Digital Broadcasting Experts Group

SET eXPerience 2021

Response to TV 3.0 project CfP Phase-1 and 2 Video Coding

DiBEG/Japan

Proposal of Video Coding by DiBEG

1. General

   We, DiBEG, or Digital Broadcasting Experts Group, of Japan, proposed Ph-1 and Ph-2 of Video Coding in response to the TV 3.0 CfP (Call for Proposal) issued by the SBTVD Forum. We describe the outline of our technical proposal of Ph-1 and Ph-2 of the video coding.

2. Outline of Video Coding

   DiBEG proposed VVC (Versatile Video Coding) which is considered as the video coding technology for the next-generation digital terrestrial TV in Japan (Advanced ISDB-T).

   We submitted the proposal about VVC technology jointly with InterDigital, Ateme and Fraunhofer. This document describes the outline of our proposed VVC features.

Ph-1 Proposal on Video Coding

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We submitted the statement based on the CfP requirements.
The following description outlines our statements on VVC Coding.

VC1.1: Resolution

Our proposed VVC applies to the resolution of 2K, 4K and 8K. Other resolutions can applies easily.

VC1.2: Scanning, progressive

Our proposed VVC can handle scanning.

VC1.3: Aspect ratio

Our proposed VVC can handle Aspect ratio.

VC1.4: Sampling; YCbCr 4:2:0

Our proposed VVC can handle Sampling.

VC2.1: Bit depth; 10-bit/component

Our proposed VVC can handle Bit depth.

Ph-1 Proposal on Video Coding

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The following description is the outline of the statement on Video Coding.

VC2.2: Dynamic range; HDR/HDR Dynamic Mapping/SDR

Our proposed VVC can handle HDR and SDR.

VC2.3: Colorimetry; WCG (Rec. ITU-R BT.2020 /BT.2100)

Our proposed VVC can handle Colorimetry.

VC3.1: Frame Rate; 120fsp, 119.88 fps, 60fsp, 59.94fsp, etc.

Our proposed VVC adopts 119.88 and 59.94fps for 4K and 8K basically.
Other frame rate can be applied easily.

VC4.1: Bit rate; 1 280x720/HDR/59.94 fps to 7 680x4 320/HDR/59.94 fps

Our proposed VVC complies with suitable bit rate.

VC5.1 & 5.2: Real-time encoding and Latency

Our proposed VVC can handle real-time encoding.

Ph-1 Proposal on Video Coding

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The following description is the outline of the statement on Video Coding.

VC6.1 to 6.12: Second video stream (Resolution, scanning, ratio, sampling, alpha blending, bit depth, dynamic range, colorimetry, etc.)

Our proposed VVC in Advanced ISDB-T is required to improve for second video stream.

VC7.1: Emergency warning information sign language video

Our proposed VVC in Advanced ISDB-T is required to improve for sign language video.

VC8.1: VR/AR/XR/3DoF/6DoF support

The VR series is included in Japan's next gen. DTTB requirements, it is considered to be implemented in the Advanced ISDB-T.

Ph-1 Proposal on Video Coding

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The following description is the outline of the statement on Video Coding.

VC9.1: Seamless and frame-accurate stream splicing

Our proposed VVC enables suitable seamless and frame-accurate stream splicing.

VC10.1: Interoperability with different distribution platforms

Our proposed VVC enables suitable interoperability.

VC11.1: Scalability; spatial, temporal, quality (bit rate)

Our proposed VVC enables these scalability with multilayer main 10 profile on the aspect of video coding.

VC12.1: Extensibility

Our proposed VVC offers suitable extensibility in Advanced ISDB-T.

Ph-2 Proposal on Video Coding

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The Laboratory tests of Video Coding in Ph-2 is conducted by Brazil side.
VVC proponents will support these laboratory tests.

DiBEG offer the following issues.

(1) Provision of Video Test Contents
DiBEG have provided some of the video contents used at CfP video coding tests.

(2) Provision of further technical report (planned)
VVC proponents are planning to provide reports according to the CfP procedure. Also, ARIB and several organizations will conduct studies on VVC as Japan's next-generation DTTB video coding.

(3) Development of VVC Encoder and Decoder
We are developing the VVC Encoder and Decoder for Advanced ISDB-T.
The outline of VVC technology describes in this document.

Outline of VVC

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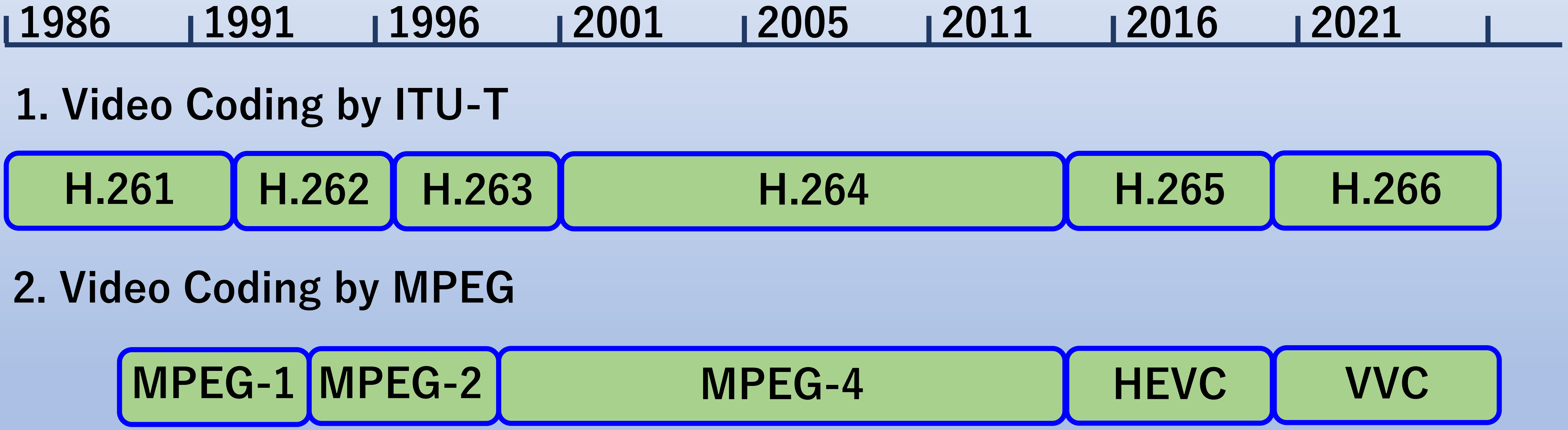
We describe the outline and history of VVC coding technologies.
Road map of video coding is shown. VVC is considered to be applied to the next-generation broadcasting.



Remarks; H.264 = MPEG-4/ H.265=HEVC/ H.266=VVC

Outline of VVC

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Necessary bit rate for each video coding is mentioned as follows.
The bit rate reduction rate of VVC is around 30 to 50 % against HEVC.

Input signal	Encoder	Output	Reduction
2K signal 1.5Gbps	MPEG-2 2K Encoder	MPEG-TS 16Mbps	
2K signal 1.5Gbps	MPEG-4 2K Encoder	MPEG-TS 8Mbps	Reduction 50%
2K signal 1.5Gbps	HEVC 2K Encoder	MPEG-TS 4Mbps	Reduction 50%
4K signal 12Gbps	HEVC 4K Encoder	MPEG-TS 25Mbps	
4K signal 12Gbps	VVC 4K Encoder	MPEG-TS 17Mbps *1	Reduction 30-50% *2
8K signal 48Gbps	VVC 8K Encoder	MPEG-TS 60Mbps	

*1 One example of test results conducted by a manufacturer.
*2 There are some studies showing up to ~50%.

Outline of VVC

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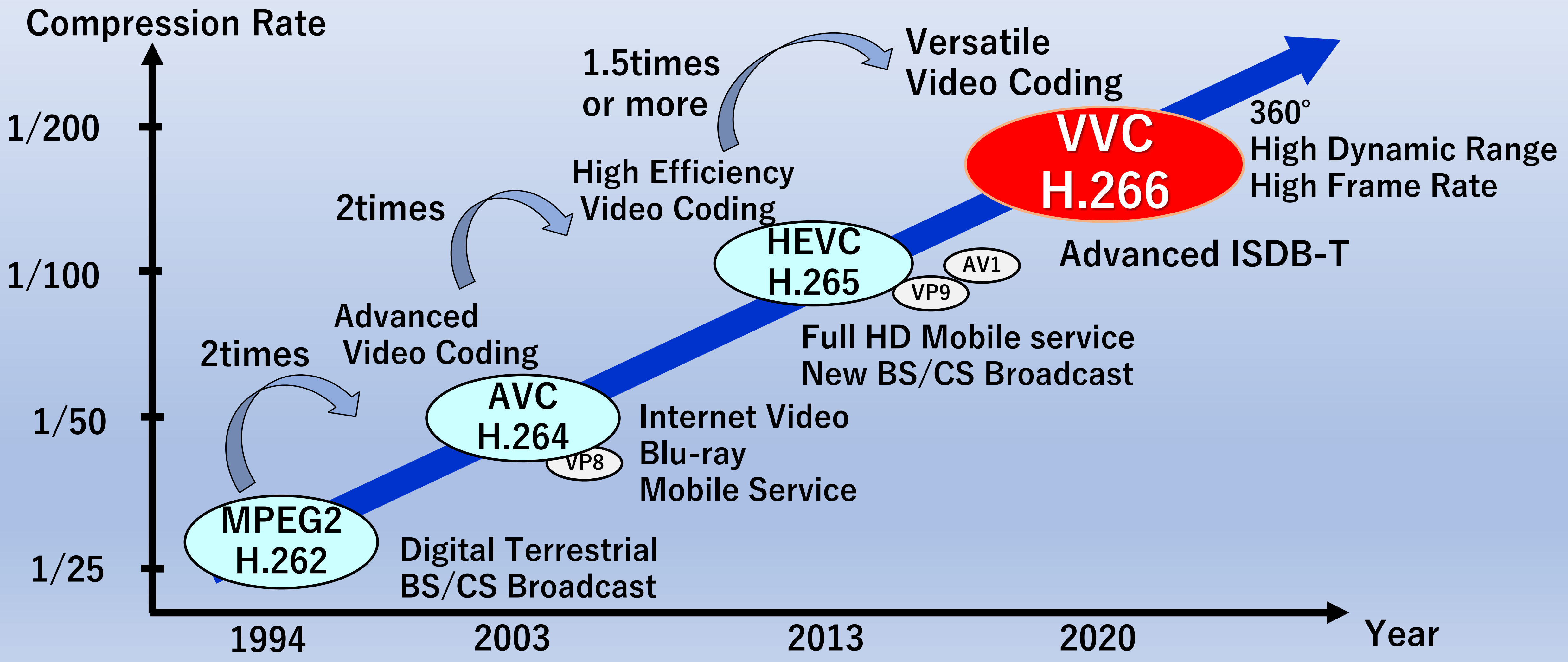
Necessary bit rate for each video coding is shown below. The compression rate of VVC is around 1.5 times or more against HEVC coding.



Outline of VVC

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What's VVC

- VVC (Versatile Video Coding) is the latest standard of Video Coding that is standardized jointly by ITU-T (H.266) and ISO/IEC (MPEG-I -Part 3) in 2020, as the next standard of High Efficiency Video Coding (HEVC/H.265).
- The bit rate needed to achieve equivalent quality is reduced compared with the preceding standard (HEVC/H.265).

Expected Usage

- Terrestrial over-the-air Broadcasting
- Video distribution on various platforms such as over-the-top, 5G mobile network, etc.
- Contribution of VR contents, etc.

Features of VVC

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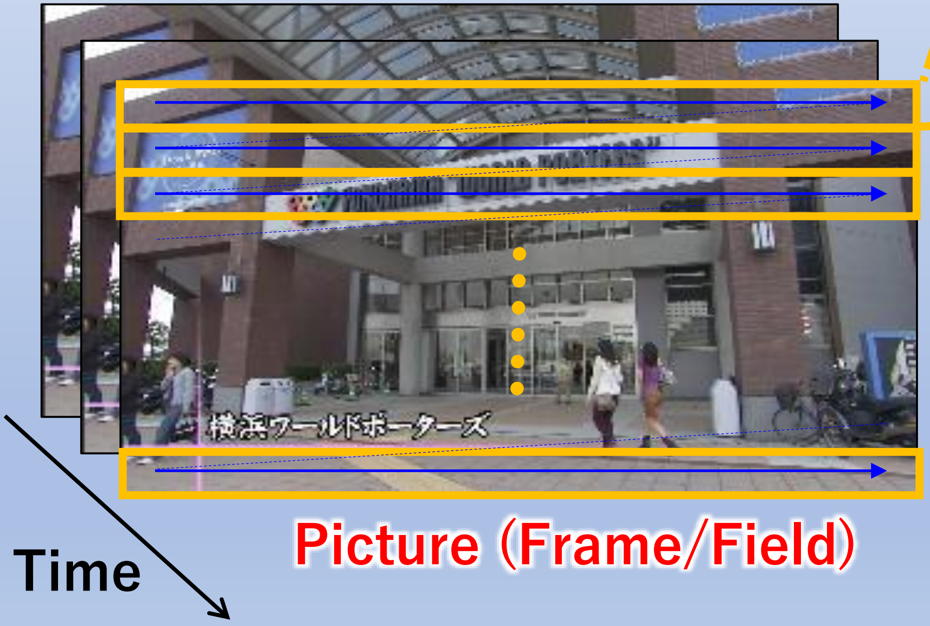
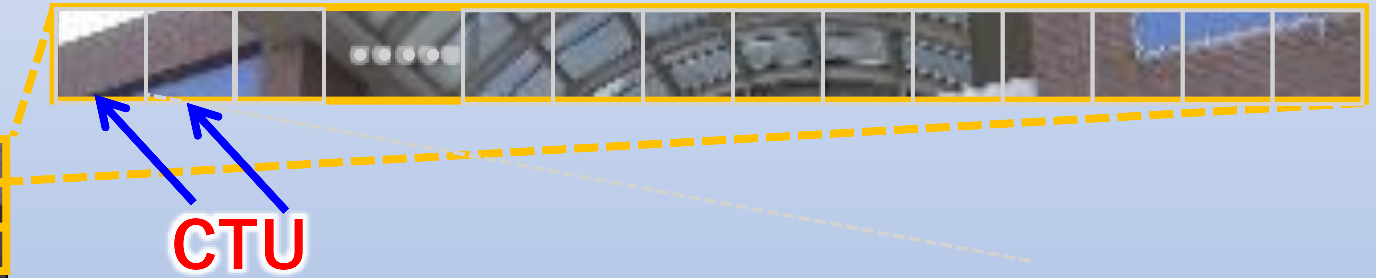
Some features of VVC are shown as follows. Block division of each coding technology is mentioned. VVC adopts CTU for picture division.

Picture is divided to units and processed.

- MPEG-2 and MPEG-4 : Macro Block
- HEVC and VVC : CTU (Coding Tree Unit)

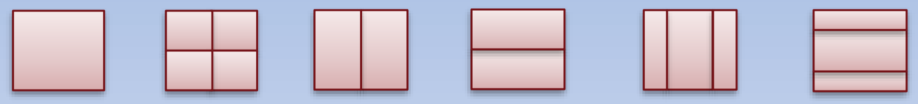




Process in the order of blue lines

Size of CTU
- HEVC : Up to 64x64 pixel blocks
- VVC : Up to 128x128 pixel blocks

Pattern of Picture division



Features of VVC

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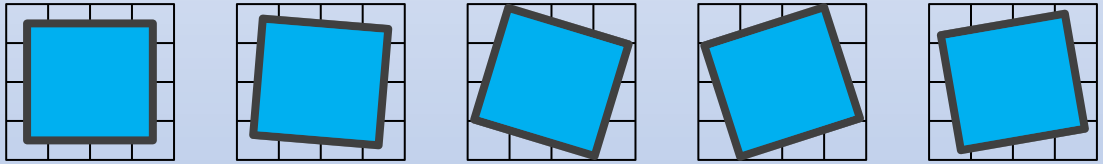
Intra-frame prediction for each coding is mentioned. VVC increases the angle to 65 directions.

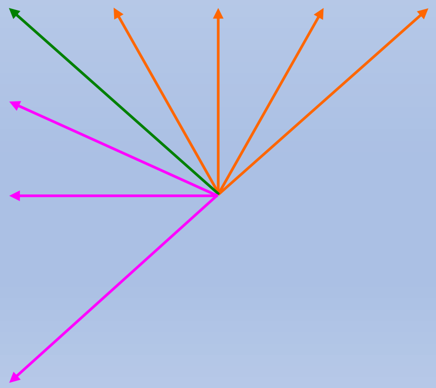
- Increase the "angle" of the intra prediction
- Generation of prediction picture closer to the original one

Need to accommodate picture from different angles



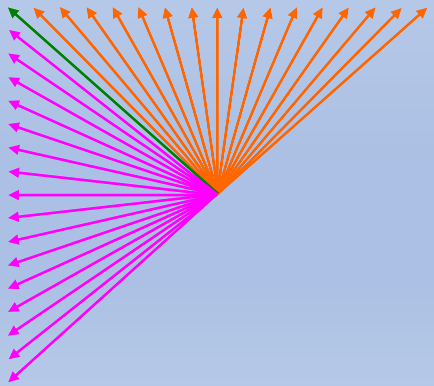
The "angle" of intra-prediction increases with evolution of coding standards

MPEG-4



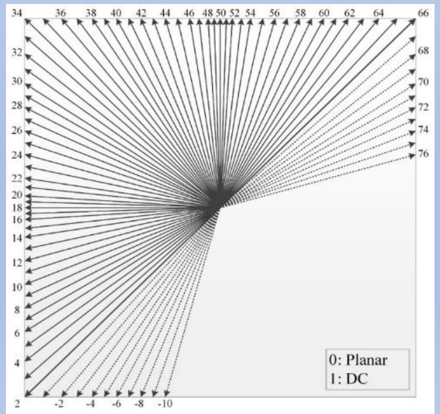
8 directios (+DC)

HEVC



33 directions (+DC+Planar)

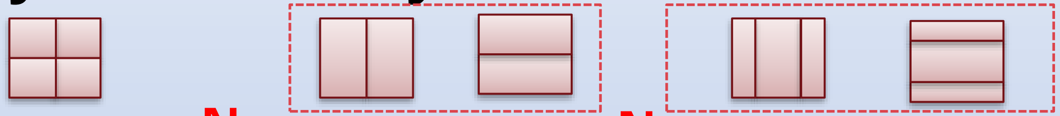
VVC



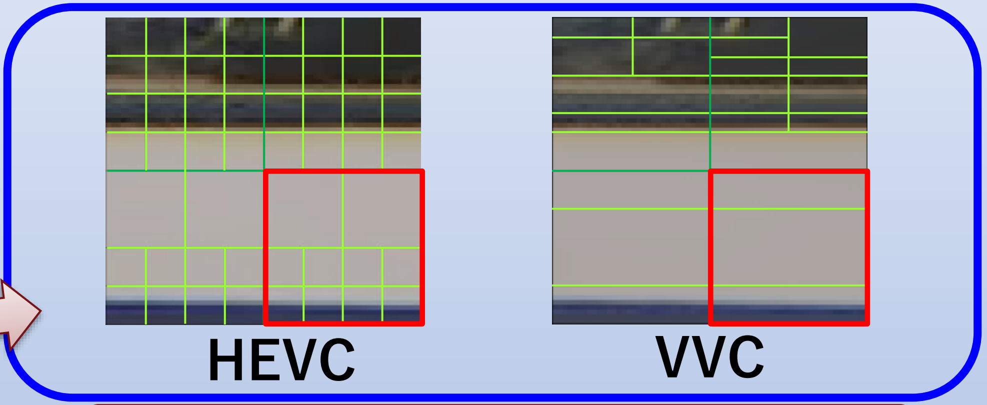
65 directions (+DC+Planar)

Features of VVC

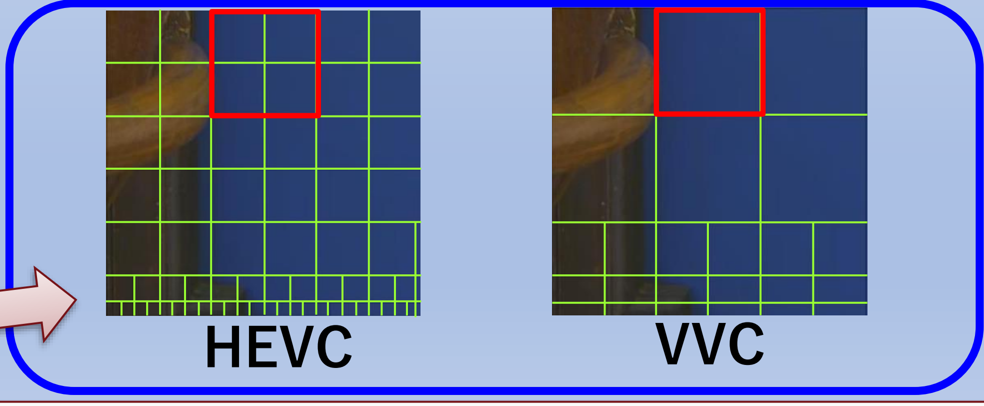
This is the key technology of block division by adopting recursive multi tree. VVC offers more flexible way of division than HEVC by newly adopting binary tree/ternary tree.



Quad tree | New Binary tree | New Ternary tree



Avoiding redundant division



Transmission efficiency of monotony are

Features of VVC

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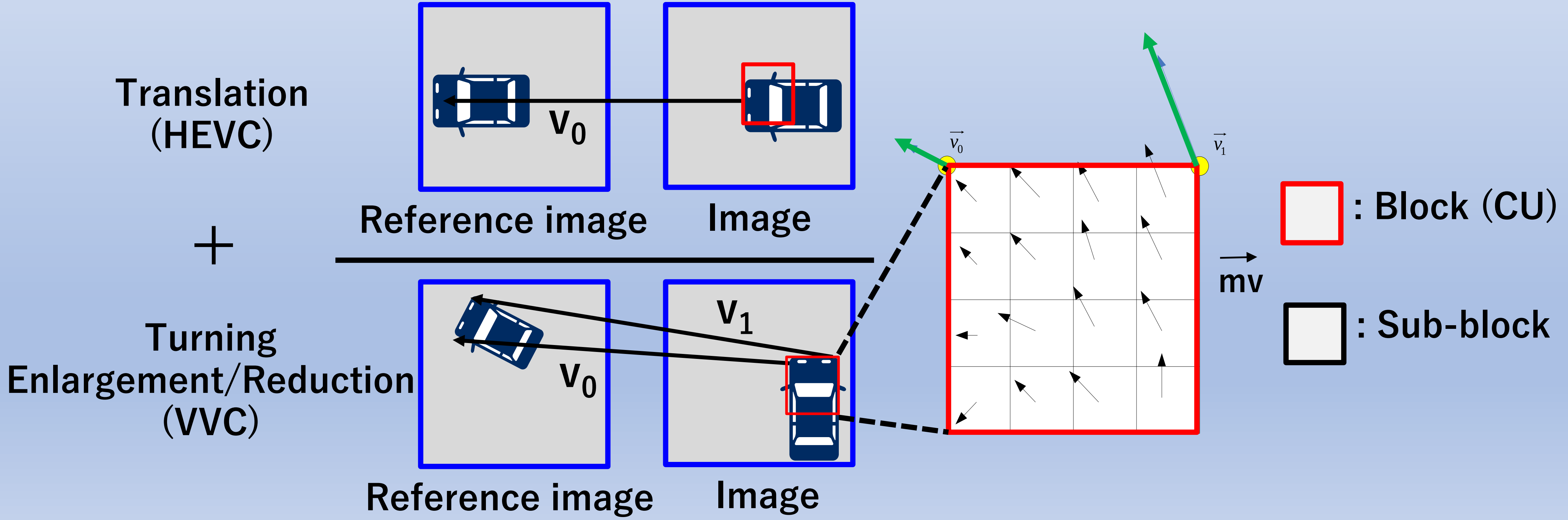
This is the key technology of a variety of Inter prediction-affine prediction. VVC achieves more flexible prediction for turning, enlargement and reduction.

Encoding movement of 2 points (v_0, v_1) and deriving movements of each sub-block (mv) from movement of (v_0, v_1).



Features of VVC

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This is a comparison table among coding methods. VVC enables to generate a predicted picture closer to the original one with smaller information.

Coding	MPEG-2	AVC/H.264	HEVC/H.265	VVC/H.266
Pixel accuracy	1/2 pixel	1/4 pixel	1/4 pixel	1/16 pixel
Block size for Motion compensation	16x16, 16x8	16x16, 16x8, 8x16, 8x8, 4x8, 4x4	4Nx4N, 4Nx2N, 2Nx4N, 2Nx2N, 3Nx4N, 4Nx3N, Nx4N, Nx4N (N=2, 4, 8, 16)	4Nx4N, 4Nx2N, 2Nx4N, 4Nx1N, 1Nx4N, 2Nx2N, 2NxN, Nx2N, NxN (N=4,8,16,32)
Motion vector prediction	Left prediction	Center prediction	Adaptive prediction	Adaptive prediction Affine Forecast Time motion vector prediction Adaptive motion vector resolution
Loop filter	N/A	De-blocking filter	De-blocking filter Sample adaptive offset	De-blocking filter Sample adaptive offset Adaptive loop filter Luma adaptive de-blocking filter

Muito obrigado!

ARIB / DiBEG extend technical cooperation to Brazil adopting Next Generation Broadcasting Standard!

di-jim3 @ arib.or.jp