Simulation of File Arrivals and Departures on Buffer sizing in Access Routers

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Abstract— **Most of the contemporary systems assumes that all the flow of packets are same and requires O(1) buffer size for transferring packets in a network. This leads to more buffer size even for short flow of packets also, which wastes the buffer size. To overcome this problem, this paper proposes a new technique which uses different buffer sizes based on the packet flows. For long packet flows longer size buffers are used, for short packet flows tiny size buffers are sufficient and for mixed packet flows medium size buffers are used. This paper also presents an approach for increasing the link utilization based on maximum window size.**

Keywords— **Buffer size, short flow, long flow, mixed flow, Maximum Window Size (MWS), link utilization.**

I. INTRODUCTION

The packet buffers of switch or router interfaces are vital component of packet networks. They take up the rate variations of incoming traffic, delaying packets when there is contention for the same destination link. In general, increasing the buffer space at a router interface tends to increase the link utilization and decrease the packet loss rate. The buffer in an Internet router has numerous roles [4]. It provides temporary bursts in traffic, without having drop packets. It keeps a reserve of packets, so that the link doesn't go idle. It also introduces queuing delay. Possibly, router buffers are the single biggest provider to uncertainty in the Internet. Given their significance, we might reasonably expect buffer sizing to be well tacit, based on well stranded theory and supported by wide experiments. [5].

Queueing theorists are used to thinking of sizing buffers so as to prevent them from overflow and losing packets. [5]. In previous paper [1] they are suggested that *O(1)* buffers are sufficient at the core routers. In this paper, we revise the buffer-size requirements of access routers when flows arrive and depart. Our conclusion is as follows: *O(1)* means the size of the buffers are constant for short packet flow, long packet flow and mixed packet flow, but in our conclusion short packet flow require tiny buffer size, for long packet flow longer size buffers are used and for mixed packet flow medium size buffers are used. In general increasing the buffer space at a router interface tends to increase the link utilization and decrease the packet loss rate. From our analysis on the average of tiny, long and mixed size buffers, the link utilization also increased.

The main theme of this paper is analysing the buffer size at access routers with short packet flow, long packet flow, mixed packet flow and increasing the link utilization. This entire process is done in simulation.

The remainder of the paper is organized as follows. Section II presents our new technique. Section III presents increasing link utilization. Section IV presents the Simulation Results. Section V presents Results and Section VI gives our conclusion.

II. A SIMULATION OF FILE ARRIVALS AND DEPARTURES ON BUFFER SIZING IN ACCESS ROUTER

This paper focuses on buffer size at access router with short packet flows, long packet flows, and mixed packet flows in the network. It also describes link utilization in the network. For analysis we are considering eight nodes in the network, among them five nodes are senders called source1, source2, source3, source4 and source5. The remaining three are destination nodes; destination1, destination2 and destionation3. Figure 1 shows network topology. Here source nodes to Access Routers bandwidth is 10mbps and delay is 50ms, Access Router to Core Router bandwidth is 10mbps and delay is 50ms, Core Router to destination nodes bandwidth is 10mbps and delay is 50ms.

A. Impact on Buffer size in Long packet flows

Most of the papers are considered the impact of flow arrivals and departures on buffer sizing in core routers. In evaluating this impact, they are assumed that all the flow of packets is same. The basis for this assumption was that most of the traffic in the Internet is due to long flows, and therefore buffer sizes are impacted mainly by such flows. However, even if the Internet traffic is heavy tailed, it is unclear whether packets that are relatively large should be viewed as "long" packets if the router capacity is very large. Therefore, for the sake of completeness, we will consider scenarios where all packet sizes are relatively short compared to the Access, Core Router speeds. We developed our model for short packet flows, long packet flows and mixed packet flows.

1) Loss Probability as a Function of Buffer Size with long packet flows

In order to build up a model for the case where all flows of packets are long, we have to make an assumption about whether the flows are in the slowstart phase or the congestion-

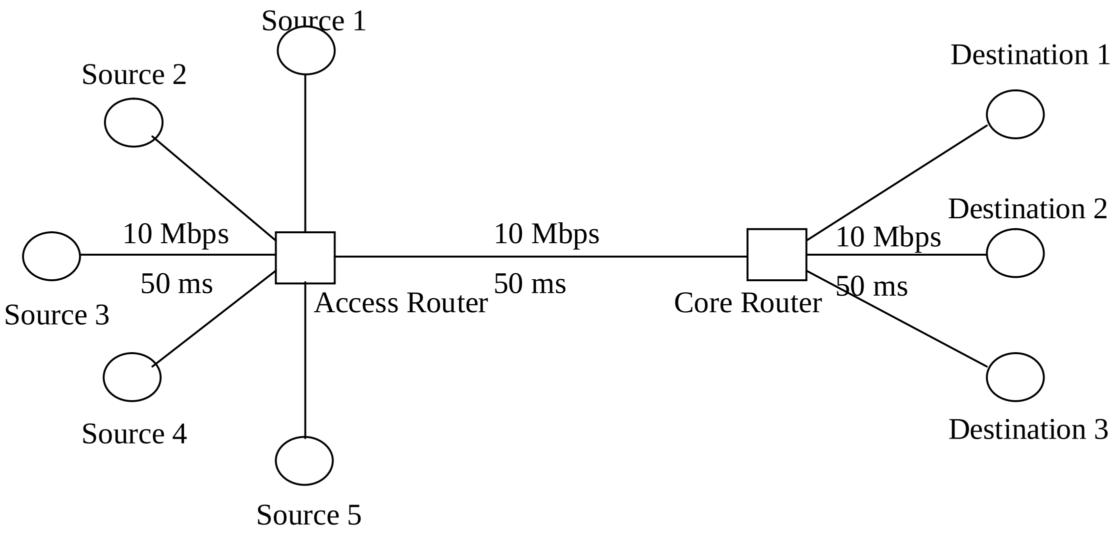


Fig1. Network Topology

avoidance phase. To get a conservative estimate on the buffer size required to achieve a certain loss probability, we assume that all flows are always in the slow-start phase since the slow-start phase generates more bursty traffic than the congestion-avoidance phase. Additionally, we assume these bursts arrive according to a Poisson process. Similar assumptions have been made in earlier work on buffer sizing [3].

B. Impact on Buffer size in Mixed packet flows

In the mixed *packet* flow, the number of packets transmitted over the network is average. In the internet general assumption is most of the traffics consists long *packet* flows. Within these long *packet* flows some *packet* flows may be small or some *packet* flows may be medium, *so* buffer sizes are impacted mainly by such flows. For this type of mixed *packet* flows medium size buffers are sufficient.

1) Loss Probability as a Function of Buffer Size with mixed packet flows

In order to build up a model for the case where the entire packet flows are mixed, we have to make an assumption that whether the flows are in the slowstart phase or in the congestion-avoidance phase. To get a conservative estimate on the buffer size, we assume that all flows are always in the slow-start phase since the slow-start phase generates more bursty traffic than the congestion-avoidance phase. Additionally, we assume these bursts arrive according to a Poisson process [3].

C. Impact on Buffer size in Short packet flows

In the short packet flow the size of the packets are short. The basis for this assumption was that most of the traffic in the Internet is due to combination of short packet flows and long packet flows, and therefore buffer sizes are impacted mainly by such flows. However, even if the Internet traffic is heavy tailed, it is unclear whether packets that are relatively small should be viewed as “small” packets if the router capacity is very large.

1) Loss Probability as a Function of Buffer Size with short packet flows

In order to build up a model for the case where all the packet flows are short. we have to make an assumption about whether the flows are in the slowstart phase or the congestion-avoidance phase. To get a conservative estimate on the buffer size, we assume that all flows are always in the slow-start phase since the slow-start phase generates more bursty traffic than the congestion-avoidance phase. Additionally, we assume these bursts arrive according to a Poisson process [3].

III. INCREASING LINK UTILIZATION

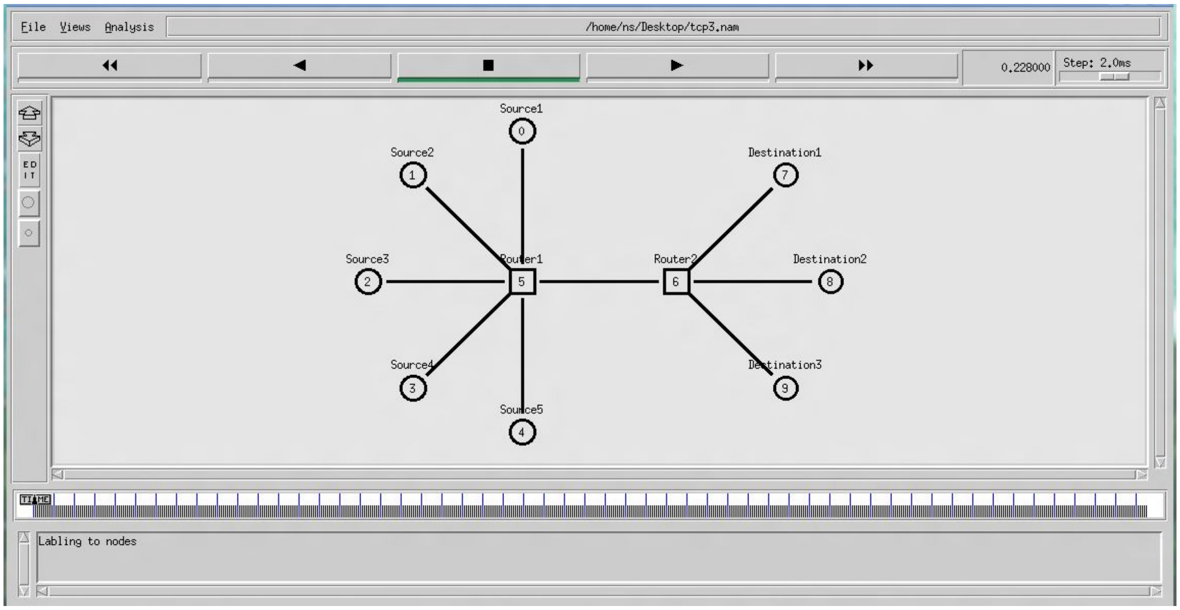
In our analysis we are taken the Link Capacity is 10000000 and number of nodes is 8 i.e. number of source nodes and number of destination nodes. For calculation of Link utilization we follow the following formulae.

$$\frac{\frac{numberof\ packets\ sent * number\ of\ nodes}{100}}{link\ capacity} * 100 \qquad \text{...... (1)}$$

Where number of nodes=8, Link Capacity = 10000000.

IV. SIMULATION RESULTS

Our objective in this section is to simulate our network and then showing the result. The following figure 2 shows our network topology in simulation. Where source1, source2, source3, source4 and source5 are source nodes and Destination1, Destination2 and Destination3 are Destination nodes and Router1 is Access Router and Router2 is Core Router.



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Labling to nodes
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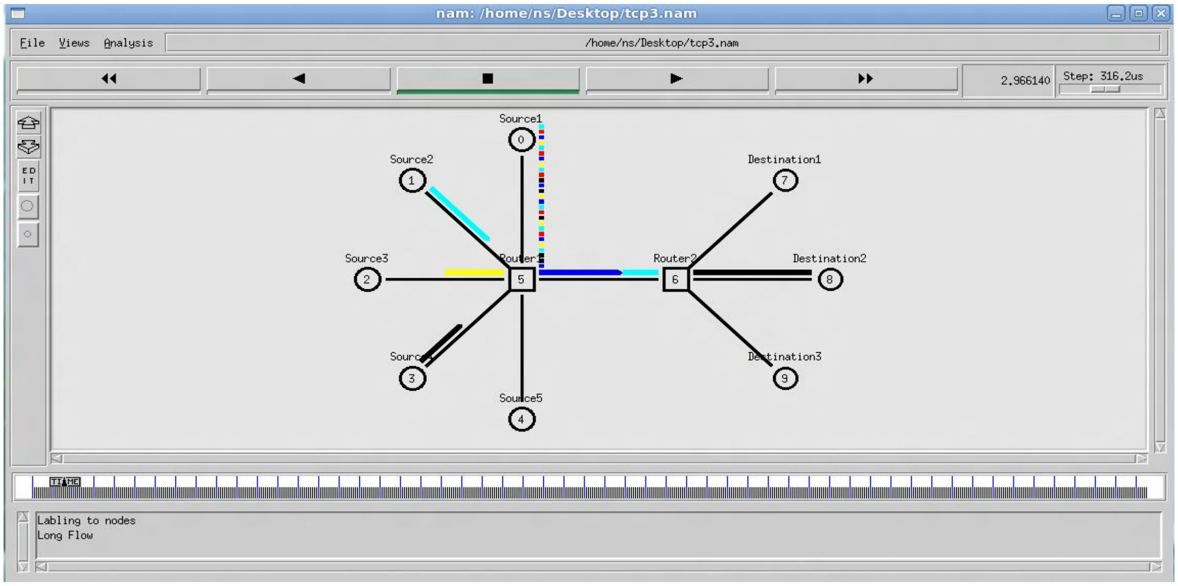
Fig. 2: Network Topology in simulation

The following Fig. 3 shows the simulation of long packet flow in the network. Here the flows of packets are high from sender to the destination nodes. i.e. more than one sender may send packets to the destination nodes at a time. Here the corresponding buffer size also long.



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Labling to nodes
Long Flow
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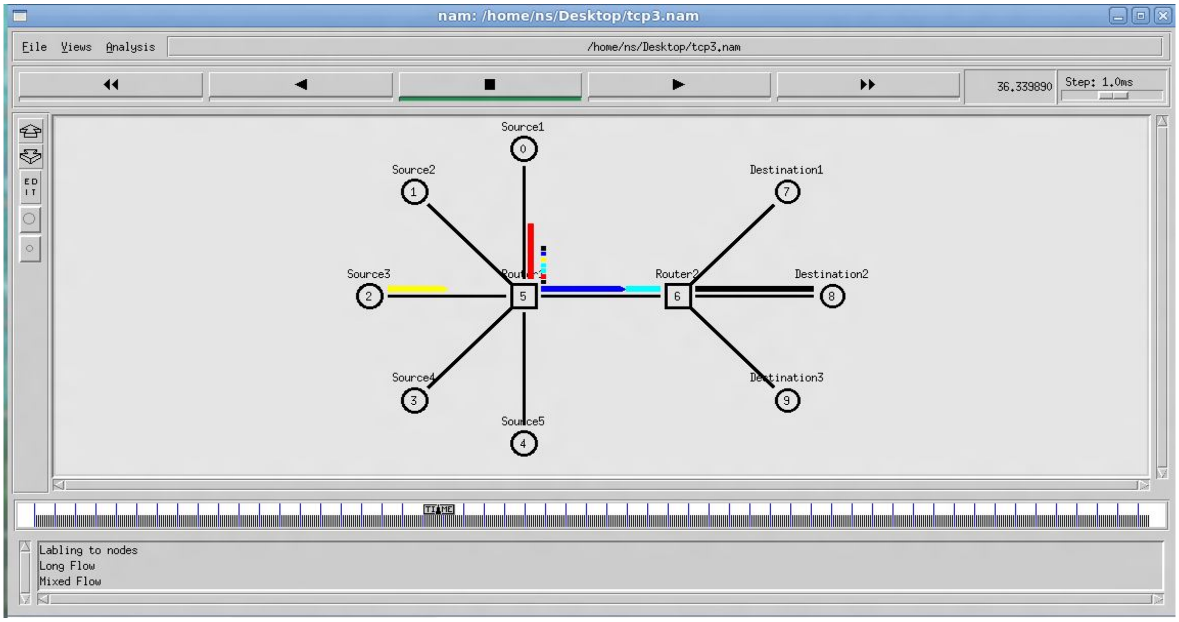
Fig. 3: Long packet flow

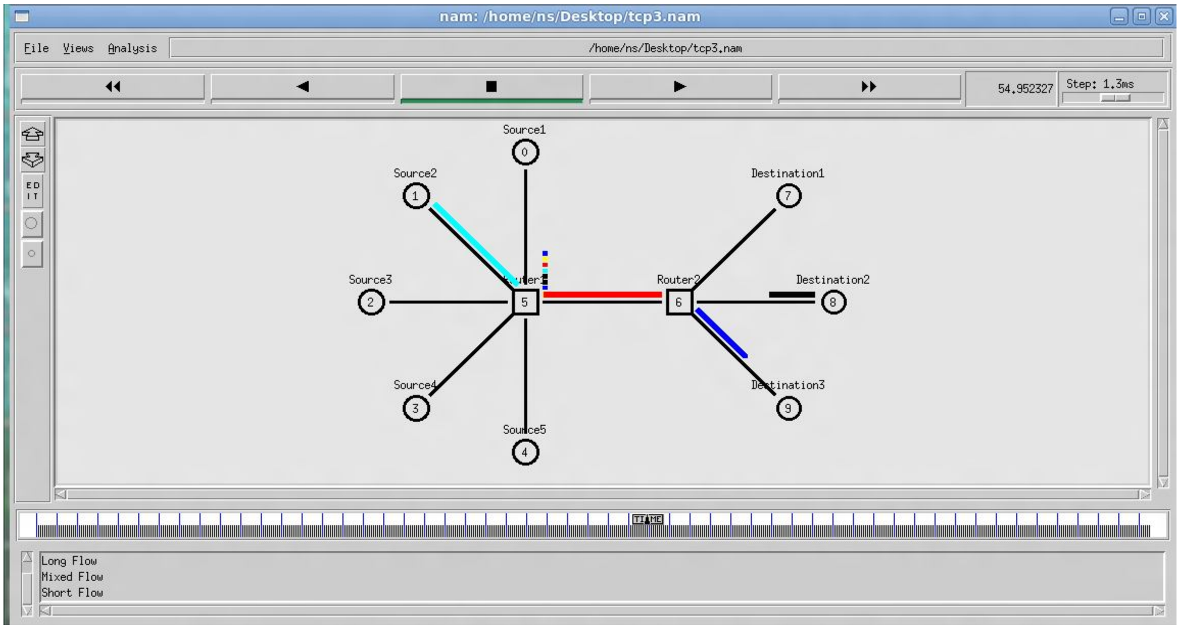
The following Fig. 4 shows the simulation of mixed packet flow in the network. Here the flows of packets are medium from sender to the destination nodes. i.e. one or two senders send packets to the destination nodes at a time. Here the corresponding buffer size is medium.



Labling to nodes
Long Flow
Mixed Flow

Fig. 4: mixed packet Flow

The following Fig. 5 shows the simulation of short packet flow in the network. Here the flows of packets are low from sender to the destination nodes. i.e. one sender send packets to the destination nodes at a time. Here the corresponding buffer size is small.



Long Flow
Mixed Flow
Short Flow

Fig. 5: Short packet flow

V. RESULTS

This section gives the comparison between the IFADBC and the proposed technique. The following Table 1 gives the buffer size used between [1] and the proposed technique. From these results we can observe IFDBC [1] has same buffer size for every packet flow. But in proposed technique uses different buffer sizes depending on the flow of packets.

Table 1: Comparison of Buffer size between IFADBC and SFADBA

	IFADBC	SFADBA
Long Packet Flow	Buffer size is same for every packet flow	Buffer size is long
Short Packet Flow		Buffer size is tiny
Mixed Packet Flow		Buffer size is medium

In the previous paper they are assumed Maximum Window Size (MWS) is 64kB i.e. 64 packets in their simulation. But in this paper we are assuming Maximum Window Size (MWS) is 1 i.e. 40 packets, MWS is 2 i.e. 80 packets and MWS is 3 i.e. 120 packets. When the MWS is increasing then the corresponding link utilization also increasing in our simulation. The following Table2 shows the link utilization based on Max Window Size (MWS).

Table 2: MWS vs. Link Utilization

Max Window Size (MWS)	Link Utilization (%)
1	98.8004
2	99.3048
3	99.8093

VI. CONCLUSION

In this paper, we have developed a simple network model to provide buffer-sizing guidelines at Access routers. Our analysis points out that it is better to use different buffer sizes depending on the flow of packets which reduce cost of transmission. This paper proposes a new technique which uses long size buffers for long packet flows, tiny size buffer for short packet flows and medium size buffers for mixed packet flows. In addition to this link utilization also increasing. Through this the cost of transmission is reduced.

REFERENCES

[1] Ashvin Lakshmikantha, Carolyn Beck, and R. Srikant, "Impact of File Arrivals and Departures on Buffer Sizing in Core Routers (IFADBC)", IEEE/ACM TRANSACTIONS ON NETWORKING, VOL. 19, NO. 2, APRIL 2011,pp. 347-358.

[2] "The network simulator: NS-2," 2007 [Online]. Available: http://www.isi.edu/nsnam/ns.

[3] G. Appenzeller, I. Keslassy, and N. McKeown, "Sizing router buffers," in Proc. ACM SIGCOMM, 2004, pp. 281–292.

[4] A. Dhamdhere, H. Jiang, and C. Dovrolis, "Buffer sizing for congested Internet links," in Proc. IEEE INFOCOM, Mar. 2005, vol. 2, pp. 1072–1083.

[5] D. Wischik and N. McKeown, "Part I: Buffer sizes for core routers," Comput. Commun. Rev., vol. 35, no. 3, pp. 75–78, Jul. 2005.

[6] N. Bansal and M. Harchol-Balter, "Analysis of SRPT scheduling: Investigating unfairness," in Proc. ACM SIGMETRICS, 2001, pp. 279–290.

[7] D. Bertsekas and R. Gallager, Data Networks. Englewood Cliffs, NJ: Prentice-Hall, 1992.

[8] T. Issariyakul, E. Hossain, *Introduction to Network Simulator NS2*, DOI: 10.1007/978-0-387-71760-9, Springer, 2009.