Robust Video Transmission Over the Internet using Multipath Routing & Network Feedback: Progress Report

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I. Background and Literature

Recent research on the subject of robust multimedia transmission over the Internet has concentrated on *Multiple Description Coding (MDC)*. A comprehensive study of Multiple Description Coding is provided in [1]. The article introduces MDC in detail, and describes it's suitability for the transmission of compressed media over the Internet. The main concept underlying MDC is that certain types of information sources have inherent redundancy e.g. sound, images, video; that can be utilized to provide robustness against transmission errors. This robustness can be achieved by transmitting the original and redundant data over different paths on the network. Since the probability of all the paths failing *simultaneously* is quite low compared to the probability of failure of each individual path, there is a high probability that at least one data stream will reach the destination with a tolerable degree of losses. These multiple streams, denoted *descriptions,* are so constructed that the more the number of descriptions received, the better the source reconstruction at the receiver.

Since retaining, or even *adding* redundancy is in direct opposition to the purpose of compression, a trade-off has be made between compression efficiency and robustness.

A number of approaches to using MDC for video transmission have been reported recently. In [8], even and odd frames of the video sequence constitute two descriptions. [4] describes MDC for Wavelet coded video. In [6], [2] *correlating transforms* are developed that *add* redundancy to uncorrelated information for the purpose of creating descriptions. This approach is used in [7] for image coding and in [11] for video coding.

In all the papers cited above, a probabalistic channel error model has been assumed. Packets on a certain path are lost with a probability p which is assumed known at the encoder. This information is used for the creation of descriptions. Specifically, the higher the loss rate, the more redundancy is added to the description to be sent over that path. Static loss rates are assumed.

The assumption of static loss rates is too simplistic, and it is not clear in the papers how these are determined at the coder. Taking the dynamic nature of the Internet with variable bandwidth, delay and loss rate into account is more realistic. The project aims at taking these dynamic network parameters into account for the purpose of robust video transmission.

II. Project Goals

Multi-resolution coded video [9], [10], arranges the video stream in various levels of priority suitable for the purpose of adding redundancy. Thus the more important packets will be protected more by adding FEC, or simply replication; and this level of protection will be progressively decreased for less important data. Data forwarding and the added redundancy will depend on the current channel conditions. For example, if there are multiple paths available to a given destination, but none of the paths have sufficient bandwidth, the video stream will be split and sent over each of these paths. This splitting is possible because of the multi-resolution representation of video indicated above.

The task of gathering information about the network and forwarding video streams over explicitly determined paths can be handled by a overlay network along with a *synergy layer* [12]. The following network parameters will be employed:

- Loss rate
- Bandwidth
- Delay

A. Simulation Software

The Wavelet based multi-resolution video codec (IBMCTF) is available. Network simulation software with overlay network and network feedback information is also available. Finally a packetizer that works in conjunction with the video codec is also available. The immediate goal is to put the pieces together and start the simulations.

References

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