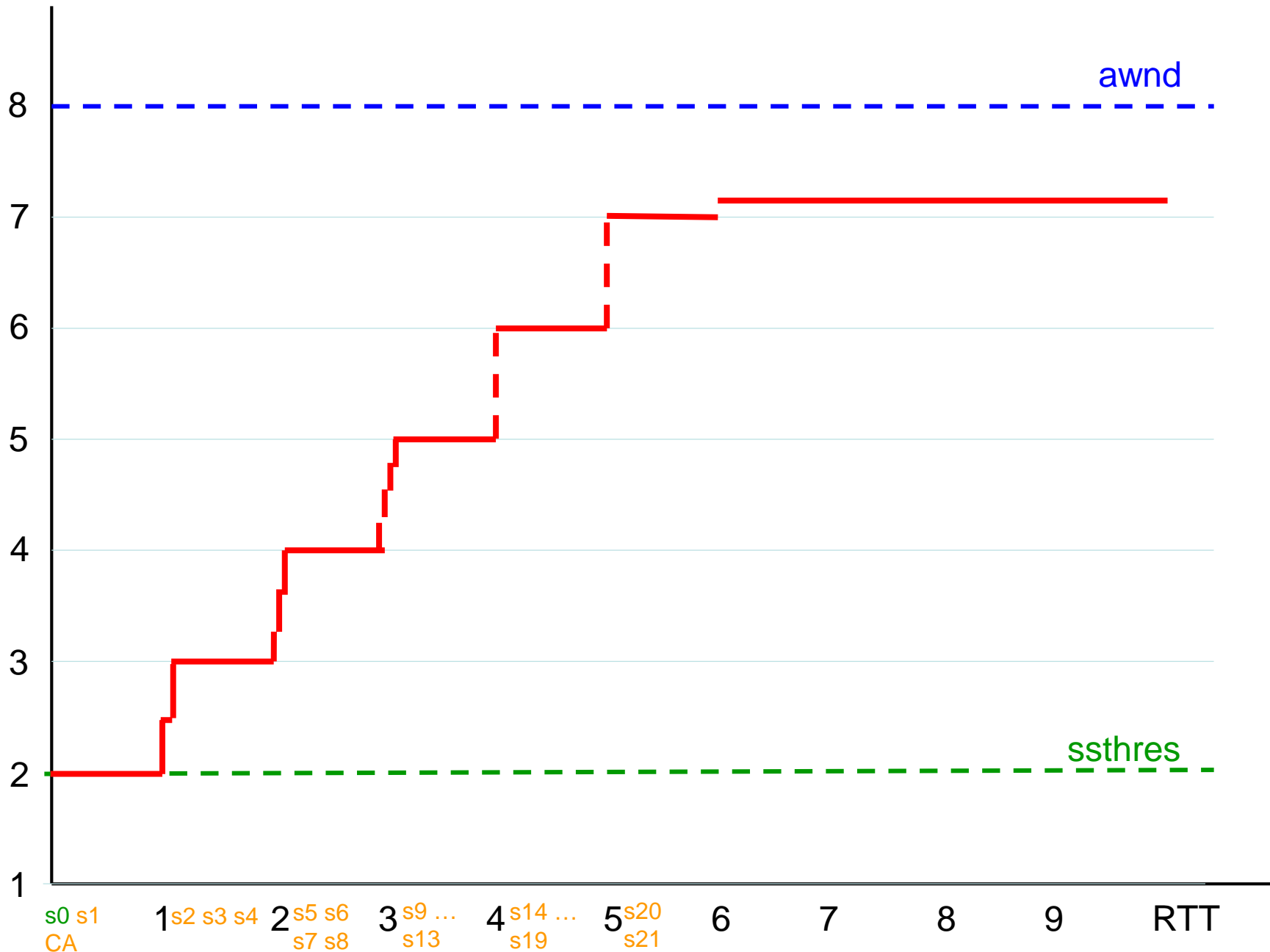1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20   t

t1   t2 t3   r1 a2 r3 t4   r3 a4 t5 t6 a5 t7 a6 r7 a7

cwnd/MSS

8 — awnd

7

6

5

4

3

2 — — — — — — — — — — — — — — — — ssthres

1

s0 s1 1 s2 s3 s4 2 s5 s6 3 s9 ... 4 s14 ... 5 s20 6   7   8   9   RTT
CA   s7 s8   s13   s19   s21