ITC19/ Performance Challenges for Efficient Next Generation Networks
LIANG X.J. and XIN Z.H.(Editors)
V.B. IVERSEN and KUO G.S.(Editors)
Beijing University of Posts and Telecommunications Press

Modeling IP traffic using a BMAP with short-term and long-term dynamics

S. Nishimura[1], M. Shinno[2] and T. Kanehori[1]

[1] Department of Mathematical Information Science, Tokyo University of Science.
1-3 kagurazaka, Shinjuku-ku, Tokyo 162-8601, Japan.
nishimur@rs.kagu.tus.ac.jp, k-tomoyuki-12@msi.biglobe.ne.jp
[2] Traffic Engineering Business Unit, NTT Advanced Technology Corporation.
2-4-15 nakamachi, Musasino-shi, Tokyo 180-0006, Japan.
miyuki.shinno@ntt-at.co.jp

Abstract. Constructing an adequate traffic model is a fundamental element in network design and its analysis is helpful for predictions of future traffic. In this paper we consider modeling IP traffic using a $BMAP$ with a characteristic of short-term and long-term dynamics. Our $BMAP$ is composed of the packet length and the arrival rate during a time interval. The rate matrices of a $BMAP$ are estimated by the EM algorithm and the probability function of a $BMAP/D/1$ queue is analytically calculated by the spectral method. As criteria of fitness, we use the total bytes per time unit and the probability function of the queue length at departures for the single server with the constant service time. Comparing simurated and analytical results, we conclude that our model captures the property of IP traffic.
Keywords: Modeling, IP traffic, Queue, BMAP, Short-term and long-term dynamics.

1 INTRODUCTION

Constructing an adequate traffic model is a fundamental element in network design and its analysis is helpful for predictions of future traffic. It has been widely recognized that traffic including Internet has a self-similar nature and is bursty on all time scales. A variety of packet lengths and a correlated arrival process have been observed. An arrival process of traffic is far from traditional Poisson processes ([4],[5]). To capture such characteristics, $MMPP$s have been studied for traffic modeling during past decade ([1], [5], [18]). A $BMAP$ (Batch Markovian Arrival Process) introduced by Neuts ([10]) includes an $MMPP$ as a special case allowing for an arbitrary large batch size and the correlations among inter-arrival times. Moreover, its queueing models are highly tractable. Recently, several studies have been made on traffic modeling using $BMAP$s and their related arrival processes ([6], [7], [13], [14], [16]). Heyman and Lucantoni in [6] propose modeling multiple IP traffic streams using a $DMMPP$. In Algorithm LAMBDA, phases are classified according to the total number of packets arriving during a time interval and