

# APEX STANDARDS

codecGPT: Mastering Section Clause Essentiality in ITU-T H.264/265/266 & VP9/AV1 Searches

Fact Sheet

codecGPT

2 June 2023

**C**odecGPT, a transformative tool that empowers patent holders to assess the alignment of their claim elements with potentially codec standards including ITU-T H.264, H.265, H.266, VP9, and AV1. With such capabilities, patent holders can uncover out-licensing opportunities, catalyzing revenue generation and fortifying their position in the burgeoning market of video codec technologies.

The emerging era of video codecs has created substantial opportunities, especially with the advent of the High Efficiency Video Coding (HEVC) and Versatile Video Coding (VVC). HEVC, as defined in various ITU-T recommendations, offers a practical licensing model, under which, royalties are calculated per unit, providing patent holders an opportunity to generate revenue while promoting widespread adoption of the technology.

HEVC's successor, VVC (H.266), presents an even more exciting frontier, boasting substantial technical improvements over its predecessors. Completed in 2020, VVC promises comparable perceptual quality to older video codecs while achieving up to 50% improvement in video coding efficiency. This leap is critical as video accounts for an increasing proportion of total mobile traffic worldwide. Ericsson's study forecasts this proportion to grow from 66% to 77% by 2026, assuming efficient compression technology.

The surging demand for video streaming, driven by global access to high-speed internet and pandemic-induced changes in lifestyle, underpins the importance of efficient video encoding. New use cases such as 360-degree video gaming applications, remote operation of manufacturing machines, and telemedicine applications are poised to increase the demand for advanced codecs like VVC. Patent holders stand to benefit from this shift, as

they can license their patents and generate revenue.

However, for VVC to reach its full potential, industry players must navigate the maze of thousands of Standard Essential Patents (SEPs). Royalty costs may impact the adoption rate of VVC, but organizations like the Media Coding Industry Forum (MC-IF) are working towards simplifying the licensing landscape.

Despite the complexity of the current situation, history shows that multiple patent pools have coexisted for a single standard. AVC (H.264) saw separate pools offered by MPEG-LA and Via Licensing. However, the licensing ecosystem has become more stratified with HEVC, with three licensing programs by HEVC Advance, MPEG-LA, and Velos Media.

**Apex Standards codecGPT** emerges as a strategic tool in this context. By enabling checking of claim elements against numerous codec standards and technical sections, it serves as a gateway to lucrative out-licensing opportunities and the ever-evolving codec technology market. Utilizing codecGPT positions your patents profitably, harnesses the potential of the next-generation video codec era, and maximizes your licensing revenue.

[www.apexstandards.com](http://www.apexstandards.com)

Contact [support@apexstandards.com](mailto:support@apexstandards.com)

## References

[1] Apex Standards Website [www.apexstandards.com](http://www.apexstandards.com)

[2] Product Matrix [www.apexstandards.com/Apex.Standards.SaaS.Product.Matrix%202022-04.pdf](http://www.apexstandards.com/Apex.Standards.SaaS.Product.Matrix%202022-04.pdf)

[3] Strategic Service Matrix [www.apexstandards.com/Apex.Standards.Strategic.SEP.Service.Matrix%202022-04.pdf](http://www.apexstandards.com/Apex.Standards.Strategic.SEP.Service.Matrix%202022-04.pdf)

[4] Apex Standards domain specific GPT [www.apexstandards.com/apex.domain.gpt.pdf](http://www.apexstandards.com/apex.domain.gpt.pdf)

Based on:

- **ITU-T H.264**: Advanced Video Coding (AVC) or MPEG-4 Part 10
- **ITU-T H.265**: High Efficiency Video Coding (HEVC) or MPEG-H Part 2
- **ITU-T H.266**: Versatile Video Coding (VVC)
- **VP9**: successor to VP8 / developed by Google
- **AV1**: successor to VP9 / developed by the Alliance for Open Media (AOMedia), a consortium supported by Google, Apple, Microsoft, Amazon etc.

Search:  H.264 (AVC)  H.265 (HEVC)  H.266 (VVC)  VP9  AV1

possible methods about bitstream matrix calculations?

8.5

Ask

Session 2 On Fri, Jun 2, 5:48 PM PDT, you asked about: "possible methods about bitstream matrix calculations?" / Section: 8.5 / Source: H.265 (HEVC) / Source: H.266 (VVC) / Source: AV1

codecGPT answered:

## Perspective 1

Possible methods about bitstream matrix calculations:

- Bitstream matrices can be used to represent two-dimensional arrays of syntax elements or variables in video coding standards such as ITU-T H.265 HEVC and ITU-T H.266 VVC. [Ref 2, 3]
- Matrix calculations can be used in the transformation process of video coding standards such as ITU-T H.266 VVC. For example, a transformation matrix can be derived based on the transform size and transform kernel type inputs, and the matrix multiplication can be applied to transform coefficients. [Ref 8, 16]
- Matrix calculations can also be used in depth representation and colour remapping information in video coding standards such as ITU-T H.264 AVC and ITU-T H.265 HEVC. For example, a transform matrix can be used to convert coded depth sample values from non-linear representation to linear representation, and a colour remapping matrix can be derived based on matrix coefficients and rounding offset. [Ref 5, 10, 12]
- Scaling matrices can be used in the quantization process of video coding standards such as AOM AV1, where the quantizer matrix is used to compute quantizers for luma plane decoding. The scaling matrix identifier variable can be specified to determine the level in the quantizer matrix to be used. [Ref 4]
- Inverse scanning processes can be applied to scaling lists or transform coefficients to generate two-dimensional arrays representing scaling matrices or transform block levels. The output variables can be used in further decoding processes of video coding standards such as ITU-T H.264 AVC and ITU-T H.265 HEVC. [Ref 6, 13, 14, 17, 19]

## Perspective 2

Possible methods about bitstream matrix calculations are:

- Matrix multiplication: For example, in ITU-T H.266 VVC, the transformation process involves multiplying a transform matrix with non-zero transform coefficients. The matrix multiplication is performed using a set of nested loops, where the size of the matrix and the coefficients are used as loop variables. [Ref 16, 8]
- Line-segment-approximation: In ITU-T H.264 AVC, a variable called DepthLUT is used to transform coded depth sample values from non-linear representation to the linear representation disparity normalized in range from 0 to 255. The shape of this transform is defined by means of line-segment-approximation in two-dimensional linear-disparity-to-non-linear-disparity space. [Ref 10]
- Scaling: In ITU-T H.266 VVC, the scaling process for transform coefficients involves clipping each coefficient to a specified range and then scaling it using a scaling matrix identified by a variable. The scaling is performed using a set of nested loops, where the size of the matrix and the coefficients are used as loop variables. [Ref 7]
- Inverse scanning process: In ITU-T H.264 AVC and H.265 HEVC, the inverse scanning process is used to map a list of transform coefficient levels to the corresponding locations in a two-dimensional array representing a scaling matrix. The process involves traversing the array in a zigzag pattern and writing the coefficient levels in the corresponding positions. [Ref 17, 6, 14, 13]
- Colour remapping matrix: In ITU-T H.265 HEVC, the colour remapping information SEI message semantics involve deriving a colour remapping matrix for each component using a set of equations that depend on the rounding offset, the matrix denominator, and the coefficients of the matrix. [Ref 12, 5]
- Quantizer matrix: In AOM AV1, the quantization params semantics involve using a variable called qm\_y to specify the level in the quantizer matrix that should be used for luma plane decoding. The quantizer matrix is used to compute quantizers that are applied to transform coefficients. [Ref 4]
- One-dimensional inverse transform: In ITU-T H.264 AVC and H.265 HEVC, the inverse transform process for 4x4 and 8x8 residual blocks involves applying a one-dimensional inverse transform to each column or row of a matrix obtained from the block. The intermediate values obtained from the transform are used to compute the final transform coefficients. [Ref 18, 20, 19]

## References

### 1 ITU-T H.266 VVC

Section: 8.5.6.7 Weighted sample prediction process for combined merge and intra prediction

Paragraph: Output of this process is the (cbWidth)x(cbHeight) array predSamplesComb of prediction sample values. The variables scaleFactX and scaleFactY are derived as follows: scaleFact X = ( cIdx = = 0 | | SubWidthC

Keywords: variables

**Apex Standards codecGPT**, an advanced tool with natural language processing capabilities, is designed to assist researchers and patent holders in analyzing the applicability of their patent claims against various video codec standards. It accepts inputs such as topics or draft patent claim elements, and uses these to evaluate if any claim features align with technical specifications in any video standards like AVC, HEVC, VVC, VP9, and AV1. For instance, if a feature from a patent claim fits the criteria of two different standards, it's termed a 'squared SEP', while meeting three standards labels it a 'cubic SEP'. By enabling this thorough cross-standard scrutiny, codecGPT enhances patent monetization potential, as the wider the claim's applicability, the higher its market value.