Network and Operating Systems Support for Real-Time Multimedia

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Multimedia systems place a high demand on the network in terms of bandwidth, maximum end-to-end delay, and delay variance. Because of the recent advances in network technology, multimedia applications are becoming popular. Ethernet, a popular network, cannot support the high demands, in terms of bandwidth and delay, imposed on the network by multimedia data. This dissertation proposes three priority Ethernet protocols which allow faster delivery of real-time multimedia data. We present a qualitative analysis describing the conditions in which each performs best. Through an an extensive simulation study using both Poisson and bursty traffic, we show the superiority of these methods over basic Ethernet.

In a multimedia application like a teleconference, one person speaks which then provokes a response from another speaker. These conversation bursts have a cause and effect relation that should be maintained at the recipients, even though the network can introduce non-uniform delays and deliver the data out of order. Since multimedia data is real-time in nature and has a limited lifetime, the causal dependencies have a limited lifetime. This dissertation presents a low-overhead algorithm that ensures delta-causal order delivery of messages, a form of causal order restricted to a limited time interval. A proof of correctness is presented and the performance is studied.

In addition, the data from each speaker in a conference call is typically sent to multiple recipients, i.e., multicast. Maintaining causal order in a multicast environment (causal multicasting) is more complicated than for a unicast environment. Every causal order algorithm imposes a message overhead by adding additional information to each message which is used to maintain causal order. In a multicast environment, the biggest challenge is to limit the bandwidth consumed by the message overhead, especially if the overhead grows with the number of sites. This dissertation presents a framework for evaluating the efficiency of multicasts, based on both the underlying communication network topology and the multicast algorithm. Finally, it presents a low-cost causal multicast algorithm, called the partition method, and compares its cost for with the cost of two previous existing algorithms for several different representative network topologies.