

SEACAST: A PROTOCOL FOR PEER-TO-PEER VIDEO STREAMING SUPPORTING MULTIPLE DESCRIPTION CODING

*Simone Zezza**, *Enrico Magli**, *Gabriella Olmo**, *Marco Grangetto†*

* Dip. di Elettronica
Politecnico di Torino
name.surname@polito.it

†Dip. di Informatica
Università degli Studi di Torino
marco.grangetto@di.unito.it

ABSTRACT

SEACAST is a peer-to-peer live streaming protocol developed in the framework of the European Project “SEA - seamless content delivery”. SEACAST represents an evolution of the VidTorrent multiple-tree protocol developed by Viral Communication [1, 2]. Similarly to other P2P streaming protocols, VidTorrent’s design is still largely based on file-sharing systems. The objective of SEACAST is to overcome this limitation, adopting techniques and protocols optimized for H.264/AVC video streaming. In particular, SEACAST introduces two main innovations, namely flow control using a proper protocol stack, and application-layer error control by means of state-of-the-art Multiple Description Coding (MDC) [3] techniques.

As for flow control, in P2P video streaming the overlay network should guarantee a constant flow of data and a low start-up latency, while coping with a significant packet loss rate. While VidTorrent systems employs TCP for video transport, SEACAST breaks this legacy of file-sharing system, and uses the RTP, UDP, and RTSP/SDP to set up sessions and enable flow control.

As for error control, the presence of prediction loops in the H.264/AVC encoder induces error propagation, and retransmission mechanisms cannot be afforded due to the constraints of real-time delivery. In SEACAST, MDC is used to cope with this vulnerability. MDC is particularly suitable for multiple tree overlay network topologies. In fact, if each description is delivered over a different tree, a suitable level of diversity is achieved, which necessary to exploit MDC. To overcome the performance loss of MDC with respect to the corresponding single-description coding, in SEACAST we employ the highly efficient state-of-the-art DIVA MDC algorithm [3] which replaces the trivial odd/even frame data splitting present in VidTorrent. DIVA is tailored to H.264/AVC, and exploits the concept of redundant slices [4] to perform MDC in a syntax-compliant way.

We have evaluated the performance of SEACAST on a local test bed, consisting of several personal computers

running Linux or Linux virtual machines. The peers are connected through the Ethernet of Politecnico di Torino, and each peer has a software module allowing to modify the available incoming and outgoing bandwidth and delay on-the-fly. Each node runs the SEACAST software and in MDC mode, the SEACAST server manages a multiple tree of order 2, and sends either description on a separate tree. Each description has a bit-rate of 512 kbit/s.

In order to assess the effectiveness of MDC, we have emulated the following scenario. Fifty peers connect to the server at random times, requesting the same video stream. Congestion are simulated on 10 randomly selected peers, such that the available bandwidth decreases from 1 Mbit/s to 400 kbit/s.

We have measured the number of descriptions received by all peers over a time interval of 45 minutes, through analysis of log files of each peer. It has been found that, using MDC, no peer suffered a service interruption due to congestion, as all of them were able to receive at least one description. Conversely, the original VidTorrent configuration suffered from severe quality degradation upon congestion of a link, as the effect would be a video freeze.

1. REFERENCES

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- [3] T. Tillo, M. Grangetto, and G. Olmo, “Redundant slice optimal allocation for H.264 multiple description coding,” *IEEE Trans. on Circ. and Syst. for Video Tech.*, vol. 18, no. 1, pp. 59 – 70, Jan 2008.
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