# Review of Video Encoding Standard: HEVC / H.265

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## ABSTRACT:-

High Efficiency Video Coding (HEVC) is a new Standard for video compression developed by the ISO and ITU-T. The Moving Picture Experts Group (MPEG) and Video Coding Experts Group (VCEG) set up a Joint Collaborative Team on Video Coding (JCT-VC) to create the new standard. HEVC is a joint publication of ISO/IEC and ITU-T, formally known as ISO/IEC 23008-2 and ITU-T Recommendation H.265. The new HEVC standard was first published in January 2013.

Some of the major Technique contributors to the higher compression performance of HEVC are the introduction of quad tree structure, larger block structures with flexible mechanisms of sub-partitioning , improved techniques to support parallel encoding/decoding, more directional intra prediction modes, support for several integer transforms with square as well as non square transforms, merging of prediction blocks for improved motion information encoding, and extensive In-loop processing on reconstructed pictures.

The primary goal of the new codec is 50 percent better compression efficiency than H.264 and support for resolutions up to 8192 x 4320. It unlocks future business notably suitable for resolutions up to Ultra High Definition (UHD) video coding in the future.

Key Words— HEVC, H.265, AVC, H.264, MPEG ,ISO, ITU-T

## HEVC Coding Design and Feature Highlights

The HEVC standard is designed to achieve multiple goals, including coding efficiency, ease of transport system integration and data loss resilience, as well as implementability using parallel processing architectures. The following subsections briefly describe the key elements of the design by which these goals are achieved, and the typical encoder operation that would generate a valid bit stream.

**Video Coding Layer:** The video coding layer of HEVC employs the same hybrid approach (inter-/intra picture prediction and 2-D transform coding) used in all video compression standards since H.261. Fig. 1 depicts the block diagram of a hybrid video encoder, which could create a bit stream conforming to the HEVC standard.

An encoding algorithm producing an HEVC compliant bit stream would typically proceed as follows. Each picture is split into block-shaped regions, with the exact block partitioning being conveyed to the decoder. The first picture of a video sequence (and the first picture at each clean random access point into a video sequence) is coded using only intra picture prediction (that uses some prediction of data spatially from region-to-region within the same picture, but has no dependence on other pictures). For all remaining pictures of a sequence or between random access points, inter picture temporally predictive coding modes are typically used for most blocks. The encoding process for inter picture prediction consists of choosing motion data comprising the selected reference picture and motion vector (MV) to be applied for predicting the samples of each block. The encoder and decoder generate identical inter picture prediction signals by applying motion compensation

(MC) using the MV and mode decision data, which are transmitted as side information. The residual signal of the intra- or inter picture prediction, which is the difference between the original block and its prediction, is transformed by a linear spatial transform. The transform coefficients are then scaled, quantized, entropy coded, and transmitted together with the prediction information. The encoder duplicates the decoder processing loop (see gray-shaded boxes in Fig. 1) such that both will generate identical predictions for subsequent data. Therefore, the quantized transform coefficients are constructed by inverse scaling and are then inverse transformed to duplicate the decoded approximation of the residual signal. The residual is then added to the prediction, and the result of that addition may then be fed into one or two loop filters to smooth out artifacts induced by block-wise processing and quantization. The final picture representation (that is a duplicate of the output of the decoder) is stored in a decoded picture buffer to be used for the prediction of subsequent pictures. In general, the order of encoding or decoding processing of pictures often differs from the order in which they arrive from the source; necessitating a distinction between the decoding order (i.e., bit stream order) and the output order (i.e., display order) for a decoder. Video material to be encoded by HEVC is generally expected to be input as progressive scan imagery (either due to the source video originating in that format or resulting from deinterlacing prior to encoding). No explicit coding features are present in the HEVC design to support the use of interlaced scanning, as interlaced scanning is no longer used for displays and is becoming substantially less common for distribution. However, a metadata syntax has been provided in HEVC to allow an encoder to indicate that interlace-scanned video has been sent by coding each field (i.e., the even or odd numbered lines of each video frame) of interlaced video as a separate picture or that it has been sent by coding each interlaced frame as an HEVC coded picture. This provides an efficient method of coding interlaced video without burdening decoders with a need to support a special decoding process for it.

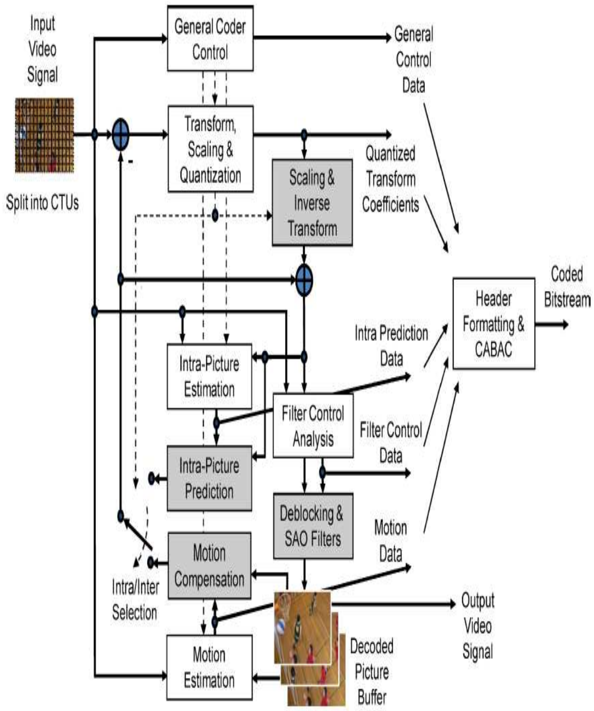


**Fig- 1. Block diagram of HM encoder**

In the following, the various features involved in hybrid video coding using HEVC are highlighted as follows.

## 1. Coding tree units and coding tree block (CTB) structure:

The core of the coding layer in previous standards was the macroblock, containing a 16×16 block of luma samples and, in the usual case of 4:2:0 color sampling, two corresponding 8×8 blocks of chroma samples; whereas the analogous structure in HEVC is the coding tree unit (CTU), which has a size selected by the encoder and can be larger than a traditional macroblock. The CTU consists of a luma CTB and the corresponding chroma CTBs and syntax elements. The size L×L of a luma CTB can be chosen as L = 16, 32, or 64 samples, with the larger sizes typically enabling better compression. HEVC then supports a partitioning of the CTBs into smaller blocks using a tree structure and quadtree-like signaling .

2. **Coding units (CUs) and coding blocks (CBs):**

The quadtree syntax of the CTU specifies the size and positions of its luma and chroma CBs. The root of the quadtree is associated with the CTU. Hence, the size of the luma CTB is the largest supported size for a luma CB. The splitting of a CTU into luma and chroma CBs is signaled jointly. One luma CB and ordinarily two chroma CBs, together with associated syntax, form a coding unit (CU). A CTB may contain only one CU or may be split to form multiple CUs, and each CU has an associated partitioning into prediction units (PUs) and a tree of transform units (TUs).

3. **Prediction units and prediction blocks (PBs):**

The decision whether to code a picture area using interpicture or intrapicture prediction is made at the CU level. A PU partitioning structure has its root at the CU level. Depending on the basic prediction-type decision, the luma and chroma CBs can then be further split in size and predicted from luma and chroma prediction blocks (PBs). HEVC supports variable PB sizes from 64×64 down to 4×4 samples.

## 4. TUs and transform blocks:

The prediction residual is coded using block transforms. A TU tree structure has its root at the CU level. The luma CB residual may be identical to the luma transform block (TB) or may be further split into smaller luma TBs. The same applies to the chroma TBs. Integer basis functions similar to those of a discrete cosine transform (DCT) are defined for the square TB sizes 4×4, 8×8, 16×16, and 32×32. For the 4×4 transform of luma intrapicture prediction residuals, an integer transform derived from a form of discrete sine transform (DST) is alternatively specified.

## 5 Motion vector signaling:

Advanced motion vector prediction (AMVP) is used, including derivation of several most probable candidates based on data from adjacent PBs and the reference picture. A merge mode for MV coding can also be used, allowing the inheritance of MVs from temporally or spatially neighboring PBs. Moreover, compared to H.264/MPEG-4 AVC, improved skipped and direct motion inference are also specified.

## 6. Motion compensation:

Quarter-sample precision is used for the MVs, and 7-tap or 8-tap filters are used for interpolation of fractional-sample positions (compared to six-tap filtering of half-sample positions followed by linear interpolation for quarter-sample positions in H.264/MPEG-4 AVC). Similar to H.264/MPEG-4 AVC, multiple reference pictures are used. For each PB, either one or two motion vectors can be transmitted, resulting either in unipredictive or bipredictive coding, respectively. As in H.264/MPEG-4 AVC, a scaling and offset operation may be applied to the prediction signal(s) in a manner known as weighted prediction.

## 7. Intrapicture prediction:

The decoded boundary samples of adjacent blocks are used as reference data for spatial prediction in regions where interpicture prediction is not performed. Intrapicture prediction supports 33 directional modes (compared to eight such modes in H.264/MPEG-4 AVC), plus planar (surface fitting) and DC (flat) prediction modes. The selected intrapicture prediction modes are encoded by deriving most probable modes (e.g., prediction directions) based on those of previously decoded neighboring PBs.

## 8. Quantization control:

As in H.264/MPEG-4 AVC, uniform reconstruction quantization (URQ) is used in HEVC, with quantization scaling matrices supported for the various transform block sizes.

## 9. Entropy coding:

Context adaptive binary arithmetic coding (CABAC) is used for entropy coding. This is similar to the CABAC scheme in H.264/MPEG-4 AVC, but has undergone several improvements to improve its throughput speed (especially for parallel-processing architectures) and its compression performance, and to reduce its context memory requirements.

## 10. In-loop deblocking filtering:

A deblocking filter similar to the one used in H.264/MPEG-4 AVC is operated within the interpicture prediction loop. However, the design is simplified in regard to its decision-making and filtering processes, and is made more friendly to parallel processing.

## 11. Sample adaptive offset (SAO):

A nonlinear amplitude mapping is introduced within the interpicture prediction loop after the deblocking filter. Its goal is to better reconstruct the original signal amplitudes by using a look-up table that is described by a few additional parameters that can be determined by histogram analysis at the encoder side.

## Conclusion and Future Works:-

The emerging HEVC standard has been developed and standardized collaboratively by both the ITU-T VCEG and ISO/IEC MPEG organizations. HEVC represents a number of advances in video coding technology. Its video coding layer design is based on conventional block-based motion compensated hybrid video coding concepts, but with some important differences relative to prior standards. When used well together, the features of the new design provide approximately a 50% bit-rate savings for equivalent perceptual quality relative to the performance of prior standards (especially for a high-resolution video). For more details on compression performance . Further In this paper ,We have Given a brief idea of HEVC , Video Compression Standard and its HM Encoder/Decoder block diagram with various steps involved in processing a Raw video .

**H.266 :-** This will be new video coding standard, successor to h.265.It should be intended for Achieving double the data compression ratio compared to H.264/MPEG-4 AVC at the same level of video quality. It can alternatively be used to provide substantially improved video quality at the same bit rate.

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