Lab 2a: Traffic Shaping

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Exercise 1.2 Reading and Writing data from a file

Modify the program so that it computes and displays the average size of the following frame types

Average I Frame: 183776.0 Average B Frame: 36093.0 Average P Frame: 111412.0

Exercise 2.3 Evaluation

A plot that shows the difference of trace file and the output file

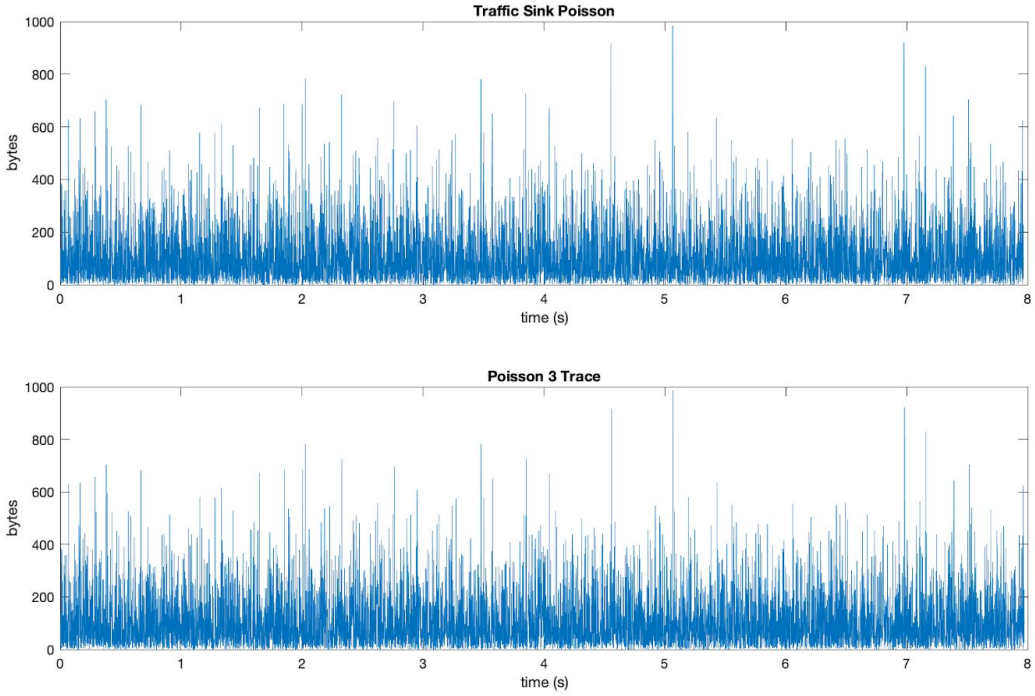

Fig 1: Comparison of packet arrivals of Poisson trace and Traffic Sink of first 10,000 packets

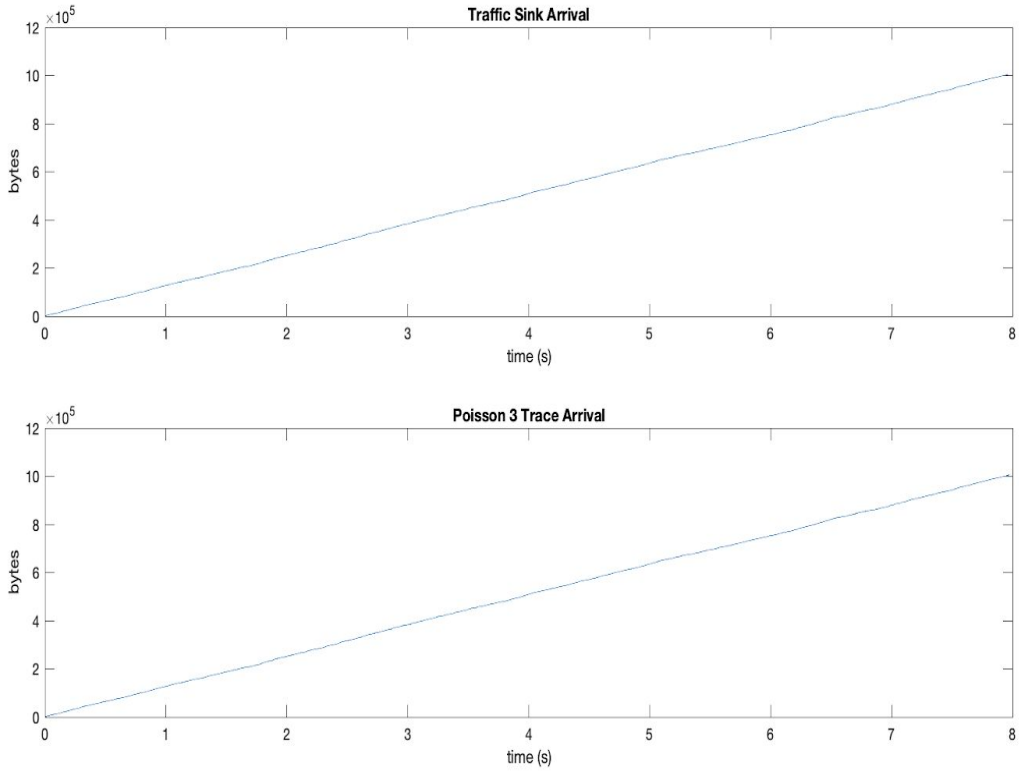

Figure 2: Comparison of cumulative arrivals of Poisson trace and Traffic Sink first 10,000 packets

Observations

The above graphs were obtained by sending packets from and to the same host machine. We observe both from the cumulative arrivals (figure 2) and packet arrival traces (figure 1) that the plots are identical. This is further supported by the fact that we observed absolutely no packet losses either.

Evaluate and graph your improvements by comparing them to the initial plot

As mentioned earlier, the plots of the Poisson trace and that obtained from our Traffic Sink are identical. Hence there were no improvements needed. To achieve this level of accuracy we used absolute time using Java's system clock API along with accounting for the initial delay of the very first packet. These modifications are both documented and included in 'TrafficGenerator_Poisson.java'.

Exercise 2.4 Account for packet losses.

Indicate in your plots from the evaluation of any packet losses.

For the 10,000 packets from the Poisson 3 trace, there was a total of 1,005,745 bytes

sent by our traffic generator. The receiver successfully received all 1,005,745 bytes, hence there were no packet losses.

Exercise 3.2 Evaluate the reference implementation for the Poisson traffic file

Prepare a single plot that shows the cumulative arrival function as a function of time of (1) trace file (2) token bucket (3) traffic sink

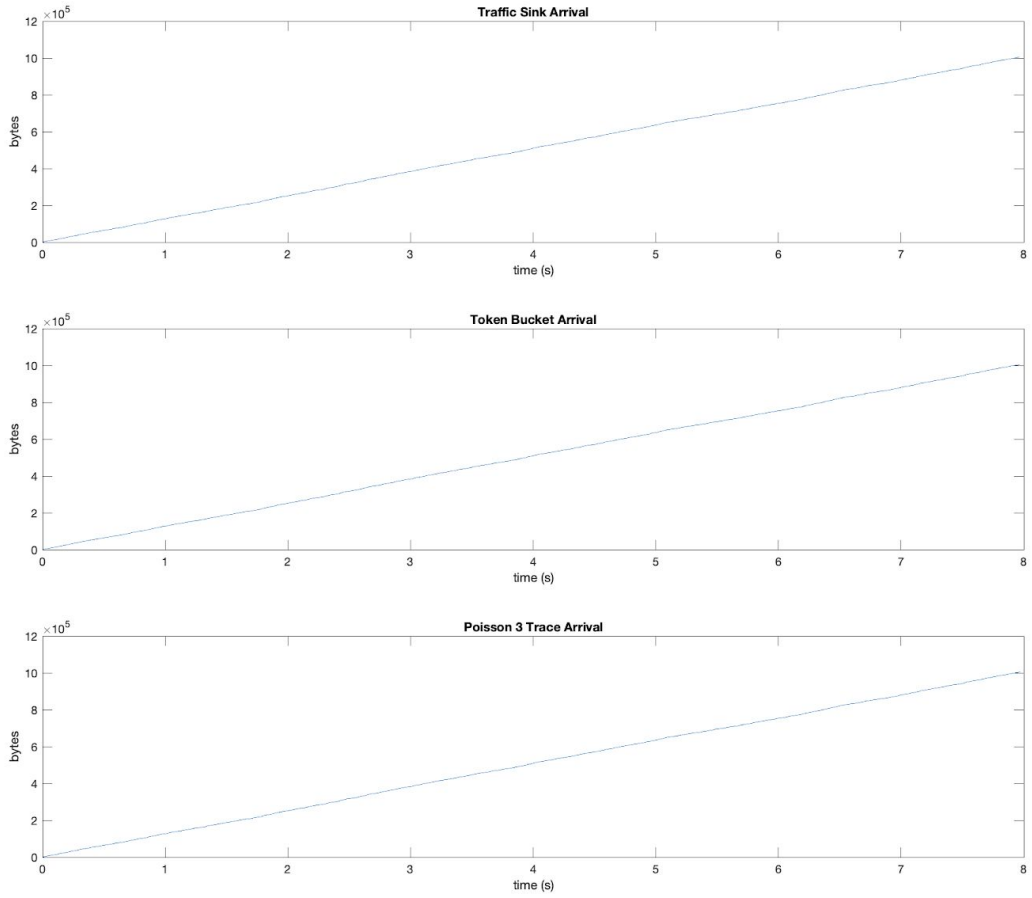

Figure 3: Comparison of cumulative arrivals of Poisson trace, sink and token bucket of first 10,000 packets

Observations

We see from figure 3 that the cumulative arrival plots of the Poisson trace in figure 3 are all identical. This is supported by the fact there is 0 packet loss (i.e. bytes sent by

generator equals bytes received by the sink). Specifically, there were 1,005,745 bytes sent and successfully received.

Provide a second plot that shows the content of the token bucket and the backlog in the Buffer as a function of time

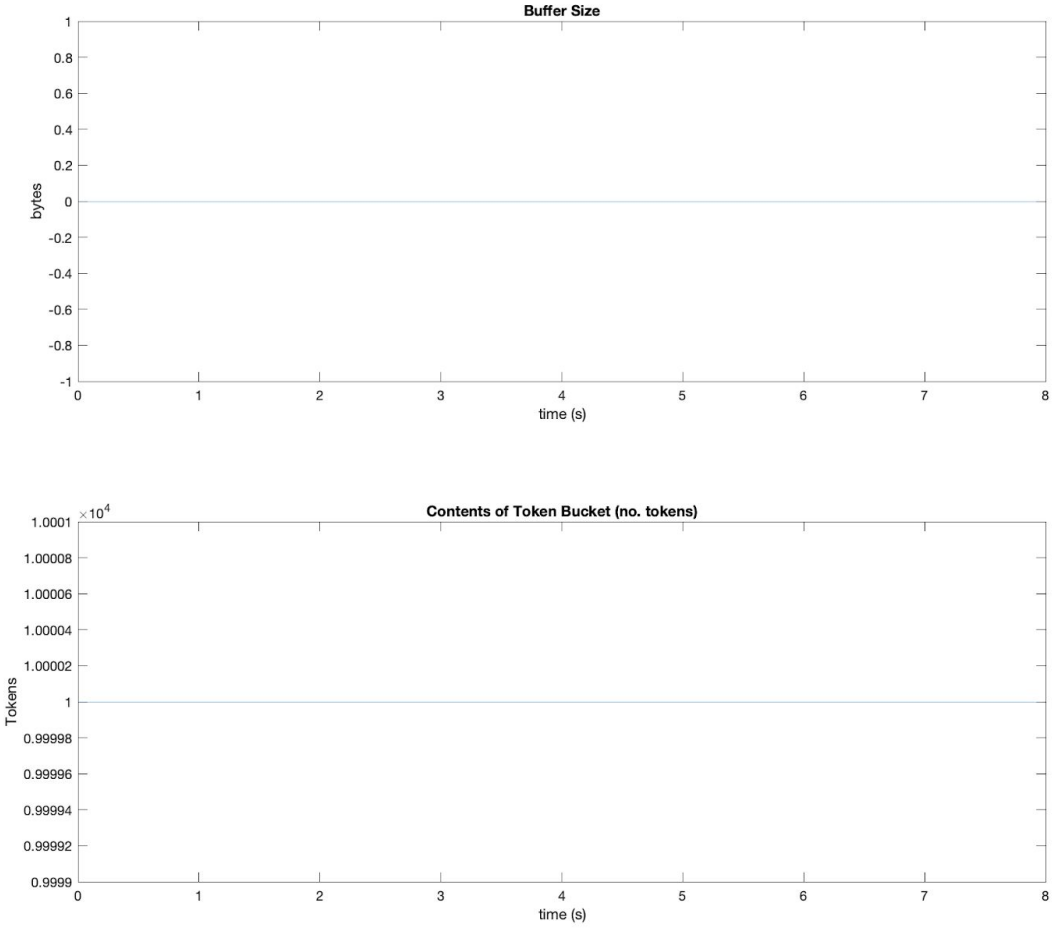

Figure 4: Contents of Token Bucket and backlog for Poisson Trace

Observations

From figure 4 we observe that the backlog (i.e. Buffer size) is always 0 and that the number of tokens is essentially constant at 10,000 tokens. From the reference TokenBucket configuration in section 3.1 of the lab manual, these observations are reasonable. Specifically, the configuration declares that the token bucket replenishes its tokens at 5000 tokens/sec and has a max capacity of 10,000 tokens, moreover, the

buffer is set to have a maximum capacity of ~100,000 bytes and max packet size is 1024 bytes. As the Poisson trace 3 has no packets exceeding 1024 bytes and that each packet is sent with a delay, it is plausible that the token bucket count and buffer size attain the constant values seen in figure 4.

Exercise 3.3 Evaluate the reference implementation for the Ethernet and Video Trace files

Video Trace File

Prepare a single plot that shows the cumulative arrival function as a function of time of (1) trace file (2) token bucket (3) traffic sink

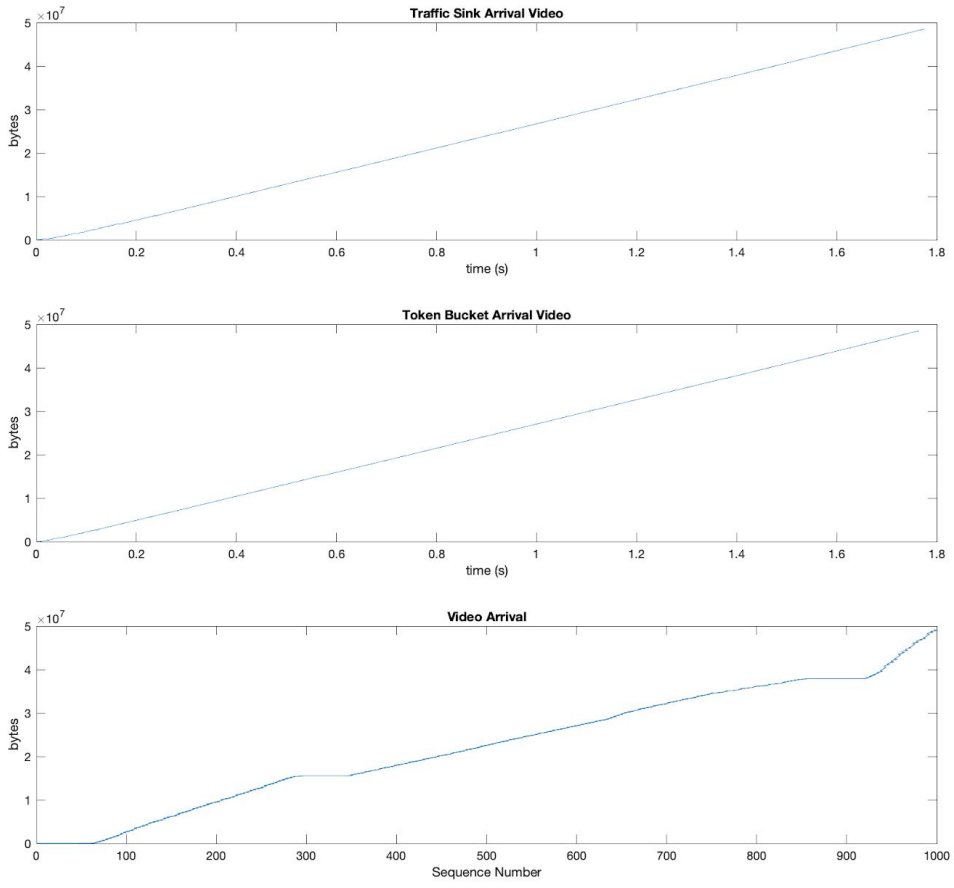

Figure 5: Comparison of cumulative arrivals of Video trace, sink and token bucket of first 1000 frames

Observations

Based on the results in figure 5, it appears that the arrivals for the token bucket and sink are nearly identical. We do observe that there is a small difference in the total number of bytes each arrival function converges to which can be attributed to packet loss. Specifically, there may have been instances where too many packets were arriving at the Token Bucket and so they were discarded. This is further supported by the fact that the total loss in bytes was observed to be 728,464 bytes (i.e. the difference between the total bytes that were sent by generator and received by the sink).

As for the video arrival trace in figure 5 (i.e. bottom most plot), we used total cumulative bytes with respect to sequence numbers. This is because the provided frame times were in relation to when the frame was displayed rather than its arrival. From the video arrival plot, we observe that it is far less linear than the above two plots where the sharp increases can be attributed to the arrival of a pair of I and P frames followed by a B frame. In the other two plots, these sharp increases do not occur as the generator fragments any frames exceeding the specified max packet size (i.e. 1034 bytes) into multiple packets that are then sent with delays.

Provide a second plot that shows the content of the token bucket and the backlog in the Buffer as a function of time

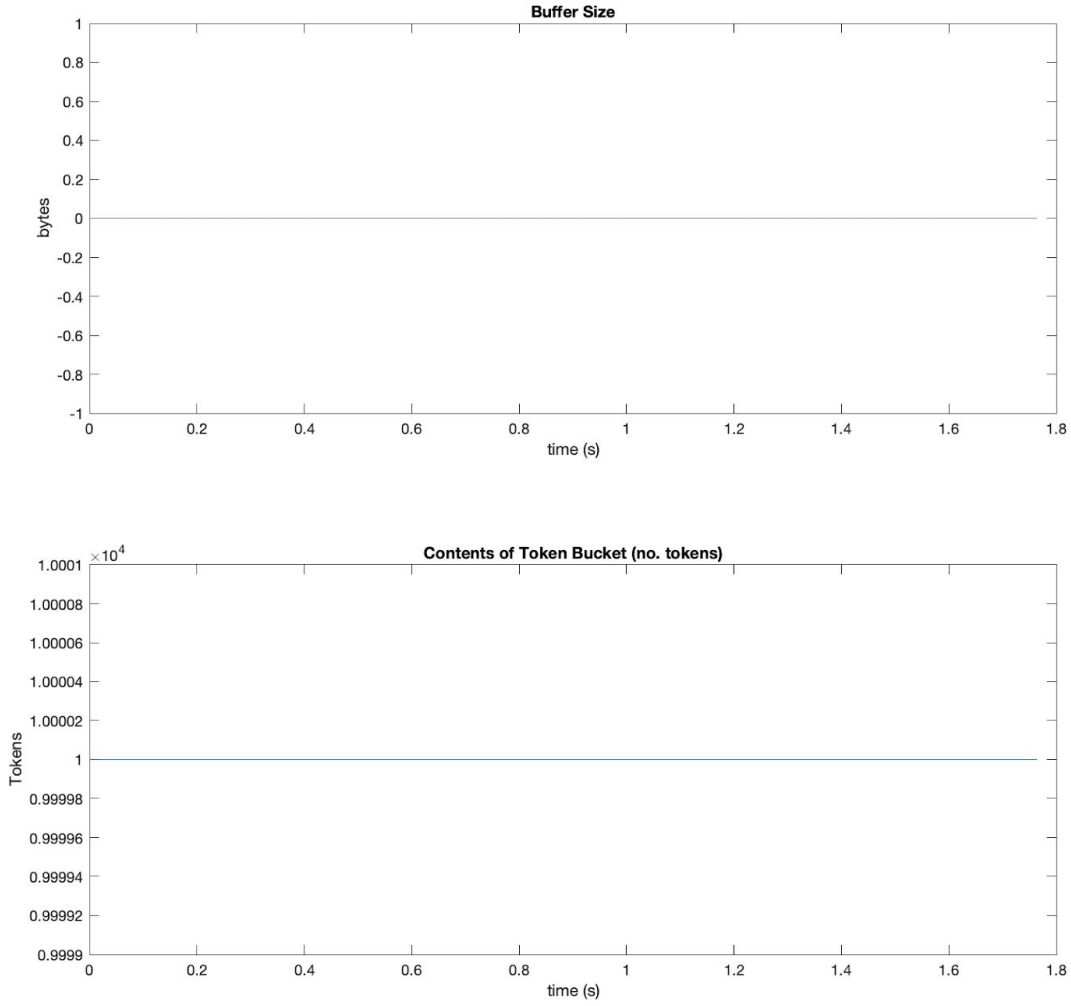

Figure 6: Contents of Token Bucket and backlog for Video trace

Observations

We observe the same results as in section 3.2 and for the same reason. It is also worth mentioning that even though in the video trace we observed packet loss unlike for the Poisson trace, this does not affect the backlog size, as any packets that would exceed the buffer capacity are simply dropped by the Token Bucket.

Ethernet Trace File

Prepare a single plot that shows the cumulative arrival function as a function of time of (1) trace file (2) token bucket (3) traffic sink

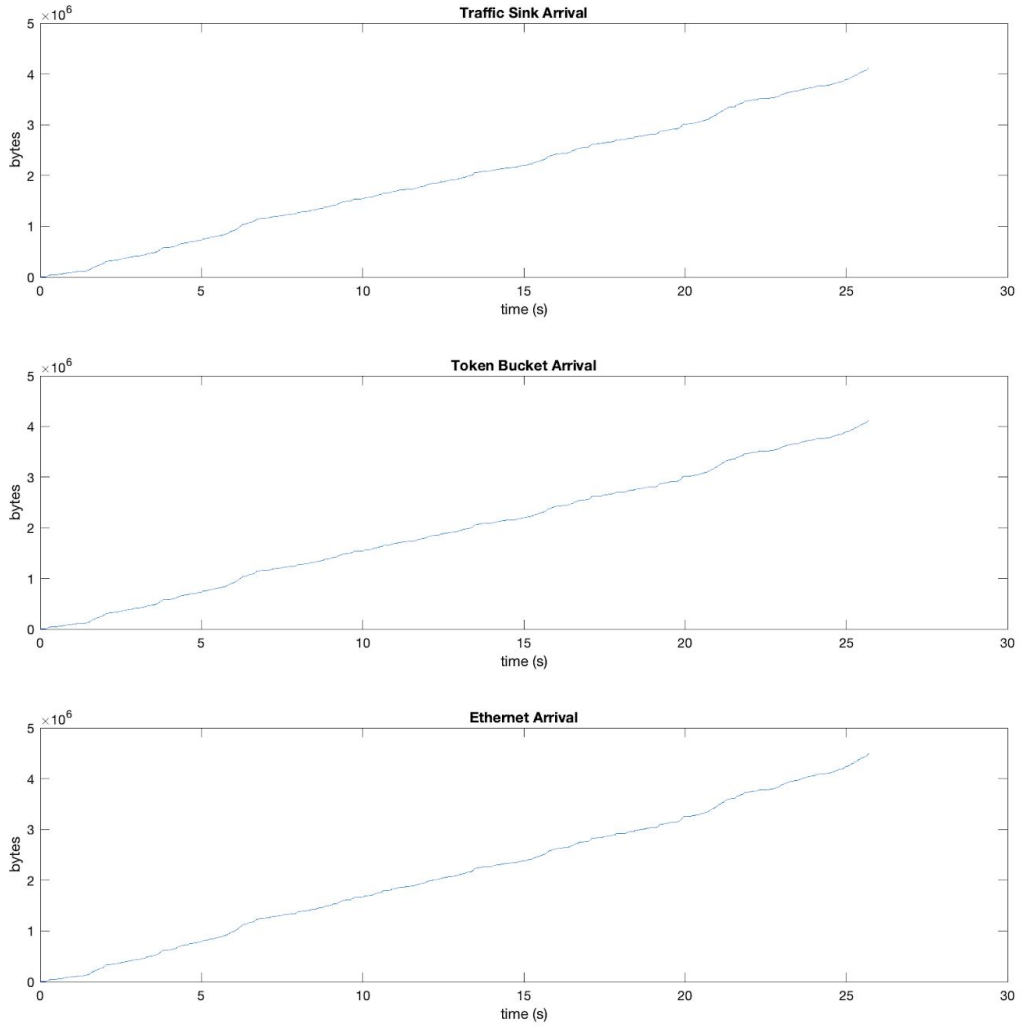

Figure 7: Comparison of cumulative arrivals of Ethernet trace, sink and token bucket first 10,000 packets

Observations

The plots from figure 7 show that the Traffic Sink and Token bucket have nearly identical plots but both converge to a smaller total bytes value when compared to the

Ethernet Arrival plot. This is due to packet losses which we observed where a total of 371,386 bytes were lost. These losses can be attributed to the arrival of too many small or large packets at the Token Bucket which were subsequently dropped. All three plots also exhibit a slight bursty behavior which is consistent with internet traffic that tends to be self-similar and bursty.

Provide a second plot that shows the content of the token bucket and the backlog in the Buffer as a function of time

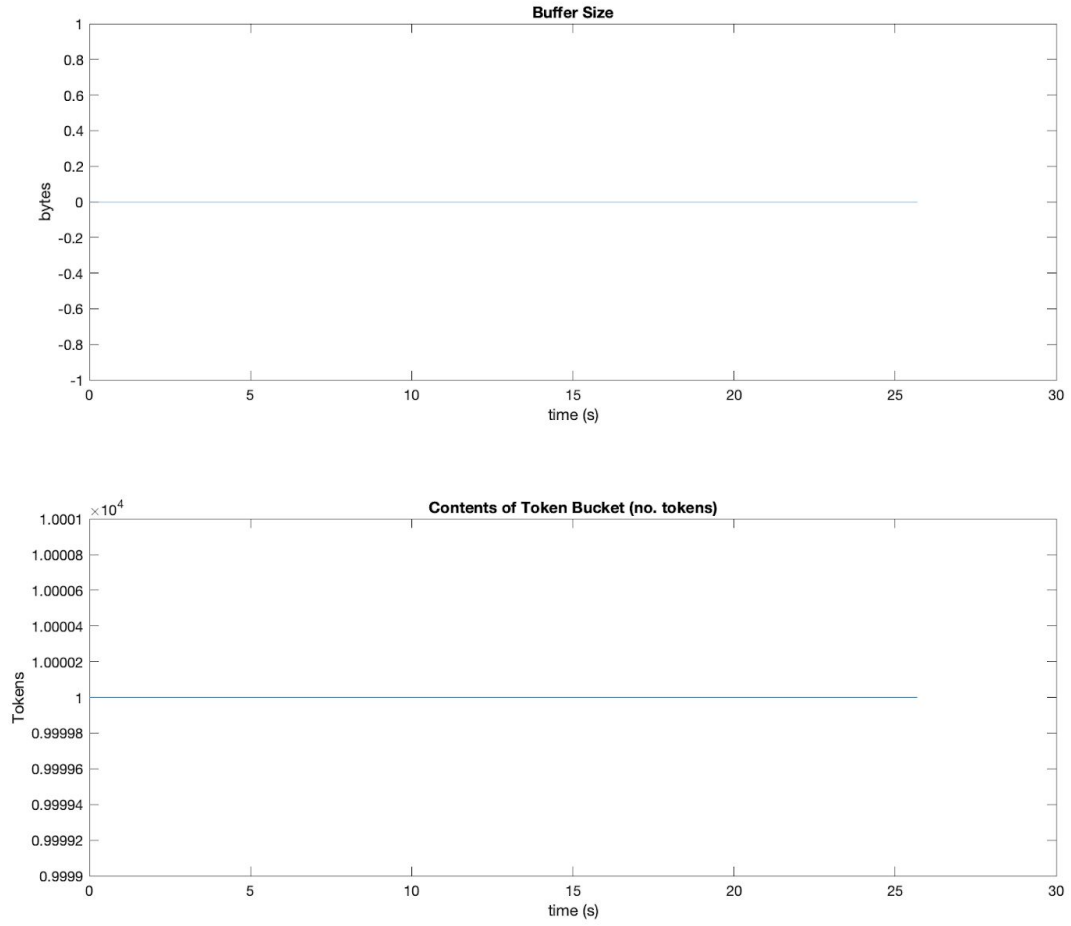

Figure 8: Contents of Token Bucket and backlog for Ethernet trace

Observations

The results obtained in figure 8 are essentially the same as that obtained in section 3.2 and for the same reasons.