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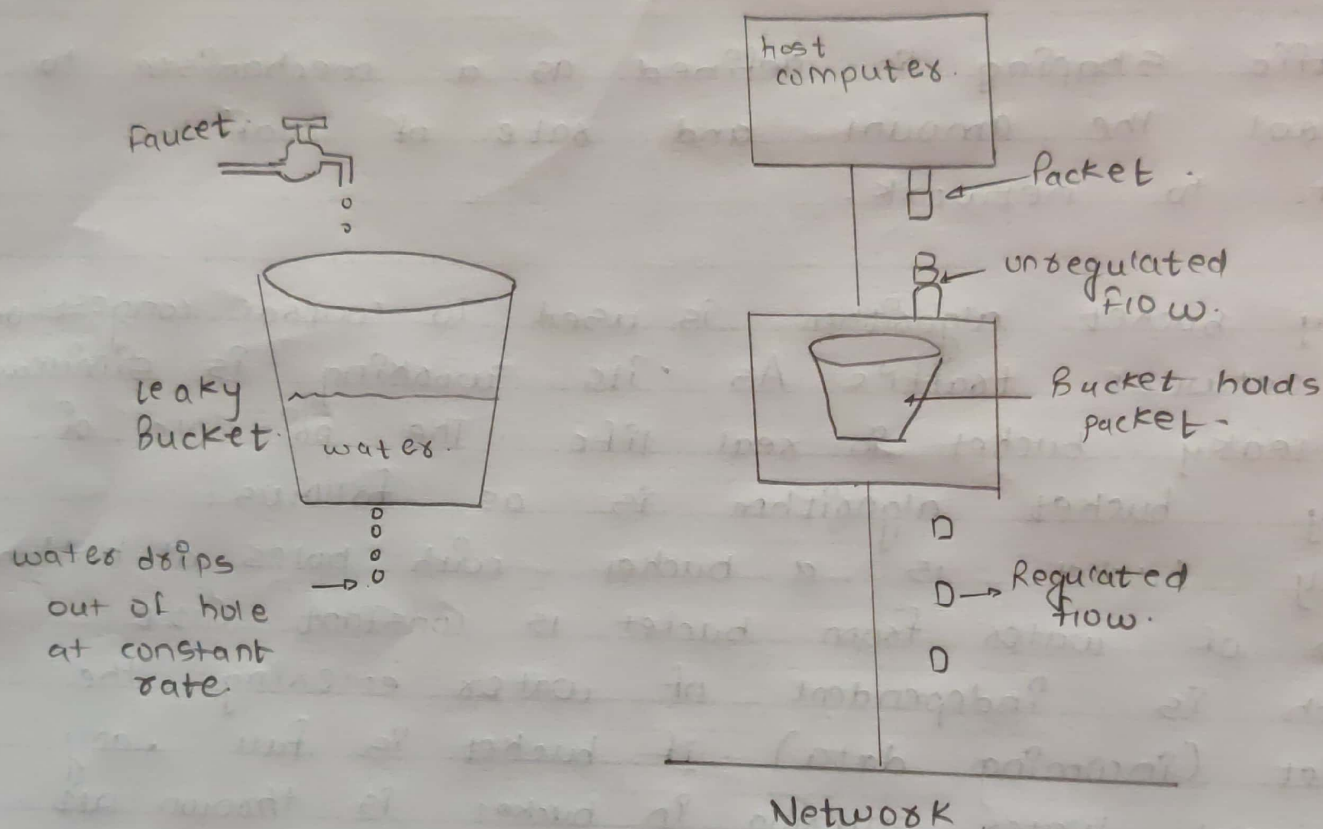
A) Traffic Shaping is defined as a mechanism to control the amount and rate of traffic sent to network.

Leaky bucket algorithm is used to control congestion in network traffic. As its working is similar to leaky bucket in real life. The principle of leaky bucket algorithm is as follows:-

Leaky bucket is a bucket with holes at bottom. Flow of water from bucket is constant rate which is independent of water entering the bucket (incoming data). If bucket is full, any additional water entering in bucket is thrown out. (Packets are discarded)

Same technique is applied to control congestion in network traffic. Every host in network is having a buffer (equivalent to bucket) with finite queue length. Packets which are put in buffer when buffer is full are thrown away. The buffer may send some no. of packets per unit time onto subnet the data flow at input of bucket is unregulated but that at bucket output is a regulated one.

A).



Leaky Bucket algorithm

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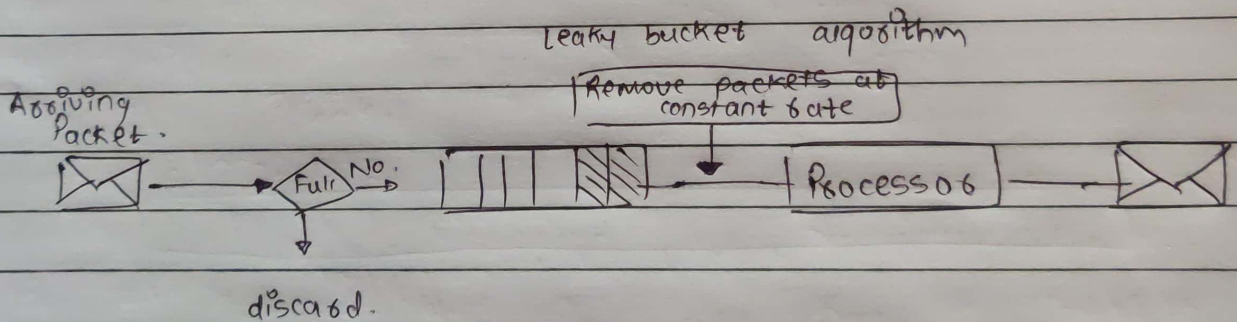
A) A FIFO queue is used for holding the packets which is equivalent to leaky Bucket. The implementation can be under two different conditions

i. For packet of fixed size.

If packets are of fixed size then the process will allow the removal of fixed number of packets from queue corresponding to every tick of the clock.

ii. Packets of variable size

If packets at input of process are of different sizes the fixed output rate will not correspond to no. of packets leaving the process but it will correspond to no. of bits leaving the process.



Implementation of leaky Bucket.

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A). Algorithm:-

The algorithm for variable length packets is as follows:-

- i. Initialize a counter to no. n at tick of clock.
- ii. If ' n ' is greater than packet size then send the packet and decrement the counter by packet size.
- iii. Repeat step 2 until ' n ' becomes smaller than packet size.
- iv. Reset the counter and go back to step 1.

—x—x—x—x—

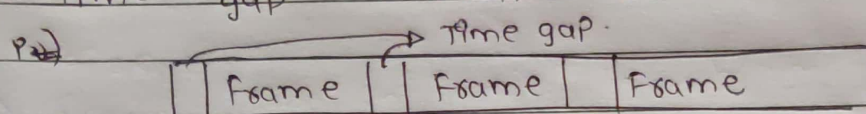
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c). i. The data link layer takes packets from the network layer and converts them into frames.
 ii. Breaking the bit stream into frames is called framing.

ii. One way of framing is by inserting the time gap between frames.

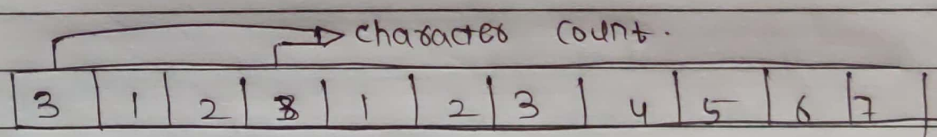


Framing example using time gaps

Framing methods:-

i. Character count.

- The first field is header specifies the number of characters in the frame.
- This number helps the receiver to know the number of characters in frame following.



Character Count Method.

disadvantage:-

Count may get garbled by transmission errors.

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c) i) character stuffing:-

- It is character oriented protocol.
- Each frame starts and ends with FLAG byte.
- Thus adjacent frames are separated by two flag bytes.
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Problem:- It is possible that FLAG is actually a part of data.

Solution:-

- At sender an ESC character is inserted just before FLAG byte present in data.
- At receiver the ESC is removed from data.
- Now if ESC is present in data then extra ESC is inserted before in data.
- This extra ESC is removed at receiver.

iii) Bit stuffing

- It is bit oriented protocol.
- Each frame begins and ends with specific bit pattern 01111110 called flag byte.
- When sender DDL encounter 5 consecutive 1's in data it automatically stuffs a '0' bit in outgoing data stream.

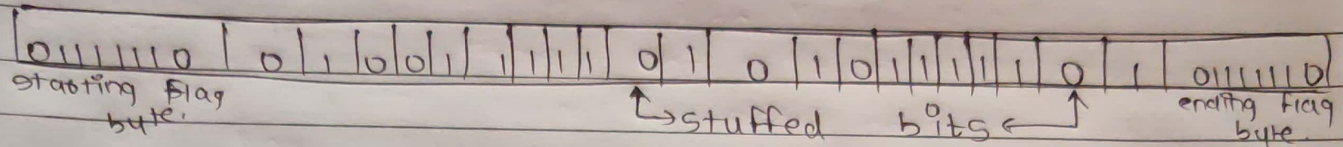
Original data

0	1	0	0	1	1	1	1	1	1	0	1	1	1	1	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

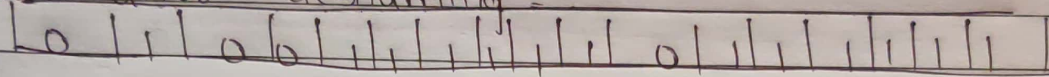
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sign E-G. Kalaw.

c). Outgoing data stream



Data after deshuffling :



The data link layer packs bits into frames so that each frame is distinguishable from other frames.

Framing can be two different types.

- a) fixed size framing
- b) variable size framing.

Advantages of variable size framing over fixed size framing.

- i) Although, the whole message could be packed in one big frame it is not done practically because for large frames the flow and error control become inefficient.
- ii) In LAN's there are more than one senders. The message sent by them could be of different size. Hence it makes system efficient by keeping frame size variable as it is possible to select an optimum frame size as per requirements.