Future Code

Progress Towards High Efficiency Video Coding

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A new video compression standard, known as High Efficiency Video Coding (HEVC), is currently being jointly developed by ISO/IEC MPEG and ITU-T VCEG, the same two standardization bodies whose previous collaboration resulted in both MPEG-2 and H.264/AVC. The goal is to achieve a factor of two improvement in compression efficiency compared to the H.264/AVC, the best performing of the current generation of standards.

HEVC Call for Proposals

The first step towards creating HEVC was the launch of a Call for Proposals, which resulted in 27 responses. Both objective and subjective quality assessments of the proposals were performed, using a standard software implementation of H.264/AVC as the anchor. The objective measurements used the Peak Signal-to-Noise Ratio (PSNR), a convenient method of giving an approximate indication of the likely video quality. However, the only way to really determine video quality is the time-consuming and expensive process of running formal subjective tests.

The responses to the HEVC Call for Proposals were analyzed during the first meeting of the Joint Collaborative Team on Video Coding (JCT-VC) in April 2010. The test results were very encouraging, especially at 1080p resolution and above. A consistent trend was that the saving in bitrate relative to the anchors was greater when considering equal subjective quality than when considering equal PSNR.

HEVC Test Models

The first formal HEVC Test Model, 'HM1', was defined in October 2010. Further improvements of the Test Model in HM2, HM3, HM4 and HM5 were specified at subsequent meetings, with each successive version achieving better performance than the previous in terms of the trade-off between coding efficiency and complexity.

At the time of writing, no formal subjective tests have yet been published using the HEVC Test Models. However, test results based on PSNR have reported bitrate savings for equal PSNR of about 44% for the 1080p sequences in 'random access' configuration[1]. Assuming that the HM shows the same trend of greater bitrate saving for equal subjective quality than for equal PSNR that was observed in the Call for Proposals, the HEVC development appears to be on target to deliver a factor of two improvement in compression efficiency compared to H.264/AVC.

The HEVC standard is scheduled to reach Committee Draft stage in February 2012 and to be published from Final Draft International Standard in January 2013. A considerable momentum has built up around the development process, with a total of 284 participants at the seventh JCT-VC meeting, held in Geneva in November 2011.

Evolution & Revolution in Video Coding

There is a general trend of improving video coding efficiency over time. Firstly, there is a gradual evolution of encoders giving greater efficiency within a specification. Secondly, there are occasional moments of revolution caused by a change of algorithm, requiring new decoders.

The primary driver for improvement is Moore's Law; more complex processing becomes practical over time. In an attempt to translate the effects of Moore's Law into bitrate, the author presented the modestly named McCann's Law at DVB World in 2003. This originally stated that the bitrate needed to achieve a given video quality halves every five years, assuming that both evolutionary and revolutionary improvements are implemented as early as possible. It was subsequently revised to predict that the bitrate required to achieve a given video quality halves every seven years.

In the real world, improvements do not follow a smooth curve, as legacy issues prevent overly frequent changes of algorithm. This is illustrated in the graph, which shows MPEG-2, H.264/AVC, HEVC and the possibility of a future standard around 2025.

When will HEVC-based Services be Launched?

The experience of MPEG-2 and H.264/AVC implies that consumers and the industry are prepared to consider a revolutionary change of algorithm roughly once a decade, provided that it can be justified by about a factor of two improvement in coding efficiency. If this experience is extrapolated to HEVC, then the timetable shown can be expected. HEVC could be the basis of a new generation of digital TV services using 1080p from about 2015. The increasingly prevalent 1080p displays would finally have a broadcast signal to do them justice!

Illustration of Bitrate Trends in Practice
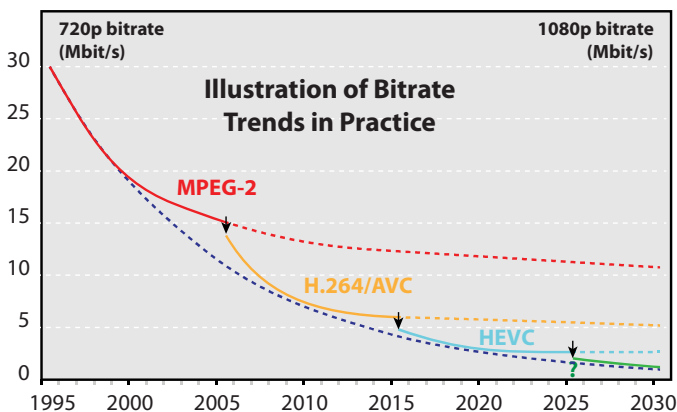
Timescales for Video Coding Standards			
	Standard Published	Added to DVB	First Broadcast Services Launched
MPEG-2	1995	1996	1997
H.264/AVC	2003	2004	2005
HEVC	2013	2014	2015

[1] "Compression Performance of High Efficiency Video Coding (HEVC) Working Draft 4", Bin Li, Gary J. Sullivan and Jizheng Xu, submitted to IEEE International Symposium on Circuits and Systems (ISCAS) 2012