Dynamics of Continuous, Discrete and Impulsive Systems
Series **B:** *Applications & Algorithms* **11 (2004)** 363-391

PERFORMANCE ANALYSIS OF THE TOKEN BUCKET CONTROL MECHANISM SUBJECT TO STOCHASTIC TRAFFIC

N.U. Ahmed, Hong Yan and Luis Orozco-Barbosa

School of Information Technology and Engineering
and Department of Mathematics
University of Ottawa,Ottawa,Canada

Abstract. In this paper we present a dynamic model for access control mechanism used in computer communication network. This model represents a substantial improvement over the models developed in the previous works [1][2]. The model is governed by a system of discrete nonlinear difference equations. In the dynamic model, token buckets police incoming traffic and one multiplexor serving all the token pools multiplexes conforming traffic using round robin scheme. For performance evaluation of the system, we construct traffic models which exhibit both short-range dependence (SRD) and long-range dependence (LRD) properties. These traffic models capture the salient features of existing network traffic characteristics such as self-similarity and long range dependence. They are constructed using homogeneous and non homogeneous Poisson processes and doubly stochastic Poisson (Cox) process driven by Fractional Brownian motion. Using the proposed dynamic model, we study several issues related to network performance corresponding to different stochastic inputs. All these are illustrated by numerical results.
Keywords. Dynamic models, access control, self-similar traffic,token buckets, multiplexor.
AMS (MOS) subject classification: 93A30, 34A36, 93C55

1 Introduction

In recent years there has been a major effort towards providing Quality of Service (QoS) to the current network users, which includes services offering a variety of performance guarantees. Token bucket algorithm has been proposed and used in many control areas to improve performance of integrated packet switched communication networks, such as admission control, access control, flow control and congestion control [2][3][4][5][6][7]. From application point of view, some of these papers are more conceptual than practical.

A token bucket (or a token pool) is a typical traffic descriptor, a set of parameters that characterizes the traffic sources [8]. It is a non-negative counter that cumulates tokens at a constant or variable rate. Each bucket has a specified capacity. When the bucket is full, newly arriving tokens are rejected. If the number of tokens in the pool is greater than or equal to