CHAPTER 6

CONCLUSIONS

This thesis presents some studies conducted on the estimation of cell loss ratio in ATM networks by applying fuzzy logic. The Markov, Geom/Geom/1/k and self-similar traffic models are considered and are analyzed in detail for accurate estimation of cell loss ratio. The fuzzy estimated results are compared with the theoretical results for validation. A novel fuzzy technique to estimate CLR from a few appropriate data for self-similar traffic considering the arrival rate and the occupancy of buffer is implemented. To model the self-similar traffic, a heavy tailed distribution function based on Pareto distribution is proposed. Jitter analysis is carried out for both Poisson and self-similar traffic and their buffer requirements are compared. A new scheme to allocate bandwidth dynamically for the heterogeneous traffic using Fuzzy Logic Controller is proposed and its performance is evaluated.

In chapter 2, the fuzzy inference scheme is analyzed in detail for the on-off source model. The main drawback of this scheme is that the observed data is required for all types of traffic classes and number of connections. Suppose, the incoming traffic does not fit into the predefined traffic class, and if the observed data is not available for a certain number of connections, then this method is not suitable for CLR estimation. A Set Right Algorithm that provides a defense mechanism against rare events and protection to the network against any irregular and possible abnormalities is proposed and analyzed for sudden
variation in CLR data. This sudden change can occur due to the failure of nodes or congestion in the network.

In order to overcome the drawbacks in FIS, a more versatile and adaptive fuzzy logic system is chosen. This adaptive fuzzy logic system estimates the CLR for large sized systems based on small amount of information from small sized systems obtained analytically using the mathematical models; Markov and Geom/Geom/1/k. From this analysis, it is observed that the fuzzy estimated CLR values are quite different from the theoretical CLR values. Hence, an improved loss calculation method for Markov, and a modified fuzzy logic system with an appropriate correction factor for Geom/Geom/k/1 are proposed and implemented. From the results, it is observed that the modified fuzzy logic system with the correction factor performs well for Geom/Geom/k/1 model.

In Chapter 3, adaptive fuzzy logic system is applied for the self-similar model and it is observed that there is a big difference in the CLR values estimated theoretically and by the fuzzy system. The modified fuzzy logic system with the correction factor also fails for the self-similar model, as there is again big difference between the CLR values estimated theoretically and by the modified fuzzy system. Hence, the implementation of the proposed novel fuzzy logic algorithm based on the $\alpha$-cuts of equivalence relation to estimate CLR for self-similar traffic is presented. In this fuzzy method, variation in the arrival rate and the occupancy of the buffer are considered as inputs and CLR as the output. It is observed that different membership functions are required to estimate the CLRs in the cell region and the burst region. The fuzzy estimated CLR values are compared with the theoretical CLR values by varying the arrival rate and the occupancy of the buffer. It is noticed from the results that the new approach not
only estimates accurately the real time CLR but also achieves it by using fewer appropriate theoretical data.

Chapter 4 deals with the proposed modified Min-max algorithm (MMA) to achieve fairness in bandwidth among the competing sources with different QoS requirements. This proposed MMA allocates bandwidth dynamically for the heterogeneous sources by considering the CLR, which is a unique feature here. The performance of MMA is compared with that of the existing dynamic bandwidth allocation algorithms. Also, MMA is compared with the Min-max algorithm and it is observed that MMA performs better than Min-max algorithm by an order. The Min-max maintains the same QoS irrespective of the source requirements, whereas MMA performs better by satisfying different QoS requirements. Since the MMA takes care only the CLR requirement, a new dynamic bandwidth allocation algorithm considering the other important QoS parameters such as CTD and CDV is developed.

The proposed FLC is designed and tested for dynamic bandwidth allocation for heterogeneous sources to support multiple classes of services with widely different characteristics and QoS requirements. The CLR, CTD, CDV and the arrival rate are taken into consideration in the design of the FLC. The goals of the design are to achieve an efficient, simple and robust algorithm that is achieved by tuning the FLC to adapt itself to the variation in the traffic rates and the QoS requirements. Since the FLC does not depend on specific traffic parameters, it is versatile and robust. The ideal and fuzzy estimated bandwidths are compared for video, audio and data sources and the results are plotted. It is seen from the graph that the fuzzy estimated bandwidth is slightly less than the ideal bandwidth that ensures network efficiency and also avoids traffic congestion and wastage of bandwidth.
In chapter 5, a simple distribution function that models self-similar arrivals by capturing their heavy tailed property is proposed and presented. Also, jitter analysis is carried out for both Poisson and self-similar traffic models. The simulation is carried out for 32768 CBR samples. From the results, it is seen that a drastic increase in buffer size is required for self-similar traffic to maintain the CLR at a predetermined value compared to Poisson traffic. But any increase in buffer size increases the cell delay. For the transport of CBR traffic in which the cell delay variation is very high, some additional measures have to be taken care of to maintain the guaranteed QoS. This could take the form of preferential treatment at the switches. Source level or switch level modeling of the traffic may be done in order to decrease the burstiness of the traffic.

If the relationship between \( \alpha \) and \( H \) is found, then the proposed 2PDPP will provide a general distribution function that can be used to model any self-similar process. This distribution can be used to generate self-similar traces that can be used in simulation. Though, this method of self-similar traces generation maybe easier to understand than the existing methods, like the FFT method it requires more time for self-similar trace generation.