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Mobile TV services through IP Datacast over DVB-H: Dependability of the quality of experience on the IP-based distribution network quality of service

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ABSTRACT

The Digital Video Broadcast-Handheld (DVB-H) is an international standard which offers broadcast data services to mobile handheld devices. Its main enhancements to conventional Digital Video Broadcast-Terrestrial (DVB-T) systems include the addition of time-slicing and an extra stage of error correction, referred to as Multi-Protocol Encapsulation-Forward Error Correction (MPE-FEC) at the link layer. The essential components required to deploy an IP-based mobile TV service on top of DVB-H are described by the DVB standard for IP DataCast specifications (DVB-IPDC). Since mobile TV services mostly consist of real-time video data, very stringent demands in terms of quality of service (QoS) are imposed to the broadcast operator's primary distribution network. In this article, the impact of packet loss, introduced in a IP-based distribution network, on the quality of experience (QoE), the video quality as perceived by the end user, is characterised. In recent work, a first analysis of the impact of random packet loss was reported upon. This paper describes a more profound analysis of both random and burst packet loss by taking into account several objective video quality metrics. It is shown that, although MPE-FEC is introduced for better reception between antenna and receiver, its use has a major impact on the effects of packet loss in the distribution network. The use of error-correction techniques in the distribution network only has a beneficial impact on the QoE when lower MPE-FEC code rates are used. Moreover, the impact of action scenes or scene switches on the perceived video quality is also characterised in detail. Based on the experimental results, an analytical model is presented which allows to predict the QoE detoriation as a function of the burst loss probability in the distribution network.

1. Introduction

1.1. Background

DVB-H is an international data broadcasting standard (ETSI EN 302304 v1.1.1:Digital Video Broadcasting (DVB), November 2004) which provides an efficient way of carrying multimedia services over digital terrestrial broadcasting networks to handheld terminals. In 2008, DVB-H was endorsed by the European Commission as the recommended standard for mobile TV in Europe and currently many commercial DVB-H services are deployed in several countries all over the world (e.g. Italy, Finland, South-Africa, Russia, Vietnam, etc.). A complete list of all commercial and trial DVB-H services worldwide can be found at (DVB-H). DVB-H adapts the successful DVB-T system for digital terrestrial television to the specific requirements of handheld, battery-powered receivers. The most remarkable enhancements are time slicing, an additional transmission mode and an additional level of advanced error correction at the link layer, referred to as MPE-FEC.

The basic idea of time slicing is to cut incoming information sequentially into slices. These time slices are encapsulated one by one into bursts, that are sent in constant time intervals (cycle times) and with higher data rate over the MPEG-2 transport stream. This mechanism is shown in Fig. 1. At the mobile device, the bursts are unwrapped and data streams are re-assembled. Because burst duration and time interval are signaled within the bursts, a handheld terminal for mobile TV is able to reduce the power-on time of its receiver according to the time of burst reception. The power-off time of 2–5 s between two successive bursts provokes a valuable saving of power consumption (up to 90%) (Faria et al., 2009). The additional transmission mode is an intermediate mode between DVB-T's standard modes, offering a trade-off between cell size and mobile reception performance.

Figure 2 shows a typical DVB-H network architecture. In this setup, several main parts or actors can be distinguished. The Content Provider streams its video data to the headend of the Service Provider. At the headend, the video content is transformed and multiplexed into a DVB-IPDC compliant MPEG-2 Transport Stream (TS). This process is detailed in Section 3.1. This MPEG-2 TS is then sent over the distribution network to the antennas. Most broadcasters use a satellite link in order to feed the antennas but in more dense areas existing fixed network infrastructure can be used.

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