High Efficiency Video Coding

H.265 Video Compression

Successor to H.264

At present, the leading video coding format is H.264/MPEG-4, which was initially developed in 1999 and has only recently become the de facto standard in the security/surveillance market. **High-efficiency video coding (HEVC), also known as H.265, is a successor to H.264/MPEG-4. This will compress video files to half the size possible using H.264**, the most-efficient current encoding format. It can alternatively be used to provide substantially improved video quality at the same bit rate. HEVC is used to compress video with 4K resolution, possibly, in the future, even 8K resolution.

History - HEVC Technology Background

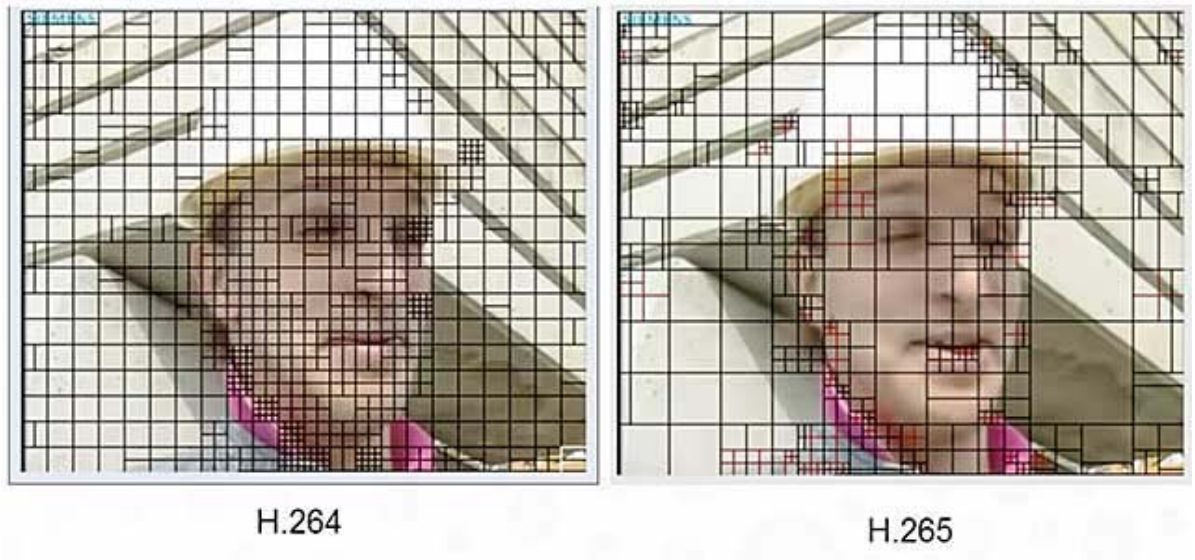
The ITU-T began development of a successor to H.264 in 2004, while ISO/IEC began working in 2007. In January 2010, the groups collaborated on a joint Call for Proposals, which culminated in a meeting of the MPEG & VCEG Joint Collaborative Team on Video Coding (JCT-VC) **in April 2010**, at which **the name High Efficiency Video Coding (HEVC) was adopted for the codec.** In October, 2010, the JCT-VC produced the first working draft specification, with the Draft Standard - based upon the eight working draft specifications - approved in July, 2012. On January 25, 2013, the ITU announced that HEVC had received first stage approval (consent) in the ITU-T Alternative Approval Process, while MPEG announced that HEVC had been promoted to Final Draft International Standard (FDIS) status in the MPEG standardization process.
The initial versions of the specification were frozen so that multiple vendors could finalize their first HEVC products. The current implementation includes a Main profile supporting 8-bit 4:2:0 video, a Main 10 profile with 10-bit support, and a Main Still Picture profile for still digital pictures that uses the same coding tools as a video "intra" picture.

HEVC will continue to advance, with work already starting on extensions for 12-bit video and 4:2:2 and 4:4:4 chroma formats, as well as incorporating scalable video coding and 3D video into the specifications.

On April 13, 2013, HEVC/H.265 was approved as an ITU-T standard. The standard was formally published by the ITU-T on June 7, 2013 and by the ISO/IEC on November 25, 2013. On October 29, 2014, HEVC/H.265 version 2 was approved as an ITU-T standard. It was then formally published on January 12, 2015. **On April 29, 2015, HEVC/H.265 version 3 was approved as an ITU-T standard.**

How HEVC (H.265) Works

Like H.264 and MPEG-2, HEVC uses three frame types, I-, B- and P-frames within a group of pictures, incorporating elements of both inter-frame and intra-frame compression. HEVC incorporates numerous advances, including:
Coding Tree Blocks: Where H.264 used macro blocks with a maximum size of 16x16, HEVC uses coding tree blocks, or CTBs, with a maximum size of 64x64 pixels. Larger block sizes are more efficient when encoding larger frame sizes, like 4K resolution. This is shown in the figure below:



Where H.264 used 9 intra prediction directions, HEVC can use over 35, adding more potential reference pixel blocks that fuel more efficient intra-frame compression. The obvious cost is the additional encoding time required to search in the additional directions.
Other advances include:

- Adaptive Motion Vector Prediction, which allows the codec to find more inter-frame redundancies
- Superior parallelization tools, including Wavefront parallel processing, for more efficient encoding in a multi-core environment
- Entropy coding is CABAC only, no more CAVLC
- Improvements to the deblocking filter and the creation of a second filter called Sample Adaptive Offset that further limits artifacts along block edges

H.265 is far more difficult to encode as a result of its complexity, and can require up to 10 times the compute power to encode at the same speed as H.264.

H.265 Implementation

The implementation of H.265 is inevitable but some years away. As with other video standards, the security market inherits the H.265/HEVC format from the much larger consumer electronics market. **Typically, after standards are developed, it takes several years for their use to make its way into various markets, starting with the consumer video market and later into security and other smaller markets.**

IP camera manufacturers supporting H.265 have just begun releasing products, with some stating they have a 40 percent or more bit rate reduction at the same visual quality as H.264. **First prototypes from major camera manufacturers were introduced at the ISC West 2015.**

Summary

- H.265 compress video files to half the size possible using H.264.
- On April 29, 2015, HEVC/H.265 version 3 was approved as an ITU-T standard.
- HEVC uses coding tree blocks, or CTBs, with a maximum size of 64x64 pixels.
- Where H.264 used 9 intra prediction directions, HEVC can use over 35.
- H.265 can require up to 10 times the compute power to encode at the same speed as H.264.
- VMS with H.265 compatibility and H.265 Cameras were introduced at the ISC West 2015.

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