Buffer Management for the Future Internet *

D.B.Pillai[1], G.Ojong [2],Dr.S.S.Xulu[3]
Department Of Computer Science, University of Zululand
Private Bag X1001, KwaDlengezwa, 3886
1. Email: divyab10@yahoo.com, 2. Email: gojong@pan.uzulu.ac.za
3. Email: ssxulu@pan.uzulu.ac.za

Abstract – The Internet has become the dominant networking technology. However multimedia communications with Quality of Service (QoS) guarantee continuously drive the need for substantial changes in the current Internet infrastructure. Multimedia services such as voice, video and other applications demand not only high bandwidth but also real-time delay constraint. Bandwidth and buffer are the main network resources that need to be considered in the transmission of flows. We intend to develop a QoS buffer management scheme that would accommodate real-time applications on the Internet. We would propose a suitable buffer management strategy that would allow the efficient transmission of both real-time and non-real-time applications with minimal packet loss rates. We will performance compare our schemes with other proposed strategies.

Keywords – quality of service, buffer management.

I. INTRODUCTION AND BACKGROUND

Internet is playing an important role in our daily lives and the number of Internet users is increasing rapidly on a daily basis. Many new applications, for example real-time multimedia applications, are being developed to offer more and more interesting services to these users. Bandwidth and buffer are the main network resources that need to be considered in the transmission of flows. Real-time applications require large [1]amount of buffers to store packets effectively and therefore buffer space has become an important constraint on the Internet. The growing demand for network bandwidth has driven loss rates up across various links in the Internet. The current Internet is based on the Best Effort (BE) service model and offers no assurance as to the eventual delivery of packets.

Congestion occurs on a communication link whenever the amount of traffic introduced on the link exceeds its capacity. This excess traffic causes queuing delays to increase rapidly as buffers fill up, and in extreme cases can cause the buffers to overflow, losing packets. In this situation the network is not capable of guaranteeing previous commitments made to applications. In the past, most applications on the Internet were elastic in nature (that is they tolerated packet delays and packet losses), and hence the BE model was adequate for these applications. New Internet applications such as real-time multimedia applications do not adapt to congestion and this leaves them with less bandwidth causing excessive dropping of packets [1]. It is important to avoid high packet loss rates because when a packet is dropped before it reaches the destination, all of the resources it has consumed in transit are wasted. Therefore, appropriate congestion control mechanisms are needed to alleviate the congestion at the buffers, while maintaining high network efficiency.

There are two broad approaches to congestion control: congestion control and recovery, and congestion avoidance [2]. Congestion control and recovery is reactive and enables the network to recover when congestion has occurred. Congestion avoidance methods are proactive and attempt to avoid congestion. Although a lot of research work (e.g. [1], [2], [3], [4], [5], [6], [7]) has focused on packet dropping policies in communication networks, to the best of our knowledge, there are still no strategies that allow efficient management of buffers for high bandwidth real-time applications. The high bandwidth required by these applications may easily cause congestion and result in packet loss. Thus it is crucial to find a suitable buffer management strategy to overcome this problem. This study will focus on developing a buffer management scheme that will overcome the above mentioned deficiencies.

The remainder of this paper is organised as follows: section II looks at some previously conducted work in this field. Section III states our research goals. The research methodology to be used is stated in section IV. Section V concludes the paper and future work is also stated.

II. RELATED WORK

Considerable research effort is currently being placed to develop a suitable buffer management scheme that will accommodate high bandwidth applications on the Internet. Congestion control and recovery, and congestion avoidance are two broad approaches considered in congestion management of buffers. Asynchronous Transfer Mode (ATM) based networks use cell discarding mechanisms which is a congestion control mechanism considered in order to alleviate congestion in buffers. Selective packet dropping can be used as the congestion control and recovery mechanism (such as the ones designed to work in the ATM UBR service category), and also as congestion avoidance mechanism (such as the ones designed to work in IP environments). Tail dropping and Front dropping has been used to efficiently transport TCP segments over ATM networks. Drop tail scheme is the simplest of all and both these schemes drop cells whenever there is no buffer space available. The drawback with these schemes is that, as

* This is a work-in-progress paper for a research study conducted at the Centre for Mobile eService for Development at the University of Zululand, South Africa. The Centre is sponsored by Telkom, Huawei, THRIP and NRF.

the connection speed increases, a greater number of packets in the buffer will be dropped during congestion periods.

Several other packet dropping policies have been introduced such as: Explicit Forward Congestion Notification (EFCN) and Explicit Backward Congestion Notification (EBCN) [8], Push-out Schemes (Push-out First-In-First-Out (Po-FIFO) and Push-out Last-In-First-Out (Po-LIFO))[5], Head of Line Priority Cell Discard (HoL-PCD) [6]. In EFCN and EBCN schemes when a buffer is detected full and starts to experience congestion, it can send a frame in the backward direction or forward direction to senders, to inform senders to slow down. Push-out schemes are comparatively simple and efficient priority queuing algorithms, in which low priority cells are discarded in a FIFO or LIFO manner to provide a higher degree of QoS for high priority cells. But the problem faced by these schemes is the higher cost of these algorithms due to the frequent scanning of the buffer to determine the cell to be discarded.

The random early detection (RED) algorithm has been proposed for IP networks with the objective of avoiding congestion and maintaining average queue size at low levels. Two differences from the other schemes are that, RED does not need the routers to keep any state information about any connection, and it was designed to work in collaboration with a transport layer congestion control protocol such as TCP. RED utilizes two thresholds, T_{low} and T_{high}, and a weighted moving average formula to estimate the average queue length. RED uses time-averaging, that is, if the queue has recently been mostly empty, RED will not react to a sudden burst as if it were a major congestion event. However, if the queues remain near full, RED will assume congestion and start dropping packets at a higher rate.The basic drawback of RED active queue management technique is that it relies only on queue length as an estimator for congestion[7]. Although a number of buffer management schemes have been proposed, they are not really efficient enough to be implemented on the future Internet.

III. RESEARCH GOAL

This research study aims at developing a buffer management strategy that would effectively allocate buffers to transmit real-time multimedia applications in the future Internet. Specifically, the research study will: 1) survey the buffer management strategies currently employed in the Internet. 2) propose a suitable buffer allocation Strategy for the future Internet.3) propose a packet dropping algorithm that reduces congestion in the Internet

IV. RESEARCH METHODOLOGY

The research design technique to be undertaken when conducting our research study is as follows:

Investigation of previous work, model proposal, simulation of the proposed model and performance evaluation of the proposed model.

A. Investigation

An investigation is going to be conducted on the currently employed schemes and the buffer management strategies proposed in order to avoid congestion of traffic over the Internet.

B. Modeling

A model of an efficient buffer management strategy based on our own design objectives would then be developed.

C. Simulation Design

A simulation for the model will be developed. An evaluation of the proposed model will then be made.

D. Performance Evaluation

The model will be analyzed and compared with other schemes such as RED.

V. CONCLUSION

In this paper we have briefly discussed the currently proposed buffer management strategies and their drawbacks. We are going to develop a suitable buffer allocation strategy that will enable the efficient transmission of real-time multimedia applications on the future Internet.

REFERENCES

[1] R. Braden, D. Clark and S. Shenker, “Integrated Services in the Internet Architecture: an Overview”, *IETF RFC* 1633, June 1994.

[2] M. A. Labrador and S. Banerjee, “Packet Dropping Policies for ATM and IP networks”, *IEEE/ACM Transactions on Networking*, 2(1):1-15.1994

[3] M. A. Labrador and S. Banerjee, “Enhancing Application Throughput by Selective Packet Dropping”, *Proc. of IEEE ICC*, pp. 1217-1222, 1999.

[4] T. V. Lakshman, A. Neidhardt, and T. Ott, “The Drop from Front Strategy in TCP and in TCP over ATM”, *Proc. of IEEE INFOCOM*, pp. 1242-1250, 1996.

[5] A.Y. M. Lin, J. A. Silvester, “Priority Queuing Strategies and Buffer Allocation Protocols for Traffic Control at an ATM Integrated Broadband Switching Systems”, Journal on Selected Areas in Communications, vol. 9, pp.1524-1536, December 1991.

[6] M. Mobasseri and Dr. V. M. Leung, “A New Buffer Management Scheme for Multimedia Terminals in Broadband Satellite Networks”, *Proc of 35th Hawaii International Conference on System Science* - 2002.

[7] S. Floyd and V. Jacobson, “Random Early Detection Gateways for Congestion Avoidance”, *IEEE/ACM Transactions on Networking*, 1(4), pp. 397–413, 1993.

[8] A. Dagiuklas and M. Ghanbari, “Rate-based Flow Control of Video Services in ATM Networks”, in *Proc. IEEE* Globecom, pp. 284-288, 1996.

D. Pillai is currently pursuing her MSc. Degree in the Department of Computer Science at the University of Zululand. Her area of interest is on Quality of Service provisioning on the Internet.