Asymptotic Cell Loss Decreasing Rate in an ATM Multiplexer Loaded with Heterogeneous ON-OFF Sources

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Abstract---Recently, some research has been done to analyze the asymptotic behavior of queue length distribution in ATM(Asynchronous Transfer Mode) multiplexer. In this paper, we relate this asymptotic behavior with the asymptotic behavior of decreasing cell loss probability when the buffer capacity is increased. We find with reasonable assumptions that the asymptotic rate of queue length distribution is the same as that of decreasing cell loss probability. Even under different priority control schemes and traffic classes, we find that this asymptotic rate of the individual cell loss probability of each traffic class does not change. As a consequence, we propose the upper bound of cell loss probability of each traffic class when a priority control scheme is employed. This bound is computationally feasible in a real-time. The numerical examples will be provided to validate this finding.

I. INTRODUCTION

Traffic control problem in ATM networks is very important to realize ATM. Specially, cell loss probability in an ATM multiplexer with possibly heterogeneous input sources may be the most important information for an effective traffic control.

This paper provides the upper bound of cell loss probability of each traffic class in an ATM multiplexer when a priority control scheme is employed. This research is based on asymptotic queue length distribution in an infinite buffer. As stated in [1], it is known that for a wide range of queueing systems including G/G/c, the tail distribution of the buffer contents has a geometric form, i.e., for sufficiently large S and certain constants η, γ, Pr[buffer contents = S] $\approx \eta\gamma^S$ and

$$\Pr[\text{buffer contents} > S] \approx \sum_{j=S+1}^{\infty} \eta\gamma^j = \frac{\eta\gamma^{S+1}}{1-\gamma} \qquad (1)$$

We relate this asymptotic behavior of queue length distribution with the asymptotic behavior of decreasing cell loss probability when the buffer capacity is increased. We find that with reasonable assumptions the asymptotic rate of queue length distribution is the same as that of cell loss probability. Even under different priority control schemes and traffic classes, we find that this asymptotic rate of the individual cell loss probability of each traffic class does not change. As a consequence, we propose the upper bound of cell loss probability of each traffic class c with the priority control scheme p like the following form.

$$\text{the upper bound of cell loss probability} = P_{c,p}\gamma^{B-1} \qquad (2)$$

where $P_{c,p}$ is the cell loss probability of a concerning traffic class c when the buffer capacity is one, γ is the asymptotic rate of queue length distribution in (1), and B is the size of buffer. $P_{c,p}$ is easily calculated with the assumed model in this paper, and γ is also easily calculatable using the method in [1]. Many papers ([5-10]) propose the exponential form of the overall cell loss probability. We extend this type of cell loss probability to give the upper bound of cell loss probability of each traffic class when a priority control scheme is employed. The research dealing with the asymptotic rate of queue length distribution in (1) is found in [1-4].

This paper is organized as follows. In the following section, we describe the queueing model of the shared buffer multiplexer. In Section III, we give the upper bound of cell loss probability of each traffic class when a priority control scheme is employed. We validate the proposed upper bound in Section IV using computer simulation. Finally, conclusions are given in Section V.

II. QUEUEING MODEL OF AN ATM MULTIPLEXER

We model the shared buffer multiplexer by the queueing system as shown in Fig.1. An ATM