

Beyond HEVC

By John Belton

The internet was not designed for the transportation of video content. However, over the past ten years, video traffic on the internet has increased dramatically, rising from one-third of all traffic in 2008 to roughly 82% in 2020.ⁱ This growth, in part, reflects the effects of the transition from analog to digital television broadcasting in 2009 and in the shift of media and entertainment transmission from serial digital interface (SDI), standardized by SMPTE in 1989, to video over IP, standardized by SMPTE in ST 2110 in 2013. Video over IP enables the widespread streaming of video content, exemplified for most consumers in the form of video-on-demand (VOD) systems, such as Netflix, Hulu, and Amazon, and in the creation of video channels on the internet by YouTube, BuzzFeed Video, and others. At the same time, video content has become more data-intensive with greater reliance on the display of content in high dynamic range (HDR), high frame rate (HFR), and wide color gamut (WCG), not to mention the growth of a consumer market for 4K content and experimental forays into the streaming of augmented reality (AR) and virtual reality (VR) material. All of these developments amount to more and more data that need to be squeezed through

the existing internet infrastructure. Cisco predicts that, by 2021, video over IP will be the equivalent of the transmission of 7.2 billion DVDs a month.

This tsunami of data has swamped the capabilities of traditional compression formats. MPEG-1 (H.261, ca. 1988) and MPEG-2 (H.262, ca. 1995) saw the industry through VHS to the DVD and digital television broadcasting era. H.263 (ca. 1996) supported improved videoconferencing, while advanced video coding (AVC; H.264, ca. 2003) became the standard format for the recording, compression, and transmission of video material [i.e., until the advent of a high-efficiency video codec (HEVC; H.265) in 2013]. AVC enabled Netflix and other VOD suppliers to stream videos in 720p and 1080p, but the transition to ultrahigh definition (UHD, also known as 4K) demanded a more powerful and more efficient compression codec. HEVC was twice as efficient as its predecessor, enabling the transition from 2K to 4K by delivering higher quality images over multiple channels, including the internet, television, and mobile devices, using available bandwidth.ⁱⁱ HEVC has played a crucial role in enabling the development of streaming as the latest revolution in video transmission and consumption. It can deliver 4K video content at a lower bitrate than AVC and, more importantly, using a bandwidth that

is low enough to enable the streaming of 4K using an internet speed that conforms with that of the U.S. national average.ⁱⁱⁱ

In 2018, the industry began experimenting with a new generation of video codecs designed to challenge the dominance of HEVC in the marketplace. In June 2018, the Alliance for Open Media (AOM) released a royalty-free codec called AV1, which was built on the algorithm for Google's VP 9. Members of AOM include Amazon, Cisco, Google, Intel Corporation, Microsoft, Mozilla, and Netflix. At the same time, the Joint Video Experts Team (JVET) began work on another new compression tool, Versatile Video Coding (VVC), which promised to double the compression capability of HEVC. VVC is capable of delivering UHD video at bit rates currently used for HDTV; it is designed to meet the needs of emerging technologies such as 360° omnidirectional multimedia and HDR; it also has what JVET describes as an "affordable royalty structure."^{iv} In July 2018, Divideon introduced a new codec, xvc, that requires users to purchase a single license and provides them with indemnification from third-party royalty claims.^v

This issue of the *Journal* provides a forum for the discussion of HEVC

ⁱ<https://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/white-paper-c11-741490.html>

ⁱⁱ<http://www.rwth-aachen.de/cms/root/Die-RWTH/Aktuell/Pressemitteilungen/November-2017/~ovhi/Engineering-Emmy-Award-fuer-HEVC-Standar?lidx=1>

ⁱⁱⁱ<https://www.lifewire.com/internet-speed-requirements-for-movie-viewing-1847401>; <https://www.usatoday.com/story/tech/columnist/2017/12/10/youre-buying-4-k-tv-how-much-internet-bandwidth-do-you-need/933989001/>

^{iv}<https://www.streamingmedia.com/Articles/ReadArticle.aspx?ArticleID=129386>

^v<https://xvc.io/>

and the new codecs that have been developed in its wake. In “Analysis of Emerging Video Codecs: Coding Tools, Compression Efficiency, and Complexity,” Julien Le Tanou and Médéric Blestel provide a comparison of AV1 and VVC (JEM) in terms of their compression and run-time performances in relation to two HEVC codecs, HM and H.265. Then, in “Understanding the Video Codec Jungle: A Comparison of TCO and Compression Efficiency,” Jean-Yves Aubié, Franck Chi, Patrick Duménil, and Thierry Fautier look at four codecs, AVC, HEVC, AV1, and VVC, in terms of their compression performance and complexity. They

evaluate each codec’s compression efficiency based on objective and subjective testing methods. Included in this issue as an Exclusive Article Online, in “The xvc Video Codec—A Revolutionary Software-Defined Video Compression Format,” Jonatan Samuelsson provides a review of licensing issues related to HEVC and describes the licensing status and compression performance of the xvc codec in comparison with HEVC and AV1, promoting it as having “a single reasonable license and with a light-weight decoding process that can be run in software on today’s mobile phones and tablets.” In “Understanding MPEG-I Coding

Standardization in Immersive VR/AR Applications,” Gauthier Lafruit, Daniele Bonatto, Christian Tulvan, Marius Preda, and Lu Yu discuss MPEG-I, a new codec for immersive formats such as 360-degree video, VR and AR. Read together, all of the essays provide vantage points from which to view the new landscape of the next generation of video compression.

About the Author

John Belton is Chair of the Board of Editors of SMPTE’s *Motion Imaging Journal*. He also edits a series of books on Film and Culture for Columbia University Press.



Design your next products with DekTec



DTA-2174

Quad 3G-SDI port with 4K UHD support

All ports programmable as input or output, ASI or SDI

Easy access to all 10-bit samples

Optimized for your 4Kp50/p60 application



DTA-2195

12G-SDI input and output

4K-UHD I/O card plus HDMI 2.0 output

Support for HDR and Dolby Atmos®

Designed for 4K encoder and decoder application



(303) 318-4298
infousa@dektec.com

Also available:
Satellite, QAM, DVB-T2, ATSC 3.0 receiver and modulator, and ASI I/O