The Impact of Bandwidth Reallocation and Dynamic Channel Rerouting on Real-Time Communications in ATM Networks

Lawrence K. Miller
Department of Electrical Engineering and Computer Science
The University of Toledo
Toledo, OH 43606

and

Ernst L. Leiss
Department of Computer Science
University of Houston
Houston, TX 77204-3475

ABSTRACT

A high priority real-time connection is denied admission to an ATM network if sufficient bandwidth is not available along all suitable paths through the network. Bandwidth reallocation and dynamic active channel re-routing are techniques that can be used to admit high priority real-time connections where traditional call admission control techniques would deny admission. A node can select lower priority channels, reallocate their bandwidth to the new higher priority connection being admitted, and reroute those channels so that their QoS requirements and transmission deadlines can still be satisfied. At call admission time, one or more backup channels are established around each potential bandwidth reallocation point (node) of the primary channel, which is likely to select the channel as a victim for bandwidth reallocation. When backup channels have not been established in advance, detouring around a specific port is utilized, if possible, to make the technique more efficient. When reroutes occur, our protocols ensure that the transmitted data are received on time and in sequence, which is essential for real-time communications. SANRoP, a cell based discrete event simulator, was used to simulate these protocols in an ATM network in order to determine how well they perform. A study was conducted to see how well these techniques perform in a larger more heavily loaded network.

Keywords: Computer Networks, Asynchronous Transfer Mode, Routing Protocols, Simulation

1 INTRODUCTION

We examine the problem of call admission of prioritized real-time communications channels with call establishment deadlines in an Asynchronous Transfer Mode (ATM) network. When a call is admitted to a typical ATM network, a path/route is selected through the network, and bandwidth/resources sufficient to meet the Quality of Service (QoS) requirements and the traffic contract are allocated/reserved along that path for the duration of the call. In an ATM network, this path is static in nature and does not change for the call's duration. Once allocated to a channel, other channels can't use its bandwidth until it is released by closing the connection. This means that other calls may not be admissible due to a lack of available resources, since admitting them could cause the QoS guarantees, and possibly transmission deadlines, of previously admitted calls to be violated. Thus, when the network load is near capacity, for example at peak usage times associated with video on demand services, interactive network games, or multi-party teleconferencing, most of the network's resources will likely be tied up and unavailable for high priority real-time connection requests. We do not want to renege on prior commitments, yet we would like to admit high priority connections as well. In our previous work [9, 10, 11], the technique of reallocating bandwidth from lower priority