

Bandwidth Prediction and Allocation for Video Delivery

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Abstract

Multimedia application has become one of the major traffic to be supported through networks. These applications require high bandwidth and stringent Quality of Service (QoS). When multimedia traffic is transported over a network, video traffic consumes most of the bandwidth. For the transport over networks, video is typically encoded to reduce the bandwidth requirements. Even compressed video, however requires large bandwidths of the order of several hundred kbps and mbps. In addition, compressed video streams typically exhibit highly variable bit rates as well as long range dependence properties, this, in conjunction with the stringent QoS, makes the transport of video traffic over communication networks a challenge problem.

Video is inherently dynamic, and MPEG video coding results in Variable Bit Rate (VBR). MPEG video traffic is correlated and its autocorrelation has a heavy tail because MPEG uses intra-frame techniques as well as inter-frame techniques. A highly correlated input process with a heavy tail, if served at a fixed rate not close to the peak rate, causes large queues, large delays and excessive cell loss. If the bandwidth is allocated according to the peak rate of the video traffic, no packet losses occurs, but a substantial amount of bandwidth is wasted during most of the transmission. On the other hand, if the bandwidth is not allocated close to the peak rate, large delays and excessive packet loss will be experienced. Dynamic bandwidth allocation is thus needed for MPEG video traffic. The dynamic approach can be divided into two groups: synchronous and asynchronous. Since the asynchronous operation can significantly reduce the adaptation frequency, it is used in our method.

Traffic prediction plays an important role in dynamic bandwidth allocation. The existence of correlation in the video trace generated from an MPEG encoder can be exploited for traffic prediction, which, when combined with dynamic bandwidth allocation, can provision both network efficiency and QoS guarantees. Earlier work in this area includes the frequency domain, wavelet domain, and time domain prediction approaches. In the time domain prediction methods, adaptive linear prediction does not require any prior knowledge of the video traffic statistics nor does it assume stationary, and is thus very suitable for on-line real time prediction. However when there are scene changes, its slow convergence may result big prediction errors. In VBR video traffic characterized by frequent scene changes, this method may result in an extended period intractability and thus experience excessive cell loss during scene changes. Our proposed fast algorithm achieves fast convergence, thus tracks scene changes better. Simulation results show that this fast algorithm not only incurs small prediction errors but more importantly also achieves fast convergence.