ABSTRACT

Asynchronous Transfer Mode (ATM) is potentially capable of supporting all classes of traffic (e.g., voice, video, and data) in one transmission and switching fabric technology. It promises to provide greater integration of capabilities and services, increased and more flexible access to the network, and more efficient and economical service.

The Available Bit Rate (ABR) service has been developed to support data applications over ATM networks. ABR is unique because the network switches can indicate to the source the rates at which they should be transmitting, thus avoiding congestion and efficiently utilizing network resources. ATM switches use their current load information to calculate the allowable rates for the sources. These rates are sent to the sources as feedback via *resource management* (RM) cells, which are generated by the sources and travel along the data path to the destination end systems. The destinations simply return the RM cells to the sources.

The point-to-multipoint ABR service within ATM is important for many emerging data applications. Examples of multipoint applications include distance learning, server and replicated database synchronization, advertising, searching and data distribution applications.

ABR traffic management for point-to-multipoint connections controls the source rate to the minimum rate supported by all the branches of the multicast tree. Feedback consolidation at the branch points becomes a necessary operation to avoid the feedback implosion problem, where the number of backward resource management (BRM) cells received by the source is proportional to the number of leaves in the multicast tree. In addition, the allowed rate of the source should not fluctuate due to the varying feedback received from different leaves.

A number of algorithms have been proposed for extending ABR congestion avoidance algorithms to perform feedback consolidation at the branch points. Schemes that attempt to maximize accuracy of feedback information tend to be slow in providing feedback to the source when the conditions in the network change. This results in a long transient period until the source is able to adjust its rate to accurately meet prevailing network conditions. Accuracy can be traded for speed by having a switch generate feedback information before it has all the necessary information from downstream paths. This can cause consolidation noise, which can result in heavy oscillation of the cell rate used by the source.

In this thesis, we propose an improved algorithm for feedback consolidation. The new algorithm combines benefits from the previous developed algorithms with reduced overhead.

The performance of the proposed algorithm and the previous algorithms is compared under a variety of conditions. Results of the simulation experiments indicate that the algorithm we propose doesn't suffer from the consolidation noise, while exhibiting a fast transient response with accurate feedback information.

We have also proposed new criteria to control the RM ratio (BRM cells received/FRM cells sent) at the source. The new criteria is very straightforward to implement and can be used by any consolidation algorithm that permit sending extra fast overload feedback cells. Results have shown that the new method has the effect of accelerating the convergence of the RM ratio to one while not affecting the transient response.

The thesis is organized as follows: *Chapter 1* presents an introduction to congestion, congestion control, and traffic management in ATM networks. A brief introduction to ATM service categories is also presented. *Chapter 2* discussed ABR traffic management framework. Behaviors of source, switch, and destination in ABR service are intensively explained. *Chapter 3* introduces the problem to be addressed. A number of previously developed consolidation algorithms are studied in that chapter. *Chapter 4* presents the proposed algorithm and the new RM ratio control method. The simulation results are analyzed and a comparison between the proposed algorithm and the previous algorithms is given. Finally, *chapter 5* concludes the thesis and proposed some future extensions.