MediaTek High Efficiency Video Coding

MediaTek White Paper

October 2014

MediaTek has pioneered the HEVC in mobile devices and will do the same for TVs by enabling HEVC in 4K TVs in during 2015. MediaTek provided the first hardware-based 4Kx2K HEVC encoder and decoder, a hardware-based implementation that consumes much less power, allowing for longer battery life in portable devices.

Introduction

Video compression has been commonplace for more than two decades. And the rise of cloud services, smartphones, tablet computers, and social media has transformed the way in which this video is created and consumed.

These days TV programming and movies are consumed on demand over the internet through a multitude of services and content providers, and are often watched on smartphones and tablets, as well as TV. Even when watched on TV the content is frequently downloaded to a smartphone or tablet and then streamed to a smart TV within the home. Video is not just streamed or downloaded from various content providers. Many consumers share their memories with family and friends by uploading videos to social media sites directly from their personal mobile devices. And commercial enterprises are also making greater use of video for traditional and social marketing, conferencing and training.

Whether watching video programming or sharing memories, consumers demand ever higher quality reproduction, and have an expectation to receive this higher quality. The increased use of video-transmitting bandwidth exceeds that of non-video traffic and the demand for this bandwidth is ever increasing.

Meeting these demands are the challenges we address in the next generation of video coding standards. There is a need to record higher resolution video, compress it more, maintain high quality reproduction, and be able to both compress and decompress not just on high performance computers or purpose-built media devices, but also on tablets and smartphones costing the consumer hundreds of dollars.

Trends

H.264/Advanced Video Coding (AVC), initially developed in the period 1999-2003 and then extended from 2003-2009, allowed for significantly better compression performance than prior video coding standards (H.261, MPEG-1, H.262/MPEG-2, H.263, MPEG-4). H.264 enabled a wide range of digital video applications, including high definition (HD) TV broadcast, video acquisition and editing systems, camcorders, remote video surveillance applications, Internet video streaming, mobile network video, Blu-ray discs, and real-time video communication systems such as videoconferencing and videophones. Today

H.264/AVC allows mainstream video resolution of these applications to increase from CIF (352x288) 15-30fps and SDTV (720x480x30fps or 720x576x25fps) to HD720p (1280x720x30fps) and full HD (1920x1080x30fps). Current projections are that mainstream video resolution will exceed current HD formats (e.g., 4K×2K and 8K×4K resolutions at 60-120fps) as the demand for higher video quality increases.

Problem

Today the industry faces two significant interrelated challenges, both the result of dramatically increased traffic demands: bandwidth transmission problems and coding insufficiencies evident in H.264. In a recent IEEE report on HEVC, researchers noted consumer driven increased desire to higher quality and resolutions in mobile applications. [i]

By 2018 a projected 60% increase in video traffic on global networks is projected. Cisco and Ericsson anticipate significant increases in global IP traffic:

- In 2016 global IP traffic: one zettabyte (1,000 exabytes) per year, 91.3 exabytes per month
- In 2018 global IP traffic: 1.6 zettabytes per year, 131.9 exabytes per month.

Globally, IP video traffic will constitute 79% of all business and consumer IP traffic by 2018, up from 66% in 2013. This percentage does not include the amount of video exchanged through peer-to-peer (P2P) file sharing. The sum of all forms of video (TV, video on demand, Internet, and P2P) will continue to be in the range of 80 to 90 percent of global consumer traffic by 2018.

Solution

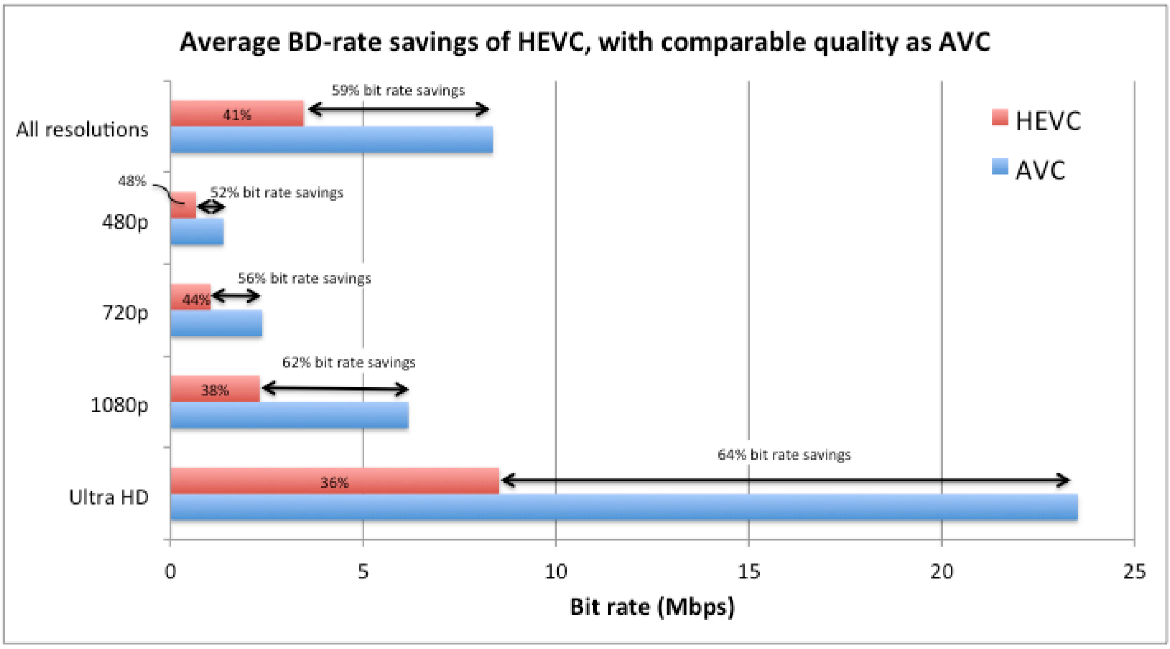
MediaTek was one of the primary contributors in a multi-year international development and the 2013 adoption of the HEVC/H.265 standard.[ii] The basic framework of this H.265/HEVC standard is the same as prior standards – block-based motion compensated transform coding. However, all H.265/HEVC building blocks have adopted advanced techniques that show significant technical improvements.

Benefits

H.265/HEVC can achieve significantly higher compression performance than prior video coding standards. IEEE researchers[iii] report impressive bit-rate savings, as shown in the table below.

Encoding	Bit-Rate Savings Relative to			
	H.264/MPEG-4 AVC HP	H.263 CHC	MPEG-4 ASP	MPEG-2 H.262 MP
HEVC MP	40.3%	67.9%	72.3%	80..1%
H.264/MPEG-4 AVC HP	-	46.8%	54.1%	67.%
H.263 CHC	-	-	1.3.2%	37.4%
MPEG-4 ASP	-	-	-	27.8%

HEVC compression performance verification testing shows the average bit-rate savings of H.265/HEVC. With comparable subjective visual quality of H.264/AVC testing shows a savings of 52%, 56%, 62%, and 64% for 480p, 720p, 1080p, and ultra HD.



Complexity was reasonably well controlled during the H.265/HEVC standardization. The H.265/HEVC decoder complexity is similar to that of H.264/AVC, while H.265/HEVC encoders are several times more complex than H.264/AVC encoders.[iv]

Real World Usage Examples

The most obvious examples for the use of the new standards are in the consumption of TV and movie content. Three particular examples stand out:

- On demand streaming from the provider to a smart TV either directly or via a tablet or smartphone. In this case the consumer is looking for the best possible video experience with the minimum bandwidth consumption and the decoding is carried out on relatively low cost low power devices
- Live streaming of events such as sports both to the home and to tablets and smartphones at the optimum resolution of the devices in use. In this case supporting a range of resolutions and bit rates to suite the different device capabilities – both screen resolution and network bandwidth
- Downloading of content for later viewing offline on tablets and smartphones. Here it is necessary to provide the best possible video experience while using a minimum of the device storage capacity

The second growing area of use is the use of video in social interactions –in social media and consumerized video calling

- Instant video sharing on social networks—utilizing smartphone or tablet to upload and publish small segments of video at acceptable resolution with a minimum overhead on processing power and network bandwidth.
- Live personal video calls and conferences are an increasingly common way for families to stay in touch from afar. The better the video quality the more it feels like the family is together sharing every day experiences.

Finally there is enterprise usage:

- Video conferencing from the desktop, smartphone, and tablets
- Video-based training and events both live and recorded for on demand consumption
- Traditional and social media-based marketing

Conclusion

This new standard allows for improved ultra high definition resolutions while minimizing the bandwidth needs. The well-controlled HEVC complexity is expected to enable its use in the wide range of consumer devices including cameras, smart TV, tablets, and smartphones, as well as the more traditional consumer and professional video devices.

During the HEVC standardization process MediaTek was recognized for our considerable technical contributions to improving compression performance and reducing complexity.

MediaTek's hardware-based implementation consumes much less power hence longer battery life in portable devices can be achieved. MediaTek pioneered the HEVC in mobile devices and will do the same for TVs by enabling HEVC in 4K TVs in during 2015.

References

---

[i] J.-R. Ohm, G. J. Sullivan, H. Schwarz, T. K. Tan, T. Wiegand, "Comparison of the Coding Efficiency of Video Coding Standards–Including High Efficiency Video Coding (HEVC)," IEEE Transactions on Circuits and Systems for Video Technology, December 2012.

[ii] The standard was finalized in January 2013 by the Joint Collaboration Team on Video Coding (JCT-VC) of ITU-T SG16 WP3 (known as VCEG – Video Coding Experts Group) and ISO/IEC JTC1/SC29/WG11 (known as MPEG – Moving Picture Experts Group), and extensions of HEVC (range, scalable, 3-D, and screen content coding extensions) are being developed. In ITU-T, HEVC is named H.265. In MPEG, HEVC is named MPEG-H Part 2 (ISO/IEC 23008-2).

MediaTek provided considerable contributions and was recognized as one of the leading companies in JCT-VC. We submitted more than 200 technical proposals and more than 100 crosscheck reports. More than 50 of our technical proposals were adopted into HEVC v1. If HEVC extensions are also counted, these numbers would be more than doubled.

[iii] J.-R. Ohm, G. J. Sullivan, H. Schwarz, T. K. Tan, T. Wiegand, "Comparison of the Coding Efficiency of Video Coding Standards–Including High Efficiency Video Coding (HEVC)," IEEE Transactions on Circuits and Systems for Video Technology, December 2012.

[iv] F. Bossen, B. Bross, K. Sühring, D. Flynn, "HEVC Complexity and Implementation Analysis," IEEE Transactions on Circuits and Systems for Video Technology, December 2012.

