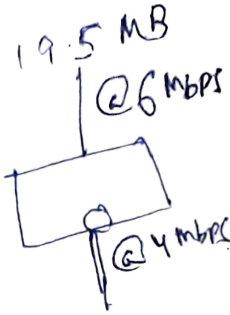
① Computer A has 19.5 MB to send on a network and transmit the data in a burst of 6 Mbps rate. The maximum transmission rate across routers in the network is 4 Mbps. If Computer A's transmission is shaped using a leaky bucket, how much capacity must the queue in the bucket hold not to discard any data?



Sol: 19.5 MB = 19.5×8 Mb.

Time to transmit 19.5 MB @ 6 Mbps (M)

$S = \frac{19.5 \times 8}{6} = 26\,s$

$C + PS = MS$
$C = S(M-P) = 26(6-4) = 52$ Mbits

Actual data sent in 26 s @ 4 Mbps (P)

= 4×26 = 104 Mbits = 13 Mbyte.

Bucket size = 19.5 − 13 MB = 6.5 MB (=52 Mb)

② A leaky bucket is at the host network interface. The data rate on the network is 2 Mbyte/s and the data rate on the link from the host to the bucket is 2.5 Mbyte/s.

(A) Suppose the host has 250 Mbyte to send onto the network and it sends the data in burst. What should be the maximum capacity of the bucket in order that no data is lost?

Sol: Time for sending 250 Mbytes @ 2.5 Mbyte/s (M) = 100 s (S).

In 100 sec, @ 2 Mbyte/s (P), 200 Mbyte can be send.

Minimum bucket size = 250 − 200 = 50 Mbyte.

$C = S(M-P)$
$C = 100(2.5-2)$
$= 50$ Mbytes

(B) Suppose the capacity of bucket is 100 Mbyte. What is the longest burst time from the host in order that no data is lost?

Soln: bucket size = 250 Mbytes − data sent

100 = 250 − data sent

data sent = 150 Mbyte.

Time requiring to send 150 Mbyte @ 2 Mbyte/s = 75 sec.

If 250 Mbyte is sent in 75 sec, the rate is $\frac{250}{75}$

$= 3.33$ Mbyte/s.

(3) Consider A has 240 Mb to send & transmit in burst of 6 Mbps. The minimum sustainable transmission rate is 5 Mbps. If A's transmission is shaped using leaky bucket what is the minimum queue size to prevent lost?

Time to send 240 Mb @ 6 Mbps = 40 sec.

~~@ 5 Mbps, to send~~ data can be sent in 40 sec @ 5 Mbps

= 200 Mbyte.

Buffer size = 240 − 200 = 40 Mbyte.

(Rate at which data accumulate in buffer = 6 − 5 = 1 Mbps.

In 40 sec, 40 Mbyte data will be accumulated in the buffer).

(4) Host A has to send 30 Mbits into a network via a token bucket regulator. The token bucket has a capacity 15 Mbits & is filled with tokens generated @ 5 Mbps. Data is buffered if it arrives at the regulator when there are no tokens in the bucket. How long does it take for the 30 Mbits to enter the network, assuming that the host sends at a peak rate of 20 Mbps & the token bucket is initially full?

Soln. The host can send all 30 Mbits to the token bucket at @ 20 Mbps.

The data leaves the token bucket in three phases:

1st second: burst of 20 Mbits, using full bucket (15 Mbits) + 1st token 5 Mbits

2nd second: " " 5 " , using 2nd token.

3rd second: " " 5 " , using 3rd token.

Thus it takes 3 seconds for the data to enter the network.

A computer on a 1 Mbps network is regulated by a token bucket. The token bucket is filled @ 2 Mbps. It is initially filled to capacity with 16 mbits. What is the maximum duration for which the computer can transmit at the full 10 Mbps?

$$C + \rho S = MS$$

$$S = C/(M-\rho) = 16/(10-2) = 2 \text{ seconds}.$$

s