ADVANCED AUDIO AND VIDEO CODING WITHIN DVB

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New audio and video compression algorithms are now emerging that challenge the dominance of MPEG-2. These new algorithms offer an improvement in compression efficiency of more than two; in other words it will be possible to obtain comparable video and audio quality with less than half the bit-rate needed for MPEG-2 video and MPEG-2 Layer II audio. The improvement is partially due to a better understanding of compression techniques and partially due to the progressive effect of Moore's Law allowing a level of complexity to be included today that could not have been contemplated in consumer-priced equipment 8 years ago.

DVB does not develop compression algorithms itself, but it does evaluate the performance of candidate algorithms against commercial requirements. DVB then specifies parameters and constraints to give a good trade-off between performance and implementation cost for DVB services. In 1995, DVB published the document that became TR 101 154, the implementation guidelines for the use of MPEG-2 systems, video and audio. Work is now well underway on a similar exercise to include the advanced audio and video algorithms in the DVB suite of standards. This will allow the new H.264/AVC video and MPEG-4 High Efficiency AAC Profile audio to be used for DVB services delivered directly over IP as well for more traditional broadcast services where the audio and video are embedded within an MPEG-2 Transport Stream.

In addition to being more efficient than any previous video compression standard, H.264/AVC also has the distinction of having more names than any previous compression standard! The work began in ITU-T under the working name H.26L. At the same time, ISO/IEC was considering Advanced Video Coding (AVC) within the MPEG-4 standard. The ITU-T and MPEG experts then agreed to form a Joint Video Team, referred to as JVT. Within ITU-T it will be published as H.264, whilst ISO/IEC will publish it as Part 10 of the MPEG-4 specification, 14496-10.

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H.264/AVC is more of an evolution from MPEG-2 video than a radical change. As with all ITU-T and ISO/IEC algorithms since H.261 and MPEG-1, the architecture is based on a motion-compensated block transform. Like MPEG-1 and MPEG-2, H.264/AVC has intra-coded pictures, predicatively coded pictures and bi-directionally coded pictures (known as I-, P- and B-frames). However, H.264/AVC has smaller, dynamically selected block sizes to allow the encoder to represent both large and small moving objects more efficiently. It also provides multiple reference frames to allow the encoder to find the best match over several frames and it supports greater precision in the representation of motion vectors. The variable-length coding used to compress the picture and motion information is context-adaptive to give greater efficiency.

MPEG-2 Advanced Audio Coding (AAC) was first published in 1997 and it offered about twice the coding efficiency of Layer II. However, initial take-up was limited, as at that time the market was not really ready for a new audio compression scheme. MPEG-4 AAC is closely based on MPEG-2 AAC but includes some further enhancements such as perceptual noise substitution to give better performance at low bit-rates. The new MPEG-4 High Efficiency AAC Profile adds spectral bandwidth replication, to allow more efficient representation of high-frequency information by using the lower harmonic as a reference.

Of course, the increased sophistication of the video and audio compression algorithms does not come without requiring increased complexity of the encoder and decoder. In terms of the number of computer cycles required for a software implementation, the new algorithms have been estimated to be around 2 to 3 times more complex than MPEG-2.

So what are the likely early applications of the new algorithms? They are unlikely to replace MPEG-2 in existing services for many years to come, but will probably be used first for totally new services. One possible example is HDTV, where the potential bit-rate saving may significantly alter the viability of the business model. Another possible example would be low-resolution DVB services delivered over IP to mobile receivers.

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