

FWF Project Proposal

Quality Adaptive Video Caching and Transport in Heterogeneous Networks

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Abstract

The transport of *video* flows is a demanding task in distributed multimedia systems based on complex, heterogeneous networks. Currently, there are two major approaches for supporting video data transport in such networks, viz. resource reservation schemes and adaptation techniques residing in the end-system applications that provide or utilize the videos.

The proposed project pursues an alternative approach: it systematically explores how video adaptation (re. quality and resource consumption) can be delegated to, or supported by, the transport infrastructure, i.e., by *network nodes* (such as routers) and *proxy caches* located in the network.

Specifically, it is proposed that *active network nodes* (routers) change video flows during transport in that they perform media scaling (and thus, quality variation) operations when required. Examples of such cases are: fluctuating network QoS, in particular congestion situations; delivery of video flows along heterogeneous paths or to end systems with different playout capabilities; and multicast transfers. The network is best positioned to quickly and gracefully react to such situations.

Moreover, it is proposed that *active proxy caches* exploit video adaptation opportunities to provide novel cache management and flexible buffering techniques. An example is that the quality (and thus storage requirements) of a video clip is reduced (in several iterations) before it is entirely replaced from the cache store.

The project shall make use of and combine three recent developments in multimedia communication and networking research: (1) a variety of video scaling options offered by modern coding standards like MPEG-4, both on a low level (filtering techniques, layered coding, fine-granular scalability) and on a higher, content-based level (e.g., priorities of video objects); (2) descriptive data about the videos and their adaptation options (akin to MPEG-7 variation descriptors), to be stored as part of the videos' meta-data and used to govern the adaptation process in the network; and (3) active network concepts and a prototype active network software system.

The project shall proceed and provide results as follows: adopt and develop, if not readily available, MPEG-4 based video coding and scaling software; identify, model, store as meta-data, and utilize relevant MPEG-7 based video adaptation descriptors (jointly with the project proposed by *Kosch/Böszörményi*); design, implement, and evaluate the basic mechanisms (*not* policies) for video adaptation in an active network; investigate and evaluate novel adaptive proxy cache management and buffering algorithms; integrate the mechanisms into an appropriate protocol architecture (RTSP and RTP/RTCP); and demonstrate and analyze the mechanisms and algorithms in a suitable larger multimedia scenario.

Keywords: distributed multimedia systems, video, streaming, adaptivity, adaptation, scalability, MPEG, quality of service, active networks, meta-data