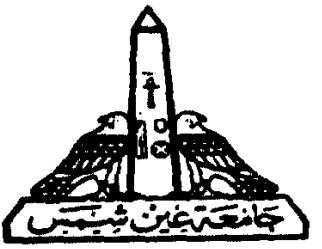

AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Electronics and Communication Engineering Department.

TRAFFIC CONTROL IN ATM BASED NETWORKS

A Thesis

Submitted in Partial Fulfillment of the Requirements of the Degree of
Doctor of Philosophy in Electrical Engineering
(Electronics and Communication Engineering)

By

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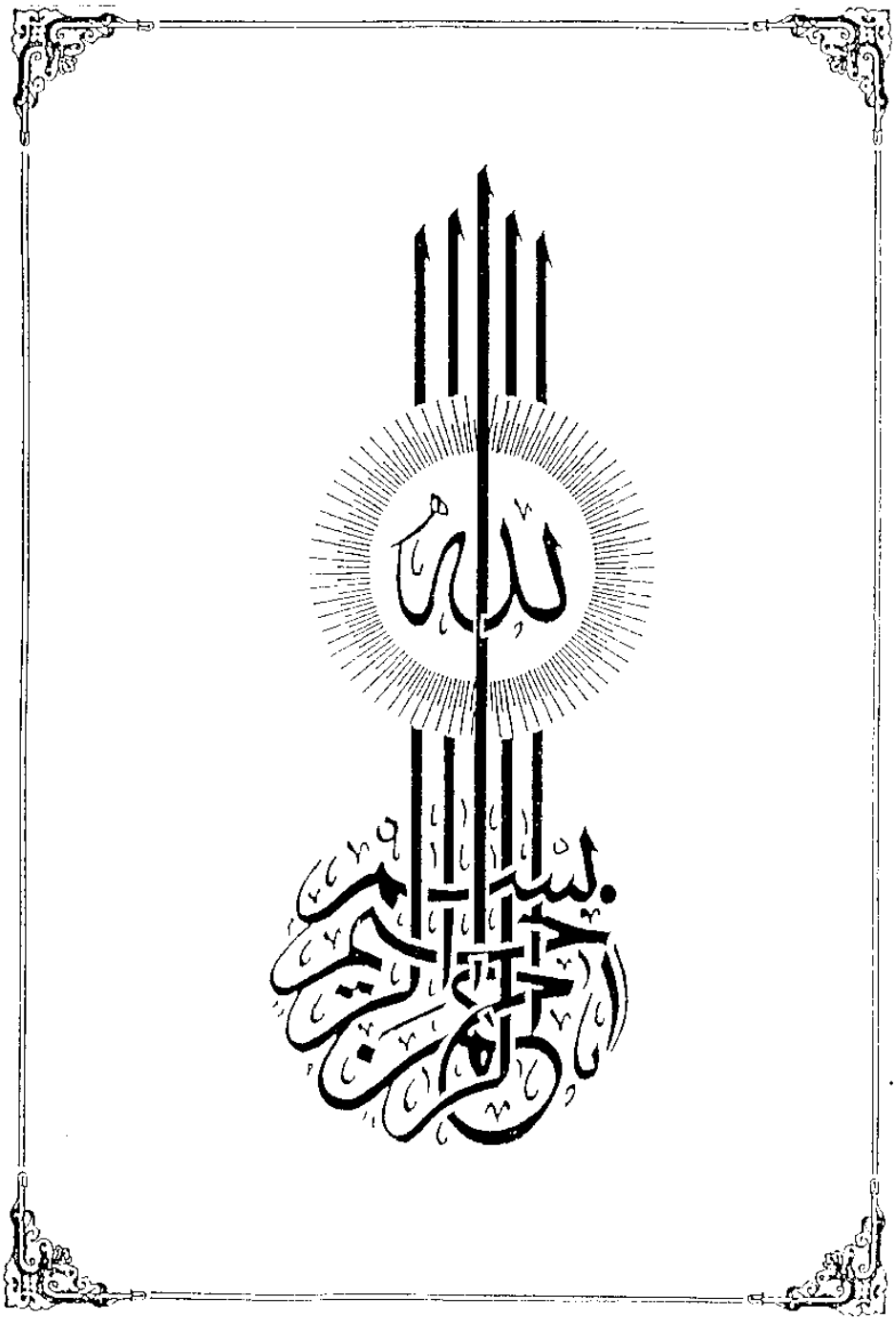
Cairo 1999



STATEMENT

This thesis is submitted in partial fulfillment of the requirements of the degree of doctor of philosophy in electrical engineering Electronics And Communication Engineering

The work included in this thesis was carried out by the author in the Department of Electronics and Communication Engineering, Ain Shams University

No part of this thesis has been submitted for a degree or a qualification at any other university or institute

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PUBLICATIONS

Research Publications

1. M. A. Mousa, S. H. El Ramly, N. El Nady and F. A. Amer, "Asynchronous Routing in Digital Telephone Networks", *proceedings of the* 14th *Radio Science Conference "NRSC'97"*, Cairo, Egypt, March 23-25, pp. 1-8 C32, 1997.

2. M A. Mousa, B. M. Nossier, and S. H. El-Ramly, "Analysis of the Leaky Bucket Policing and Used Feedback Control in ATM LANs Networks", *Egyptian Computer Society*, No. 2, 1998.

3. M A. Mousa, B. M. Nossier, and S H. El-Ramly, "Performance of the Buffered and Unbuffered Leaky Bucket Policing Mechanism and Used Feedback Control Loop in ATM Networks", *proceedings of the 16th Radio Science Conference "NRSC'99"*, Ain. Shams Univ., Egypt, February 23-25, pp. 1-8 C12, 1999.

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ABSTRACT

Mahmoud Ahmad Mousa "Traffic Control in ATM Networks" Ph D Degree, Ain Shams University Faculty of Engineering Electronics and Communication Engineering Department 1999

ATM is the transfer mode of choice of the B-ISDN ATM is a packet-oriented switching and multiplexing technique. High transmission rates are expected to offer full bandwidth flexibility and high bandwidth utilization, and provide the quality of services required by applications with a wide range of performance requirements through statistical multiplexing. ATM networks have multiple service classes allowing voice, video, data, and text in an integrated manner to share the same network. Of these, the Available Bit Rate (ABR) service class is designed to efficiently support data traffic.

The general problem of network traffic involves all the available traffic classes. In this thesis, we address the problem of designing traffic control mechanisms for one class- the ABR service class in ATM networks.

Congestion control in ATM networks has been classified into two categories preventive and reactive control. The former tries to prevent congestion before it happens while the latter reacts to the congestion after it occurs and tries to bring the degree of network congestion to an acceptable level.

Preventive control consists of Usage Parameter Control (UPC)and Connection Admission Control (CAC). The role of the UPC is to police established connections and ensure that the users traffic conforms with the requirements agreed during connection establishment. The CAC is responsible for allocating resources dependent on the type of traffic the user wishes to send over the network, for each connection set-up. Accurate and simple characterization of the different possible sources are therefore very important. This work began, therefore, with an examination of the various traffic models that are available. The most versatile of these models; the On-Off model has been used to represent ATM sources. We then studied the known CAC algorithms both analytically and by simulation from which we concluded that the bandwidth assignment is strongly dependent on the particular traffic characteristics.

In this thesis, we investigate the use of preventive control mechanisms in solving the problem of traffic control, (using leaky bucket policing mechanism). Emphasis in this work is given to determine the parameters of the leaky bucket and to optimize the mechanism, which is used to monitor and control the traffic in terms of conformity with the agreed traffic contract at the user access. We also examined the performance characteristics such as reaction time, cell loss

probability and cell delay. The performance of both buffered and unbuffered LB are analyzed using the fluid-flow model. Closed form formulas are derived to calculate the mean queuing delay and mean reaction time of the LB. Numerical calculations and simulations are performed for different traffic sources which are characterized by their mean bit rate, peak bit rate and average number of bits generated during the burst. The results obtained confirm the performance studies done so far, showing that one LB is not sufficient to police all the source traffic parameters. It has been found that a three-fold trade-off exists between sensitivity to violation, reaction time and cell queuing delay.

According to the analysis done a new scheme called triple leaky bucket mechanism is proposed which provides an effective solution if tight control, fast reaction time and small queuing delay are required.

Preventive control is an open loop control policing since no feedback information is sent from the network to the sources and the policing device. Thus in the case of congestion in the network no action can be taken.

A new approach is thus proposed where the leaky bucket parameters are made adaptive using combined preventive and reactive control. This approach work as follows:

A congested network element sends a congestion message to the source asking for a reduction in the transmission rate. The rate of reduction which is pre-specified will be called the throttling rate. In our simulation we used a multiplexer buffer to represent a network element that sends congestion messages. If the multiplexer buffer exceeds a certain threshold, feedback information is sent to the sources instructing them to reduce their transmission rate. The same information is sent to the LB, but delayed by the round-trip propagation delay. The scheme which carries this information is called Backward Explicit Congestion Notification (BECN). When the network element (the multiplexing buffer) recovers from congestion a message is sent to the sources and LB mechanisms changing its parameters to their initial value.

Implementation of the proposed scheme by simulation and comparison with the static state, showed that, the proposed scheme improves the cell loss probability due to congestion especially in ATM LANs network.

Key Words: *Traffic Control in ATM Networks, communication networks.*

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