Analysis of Future Emerging Video Codec's AV1, NETVC, VP10, HEVC, THOR and DaaLa

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Abstract: Image and video compression is an emerging area with much ongoing research because most of the peoples they are enjoying with YouTube on web nowadays. By observing the need for even greater compression efficiency due to the on growing demand for video on the web we need to have better video compression as possible. So New demands for higher quality and higher resolution video has increased the needs for better compression the reason is resolution, bit rate and bandwidth capacity has not scaled with the new demands. In this paper many of the future emerging video codec's are AV1, NETVC, THOR, VP9, VP10, DaaLa, HEVC are analyzed and compared with other technologies and try to give new proposal for getting the best video codec to achieve high compression ratio.

I. INTRODUCTION

As input data the encoder takes a video that consists of a series of digital pictures. The act of compressing video [1] is called encoding and the inverse action of uncompressing is called decoding. As computers have become faster over the years so has video encoding methods become more complex in order to get even better compression results. H.265/HEVC, VP9, VP10, NETVC, DaaLa is today one of the latest methods in which very good quality per bit-rate is achieved by requiring high computational complexity in the encoding process. Usually video contains a large amount of bulky redundant information. The main objective of video compression [2] is to remove the duplicate data. When video dominates our life becoming the essential part of multimedia recent days, due to this large amount of storage space and transmission bandwidth is required. This type of data we can call uncompressed data but this is not efficient due to poor quality of video, so we need to compress the data to improve the quality of video. Video codec's are video compression standards done through software or hardware applications. Each codec is comprised of an encoder, to compress the video, and a decoder, to recreate an approximate of the video for playback. The name codec actually comes from a merging of these two concepts into a single word: enCOder and DECoder[3]. The video coding performance [4] improves around 50% every 10 years under the cost of increased computational complexity and memory. And now it encountered great challenges to further significantly improve the coding efficiency and to deal efficiently with novel sophisticated and intelligent media applications such as face/body recognition, object tracking, image retrieval, etc. So there exist strong requirements to explore new video coding directions and frameworks as potential candidates for future video coding schemes. Video compression can be done using various technologies, some of these very traditional and not suitable for recent days having more competitive, so we are facing new emerging technologies.

II. FUTURE TECHNOLOGIES

AV1 CODEC: It is an emerging open-source [5] and royalty-free video compression format, which is jointly developed and finalized in early 2018 by the Alliance for Open Media (AO Media) industry consortium. The focus of AV1 development includes, but is not limited to achieving on demand resources over internet or somewhere. AV1 codec was first initialized with VP9 tools and enhancements, and then new coding tools were proposed, tested, discussed and iterated in AO Media's codec, hardware, and testing workgroups. AV1 contains some coding techniques are: Coding Block Partition, Intra Prediction, Inter Prediction, Transform Coding, Entropy Coding, In-Loop Filtering Tools and Post-processing literature. AV1 is a traditional block-based[6] frequency transform format featuring new techniques taken from several experimental formats and provides better resolution in low contrast areas, instead of blurring and reducing detail, the codec hides quantization artifacts. AV1 introduces T-shaped partitioning scheme inherited from VP10 for coding units. AV1 predicts chroma coefficient from luma coefficients. From Daala and Thor, the codec takes a deblocking filter in the place of in-loop filtering. When I compare AV1 against VP9, indicating AV1 substantially outperforms VP9 by around 30%. AV1 can integrated basic technologies of 3 other existing codec's are Google's VP9 codec, Cisco's Thor codec, and the Daala codec and ready to compete with any other technologies.

NETVC CODEC: It is an internet video codec [7] and also a standardization project by the Internet Engineering Task Force (IETF) for a next-generation royalty-free codec. NETVC is most likely to create the new industry standard (which will hopefully support spatial audio natively), because it is run by the IETF, the main standards organization of the internet. NETVC will likely take the best parts of the other codec's in the list to create one best-in-class, open standard.

Two tech industry giants, Cisco and Mozilla, have contributed from their codec codebases to aid NETVC in their effort to craft a high-quality standardized video codec. The fact that these companies have "opened" these portions of their codebases for the NETVC project means that any interested party can review the code, modify it, test it, and contribute to the end result.

THOR *CODEC*: The Thor video codec [8] is being developed by Cisco with the intention to use only royalty-free coding tools. The video codec is based on the well-known block-based hybrid video coding approach, but with some significant changes compared to existing standards such as AVC/H.264 and HEVC/H.265. These changes include transform coefficient coding, deblocking filter, a separate deringing filter, and interpolated reference frames. Although there are many similarities between HEVC and Thor, there are also many differences, such as non-arithmetic entropy coding, lack of temporal motion vector prediction, only one level of TB partitions, no asymmetrical PB partitions, no DST transform for intra, simplified skip logic and deblocking filter

VP9 CODEC: Google has recently finalized a next generation open-source video codec [9] called VP9 (2018), as part of the libvpx repository of the WebM project (http://www.webmproject.org/) and it is the successor of VP8 released in 2010. After VP8 at the same year Google has started WebM project [10]as a community effort to develop an open web media format. WebM is an open, royalty-free, media file format that defines not only the file container structure, but also the video and audio formats. why google has started VP9, due to ever-increasing demand for high-quality video content for consumption on the web VP8 is not that much efficient to manage this so obviously VP9 take over this. VP9 consisting of some coding tools are Subpel Interpolation, Prediction Block-sizes, Prediction Modes, Transform Types, Entropy Coding and Adaptation, Loop Filter, Segmentation and also consists bit streams are Error-resilienc, Frame-Parallelism, Tiling, Alternate Resolution Reference Frames. VP9 to be quite competitive with mainstream state-of-the-art codecs much more compact bit-stream than predecessor VP8 and when I compared with HEVC quite better in some context because HEVC reference software only supports 1-pass encoding. In contrast, the libvpx VP9 encoder supports 2-pass encoding only but almost same in some contexts. Overall VP9 is seen to be quite competitive with the reference implementation of HEVC while vastly outperforming the X.264 implementation of H.264/AVC.

Enhancement of VP9 [VP10]: we all known Google has released webmproject, VP9, is currently served by YouTube in internet and enjoys many of the peoples nowadays. By observing the need for even greater compression efficiency due to the on growing demand for video on the web, web team planning to develop a next generation codec VP10, just it is successor of VP9. Before developing VP10 we need to overview of VP9 transform coding framework[11] it uses recursive block partitioning scheme used to produce partition tree of smaller prediction blocks which is encoded using either intra and inter mode. Sometimes they differ in some contexts thus require different transform coding methods. VP10 is likely to build upon the mentioned transform tools in VP9 and introduce a richer and flexible available transforms for both methods. That additional transform tools are super transforms, recursive transform units, rectangular transforms, extended transform types. By considering this, new transform coding tools that are being explored as a part of VP10 development, preliminary results indicate that increasing transform flexibility can achieve some percentage. VP10 development is an open source project and invited those who are interested by the organization to join the effort to create tomorrow's royalty free codec.

Daala codec: It is a new royalty-free video codec [12] that is entirely different from traditional approaches already has been developed earlier. Daala [13] is a video codec designed to explore a set of a typical techniques like, Lapped Transforms, Haar DC, Multi-Symbol Entropy Coder, Overlapped Block Motion Compensation, Perceptual Vector Quantization, Chroma from Luma (CfL) Prediction, Directional Deringing Filter, to avoid the patent thickets built around most current codec's. Some of these techniques are new to Daala, while others already existed, but are not used in popular standards. Although Daala is not yet a competitive codec on its own, some of the techniques it uses are currently being integrated in the Alliance for Open Media (AOM) [14] codec, AV1. The recently-formed Alliance for Open Media (AOM) is currently specifying AV1, a royalty-free video codec. The initial development is based on technology from three existing codec's: Google's VP9 [15] codec, Cisco's Thor [16] codec, and the Daala codec presented here. For this reason, some of the techniques used in Daala are currently being considered for inclusion in AV1. Daala is greatly differs than other video codec's generally better than H.264, and slightly worse than HEVC and AV1.

HEVC [H.265] codec: Increasing demand for high definition and ultra-high definition video, along with an increasing desire for video on demand has led to exponential growth in demand for bandwidth and storage requirements. These challenges can be met by the new High Efficiency Video Coding (HEVC) standard, also known as H.265 [17]. The x265 HEVC encoder project was launched by MulticoreWare in 2013, aiming to provide the most efficient, highest performance HEVC video encoder. The video ecosystem is evolving, and the hot topic right now is the shift from AVC to HEVC. The main feature [18] of the HEVC video coding standard is to increase the video compression ratio for the same video quality compared to the H.264/AVC standard. The HEVC achieves this feature by changing the core of the coding layer from macro block with fixed size to the coding tree unit (CTU) with flexible larger size. In the H.264/AVC standard the macroblock consists of one 16 x 16 block of luma and two 8 x 8 blocks of chroma but the coding tree unit (CTU) in the HEVC standard consists of coding tree block (CTB) of luma and coding tree block (CTB) of chroma with size 16 x16, 32 x 32or 64 x 64 this shows HEVC is always better and much efficient than predecessor H.264/AVC and other traditional codec technologies and dominates the today's world.

III. CONCLUSION

In this paper we have investigated and compared the performance of future emerging video codec's, AV1, NETVC, VP10, THOR, DAALA, HEVC, out of these AV1 and HEVC performed best and more efficient than other technologies. After analyzed these codec's we got an idea to develop a new royalty free codec by combining the features of AV1 and VP10 and presented here as a proposal for future enhancement. The authors would like to thank the experts who are all working in various fields of video compression and remembrance for their great contributions.

REFERENCES

[1] "Optimizing an H.264 video encoder for real-time HD-video encoding," per hermansson master of science thesis Stockholm, Sweden 2011.

[2] "Video Compression Based on Hybrid Transform and Quantization with Huffman Coding for Video Codec,"

[3] "https://video.ibm.com/blog/streaming-video,"

[4] "Learning for Video Compression," Zhibo Chen, Senior Member, IEEE, Tianyu He, Xin Jin, Feng Wu, Fellow, IEEE

[5] "An Overview of Core Coding Tools in the AV1 Video Codec," Yue Chen_, Debargha Murherjee_, Jingning Han_, Adrian Grange_, Yaowu Xu_, Zoe Liu_, Sarah Parker_, Cheng Chen_, Hui Su_, Urvang Joshi_, Ching-Han Chiang_, Yunqing Wang_, Paul Wilkins_, Jim Bankoski_, Luc Trudeauy, Nathan Eggey, Jean-Marc Valiny, Thomas Daviesz, Steinar Midtskogenz, Andrey Norkinx and Peter de Rivaz _Google, USA yMozilla, USA zCisco, UK and Norway xNetflix, USA Argon Design, UK.

[6] "Performance Analysis of H.264, H.265, VP9 and AV1 Video Encoders," Md Abu Layek1, Ngo Quang Thai1, Md Alamgir Hossain1, Ngo Thien Thu1, Le Pham Tuyen1, Ashis Talukder1, TaeChoong Chung1 and Eui-Nam Huh1

[7] "HEVC, VP9 and The Future of Video Codecs," Nick Kraakman May 18 2017.

[8] "The Thor Video Codec ," Gisle *, Thomas Davies+, Arild Fuldseth* and Steinar Midtskogen* Cisco system.

[9] "The latest open-source video codec VP9 – An overview and preliminary results," Debargha Mukherjee, Jim Bankoski, Adrian Grange, Jingning Han, John Koleszar, Paul Wilkins, Yaowu Xu, Ronald Bultje Google, Inc., Mountain View, CA 94043, USA.

[10] "http://www.webmproject.org"/

[11] "On Transform Coding Tools Under Development For VP10," Sarah Parker * , Yue Chen * , Jingning Han * , Zoe Liu * , Debargha Mukherjee * , Hui Su * , Yongzhe Wang * , Jim Bankoski * , Shunyao Li +

[12] Daala: Building A Next-Generation Video Codec From Unconventional Technology," Jean-Marc Valin, Timothy B. Terriberry, Nathan E. Egge, Thomas Daede, Yushin Cho, Christopher Montgomery, Michael Bebenita Mozilla, Mountain View, USA Xiph.Org Foundation, USA jmvalin@jmvalin.ca.

[13] "Daala website," https://xiph.org/daala/.

[14] "Alliance for Open Media website," http://aomedia.org/.

[15] A. Grange, P. de Rivaz, and J. Hunt, "VP9 bitstream & decoding process specification," http://www.webmproject.org/vp9/, 2016.

[16] A. Fuldseth, G. Bjøntegaard, S. Midtskogen, T. Davies, and M. Zanaty, "Thor video codec," https://tools.ietf.org/html/ draft fuldseth-netvc-thor-02, 2016.

[17] "http://x265.readthedocs.io/en/default/introd uction.html

[18] "Perfforrmance Study off HEVC and H..264 Video Coding Standards ," Ahmed I. Sallam*, Osama S. Faragallah*, and El-Sayed M. El-Rabaie**