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A Literature survey on Video codecs and VP8 Codecs

Basavaraju S[#1],
Research Scholar,PRIST Unuversity, Thanjavur,

Dr.Sivakumar B[#2]
Prof and HOD TC dept, Dr AIT, Bangalore

Abstract: The intention of this report is to summarize the impact of new COder-DECoders (Codecs) for video compression on output video bit rates.. There is no doubt that without codecs such as the MPEG and the H.26x series the present developments of digital television and storage would not have taken place, as bandwidth capacity for transmission and storage would be insufficient. Codec standardisation by the standard authorities, the ISO and ITU, provide a stable environment for broadcasters and manufacturers to develop their systems and services. A very simple technique for improving the compression by coding only the changes in a video scene is called conditional refreshment and also it is only the temporal redundancy reduction method used in earlier stages. Also to improve the performance many rate distortion algothims were implemented for earlier Video coding techniques, So in same manner for VP8 video codecs also implemented the same rate distortion algoorthim and get the good performance in terms of Quality and bit rate At the same time, codecs allow the regulation of delivered video quality by variation of the compression ratio, Similarly google's VP8 codcs also playing major role in Multimedia mobile communication applications, Because of its enumorous disttictive features compared to existing Video codecs.

***Keywords*—Video, VP8, Bitrtae, PSNR, H264 , MPEG**

1 Introduction

Video is an significant part of modern life, from movies and television shows, to news,sports, home videos and events. The Internet has been expanding in bandwidth usage at an enormous rate, and Internet video tops the growth demographics In the last fifteen years, there has been a continuous evolution of video and there is no sign that this evolution is at an end. MPEG-2[10] is started in full format in earlier days , and been overtaken in respect to the degree of achievable compression by H.263, MPEG-4[1] and in 2003 by H.264[3]. Along with H.261, MPEG-1 and MPEG-2 were the first codecs to combine multiple ways (algorithms) of removing redundancy in one codec. Now VP8 Video codecs is now an "elderly" codec, having been standardized by international authorities in the period Essentially, each video frame is split into blocks and matching blocks between successive frames are sought. Only the difference after it has been further encoded is then transmitted or stored. Each of the contributory algorithms has been refined over the years as intensive and competitive global research has taken place. Much of this report is taken up with the impact of those algorithms in the next two decade.
The latest codec to emerge, H.264 and after this VP8 recently released by ON2 , has taken advantage of the hardware bonus, as achievable computational complexity has increased in line with Moore's law (a doubling of processing power every 18 months). In particular, the size of the blocks that are compared has been reduced and made more flexible, which reduces the difference data that remains to be encoded. Of course, improved compression allows either a reduction in the spectrum required to transmit the same programmes or improved video quality using the existing spectrum or a combination of both. With the advent of second generation High Definition Television (HDTV) in Europe there will be an inevitable demand for greater bandwidths, as bit-rates of about three times those of Standard Definition Television (SDTV) are expected. It is likely that H.264[1] will provide many times the compression that was once achieved by MPEG-2 but that the gain will vary according to the size, resolution and quality of the image, either HDTV, SDTV or one of the smaller formats for handheld devices.

1.1 Evolution of codecs:

To understand the evolution of codecs it is necessary to understand the standardization process. Due to engineering research there is a continual invention or refinement of compression algorithms, which is reported in journals such as those of the IEEE in the US. These innovations, after competitive assessment, are encapsulated by one of the two standards bodies, the ISO and the ITU, in standard codec specifications such as the MPEG and the H.26x[2] series. However, the standard body standardizes only the format of the bit stream arriving at the decoder end, though obviously it is aware of algorithms that can exploit the information in the bit stream. The advantage of this procedure is that successive refinements can be made to the algorithms at the encoder or sender side, without occasioning the replacement of end-users' equipment, that is the myriads of set-top boxes, digital televisions, and so on, or the need to transmit multiple encoded formats (simulcast). A codec can be implemented as software and to the surprise of some it has become possible to run MPEG-2 software on a PC at video rates. This is not the case for the latest codec in its current form (H.264)[2] but already the first all hardware solutions have been produced that will form future 4set-top boxes. Simplification of the codec holds out the prospect of an eventual software version appearing.

New codecs are introduced to service new applications. MPEG-2 was developed for video broadcast, whereas its predecessor was intended for video storage on CD-ROM. H.263 was intended for video conferencing. From MPEG-4[3], the MPEG series have diverged towards compression services, including video animation and video database construction. H.264 aims to serve a variety of applications (Section 2) from very low bit rates of less than 20 kbit/s to HDTV[6] quality video at around 20 Mbit/s

Where as Fig 1 shows that period to period evolution video codecs in differnt time.

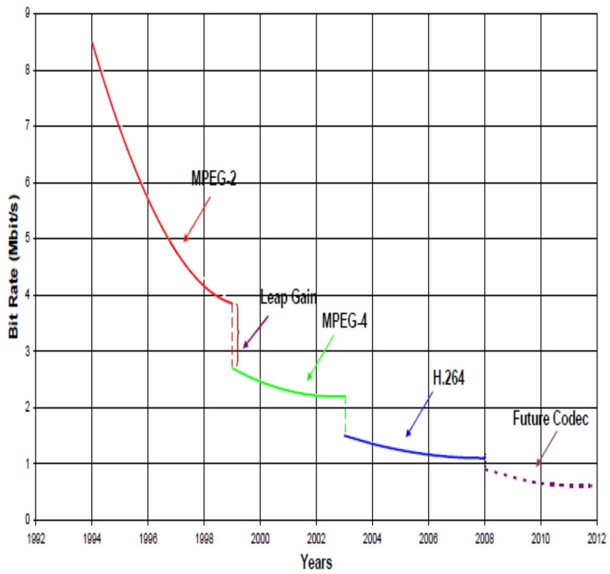

Fig 1:Evolution of standard codecs over time

1.2: Quality expectations

It is important to realise that for the sake of comparison, Figure 1 compares video of the *same* quality. The degree of compression influences the quality of the video as measured at the receiver device after decoding. MPEG-2[10] was designed to output good-quality video at medium bit rates, while very low bit-rate video (i.e. highly compressed video) is better achieved with H.263/4 as well in VP8 also. However, lower quality is only acceptable for some applications suchas video conferencing, and is heavily dependent on viewer expectations. At highercompression ratios and lower bit rates artefacts such as temporal flicker (awareness ofpicture/frame changes) or blockiness become apparent

Owing to expectations of higher quality services[12], the new generation codec achieves a relatively lower rate of coding gain when applied to high quality HDTV than they do when required to compress medium to low quality. Published results resulting from tests made when H.264 was first introduced tended to concentrate on lower pixel resolutions when quality defects are less apparent. However, it would be wrong to extrapolate from these results to HDTV. This is because H.264 largely improves over earlier codecs by more precisely identifying or addressing matching areas in successive video frames. This means that the residual information that is actually transmitted is reduced. In fact, for lower quality video much of the residual information is simply not transmitted. However, for higher quality video it becomes essential to transmit that information albeit in encoded form.

Simillarly fig 2 shows that different bitrates applicable for multimedia applications which arising from evolution of Video codecs in different period to period.

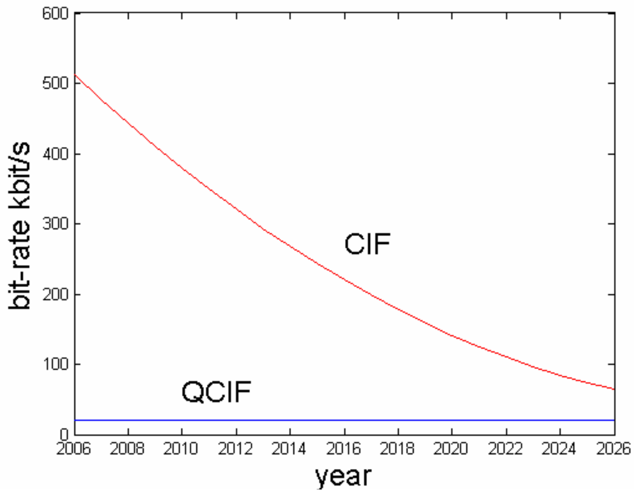

Fig 2: Predicted bitrates for different multimedia applications arising from evolution different video codecs

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And also on important parameter is other post processing[12] algorithms have been proposed for video coding, most of them applying a one dimensional vertical filter to remove horizontal edges, followed by another one dimensional horizontal filter to remove vertical edges , resulting in a large number of redundant operations. Furthermore, these methods operate on previously decoded frames as a processing unit, where each decoded picture should be fetched and stored in external memory twice for applying filters in both directions, which increases drastically the memory bandwidth.

H.264/AVC[4] is newest video coding standard of the ITU-T Video Coding Experts Group and the ISO/IEC MovingPicture Experts Group. The main goals of the H.264/AVC[11] standardizationeffort have been enhanced compression performanceand provision of a “network-friendly” video representationaddressing “conversational” (video telephony) and “nonconversational”(storage, broadcast, or streaming) applications.H.264/AVC[3] has achieved a significant improvement in rate-distortionefficiency relative to existing standards. This article providesan overview of the technical features of H.264/AVC, describesprofiles and applications for the standard, and outlines the historyof the standardization process. However, an increasing number of services and growing popularity of high definition TV are creating greater needsfor higher coding efficiency. Moreover, other transmission media such as Cable Modem,

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xDSL, or UMTS offer muchlower data rates than broadcast channels, and enhanced codingefficiency can enable the transmission of more video channels or higher quality video representations within existing digital transmission capacities.

The moreaccurate prediction of codec is the smaller the predictionerrors and use fewer number of bits for representing them. And also even to make more accurate predictions, more
neighbouring pixels should be taken into consideration.

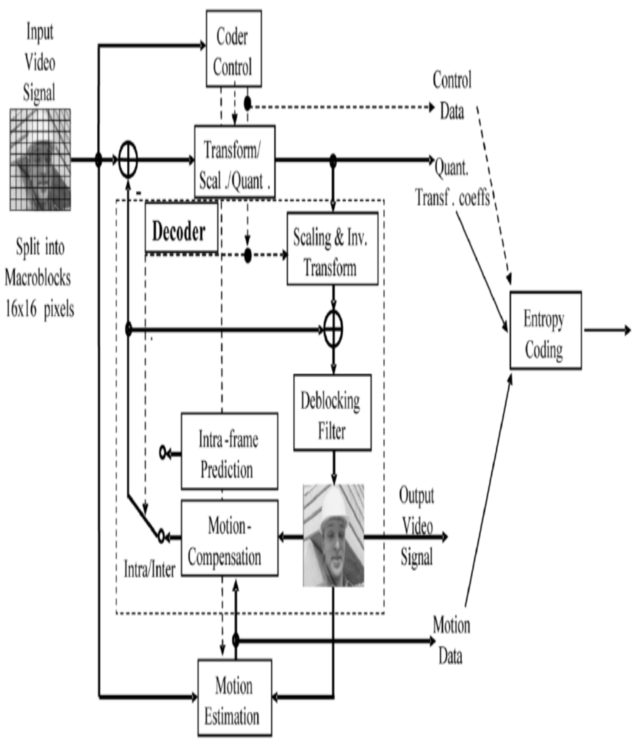

Fig 3: H 264 Codec

H.264 Streaming Support:

Several features contribute to H.264's streaming support. The most fundamental is H.264's network abstraction layer (NAL). It is flexible enough to allow the video coding layer(VCL) to be applied to different transport layers – such as file containers, such as MP4,or Matroska – or to RTP for lossy distribution of video, or to protocols such as H.32X[23].To do this effectively, the VCL[5] organizes data into NAL units, which represents a packet of data. The entire scope of the NAL is outside the purview of this thesis, but it offers apowerful system for organizing H.264 data in many different ways to fit many different scenarios. Inherent in this, however, is its relative complexity to VP8's bitstream. VP8'sbitstream offers little of the same features, however, it is simpler to implement

2. VP8 Video codec:

VP8 was developed by On2 Technologies[8], later bought by Google Inc., to provide highquality video for the web and mobile devices. It has a perpetual patent grant – somethingwhich gives the implementor a no-charge, royalty-free, irrevocable patent license to useor sell VP8, and the official reference implementation is open source.To analyze VP8 effectively, tests were designed to measure how each vital feature of VP8 compares to a similar feature in H.264, as well as how each performs overall andin several use case scenarios.

The general method for comparing VP8 and H.264 is to analyze the components thatdefine the codecs, design methodology to compare these individual features, and runtests on a varied set of source videos to gain an accurate understanding of how each componentcompares to its counterpart in the other codec. By analyzing the codec by

parts,rather than by the whole, emphasis can be placed on where optimization should takeplace. This also gives a more detailed view on the codecs, and can ignore implementationspecificbugs and shortcomings.

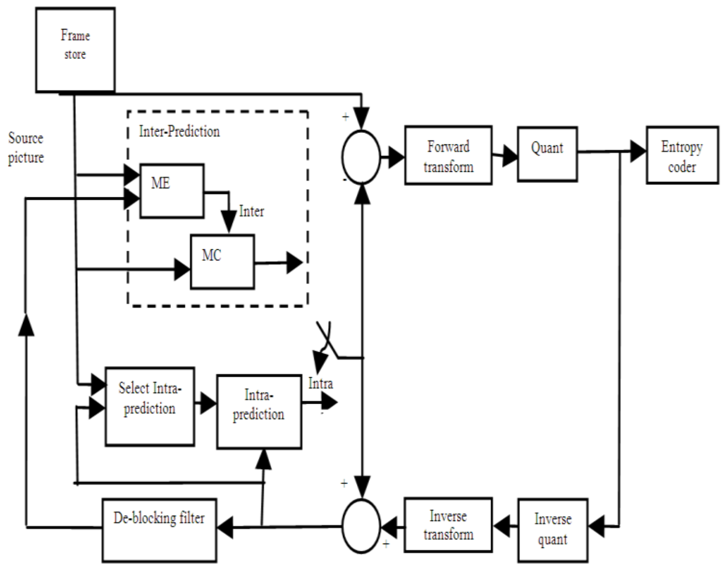

Fig 4: Video Encoding

Basically VP8[8] is designed to be simpler than H.264, and as such contains fewer color modes, less available transformation sizes, a simpler loop filter; all while delivering a similar bitrate and visual quality to the end user. H.264's complexity results in an efficient bitstream that is already well supported by both hardware and software platforms. It will need to be seen if VP8's deviations will result in a quality video codec.

VP8 Streaming Support:

VP8 [8] offers relatively few streaming features. Like H.264, many of VP8's encoding features, such as the arithmetic coder, are context adaptive. If an incremental update to such an adaptive table is lost, all data until the table is fully defined again (usually at an I frame) will be corrupt. VP8 can optionally fully define all adaptive context tables at all golden frames, allowing the stream to recover quickly VP8 video

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compression codec of the WebM open video format that is available freely. And A 3-bit version number (0 - 3 are defined as four different profiles with different decoding complexity; other values may be defined for future variants of the VP8 data format).
There are two decoders 1) VPX decoder 2) Simple Decoder the only difference between the two is that msimple decoder just simply decodes a stream and nothing else, while the vpxdec can do plenty of other things.

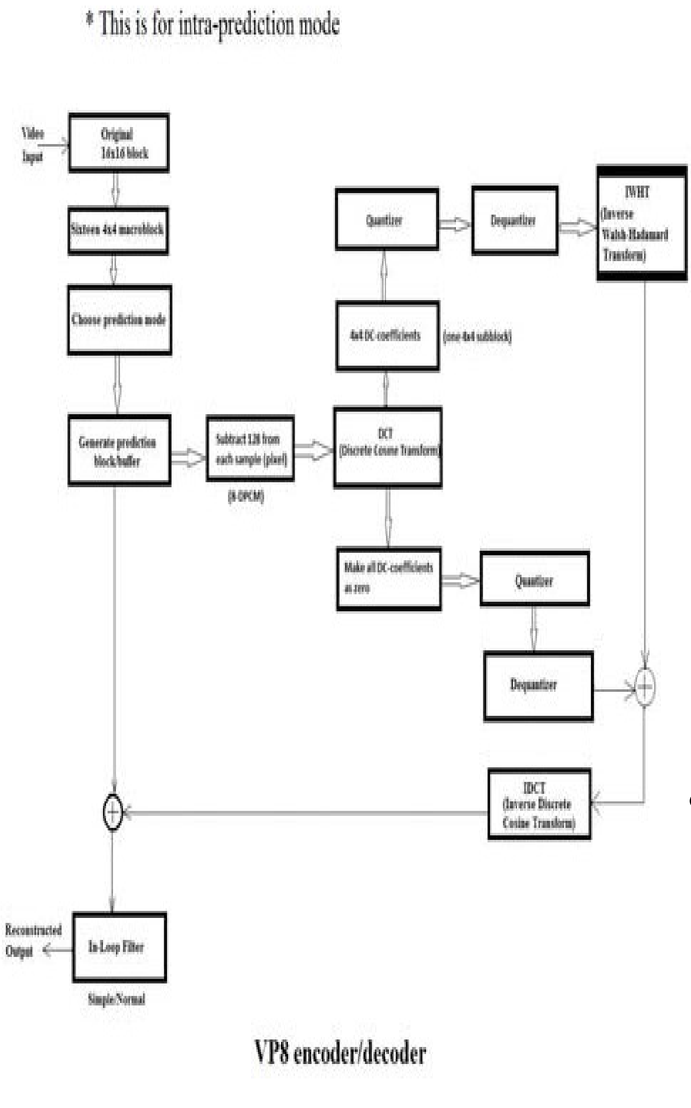

Fig 5: VP8 Video encoder and decoder

3. Result analysis

Fig 6: Akiyo_qcif for H 264 video code

Fig 7: Akiyo_qcif for MPEG 4 video codec

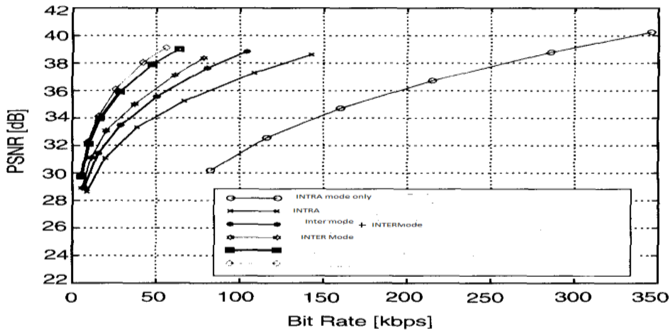

Fig 8: **Bitrates VS PSNR for different video codecs**

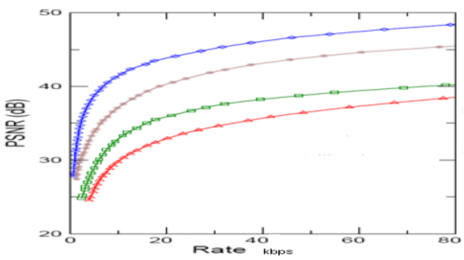

Fig 9: **Bitrates VS PSNR for different Video test streams**

Conclusion and Future work:

In this paper, analyse the differnt Video codecs and also comparistion w.r t to VP8 has done Here analysis done for bitrates , quality of the data and also PSNR for the different Video codecs has been done , with help of this analyis VP8 codecs features can be apply for different multimedia applications.

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Basavaraju.S holds the Master degree from VTU, Karnataka, and currently pursuing PhD at PRIST University Thanjavur, India, and Earlier worked at several software industries in signal and multimedia processing domain and currently working as Assistant professor in Sapthagiri College of engineering, Bangalore.

Dr B Sivakumar holds PhD degree from Anna University Tamilnadu, and currently working as Professor and head of the Telecom dept at Dr AIT