HDTV: WHAT NEXT?

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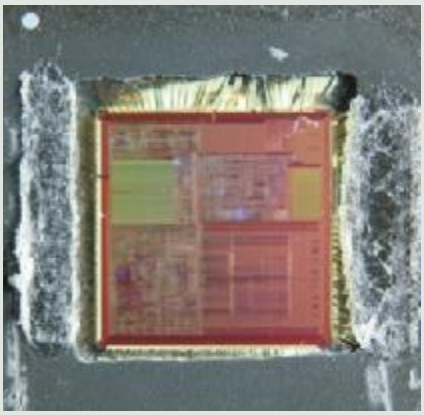

Single chip HDTV resolution H.264/AVC encoder from Ambarella Inc.

DVB specifications have supported HDTV since 1998 and the first commercial HDTV deployment in the DVB world began in Australia in 2001. But HDTV really took off for DVB in 2006 with the availability of second generation systems, e.g. using DVB-S2 transmission and H.264/AVC video compression coding. Initially regarded as very challenging, the technology required to perform HDTV compression has advanced rapidly and it is now possible to perform H.264/AVC encoding at HDTV resolution using a single chip. With the success of HDTV now looking assured, a reasonable question is 'what next?'.

The current HDTV transmissions use one of two video formats:

- '720p', i.e. 720 lines x 1280 pixels at 50 or 60 frames/s (progressive)
- '1080i', i.e. 1080 lines x 1920 pixels at 25 or 30 frames/s (interlaced)

There has been fierce debate over the relative merits of the two formats, with advocates of 720p pointing to its better motion portrayal and more efficient compression, whilst proponents of 1080i highlight its superior static resolution. From the point of view of a content provider, the existence of the two formats is an unwanted complication. The best way to be able to provide content in either format is to actually shoot it in a third format:

- '1080p/50-60', i.e. 1080 lines x 1920 pixels at 50 or 60 frames/s (progressive)

This provides good quality down-sampling to either 720p or else 1080i, hence maintaining the value of a content provider's archive.

The smallest object that a person with normal vision can discern subtends an angle of about 1 minute of arc. The line structure of a 720p system would therefore not be visible unless the screen occupied an angle of more than about 12° vertically, corresponding to just over 20° horizontally for a 16:9 screen.

A BBC study of domestic viewing arrangements found that the viewer sat an average of about 2.7m from the screen. From this distance, the pixel structure of a 720p system would be invisible unless the diagonal screen size was greater than about 45 inches. The spatial resolution of the 720p format is therefore well suited to the typical usage scenarios of today. Furthermore, with bit-rate being a scarce resource it is likely that the threshold for annoyance will be set by the visibility of compression coding artefacts rather than the visibility of pixel structure.

If the 1080p/50-60 production format were used for transmission and display, then the maximum horizontal angle with invisible pixel structure would increase to about 30°. This would correspond to upgrading to a 67 inch display, when viewed from 2.7m. The EBU has recently performed a study which concluded that encoding 1080p/50 without visible artefacts did not actually require a greater bit-rate than 1080i/25, due to the higher pixel rate being offset by the more efficient compression encoding of non-interlaced content. However, the main barrier to using 1080p/50-60 for transmission is the decoder. A 1080p/50-60 decoder requires double the memory bandwidth of 1080i, a significant technical problem when the current HDTV standards were devised. Although much less of a technical challenge today, the growing number of deployed HDTV receivers and screens would not be compatible with new 1080p/50-60 transmissions. It may be that 1080p/50-60 would not give enough of a step change in quality to justify destabilising this established HDTV market.

For the longer term, we can consider 'Ultra HDTV' formats, giving a truly immersive viewing experience. A 2160-line system would allow a maximum viewing angle of about 60°, corresponding to a 135 inch screen viewed from 2.7m. A 4320-line system would allow a maximum viewing angle of around 100°, which would be rather challenging to fit in many living rooms; a display occupying an entire wall is probably the logical end point in the search for ever larger screens. A 4320-line TV system may seem fanciful, but NHK demonstrated just such a system, accompanied by 22.2 channel audio, at NAB and IBC in 2006. However, this would not be practical in the average home for a few decades!

Of course, it may be that ever higher resolution is not the main way that TV will evolve in the future. The next big thing could be 3D TV or even adding support for other senses beyond sight and vision. Anyone for smellyvision?

"For the longer term, we can consider 'Ultra HDTV' formats, giving a truly immersive viewing experience."

Format	Approximate maximum horizontal viewing angle
720 lines x 1280 pixels ("720p")	20°
1080 lines x 1920 pixels ("1080p/50-60")	30°
2160 lines x 3840 pixels	60°
4320 lines x 7680 pixels	100°

Ken McCann is a director and co-founder of ZetaCast, an independent technology consultancy company specialising in digital TV. Prior to founding ZetaCast, Ken worked at NTL, Symbionics and Philips. He was responsible for the development of the world's first broadcast quality MPEG-1 decoding equipment and the world's first real-time MPEG-2 encoding system. Ken contributed significantly to the development of the MPEG-1 and MPEG-2 standards and has chaired the DVB technical group responsible for audio visual coding specifications (TM-AVC) since its inception over 10 years ago.