NETWORK PROTOCOLS & SECURITY
23EC2210 R/A/E

Topic:

QUALITY OF SERVICE

Session - 29

AIM OF THE SESSION

To familiarize students with the basic concept of Quality of Service

INSTRUCTIONAL OBJECTIVES

This Session is designed to:

1. Introduction to Quality Of Service
2. Various Techniques of QOS

LEARNING OUTCOMES

At the end of this session, you should be able to:

1. Describe the concepts of Quality Of Service
2. List out different Techniques of QOS

AGENDA

- Quality of Service
- Techniques To Improve QOS

QUALITY OF SERVICE

- A stream of packets from a source to destination is called a flow.
- In a connection-oriented network, all the packets belonging to a flow follow the same route.
- In a connectionless network, they may follow different routes.
- The needs of each flow can be characterized by four primary parameters: reliability, delay, jitter and bandwidth.
- Together these determine the QOS (Quality Of Service) the flow requires.

TECHNIQUES TO IMPROVE QOS

1. Over provisioning
2. Buffering
3. Traffic shaping
    i. The leaky bucket algorithm
    ii. Token Bucket algorithm
4. Packet scheduling
5. Admission control
6. Integrated services
    i. RSVP – Resource Reservation Protocol
7. Differentiated services
    i. Expedited forwarding
    ii. Assured forwarding

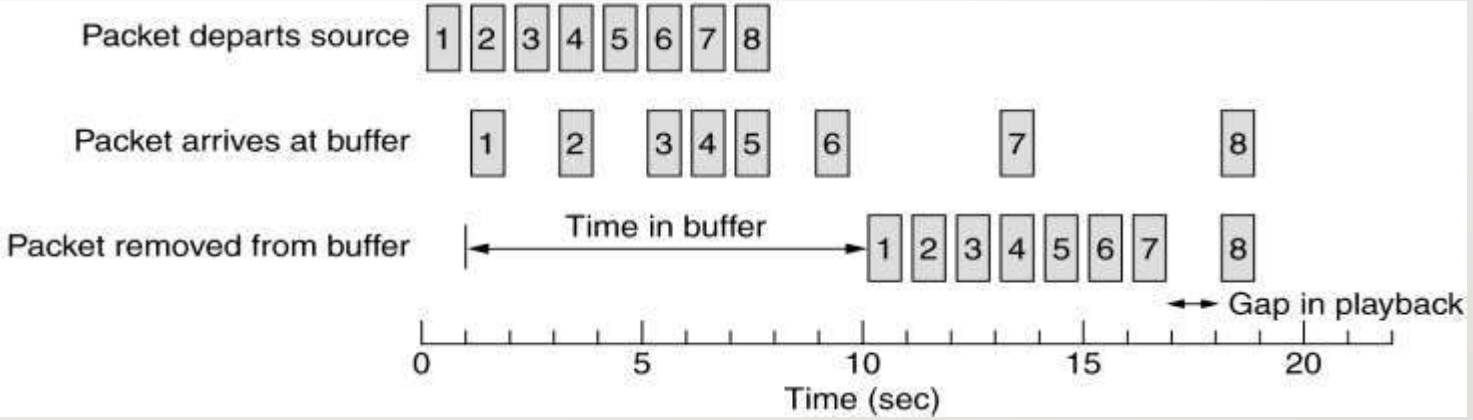
QOS TECHNIQUE – OVERPROVISIONING

- **Overprovisioning:**
  - An easy solution is to provide so much router capacity, buffer space and bandwidth that the packets just fly through easily.
  - The trouble with this solution is that it is expensive.

QOS TECHNIQUE – BUFFERING

Buffering:

- Flows can be buffered on the receiving side before being delivered.
- Buffering them does not affect the reliability or bandwidth and increases the delay, but it smooths out the jitter.
- For audio and video on demand, jitter is the main problem, so this techniques helps a lot.



Smoothing the output stream by buffering packets.

Traffic Shaping

QOS TECHNIQUE – TRAFFIC SHAPING

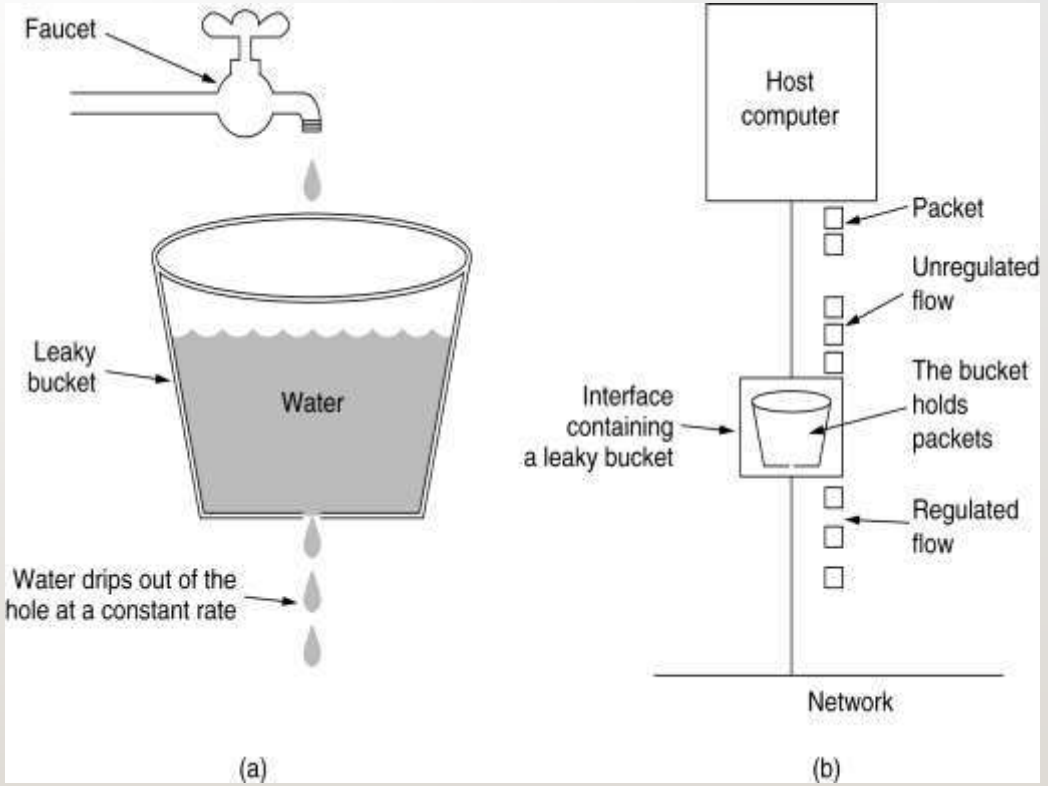
- **Traffic Shaping** is a mechanism to control the amount and the rate of the traffic sent to the network.
- Approach of congestion management.
- Traffic shaping helps to regulate rate of data transmission and reduces congestion.
- There are 2 types of traffic shaping algorithms:
  - **Leaky Bucket**
  - **Token Bucket**
- Monitoring a traffic flow is called **traffic policing.**

LEAKY BUCKET ALGORITHM

QOS TECHNIQUE – TRAFFIC SHAPING

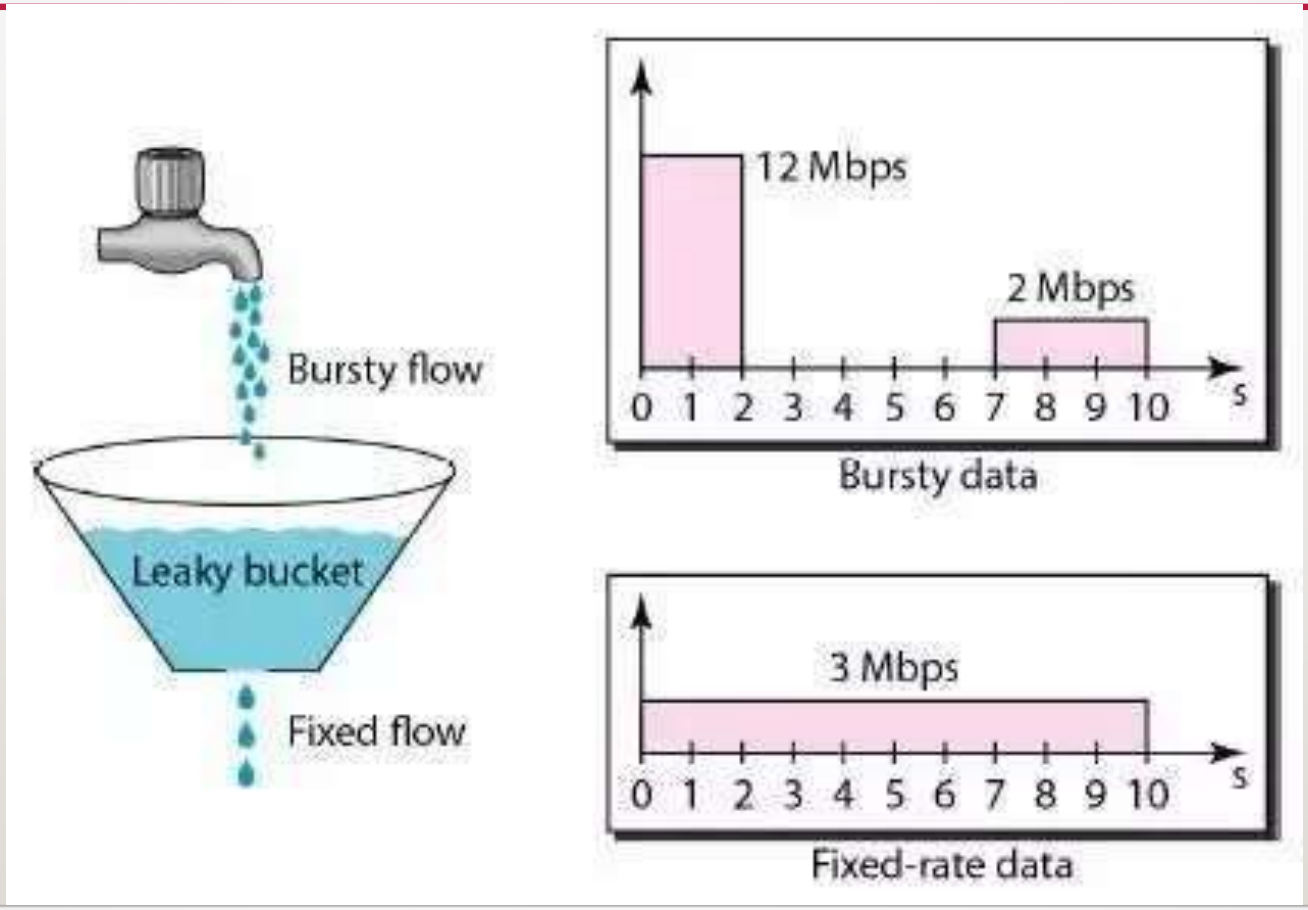
LEAKY BUCKET

- Suppose we have a bucket in which we are pouring water in a random order but we have to get water in a fixed rate, for this we will make a hole at the bottom of the bucket.
- It will ensure that water coming out is in a fixed rate, and also if bucket will full we will stop pouring in it. The input rate can vary, but the output rate remains constant.
- Similarly, in networking, a technique called leaky bucket can smooth out bursty traffic. Bursty chunks are stored in the bucket and sent out at an average rate.



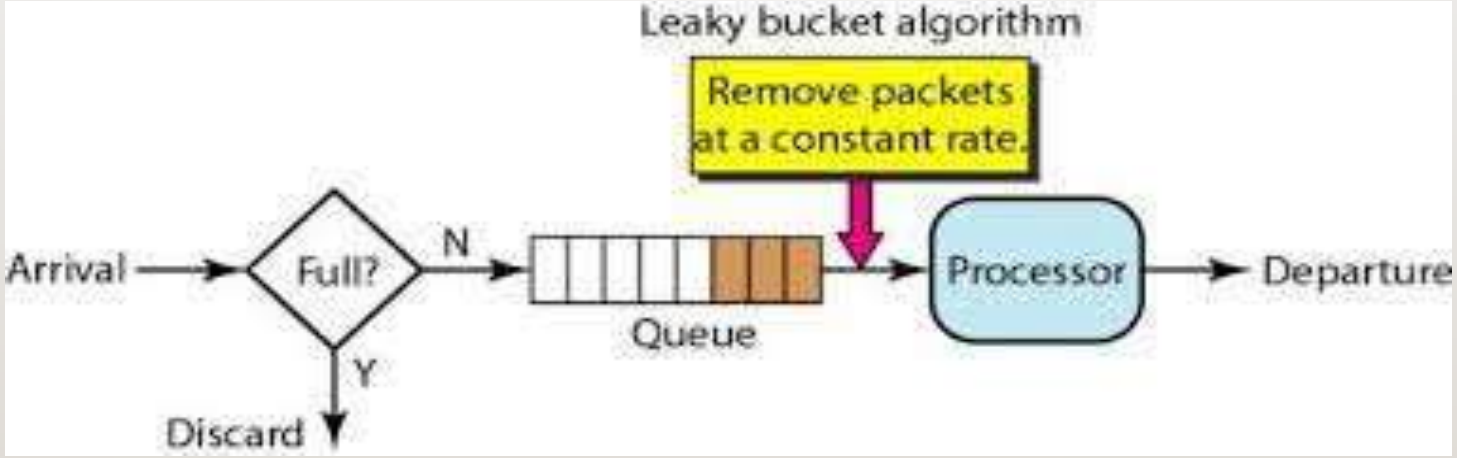
QOS TECHNIQUE – TRAFFIC SHAPING

LEAKY BUCKET



IMPLEMENTATION OF LEAKY BUCKET ALGORITHM

- A simple leaky bucket algorithm can be implemented using FIFO queue.
- A FIFO queue holds the packets.
- If the traffic consists of fixed-size packets, the process removes a fixed number of packets from the queue at each tick of the clock.
- If the traffic consists of variable-length packets, the fixed output rate must be based on the number of bytes or bits.



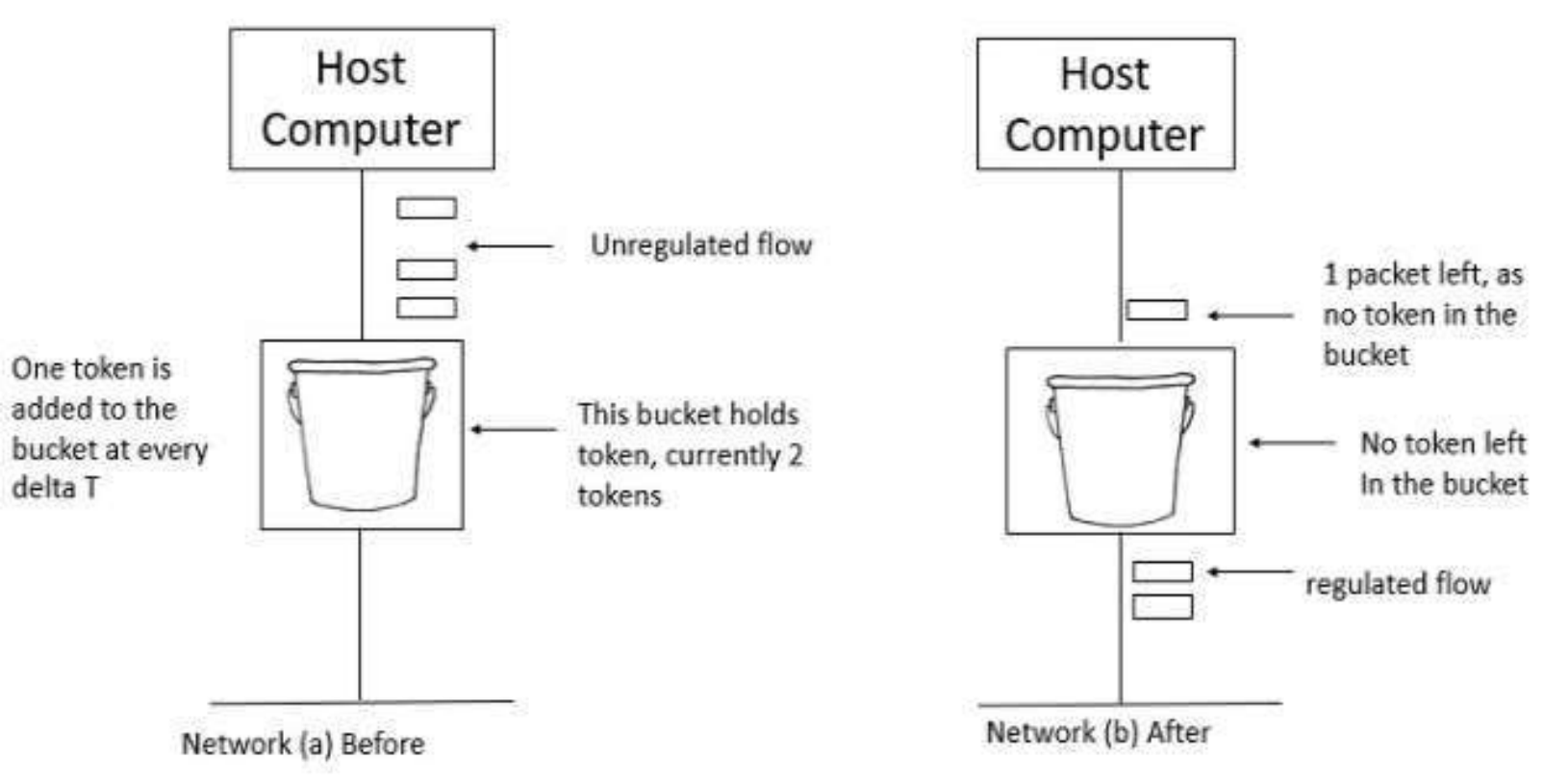
TOKEN BUCKET ALGORITHM

QOS TECHNIQUE – TRAFFIC SHAPING

TOKEN BUCKET

- The leaky bucket algorithm enforces output patterns at the average rate, no matter how busy the traffic is.
- So, to deal with the more traffic, we need a flexible algorithm so that the data is not lost. One such approach is the token bucket algorithm.
- Let us understand this algorithm step wise as given below −
  - **Step 1** − In regular intervals tokens are thrown into the bucket f.
  - **Step 2** − The bucket has a maximum capacity f.
  - **Step 3** − If the packet is ready, then a token is removed from the bucket, and the packet is sent.
  - **Step 4** − Suppose, if there is no token in the bucket, the packet cannot be sent.

TOKEN BUCKET



- In figure (a) the bucket holds two tokens, and three packets are waiting to be sent out of the interface.
- In Figure (b) two packets have been sent out by consuming two tokens, and 1 packet is still left.

QOS TECHNIQUE – TRAFFIC SHAPING

TOKEN BUCKET IMPLEMENTATION

- When compared to Leaky bucket the token bucket algorithm is less restrictive that means it allows more traffic.
- The limit of busyness is restricted by the number of tokens available in the bucket at a particular instant of time.

- **The implementation of the token bucket algorithm is easy −**
  - A variable is used to count the tokens.
  - For every t seconds the counter is incremented and then it is decremented whenever a packet is sent.
  - When the counter reaches zero, no further packet is sent out.

REFERENCES FOR FURTHER LEARNING OF THE SESSION

TEXTBOOKS:

1. Data Communications and Networking(3rd Edition) – B A Ferouzan – TMH
2. Computer Networks (4th Edition) – A S Tanenbaum - Pearson Education/PHI

Reference Books:

1. Data Communications and Networking(5th Edition) – W. Stallings - Pearson Education/PHI
2. Network for Computer Scientists & Engineers, Zheng & Akhtar, OUP

WEB REFERNCES/MOOCS:

1. Kurose and Rose – "Computer Networking -A top down approach featuring the internet"– Pearson Education
2. "Communication Networks" – Leon, Garica, Widjaja TMH
3. "Internetworking with TCP/IP, Comer – vol. 1, 2, 3(4th Ed.)" – Pearson Education/PHI
4. https://www.tutorialspoint.com/what-is-closed-loop-congestion-control/
5. https://www.geeksforgeeks.org/congestion-control-techniques-in-computer-networks/3.

THANK YOU

Team – NETWORK PROTOCOLS AND SECURITY