CS & IT ENGINEERING

COMPUTER NETWORKS

TCP & UDP

Lecture No-16

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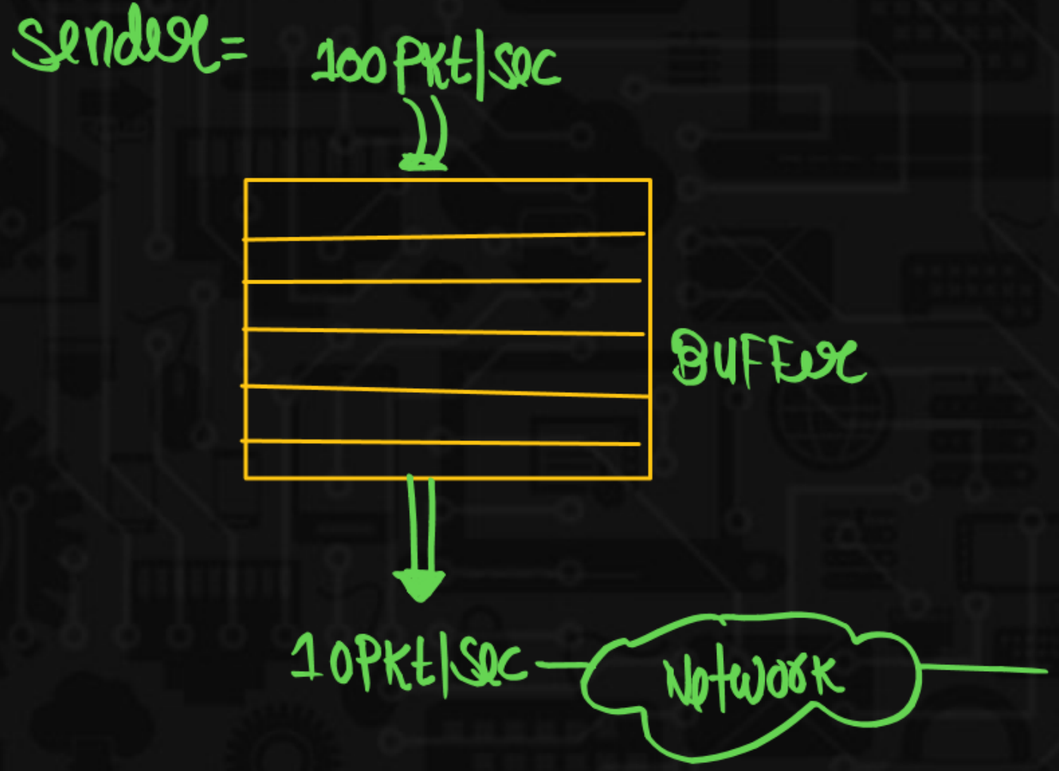
Traffic Shaping

Traffic Shaping



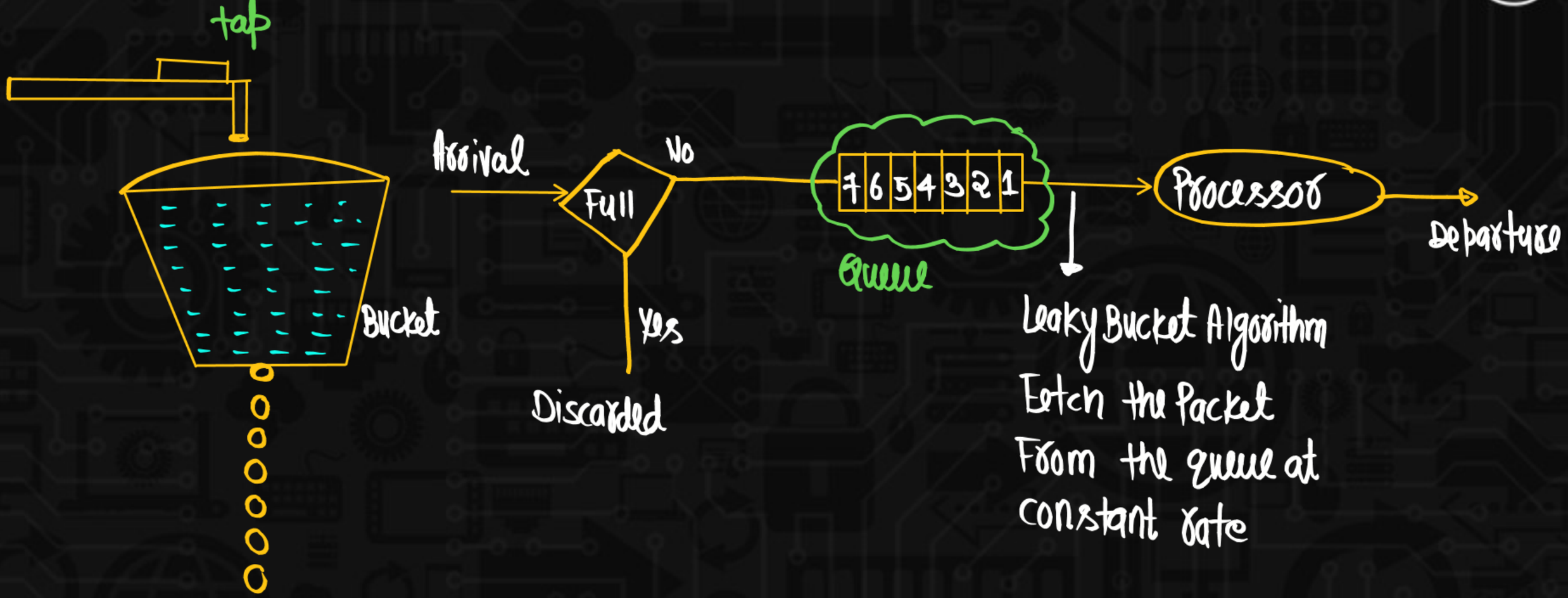
i) Leaky Bucket
ii) Token Bucket

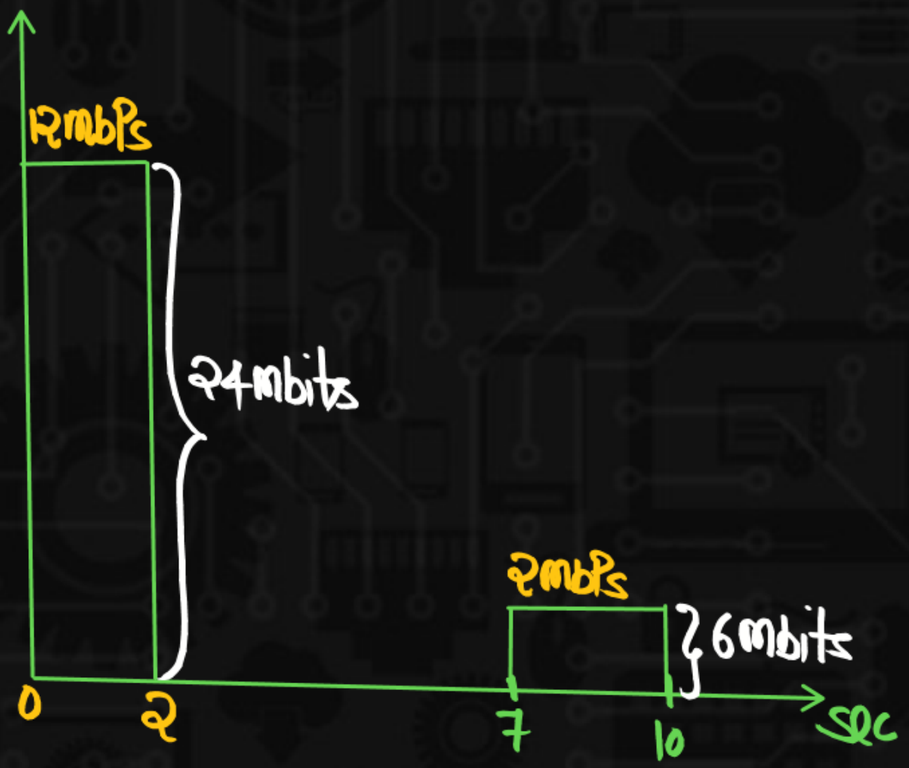
Traffic Shaping

1. Another method of congestion control is a “shape” the traffic before it enters into the Network.
2. Traffic shaping control the “rate” at which packet are sent.
3. During connection establishment, the sender and carrier negotiate a traffic pattern.

Leaky Bucket

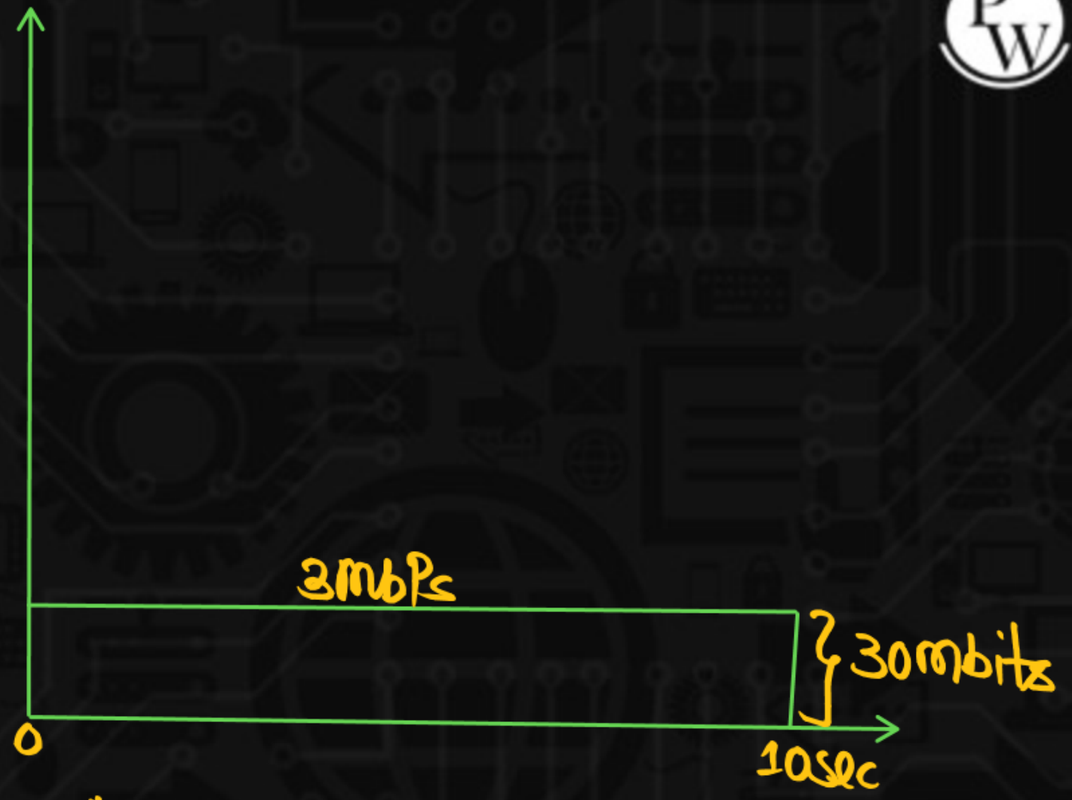
1. If a bucket has a small hole at bottom, the water leaks from the bucket at a constant rate as long as there is a water in the bucket.
2. The rate at which the water leaks does not depends on the rate at which the water is input unless the bucket is empty.
3. If the bucket is full, water overflows. The input rate can vary, but the output rate remains constant.
4. Similarly in networking , a technique called leaky bucket can smooth out bursty traffic.
5. Leaky bucket Algorithm shapes the Bursty traffic into Fixed rate traffic by Averaging the rate.


tap
Bucket
Arrival
Full
No
Yes
Discarded
7 6 5 4 3 2 1
Queue
Processor
Departure
Leaky Bucket Algorithm
Fetch the Packet
From the queue at
constant rate



Bursty data

10sec ⇒ 24mbits + 6mbits = 30mbits



10sec ⇒ 30mbits

Fixed data rate

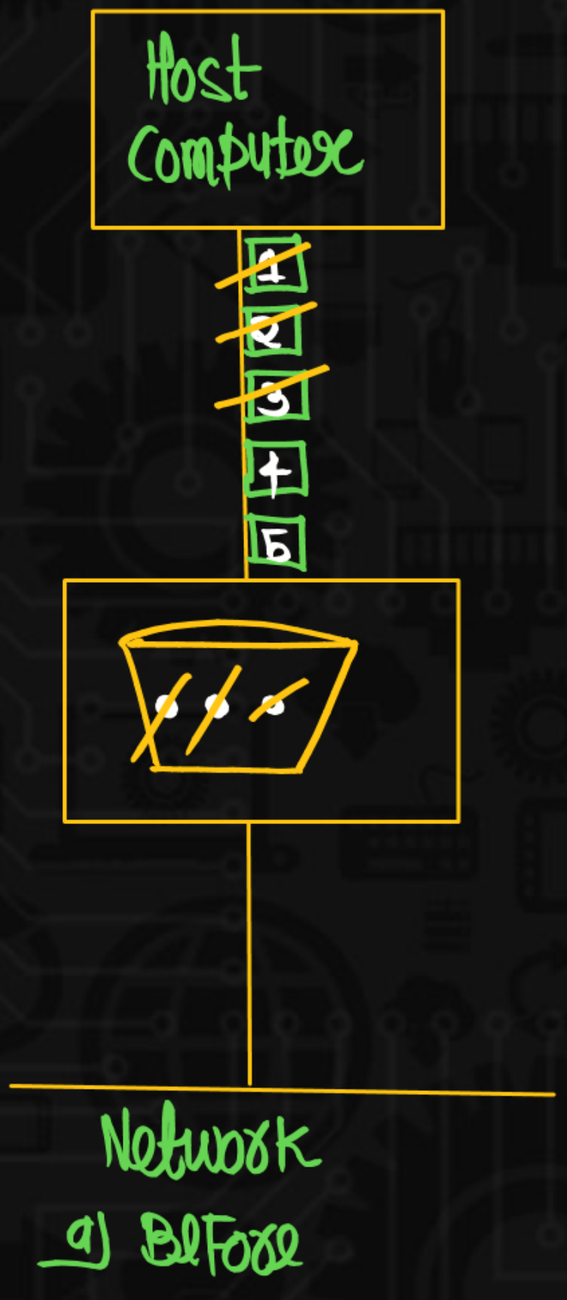
Disadvantage of Leaky Bucket

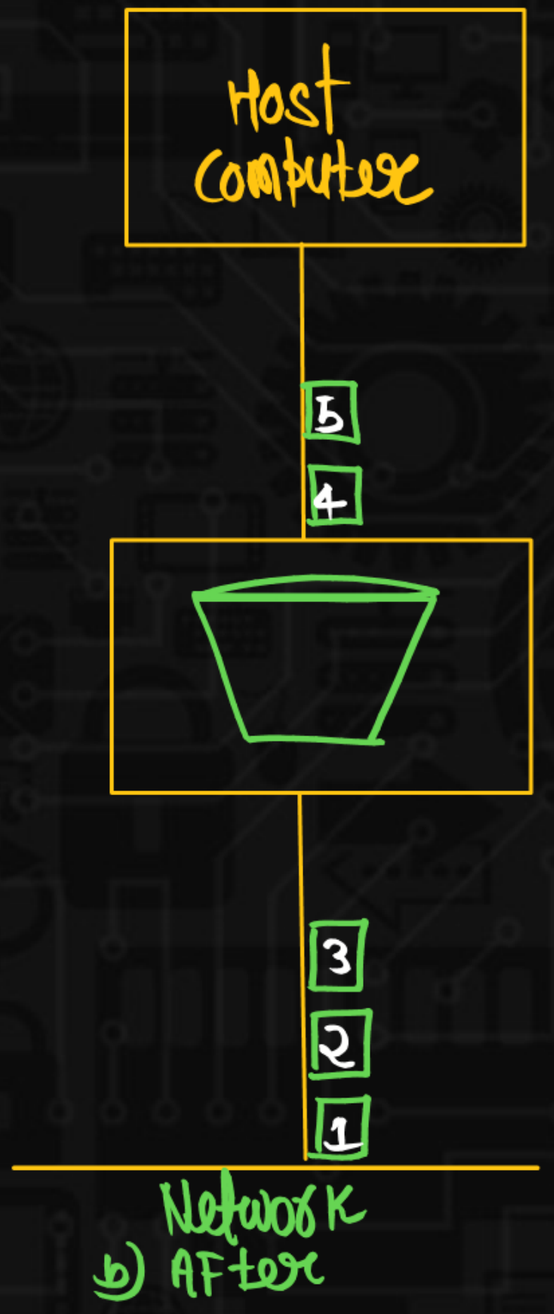
The Leaky Bucket is very Restrictive. It does not credit for an ideal Host. For example, If a Host is Not sending for a while, its Bucket becomes empty. Now if the Host has bursty data, the Leaky Bucket allows only an average rate. The time when the Host was ideal is not taken into Account.

Token Bucket:

Token Bucket Algorithm allows ideal Hosts to accumulate credit for the Future in the form of tokens.

- In regular interval tokens are thrown into the bucket
- Bucket has a maximum capacity
- If there is a ready packet, a token is removed from Bucket and packet is sent.
- If there is no token in the Bucket the pocket can not be sent.


Host Computer
1
2
3
4
5
Network
a) Before

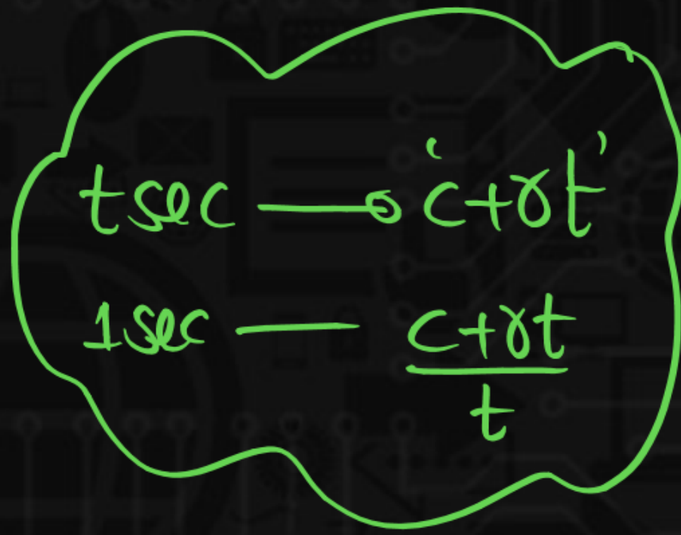

Host Computer
5
4
3
2
1
Network
b) After

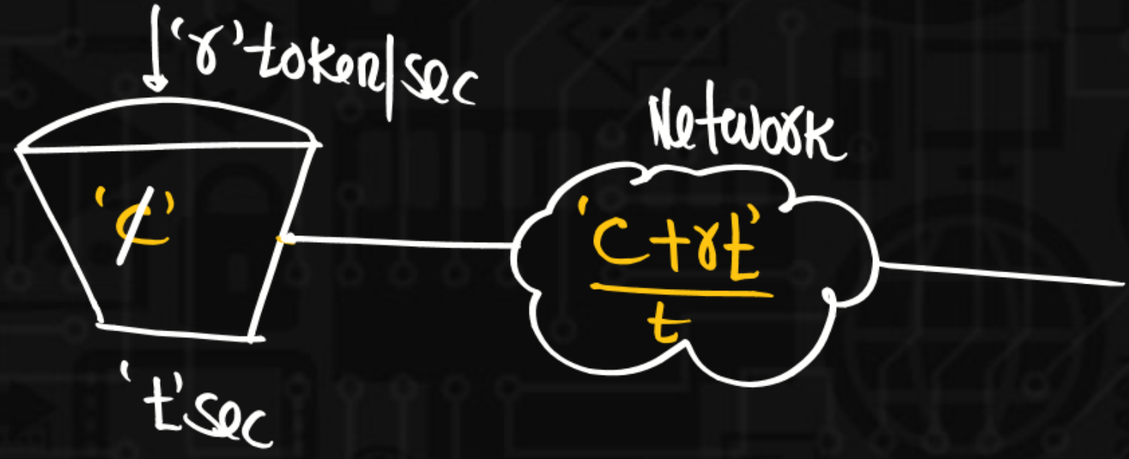
Let the capacity of token Bucket is 'C' token and token enter into the Bucket at the rate of 'γ' token Per seconed

Maximum No. of Packets that can be entese into the Network during any time interval of Length 't' is

Maximum No. of Packets = $C+\gamma t$

Maximum Avg rate For token Bucke 'm' = $\frac{C+\gamma L}{t}$





Problem Solving
on
Traffic Shaping

Q.1 Consider a token Bucket of capacity 250 KB and the tokens arrive at a rate of 2 MB/sec. if the maximum output rate is 25 MB/sec. What is Burst Time?

$C = 250KB$, $\gamma = 2MB/sec$, $M = 25MB/sec$

$t = ?$

$$M = \frac{C + \gamma t}{t}$$

$$Mt = C + \gamma t$$

$$Mt - \gamma t = C$$

$$(M - \gamma)t = C$$

$$t = \frac{C}{M - \gamma}$$

$$t = \frac{250KB}{25MB/sec - 2MB/sec}$$

$$t = \frac{250KB}{23MB/sec}$$

$$t = 10.86msec$$

$$m = \frac{c+\gamma t}{t}$$

$$\lim_{t \to \infty} \frac{c+\gamma t}{t}$$

$$\lim_{t \to \infty} \frac{c}{t} + \gamma$$

$$m = 0 + \gamma$$

$$\boxed{m = \gamma}$$

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

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A. 1.6 seconds

B. 2 seconds ✓

C. 5 seconds

D. 8 seconds

$\gamma = 2$ mbps

$C = 16$ mbits

$m = 10$ mbps

$$t = \frac{C}{m - \gamma}$$

$$t = \frac{16 \text{ mbits}}{10 \text{ mbps} - 2 \text{ mbps}} = \frac{16 \text{ mbits}}{8 \text{ mbps}} = \frac{16 \text{ mbits}}{8 \text{ mbits/sec}} = 2 \text{ sec}$$

(2sec)

16mbits + 4mbps = 20mbps

10mbps ⇒ 2sec

Q.3 A computer on a 6-Mbps network is regulated by a token bucket. The token bucket is filled at a rate of 1 Mbps. It is initially filled to capacity with 8 megabits. How long can the computer transmit at the full 6 Mbps?

A. 1 sec

B. 1.6 sec ✓

C. 2 sec

D. 2.6 sec

$M = 6\ \text{mbps}$

$\gamma = 1\ \text{mbps}$

$C = 8\ \text{mbits}$

$t = ?$

$$t = \frac{C}{M - \gamma}$$

$$t = \frac{8\ \text{mbits}}{6\ \text{mbps} - 1\ \text{mbps}}$$

$$t = \frac{8\ \text{mbits}}{5\ \text{mbits/sec}}$$

$$t = 1.6\ \text{sec}$$

Q.4 Imagine that the maximum packet size is 1000 bytes, the token bucket rate is 10 million bytes/sec, the token bucket size is 1 million bytes, and the maximum transmission rate is 50 million bytes/sec. How long can a burst at maximum speed last?

A. 15 msec

B. 20 msec

C. 25 msec ✓

D. 30 msec

$\gamma = 10\,MB/sec$, $C = 1\,Mbyte$

$M = 50\,MB/sec$

$t = ?$

$$t = \frac{C}{M - \gamma}$$

$$t = \frac{1\,Mbyte}{50\,MB/sec - 10\,MB/sec}$$

$$t = \frac{1\,Mbyte}{40\,Mbyte/sec}$$

$t = 0.025\,sec$

$t = 25\,msec$

Q.5 For a host machine that uses the token bucket algorithm for congestion control, the token bucket has a capacity of 1 megabyte and the maximum output rate is 20 megabytes per second. Tokens arrive at a rate to sustain output at a rate of 10 megabytes per second. The token bucket is currently full and the machine needs to send 12 megabytes of data. The minimum time required to transmit the data is 1.1 seconds.

GATE CS 2016
(2 Marks)

$C = 1MB$, $M = 20MB/sec$, $\gamma = 10MB/sec$

$$t = \frac{C}{M - \gamma}$$

$$t = \frac{1MB}{20MB/sec - 10MB/sec}$$

$$t = \frac{1MB}{10MB/sec}$$

$t = 0.1 sec$

Time taken to empty the Bucket

In 0.1sec we can transfer data = 0.1*20mB = 2mByte

Total data = 12MB

Remaining data = 12MB - 2MB = 10mB

So For transferring 10mB data we need only 1 sec (bcz γ = 10mB/sec)

Total time = 0.1sec + 1 sec

= 1.1 sec


THANK YOU
GW
SOLDIERS !