

Eric Setton esetton@stanford.edu
Frederic Sarrat fsarrat@stanford.edu

Reliable video transmission using multiple paths over a lossy packet network

The Internet is an error prone network on which packet losses often occur in bursts. In video transmission, this can lead to the critical loss of several consecutive frames, resulting in a degradation of the video quality and in the forward propagation of errors. By using multiple paths, e.g. [1], [2], [4], the probability of loss is reduced and a better recovery of the lost blocks or frames is possible. When the video is coded into two independent streams as in [1] or [2], the distortion is further reduced, but since the reference frames are spaced further apart, this leads to a decrease in the compression efficiency. Our goal is to propose a new sending strategy for the transmission of video using two different paths and feedback information from each channel. Our main concern is to detect channel bursts and to avoid sending packets on a path that is presumably down.

Often, the channels are modelled using the loss probability only. A two-state Gilbert model (one probability for the transition from good state to bad state, another one for the transition from bad state to good state) allows simulating the network more accurately.

Also, provided a delay, the sender can have access to feedback information sent by the receiver e.g. [3]. This information and the statistics of the channel can be used to improve the sending strategy of [1] and [2].

Finally, if a frame is lost during the transmission, the decoder can use several different methods to estimate the frame from the other correctly received frames as in [2].

We encode the video into two independent streams as in [2] and send each stream on a different path as long as we don't detect a burst. When we do detect a burst on one path, we send both streams on the path that is assumed to be in good state. Using probe packets, we detect the time when the burst is over and resume the transmission of each stream on a different path.

Our project aims at comparing this new transmission strategy of video over two paths to the strategy used in [1] and [2] by implementing both in H26L. This state of the art codec provides an up-to-date experimental framework to our project. Several parts of this codec will have to be modified, in order to :

- enable the simulation of a 2-channel transmission scheme ;
- change the reference frame selection ;
- use a good recovery strategy of lost frames.

References :

[1] John G. Apostolopoulos, "Error Resilient Video Compression via multiple state encoding", VLBV'99, Kyoto, Japan, October 1999

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[3] Yi J. Liang, Markus Flierl and Bernd Girod, "Low Latency Video Transmission over Lossy Packet Networks using Rate-Distortion Optimized Reference Picture Selection", to be published in ICIP 2002.

[4] Shunan Lin, Shiwen Mao, Yao Wang, Shivendra Panwar, "A Reference Picture Selection Scheme for Video Transmission over ad-hoc networks using multiple paths", ICME 2001.