# Multimedia Cloud-based Video Streaming

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## Multimedia cloud

Cloud computing is a service providing data storage and remote applications. Commercial companies can configure virtual servers formed from uncommitted hardware, permitting scalability and accessibility as a business grows, without the need to maintain physical servers. Alternatively, developers can configure their applications via a cloud API without concerning themselves with the server provision. However the cloud service is configured, client devices do not access the services directly but access derived services within a cloud. This model of computing has a special resonance for: mobile devices, as these face challenges in terms of energy consumption and processor capability; and for heterogeneous consumer devices, which have a dedicated functionality which does not easily adapt.

A multimedia cloud can be placed at the network edge to provide services such as image processing, media adaptation including transcoding, video storage and selective retrieval, and video streaming for applications such as mobile video conferencing. As such a multimedia cloud extends both content distribution networks and peer-to-peer streaming, provided content privacy can be ensured.

## Media sharing

Within the domestic home a good number of devices (tablet computers, smartphones, TVs, laptops, …) may have video-display capability and wireless interfaces but they will often have different screen resolutions and/or codecs. This is an impediment to media sharing, for which there is a growing demand. Examples of sharing include: uploading a video clip from a smartphone or camcorder to a TV, and streaming IPTV, originally received on a TV via a set-top-box, to a tablet computer. Examples of media sharing extend to audio and picture exchange, possibly after some additional processing. It also may be the case that direct exchange of media between two devices is not feasible because of different network interfaces or because the wireless channel is prone to interference during log streaming sessions.

## Cross-device streaming

This poster describes an architecture (Fig. 1) by which consumer devices, which are essentially thin clients to various degrees, can interact via a multimedia cloud. Within the home, a source device supplies the stream characteristics and network conditions, while a target device makes the cloud home monitoring unit (HMU) aware of its screen resolution, codec, and decoding rate. At the cloud, based on these parameters, a transcoder bank, as is necessary, performs cross-codec and spatial-resolution adaptation before passing the re-configured stream to a video server. Notice, however, that some negotiation of parameters may be needed between the HMU and video source to ensure a compatible stream is sent.

While bit-rate transcoding is possible for legacy codecs such as MPEG-2, functional non-linearity in an H.264/AVC codec, makes rate control by transcoder unlikely. Therefore, we propose streaming at the cloud server by prioritized transmission through *unStream*, a development of the authors that adapts to adverse wireless conditions within the home WiFi and/or burst errors across ADSL. *unStream* changes its streaming mode depending on the transcoded input. The whole system avoids the need for developing a complex hardware scalable video encoder for home devices, which would be the main alternative to centralized transcoding.

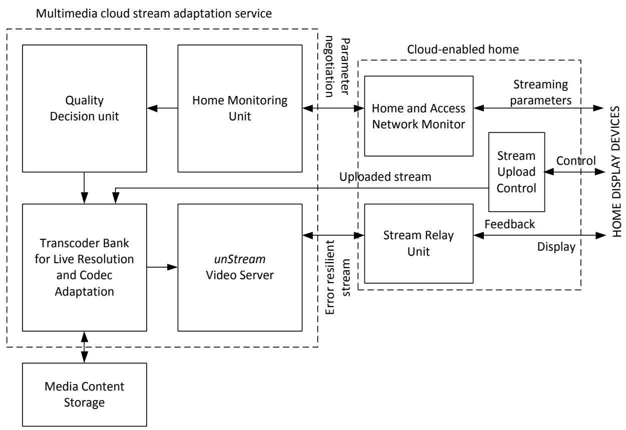


**Fig. 1. Cloud-based home video streaming.**

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# Multimedia Cloud with unStream

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## Introducing unStream

unStream is a form of video transport that adds reliability to the User Datagram Protocol (UDP) and exploits the features of recent video codecs (though is not codec dependent) to improve the streaming experience. Added to this is an adaptive streaming mechanism that distinguishes congestion from wireless channel deterioration. One application targeted is media sharing through a multimedia cloud. Work is in progress to develop an unStream demonstrator.

## unStream adaptation

An unStream receiver monitors relative one-way trip-time (ROTT). By comparing the ROTT with two thresholds (low α and high β), the receiver can dynamically decide which video packets to request retransmission of. Requests are by a negative acknowledgment (NACK). In the example of Fig. 1, the video stream has been decomposed into three layers, with packets from an base layer (B) and a number of enhancement layers (E1, E2 and E3). If packet loss is due to a poor wireless channel there is no point in staunching the number of retransmissions and all lost packets (from B, E1 to E3) are NACKed. If congestion is high then retransmissions will add to congestion and only lower quality packets (from B and E1) are NACKed. Otherwise, the high quality packets from E3 are declared lost if they fail to arrive. It is important to realise that unStream can work with a number of ways of prioritizing compressed video data. We have tested using I, B, and P frame types, as well as A, B, and C data partitions within the H.264/AVC (MPEG-4 Part 10) codec.

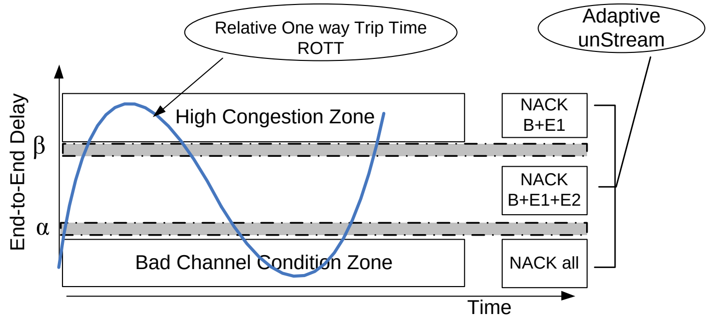
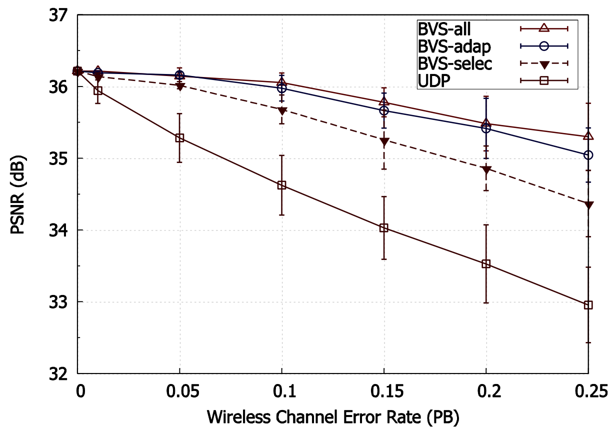
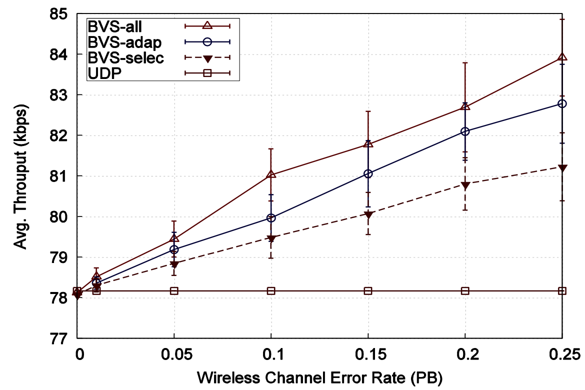



**Fig. 1. Operation of unStream.**

## Comparisons

We compared adaptive unStream against three alternatives: 1) raw UDP transport; 2) negative acknowledgment of all lost packets (BVS-all); and 3) just requesting high-priority packets (BVS-selec).



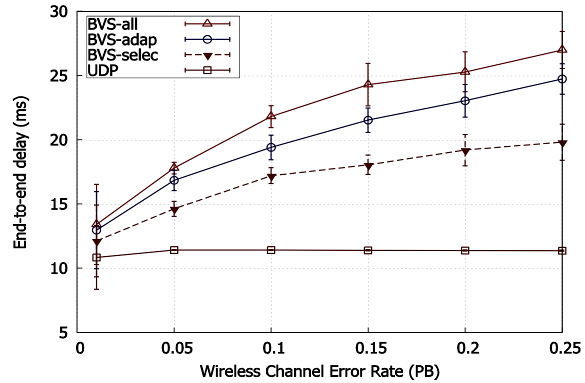




**Fig.2. unStream (BVS-adap) performance comparison.**

In Fig. 2, unStream (labelled BVS-adap) ) has similar video quality to BVS-all; is better than just resending some prioritized packets (BVS-selec); but has reduced throughput and reduced end-to-end delay compared to BVS-all. UDP results in severe packet loss over a bursty wireless channel.