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Benefits and costs of scalable video coding for internet streaming

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Abstract

Benefits and costs of scalable hybrid video coding techniques are analyzed with respect to internet streaming. Temporal, spatial, amplitude scalability, and combinations as described in MPEG-4 are considered. Benefits are a reduction of the server storage capacity, a reduction of the netload for multicast delivery and a graceful degradation in case of transmission errors. Costs are an increasing netload for unicast delivery and an increasing computational expense in the decoder. The result of an evaluation shows that temporal scalability has minimum costs among all analyzed techniques. It increases the netload for unicast only marginally with no additional computational expense in the decoder. Temporal scalability provides a reduction of the server storage capacity and netload for multicast by about 30% and two steps of graceful degradation. All other known standardized and nonstandardized techniques of spatial and amplitude scalability are associated with costs that appear too high to be attractive for internet streaming. Therefore, only temporal scalability is used at the present. Some of the scalable video coding techniques may become of interest for other applications where the investigated costs are less relevant.

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Keywords: Video coding; Scalable video coding; Scalability; MPEG-4

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1. Introduction

As a result of the increasing multimedia communication via the internet, streaming of audiovisual content over IP-based heterogeneous networks becomes more and more important. In this scenario, which is illustrated in Fig. 1, content is provided by a streaming server and can be streamed to one or various clients.

Streaming services can be classified by the transmission mode. Each transmission mode is described by the delivery mode and by the transmission direction. The delivery mode can be either unicast or multicast. Unicast means that the server has a separate point-to-point connection to each participating client. Multicast means that the server has one point-to-multipoint connection to all participating clients (see Fig. 2).

The transmission direction can be either unidirectional or bidirectional.

The variety of individual clients causes the challenge to provide bitstreams of different data rates simultaneously for the same content because of different connections to the network and different processing speeds of these clients. Due to the heterogeneity of the network, beside various different available channel capacities, also different transmission error behaviors have to be handled, as well as fast variations of the available channel capacity.

Scalable video coding allows the decoding of only parts of the whole bitstream. Scalable encoded data contains one so-called base layer bitstream and one or more so-called enhancement layer bitstreams. A video of low resolution can be received by

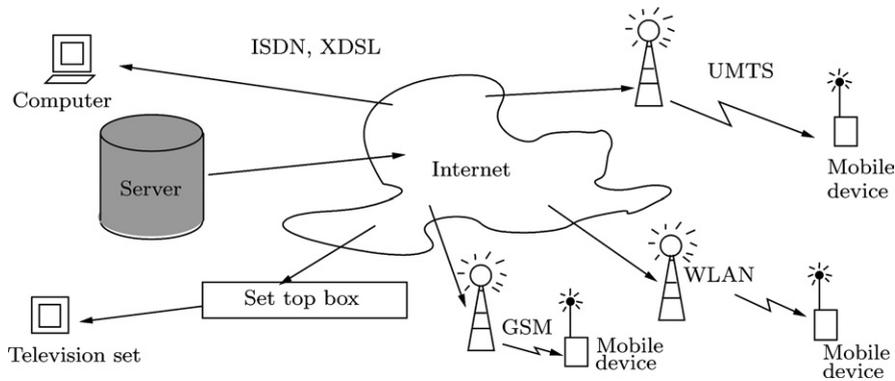


Fig. 1. Scenario of internet streaming.

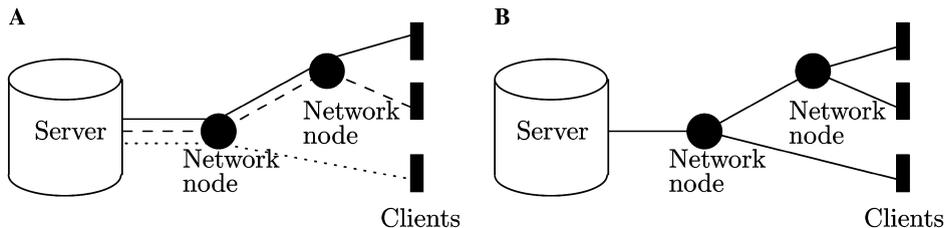


Fig. 2. Delivery modes: (A) Unicast, (B) multicast.

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