A Design of Adaptive Double Leaky Bucket in Traffic Shaping over VDSL Network

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Abstract:- Traffic shaping in high speed networks, including VDSL networks, occurs when congestion builds up in the outgoing VDSL network. Shaping mechanisms want smooth traffic. We used a leaky bucket too achieve traffic shaping. But leaky buckets still have a lot of non-conforming frames. However, as one way to solving this problem, we purpose a double-leaky bucket as the traffic shaping mechanism that has proven to be efficient in coping with conflicting requirements, that is, low non-conforming frames. We evaluate and compare the performance of a double-leaky bucket in traffic shaping mechanisms (DLB) and leaky buckets (LB). The performance of the double-leaky bucket was investigated through fluctuations in telecommunication traffic streams (burst/silent type). Simulation results showed that on VDSL frames, a double-leaky bucket helps improve the performance in a traffic-shaping system much better than conventional, leaky-bucket systems by about 30 %, in terms of conforming and non-conforming frames. Once various types of burst/silence traffic are generated, the leaky bucket is much better than other schemes by about 29 % in terms of utilization.

Key-Words:- Double leaky bucket , congestion, traffic shaping mechanism.

1 Introduction

When a high-speed network device receives more frames than it can transmit to a destination, the receiver begins to non-conforming frames. This leads to network congestion because the source device retransmits frames and this causes a degraded throughput.

In the other words, congestion in VDSL networks causes greater loss of frames in a shorter period of time. The solution to this problem is to take precaution before the congestion will occur. The mechanisms developed can be classified in two main groups in traffic shaping mechanism. The first group is the token leaky bucket mechanisms and the second group is the leaky bucket mechanisms. Token leaky bucket has difficulties and is complicated to implement; however, the leaky bucket is easy to implement and can applied to the network [1][2][3].

In this paper, we apply double leaky bucket concepts to network of queue and evaluate the performance using a high speed network model. There were many previous studies involving traffic shaping mechanism[4][5], however, double leaky bucket compared with the behavior of leaky bucket in term of traffic shaping is not mentioned. We therefore proposed that the performance comparison between double leaky bucket and traditional leaky bucket of the VDSL network.

This paper is organized as follows, in section 2, an overview of the most significant traffic shaping mechanisms already proposed in literature is proposed. Section 3, we defines the simulation model. Section 4 contains a performance evaluation of the proposed solution and comparison to double leaky bucket , leaky bucket scheme. In section 5, some conclusion and recommendations for future research are presented.

2 Description and modeling of traffic shaping

2.1 Requirement for shaping mechanism

Traffic shaping mechanism system can monitor traffic parameters as defined earlier such as, peak rates (see Figure 1). When an arriving frame is detected as being in excessive of the receiving system, the network monitor can mark frame as the

non-conforming frames. The traffic shaping mechanism system wants smooth traffic connections from compromising the performance of other connections, and significantly improves the quality of service(QoS).

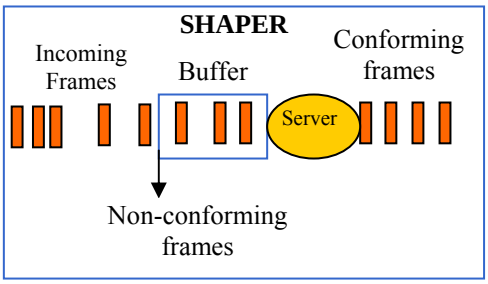

Figure 1 Traffic shaping mechanism

Traffic shaping mechanism system allows us to control the smooth data rate of traffic sent during the active phase and can be operated in real time. The mechanisms have been proposed which are described in following sections.

2.1.1 Traffic source models

In our simulation, a single source can generate Burst/Silence traffic stream. Burst-periods and Silence-periods are strictly alternating.

2.1.2. Traffic shaping mechanism model

Traffic shaping in a network is done at the egress of the network for frame-based traffic. This mechanism decides whether to accept a unit of incoming traffic and sends it as smooth traffic or marking a frame as non-conforming frame. This paper selected two shaping mechanisms, including the Leaky Bucket (LB) ,the Double-Leaky Bucket (DLB).

Leaky bucket process model

The VDSL network must provide a large bandwidth and handle the quality of service (QoS) guarantees. The Leaky Bucket (LB) mechanism (see figure 2) ensures that the source traffic does not exceed the negotiated rate. The bucket-size can be represented as a buffer with capacity N. If the buffer is filled up with frames until it is overflowing, then the frames are dropped. The server generates at a specific data rate, R. The LB is a commonly used for traffic control in high-speed networks

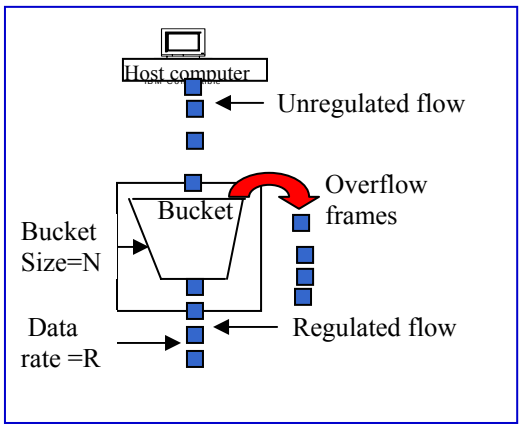

Figure 2 Leaky bucket mechanism.

The double leaky bucket mechanism (DLB)[6]

The traffic shaping mechanism system can be used a double-leaky bucket algorithm that requires a high-speed network. As indicated by the name, the behavior of a leaky bucket is similar to a bucket with a hole in its bottom. If data flows into the bucket faster than it flows out of the bucket, then the bucket overflows. This causes data to be dropped until there is enough room in the buffer to accept new data. A leaky bucket uses two parameters to control the flow of traffic:

• Data rate — the number of frames per second that leak from the leaky bucket; permitting data to enter the network.

• Burst/Silence size — the number of groups of frames that are allowed to accumulate in the bucket and Burst/Silence traffic stream. Burst-periods and Silence-periods are strictly alternating.

It is important to ensure that the data rate is appropriate for the frame egress interface of network. The use of double-leaky buckets as a traffic monitor is shown in Figure 3.

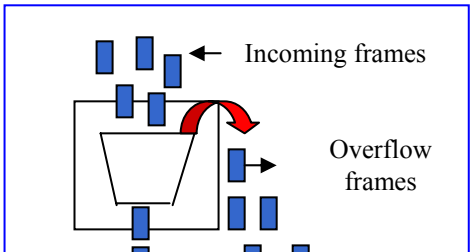

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Figure 3 Double leaky bucket traffic shaper.

The insured rate bucket in Figure 3 determines whether an incoming unit of data can be accepted by the bandwidth for this network connection. The parameters for this double leaky bucket are the data rate and burst size for the VDSL network.

3 Simulation model

Figure 4 shows a simulation model used in this paper.

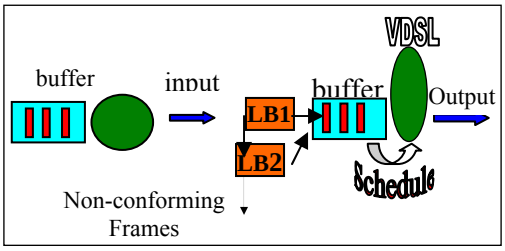

Figure 4 Simulation model.

3.1 Input traffic

This paper limits the discussion to main data only. In telecommunication, destination node always receives waver traffic.

3.2 Characteristics of queuing network model

Here are three components with characteristics that must be investigated before the simulation models are developed.

3.2.1 Arrival characteristics

The arrival pattern of the input traffic is primarily characterized as the *Poisson arrival process*[10]. In this paper, the burstiness of ON and OFF is firstly fixed to be 100/100.

3.2.2 Service facility characteristics

In this paper, service times are randomly distributed by the *exponential probability distribution*. This is a mathematically convenient assumption if arrival rates are Poisson distributed. In order to examine the traffic congestion at output of VDSL downstream link (15Mbps) [7], the service time in the simulation model is specified by the speed of output link, given that a service time is 216 μs per frame where the frame size is 405 bytes [8].

3.2.3 Source traffic descriptor

The parameters of traffic source are characterized by the traffic that will during the connection. The relation of each traffic parameter used in the simulation model is defined below.

PFR(peak frame rate)= $\lambda a = 1/T$ in units of labels/second, where T is the minimum inter-frame spacing in seconds. This research focuses on :

Leaky bucket 1 has parameters as
PFR = λa = 10 Mbps(~3,086 frames/s)
Hence, T=324 μsec.
Queue length = 15 frames

Leaky bucket 2 has parameters as
PFR = λa = 10 Mbps(~3,086 frames/s)
Hence, T=324 μsec.
Queue length = 30 frames

4 Results and analysis

The comparison between double leaky bucket and traditional leaky bucket in traffic shaping is shown in figures 5-9.

4.1The comparison between double leaky bucket, traditional leaky bucket in traffic shaping

This section indicates simulation results from double leaky bucket and traditional leaky bucket, that are, double leaky bucket (DLB), and traditional leaky bucket (LB) performance will be compared. The input frames (frame rate

varies from 10 Mbps to 60 Mbps) with burst/silence ratio of 100:100 performed simulation results as shown in Figure 5. It clearly determines that the double leaky bucket is the best of guarantee the throughput. Throughput is one of factor of QoS that help guarantee higher reliability of network performance. In conclusion, the double leaky bucket may assure higher reliability to handle real time applications such as multimedia traffics, when compared to traditional policing mechanism scheme.

Figure 6 double leaky bucket will produce the lowest non-conforming frames compared to leaky bucket in term of traffic shaping mechanism schemes..

In Figure 7, the result determines that the utilization of the leaky bucket in traffic shaping mechanism scheme is the lowest. From this viewpoint, the processing unit will be available for other sources in terms of sharing. The result is in the line of low processing power required by LB because LB produces less conforming frames and higher non-conforming frames. It is no problem about utilization of double leaky bucket because it is a little higher than 80 %.

In conclusion, double leaky bucket in traffic shaping mechanisms perform better than traditional leaky bucket in from of conforming and non-conforming frame.

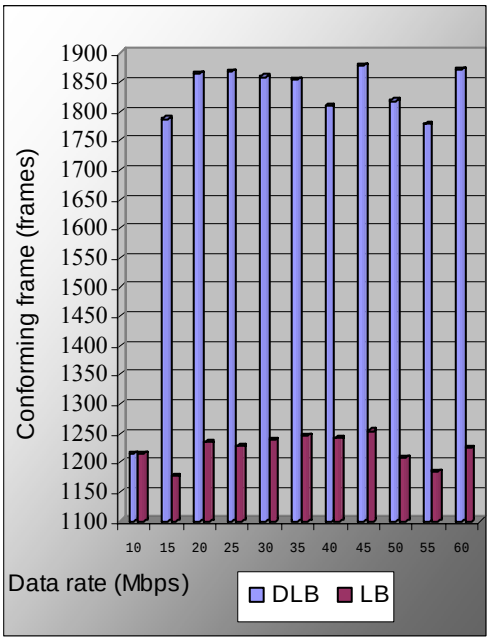

Figure 5 illustrates conforming frames comparison between double leaky bucket(DLB and leaky bucket(LB) in traffic shaping mechanism with burst : silence =100:100.

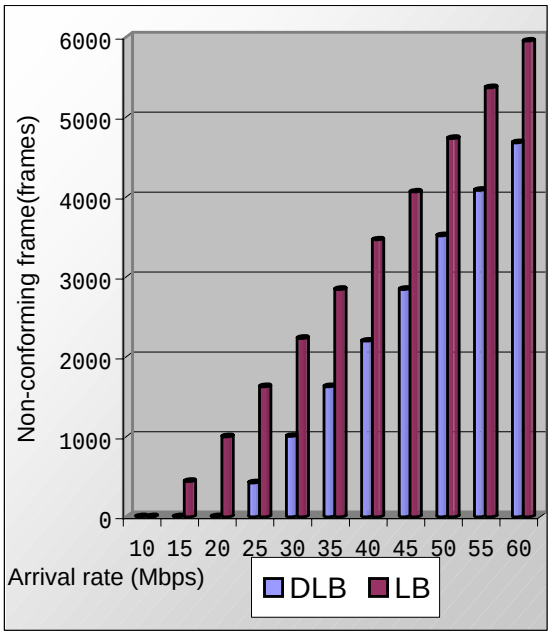

Figure 6 illustrates non-conforming frames comparison between double leaky bucket(DLB) and leaky bucket(LB) in traffic shaping mechanism with burst : silence =100:100.

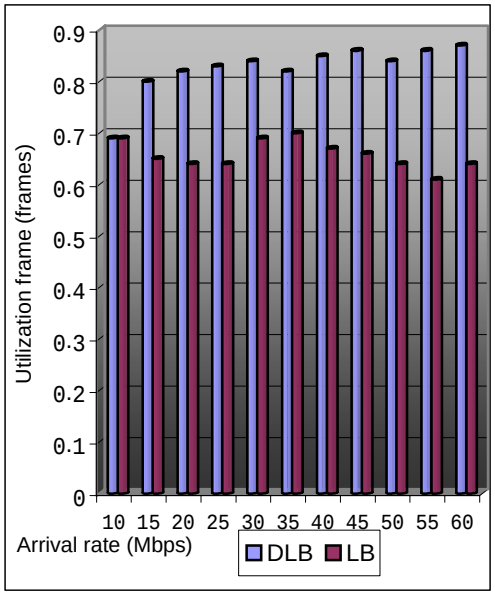

Figure 7 illustrates the utilization comparison between double leaky bucket (DLB) and leaky bucket(LB) in traffic shaping mechanism with burst : silence=100:100

5 Conclusions and recommendations for future research

In this paper, we carried out a comprehensive study to investigate the performance of double leaky bucket in traffic shaping mechanism and leaky bucket with fixed types of traffic. The study was accomplished through simulation after developing an analytical queuing model.

We found that based on simulation results in general, the double leaky bucket in traffic shaping mechanism scheme is the best conforming frame and non-conforming frames compared to traditional leaky bucket. Only the case that the network seeks for sharing or availability of the utilization, LB scheme will be the only choice. DLB is suitable for multimedia traffics such as voice, video because it wants high throughput and less non-conforming frames.

In the future work, we will focus on the investigation of fuzzy control queuing system, transmission and processing delay with traffic shaping mechanism.

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