HW #4

Slow-Start Analysis:

The attached figure shows the progression of the sliding window protocol under ideal conditions. It is assumed that the round-trip time is fixed at s:

s = transp + transa + 2 * (proc + prop)

Assume that Wmax is even and that s = Wmax * transp

Let

a = transp
b = transa
s = a + b
Wmax = (a + b)/a = 1 + b/a

The efficiency is simply a measure of the ratio of 'active time' during new packet transmission is taking place divided by the total elapsed time. The following 'table' illustrates the progression for slow-start and congestion avoidance from W=1 to W=Wmax as shown in the diagram:

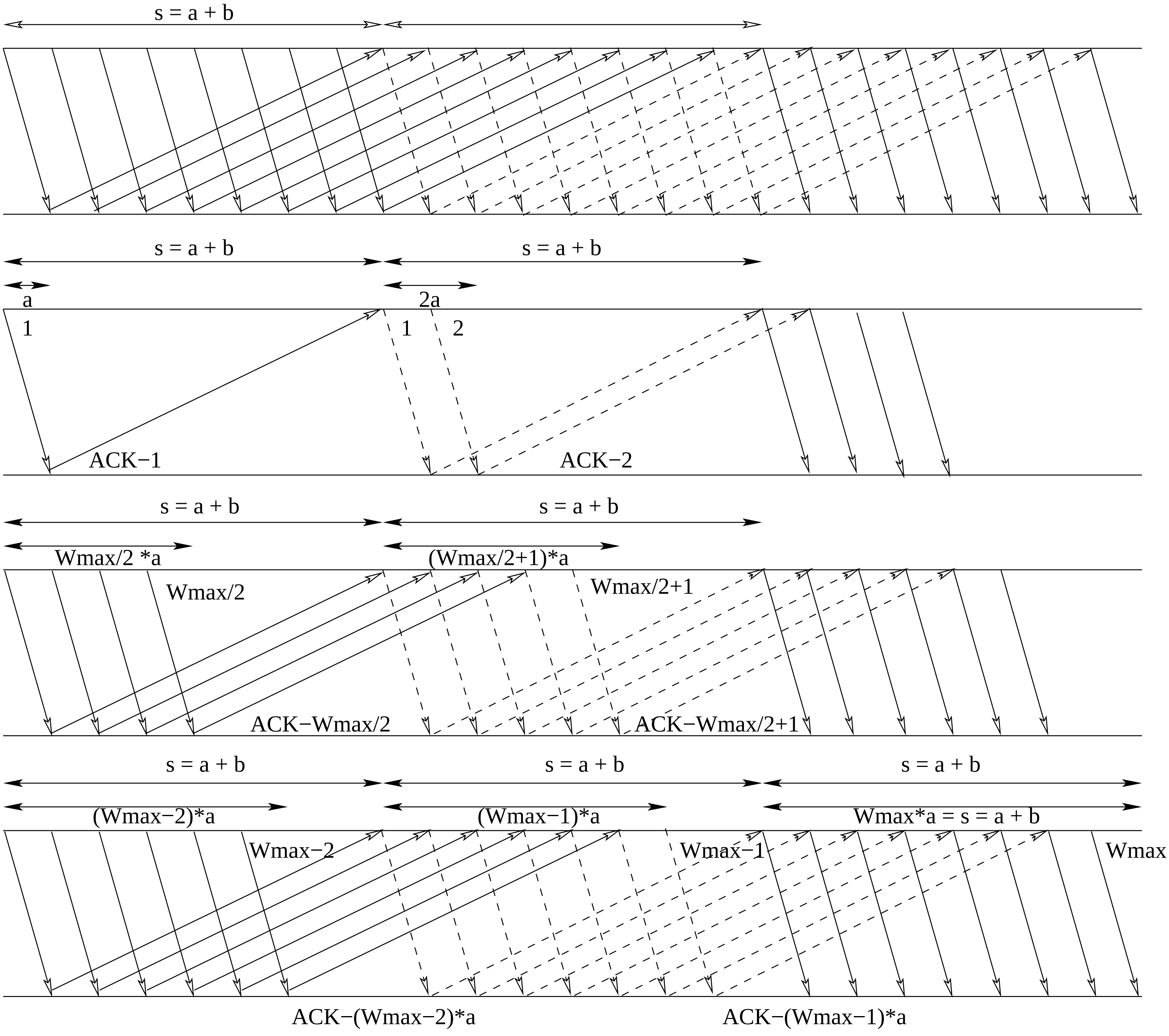
Active Time	Elapsed Time	Next Window
a	s = a + b	2
2a	s = a + b	4
…….	s = a + b	
Wmax/4 * a	s = a + b	Wmax/2
Wmax/2 * a	s = a + b	Wmax/2 + 1
(Wmax/2 + 1) * a	s = a + b	Wmax/2 + 2
…….	s = a + b	
(Wmax – 1) * a	s = a + b	Wmax
Wmax * a	s = a + b	Wmax

Total Active Time = $a * \Sigma 2^{w} + a * \Sigma w$

The limits of the first sum are: w = 1 to w = log-base-2 Wmax/2
The limits of the second sum are: w = Wmax/2 + 1 to w = Wmax

Total Elapsed Time = (a + b) log-base-2 Wmax/2 + (a + b) Wmax/2

The final solution can be simplified as desired.



s = a + b
s = a + b
s = a + b
a
2a
1
1
2
ACK−1
ACK−2
s = a + b
s = a + b
Wmax/2 *a
(Wmax/2+1)*a
Wmax/2
Wmax/2+1
ACK−Wmax/2
ACK−Wmax/2+1
s = a + b
s = a + b
s = a + b
(Wmax−2)*a
(Wmax−1)*a
Wmax*a = s = a + b
Wmax−2
Wmax−1
Wmax
ACK−(Wmax−2)*a
ACK−(Wmax−1)*a