End-to-End Performance Evaluation of Datagram Acceptance Control in DQDB-ATM-DQDB CL Network

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Abstract. In this paper we extend a buffer overflow control scheme called datagram acceptance control (DAC) to shared buffers, then evaluate its end-to-end performance and compare it with another two methods. To manage CL traffic in an interconnected CL overlaid network operated in on-the-fly mode, one can use loss mechanisms by discarding cells at a congested buffer. However, since the size of a typical datagram is larger than the payload size of a cell, cell discarding without taking into account the integrity of a datagram can produce corrupted datagrams. As a corrupted datagram is dropped at its final destination, the network resources used on its route are wasted. Moreover, it is observed in our studies that when the network is overloaded even with a simple buffer overflow control scheme the waste still can be a large portion. Thus, cell discarding at congested buffers has to be treated with the consideration of concentrating discarded cells upon as few datagrams as possible to achieve reducing the waste but not at the expense of the overall datagram loss ratio. It is shown by our simulation results that DAC, by managing a buffer together with its associated outgoing bandwidth, can achieve the stated objectives end-to-end. It is also observed in our studies that increased buffer size can only improve the datagram loss ratio for load levels up to 100%. Once overload occurs an eightfold/sixteenfold increased buffer size, which is 10 times of the mean frame length, has virtually no impact on the datagram loss ratio. Thus, losses due to overload cannot be avoided by large buffer capacity.

Keywords: Buffer management for B-ISDN, Congestion control for B-ISDN, Performance evaluation, DQDB/ATM internetworking

1 Introduction

In a public ATM network connectionless server (CLS), due to its simplicity in controlling the impact of bursty LAN/MAN data traffic and its flexibility in scaling up the capacity, will likely be used at first to provide CL service for interconnecting LANs/MANs (see an example in Fig. 1). An interworking unit (IWU), between a DQDB MAN and the ATM network, can simply forward inter-MAN datagrams to its local CLS. CLSs are responsible for routing of datagrams. To reduce connection setup delays, semipermanent VP/VCs can be used. It is
supposed that ATM Adaptation Layer (AAL) 3/4 is employed to support the datagram service (though it has an overhead of four bytes compared with AAL5), because it provides not only the possibility of multiplexing at adaptation layer but also the reliable identification of a routing relevant cell.

Due to the payload size of a cell (a DQDB slot as well), a datagram may have to be carried in up to 210 of them. After passing through DQDB MAC or ATM switching facilities, datagrams are interleaved. In such an environment, buffer overflow control becomes critical especially for IWUs and CLSs operated in the so-called on-the-fly mode (without reassembling), because discarded cells at congested internal buffers may belong to different datagrams. If only one cell of a datagram is lost, all the other cells of the datagram become useless and start wasting the buffers and bandwidth on their way after. Therefore, uncontrolled buffer overflow may corrupt a large number of datagrams at heavy load and overload, which not only reduces the datagram throughput of a network dramatically but may also waste a large portion of network resources by the useless cells.

Thus, central objectives of an overflow control scheme are to avoid discarding cells of different datagrams, and to reduce the number of useless cells transmitted in the network. But, the waste reduction should not come at the expense of the overall datagram loss ratio. Furthermore, a control scheme should not trade in an overcontrolled performance at light or normal load for a better one at heavy load and overload.

Four buffer overflow control schemes have been proposed. They are: basic scheme (BAS); discard (DIS) algorithm [1]; pushout buffer [2]; and datagram acceptance control (DAC) by the authors in [3]. [1] and [4] have studied the performance of DIS and compared it with BAS. [2] has studied the performance of the pushout buffer. [5] has compared BAS, pushout buffer and DAC but without any on-line estimation of cell/slot arrival rate. The authors in [6] have studied DAC with an on-line estimation of cell/slot arrival rate but for a dedicated buffer, and have compared it with BAS and DIS. However, all studies have been conducted only at a single hop. Moreover, none of them, except [4], have looked into the efficiency of the schemes in reducing the wasted resources in terms of useless cells transmitted. This paper, however, will show: the end-to-end simulation studies of datagram delay and datagram loss of three schemes (BAS,