SCALING NEW HEIGHTS

Scalable Video Coding within DVB

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The two main DVB Audio-Visual Coding specifications, for broadcast applications based on the MPEG-2 Transport Stream and for DVB applications delivered directly over IP protocols, are currently being revised to add new options to the toolboxes. Probably the most significant of these new options is Scalable Video Coding (SVC), defined by an amendment to the H.264/AVC specification.

Scalable video coding is sometimes referred to as hierarchical coding or layered coding. The objective is to produce an encoded signal that has the capability of being decoded to give video, albeit at reduced quality, from only part of the bitstream. There are three basic methods that can be used:

- Temporal scalability, where intermediate video frames are encoded in a way that allows them to be dropped
- Spatial scalability, where video is encoded in a way that allows it to be decoded at multiple spatial resolutions
- Fidelity scalability, sometimes called SNR scalability or quality scalability, where video is encoded at a single spatial resolution but in a way that allows it to be decoded at different subjective qualities

At first sight, the current degree of excitement about scalable video coding might seem strange; scalable coding tools have been included in the MPEG-2 video specification for many years but have been rarely used in practice. However there are two very good reasons why scalable video coding is now of much greater relevance. Firstly, compression techniques have improved and the new H.264/AVC scalability tools simply work more efficiently than the old MPEG-2 tools. Secondly, there are now a range of applications being considered which are inherently more conducive to the use of scalable coding. Two key issues that affect suitability are whether any coding layer uses interlaced video and the proportion of the total bitrate that is allocated to the base layer; the higher the proportion, the greater the benefit that can be gained through the use of scalable video coding.

For example, one potential application that was considered many years ago was a scalable MPEG-2 HDTV system with conventional interlaced SDTV as the base layer. This scenario was not well suited to the use of scalability, since the bitrate for the base layer was generally less than a quarter of the total and interlace was used in at least one layer. When the use of the old MPEG-2 scalability tools was evaluated for this application, the conclusion was that there was actually very little benefit compared to using a simple simulcast approach. In the absence of a commercially interesting DVB application where MPEG-2 scalability would have been technically beneficial, we decided that the MPEG-2 scalability tools should not be included in the DVB toolbox.

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By contrast, a recent evaluation of the options for a future launch of 1080p HDTV has shown that this is a situation where SVC tools would offer significant benefits. There are three basic approaches that could be followed when launching 1080p services: single layer, simulcast or scalable video. Single layer H.264/AVC 1080p would obviously require the lowest bitrate; 13Mbit/s was found to give reasonable quality with the software-based encoder used in the evaluation. However, today’s 720p/1080i HDTV receivers would be incapable of decoding this signal at all. Adding a reasonable quality 720p simulcast signal to provide backwards compatibility required a further 8Mbit/s, giving a total of 21Mbit/s. Alternatively, 15.4Mbit/s was found to be sufficient when using SVC tools to provide backwards compatibility with a two-layer 720p/1080p signal of the same subjective quality with the same encoder.

Further promising applications for SVC can be seen with IPTV and mobile TV, which tend to have a wider range of connection qualities and receiving devices than traditional broadcasting. For example, a two-layer SVC bitstream in combination with hierarchical DVB-H modulation could be used to provide a robust signal for indoor reception at slightly reduced video quality, together with full quality video for outdoor reception. In some cases, this could significantly reduce the network build costs and hence improve the viability of the business case for launching a new mobile TV service.

To conclude, SVC is a worthy addition to the DVB toolbox, applicable to a wide range of potential applications. However, as with the other tools, it should be selected for use when appropriate; it is not a ‘magic bullet’ that gives benefits under all circumstances.