Continuous Media Dissemination over ATM Networks

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Abstract

Interactive continuous media (such as audio and video) generate large amounts of traffic and have stringent delay requirements. One of the most central issues for ATM networks carrying continuous media (CM) is the significant congestion control problems that can arise due to the statistical multiplexing of many very high burstiness signals. A key property of any congestion control approach not based on resource reservation at the peak rate of the sources is the ability to shed load quickly and without causing an avalanche of retransmissions of dropped traffic.

We are investigating the communications aspects of layered coding (also referred to as hierarchical or subband) techniques for CM dissemination over ATM and other packet-switching networks. Layered coding (LC) techniques split signals into components of varying importance. The aggregation of these components reconstructs the original signal, but subsets of the data can also provide various degrees of approximation to the original signal. LC is important for the efficient use of ATM networks. With LC of CM, when network congestion arises it is possible to drop the less important signal components without causing service interruption, and without the need for retransmissions. We refer to this as an open-loop approach. An open-loop approach is particularly helpful for continuous media dissemination because dealing with feedback in a multipoint environment is particularly difficult. In addition, using LC can more easily support heterogeneous receivers and can also play an important role at the receiver because it provides the system software with the capability of allocating resources based on local specifications and priorities.

We have developed a prototype interactive video distribution application in an ATM environment to investigate the effectiveness of our open-loop approach to CM dissemination. We advocate using a time-driven rather than data-driven presentation approach. Traditional CM applications are data-driven, i.e., the system displays a frame at the moment it has received all data pertaining to that frame. (Frames are typically segmented over multiple packets or cells because of size constraints.) Therefore, delay and loss in the network cause jitter, i.e., result in irregular display times. (Reliable communication protocols are often used and therefore loss results in further delay in order to successfully re-transmit the lost data.)

We have experimented over an ATM LAN consisting of a Fore Systems ASX-100 ForeRunner ATM switch and DECStation 5000/200 workstations, running Ultrix version 4.2A with Fore Systems TCA-100 Turbochannel adapters. Signaling was performed with Fore's proprietary Simple Protocol for ATM Network Signaling (SPANS) that supports unidirectional virtual-circuits, which can have multiple destinations. Due to the bus-based architecture of the switch, support for multicasting is straight-forward and efficient.

We present measurements demonstrating that independently-received signal components do not cause significant communication overhead, while improving tolerance to end-system load variations and network delay and jitter. We also discuss the impact of these techniques on application programming.