Fuzzy Logic Control in ATM network

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ABSTRACT

Future high speed network must be able to support a various mix of heterogeneous network traffic, while at the same time satisfy the high bandwidth requirements of applications. Asynchronous Transfer Mode (ATM) is viewed as the most promising technology that can satisfy the above requirements. ATM is potentially able to support all classes of traffic including voice, video and data in a single transmission and switching technology. The ATM network promises greater efficiency in handling different kind of traffic types without compromising the desired quality of service requested. Traffic flows which have completely different characteristics are statistically multiplexed to share transmission and switching resources, and to maximize utilization of resources.

However, due to the unpredictable statistical behavior of the traffic and various traffic characteristics, it has become a great challenge for ATM networks to effectively control the traffic and congestion while at the same time provide the desired quality of service.

The ATM traffic management framework has defined a set of traffic and congestion control functions to overcome the above problem. These functions have been extensively studied in the literature. On the other hand, the success of fuzzy logic control in controlling ill-defined and non-linear systems is seen as a possible solution to the problem. The ability to incorporate expert's knowledge and use of linguistic rules provides fuzzy systems with incredible flexibility and adaptability. Fuzzy logic control provides an alternative to the conventional method of implementing ATM traffic and congestion control functions.

The proposed fuzzy logic based traffic controller utilizes a set of linguistics rules (based on expert's knowledge) manipulated by means of fuzzy set theory and fuzzy logic in making control decisions. It consists of a Fuzzy Policer and a Fuzzy Congestion Controller. The Fuzzy Policer's main task is to monitor and restrict the behavior of traffic source to its

negotiated parameters. This is accomplished by discarding cells that violates the negotiated values. The Fuzzy Congestion Controller aims to prevent or relieve network congestion. It will notify the sources to adjust their transmission rates depending on the congestion state of the network, thus minimizing the occurrence of congestion. Simulation is carried out to evaluate the performance of the proposed fuzzy traffic controllers. Favorable results have been produced that shows the feasibility and effectiveness of utilizing fuzzy logic control in ATM networks.

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ABBREVIATIONS

ATM	Asynchronous Transfer Mode
CAC	Connection Admission Control
UPC	Usage Parameter Control
FLC	Fuzzy Logic Controller
COA	Center of Area
MOM	Mean of Maximum
TCP/IP	Transmission Control Protocol/Internet Protocol
QoS	Quality of Service
VPI	Virtual Path Identifier
VCI	Virtual Channel Identifier
CRC	Cyclic Redundancy Check
UNI	User-network Interface
NNI	Network-network Interface
GFC	Generic Flow Control
PT	Payload Type
CLP	Cell Loss Priority
HEC	Header Error Control
VP	Virtual Path
VC	Virtual Channel
VCC	Virtual Channel Connection
VPC	Virtual Path Connection
SVC	Switched Virtual Channel Connection
PVC	Permanent Virtual Channel Connection
AAL	ATM Adaptation Layer
PCR	Peak Cell Rate
SCR	Sustainable Cell Rate
MBS	Maximum Burst Size
MCR	Minimum Cell Rate
CDVT	Cell Delay Variation Tolerance
CDV	Cell Delay Variation

CTD	Cell Transfer Delay
CLR	Cell Loss Ratio
CBR	Constant Bit Rate
rt-VBR	Real-Time Variable Bit Rate
nrt-VBR	Non-Real-Time Variable Bit Rate
UBR	Unspecified Bit Rate
ABR	Available Bit Rate
EFCI	Explicit Forward Congestion Indication
GCRA	Generic Cell Rate Algorithm
TAT	Theoretical Arrival Time
LCT	Last Compliance Time
RM	Resource Management
FP	Fuzzy Policer
FCC	Fuzzy Congestion Controller