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COMPARATIVE STUDY OF VIDEO COMPRESSION TECHNIQUES-H.264/AVC

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***Abstract*- H.264/AVC is a recently completed video compression standard jointly developed by ITU-T and ISO MPEG standards committees. The standard is becoming more popular as it promises much higher compression than that possible with earlier standards. The intent of the H.264/AVC project was to create a standard ,capable of providing good video quality at substantially lower bit rates than previous standards (i.e., half or less the bit rate of MPEG-2, H.263, or MPEG-4 Part 2), without increasing the complexity of design. This paper provides an overview of the H.264 features and summarizes the emerging studies related to new coding features of the standard. H.264 entails significant improvements in coding efficiency, latency, complexity and robustness. It provides new possibilities for creating better video encoders and decoders that provide higher quality video streams at maintained bit-rates (compared to previous standards), or, conversely, the same quality video at a lower bit-rate. Hence, appropriate video compression techniques that meet video applications requirements have to be selected.**

***Keywords*— H.264/AVC, video compression, Video Comparison, Intra-prediction, Rate distortion, Pixels.**

I. INTRODUCTION

As recent multimedia applications (using various types of networks) are growing rapidly, video compression requires higher performance as well as new features. The newest video coding standard is developed by the joint of video teams of ISO/IEC MPEG and ITU_T VCEG as the international standard 14496-10 (MPEG-4 part 10) advanced video coding (AVC). H.264/AVC has gained more and more attention; mainly due to its high coding efficiency (the average bit rate saving up to 50% as compared to H.263+ and MPEG-4 Simple Profile), minor increase in decoder complexity compared to existing standards, adaptation to delay constraints (the low delay mode), error robustness, and network friendliness. Table 1 and Figure 1 show the performance comparisons using MPEG-2, MPEG-4 (ASP), and H.264/AVC. To achieve outstanding coding performance, H.264/AVC employs several powerful coding techniques such as 4x4 integer transform, inter-prediction with variable block-size motion compensation, motion vector of quarter-pel accuracy, in-loop de-blocking filter, improved entropy coding such as context-adaptive variable-length coding (CAVLC) and content-adaptive binary arithmetic coding (CABAC), enhanced intra-prediction, multiple reference picture, and the forth. Due to this new features, encoder computational complexity is extremely increased compared to previous standards. This makes H.264/AVC difficult for applications with low computational capabilities (such as mobile devices). Thus until now, the reduction of its complexity is a challenging task in H.264/AVC. Among many new features, the intra-prediction technique is recognized to be one of the main factors that contribute to the success of H.264/AVC.

Table 1: Average Bit-Rate Reduction Compared To Prior Coding Schemes.

Standards	MPEG-4		H.263	MPEG-2
H264/AVC	38.62%		48.80%	64.46%
MPEG-4	….		16.65%	42.95%
H.263	….		….	30.61%

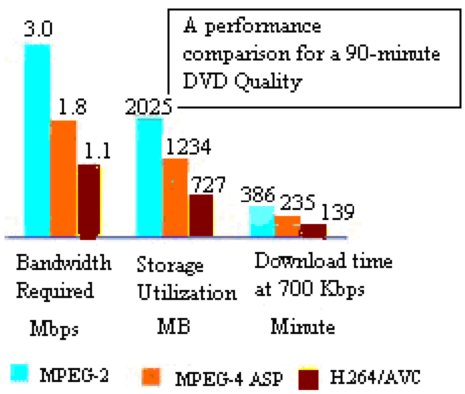

Figure1: Performance Comparison Of Different Video Coding Standards

II. OVERVIEW OF THE H.264 STANDARD

H.264/MPEG-4 AVC is a block-oriented motion compensation based codec standard developed by the ITU-T Video Coding Experts Group (VCEG) together with the ISO/IEC JTC1 Moving Picture Experts Group (MPEG) [1]. The project partnership effort is known as the Video Team (JVT). The ITU-T H.264 standard and the ISO/IEC MPEG-4 AVC standard are jointly maintained so that they have identical technical content. The standard provides flexibilities in coding and organization of data which enable efficient error resilience. The increased coding efficiency offers new application areas and business opportunities. As might be expected, the increases in compression efficiency and flexibility come at the expense of increase in complexity, which is a fact that must be overcome. Figure 2 shows the Structure of H.264/AVC video encoder [2]. To deal with the need for flexibility and customizability, the H.264 standard covers a Video Coding Layer (VCL), which is designed for well-organized representation of the video content and is a block based hybrid video coding approach , and a Network Abstraction Layer (NAL), which formats the VCL representation of the video and provides header information in a way that is appropriate for transportation by different transport layers or storage media. A picture may be split into one or several slices. In H.264, slices consist of macro blocks processed in raster scan order. A picture then can be split into many macro block scanning patterns such as interleaved slices, dispersed macro block allocation. H.264 standard is more flexible in the selection of motion compensation (MC) block sizes and shapes than any previous standard, with a minimum luma Macro block size as small as 4x4 [3],[4].

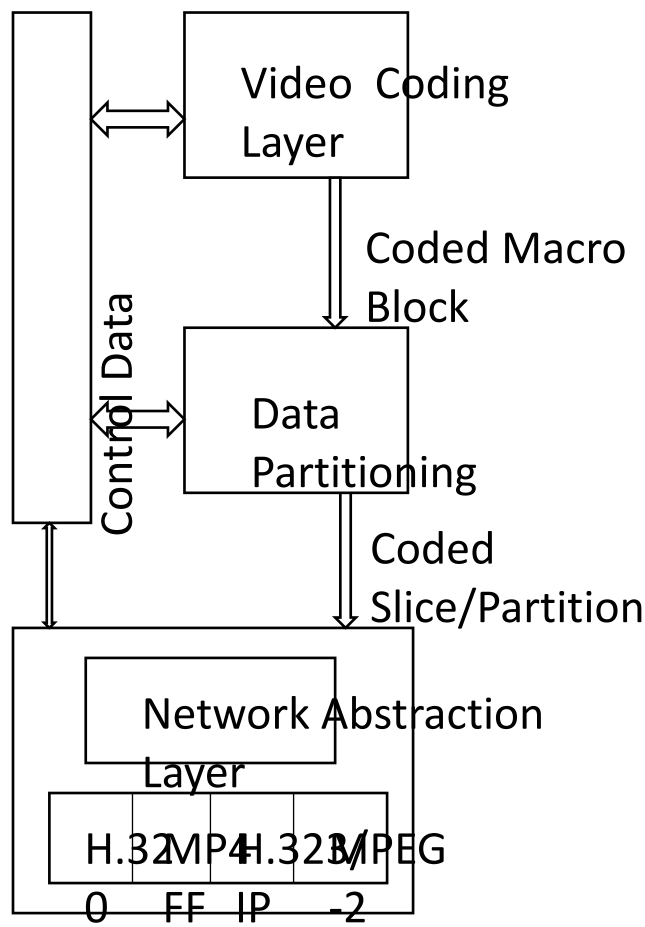

Figure 2. Structure of H.264/AVC Video Encoder

III. H.264 FEATURES

H.264/AVC/MPEG-4 Part 10 contains a number of new features that allow it to compress video much more effectively than older standards and to provide more flexibility for application to a wide variety of network environments. In particular, some such key features include:

- Multi-picture inter-picture prediction.
- Variable block-size motion compensation
- The ability to use multiple motion vectors per macro block.
- Quarter-pixel precision for motion compensation.
- spatial prediction from the edges of neighbouring blocks for "intra" coding.
- Flexible interlaced-scan video coding features.
- New transformation design features.
- An entropy coding design including context adaptive binary arithmetic coding and

Context adaptive variable-length coding.

IV. H.264 APPLICATION

The H.264 was designed to be flexible video format and has a very broad application range including [5]

- Low bit-rate Internet streaming applications.
- HDTV broadcast and Digital Cinema applications.
- Web software embedding.
- Mobile TV standardization.
- Video conferencing products.
- SDTV and HDTV standardization and deployment.
- HD Video Storage applications.

V. LITERATURE SURVEY

Digital video coding paradigm, represented by the ITU-T VCEG and ISO/IEC MPEG standardization efforts, relies on inter-frame predictive coding and block-based DCT transform in order to exploit both the temporal and spatial redundancy present in the video sequence [6]. In this framework, the encoder has a higher computational complexity than the decoder (typically 5 to 10 times more complex). This is mainly due to the motion estimation and mode decision tools used to efficiently explore the temporal correlation [7]. In fact, the encoder is responsible for all coding decisions to attain optimal rate-distortion (RD) performance, while the decoder remains pure executer of the encoder “orders” [8]. This type of architecture is well-suited for applications where the video is encoded once and decoded many times, i.e. one-to-many topologies, such as broadcasting or video-on-demand, where the cost of the decoder is more critical than the cost of the encoder. In recent years, with emerging applications such as wireless low-power surveillance, multimedia sensor networks, wireless PC cameras and mobile camera phones, the traditional video coding architecture is being challenged [9]. These applications have different requirements than those of traditional video delivery systems. For some applications, it is essential to have low power consumption both at the encoder and decoder, e.g. in mobile camera phones. In other cases, notably when there are several encoders and only one decoder [10], e.g. in video surveillance applications, low complexity encoder devices are needed, possibly at the expense of a high-complexity decoder. While shifting the complexity burden from the encoder to the decoder, it is important to achieve a coding efficiency.

Among the new techniques introduced by H.264, intra mode plays a vital role because it can reduce spatial redundancy substantially. That is, the current macro block is predicted by adjacent pixels in the upper and the left macro block that are coded earlier [11]. In order to attain the best coding performance, a very time-consuming technique named RDO (rate distortion optimization) is used. It computes the real bit-rate and distortion between original and reconstructed frames for each mode [12]. For video storage, if we have a small file with good quality and a large file with same quality, we would go for the small file than the large file. So if we could compress some video to a smaller file with the same video quality then that would be much preferable for us [13]. H.264 is a kind of video compression which is much advance, and so we can use H.264 for video compression.

The high bit rate that result from the various types of digital video make their transmission through their intended channels very difficult. Even entertainment video with modest frame rates and dimensions would require bandwidth and storage space far in excess of that available from CD-ROM [14]. Thus delivering consumer quality video on compact disc would be impossible. This is analogous to an envelope being too large to fit into a letter box. Similarly the data transfer rate required by a video telephony system is far greater than the bandwidth available over the plain old telephone system (POTS). Even if high bandwidth technology (e.g. fiber-optic cable) was in place, the per-byte-cost of transmission would have to be very low before it would be feasible to use it for the staggering amounts of data required by HDTV [15]. Finally, even if the storage and transportation problems of digital video were overcome, the processing power needed to manage such volumes of data would make the receiver hardware very expensive.

VI. CONCULSION.

Video compression is gaining popularity since storage and network bandwidth requirements are able to be reduced with compression. Many algorithms for video compression which are designed with a different target in mind have been proposed. This study explained the standardization efforts for video compression such as H.263 and 263+, MPEG-2, 4, and H.264/AVC represents a major step in the development of video coding standards, in terms of both coding efficiency, enhancement and flexibility for effective use over a broad variety of network types and application domains. Designers of video services need to choose an appropriate scalable video coding scheme, which meets the target efficiency and flexibility at an affordable cost and complexity.

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