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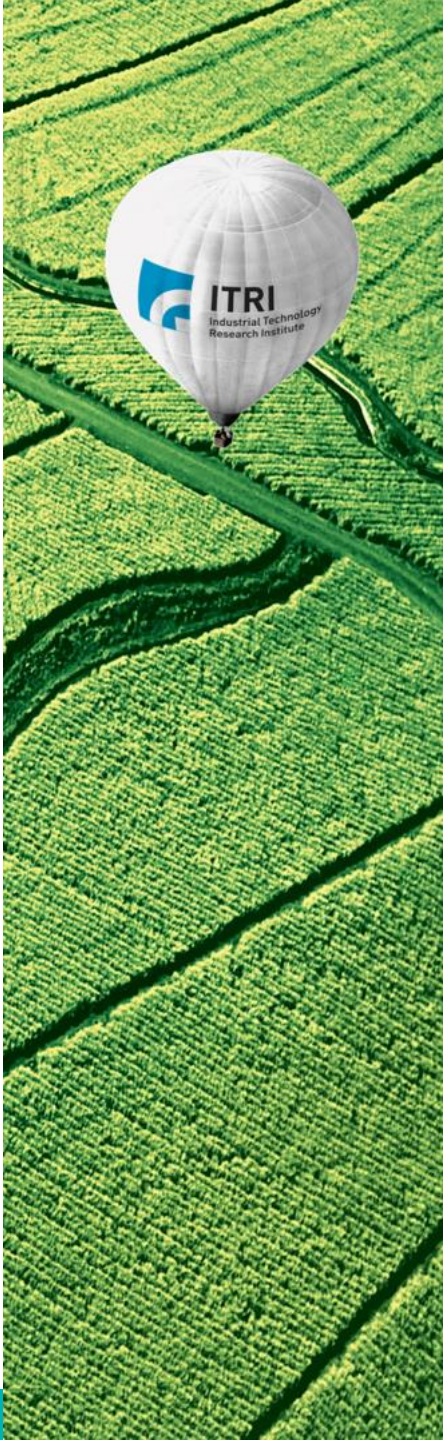

ISO/IEC SC29國際會議分享

Ching-Chieh Lin

26th March 2021

Outline

- Joint Video Expert Team(VVC/H.266)
- Video Coding for Machine(VCM)
- Point Cloud Compression(PCC)

Joint Video Expert Team

Joint Video Expert Team

- 21st Meeting of JVET (Virtual meeting)
  - Date: 6 ~ 15 January, 2021
  - Approximately 350 participants
  - Approximately 80 proposals
    - 10 High-level syntax and profile
    - 49 Low level tools technology
      - 21 High Bit-depth coding
      - 24 Neural Network-based technology
      - 4 other coding technologies
    - 9 Others(Standard development, Text errata, test condition, test material)
    - 8 Verification test and conformance test
    - 7 Software development, Implementation, complexity analysis and encoder optimization

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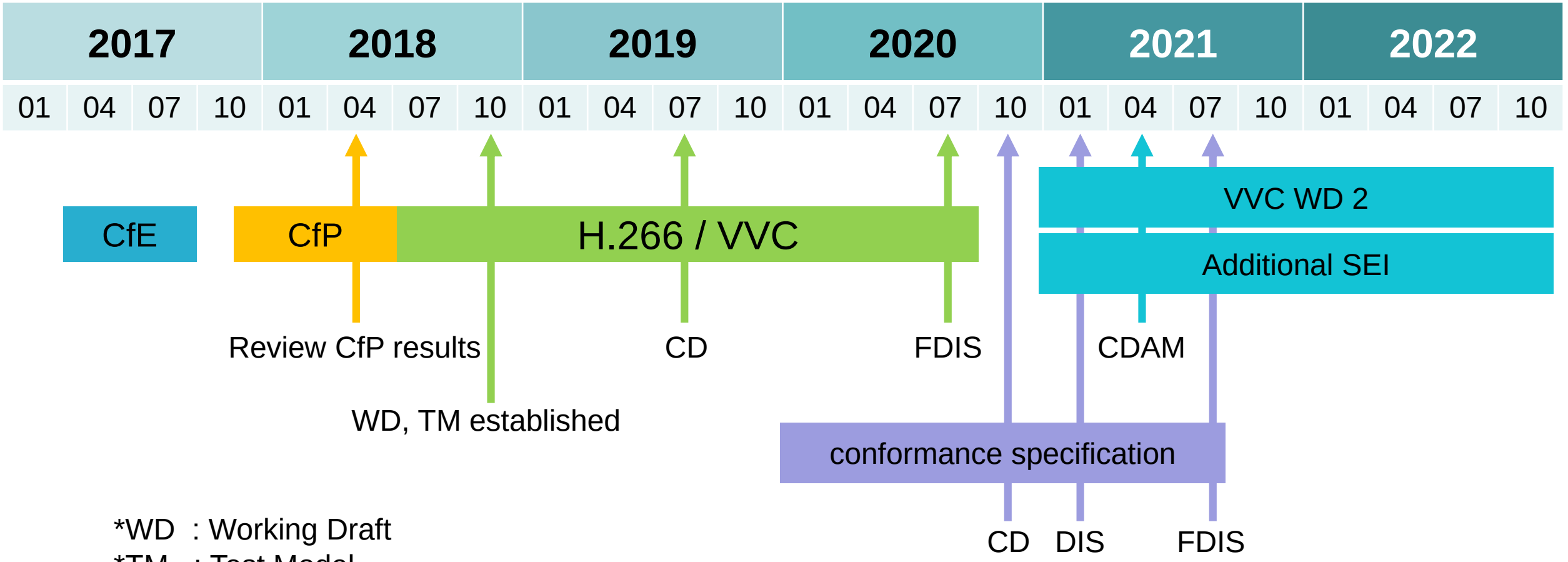
H.266 Timeline



*WD : Working Draft
*TM : Test Model
*CD : Committee Draft
*FDIS: Final Draft International Standard

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Status of VVC(1/3)

- VVC version 2
  - VVC Working Draft 2 of ISO/IEC 23090-3 Amd.1 (N34 | JVET-U2005)
  - Currently includes new level, and SEI hooks (payload type added)
  - Entropy coding requires changes for high bit depth and high bit rate, currently under investigation in CE
- Versatile SEI messages for coded video bitstreams
  - Working Draft 1 of ISO/IEC 23002-7 Amd.1 Additional SEI messages (N 31 | JVET-U2006)
  - SEI messages added: Scalability dimension, multiview acquisition information, depth representation information, alpha channel information, and extended DRAP
- Test Model & Reference Software
  - Test Model 12 of Versatile Video Coding (VTM 12) (N32 | JVET-U2002)
  - ISO/IEC DIS 23090-16 Reference Software for Versatile Video Coding (N 39 | JVET-U2009)
  - Various editorial improvements of encoder description
- Conformance and Verifiacation test
  - ISO/IEC DIS 23090-15 Conformance Testing for Versatile Video Coding (N 37 | JVET-U2008)
  - VVC verification test plan (Draft 5) (N33 | JVET-T2021)
  - Next round of verification tests: Ready to go for HD SDR (RA/LD conf.) and for 360° video, and progress in HDR
  - Follow-up report of verification tests planned to be available in April (if Covid-21 allows)

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Status of VVC(2/3)

- Current Common Test Conditions(CTC)
  - 360 (updated)
  - HDR/WCG (JVET#19)
  - non-420 / SCC (JVET#18)
  - Lossless, near lossless, and mixed lossy/lossless
  - SDR
  - reference picture resampling
  - HM Video Coding Experiments
  - neural network-based video coding technology
  - High Bit Depth and High Bit Rate Coding
  - enhanced compression tool testing
- Profiles for Version 1 (6 profiles)
  - “Main 10 Still Picture” profile and “Main 10 4:4:4 Still Picture” profile
  - “Main 10” and “Multilayer Main 10”
  - “Main 10 4:4:4” and “Multilayer Main 10 4:4:4”
  - Additional profile for multilayer 8K was agreed to be established

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Status of VVC(3/3)

- Core Experiment
  - Core experiment on high bit depth and high bit rate entropy coding in VVC (N 35 | JVET-U2018)
- Explorations
  - Exploration experiment on neural network-based video coding technology (N 40 | JVET-U2023)
  - Exploration experiment on enhanced compression beyond VVC capability (N 40 | JVET-U2024)
- AHGs
  - Project Management (AHG1)
  - Draft text and test model algorithm description editing (AHG2)
  - Test model software development (AHG3)
  - Test material and visual assessment (AHG4)
  - Conformance testing (AHG5)
  - 360° video coding tools, software and test conditions (AHG6)
  - Coding of HDR/WCG material (AHG7)
  - High bit depth, high bit rate, and high frame rate coding (AHG8)
  - SEI message studies (AHG9)
  - Encoding algorithm optimization (AHG10)
  - Neural network-based video coding (AHG11)
  - Enhanced compression beyond VVC capability (AHG12) (new)

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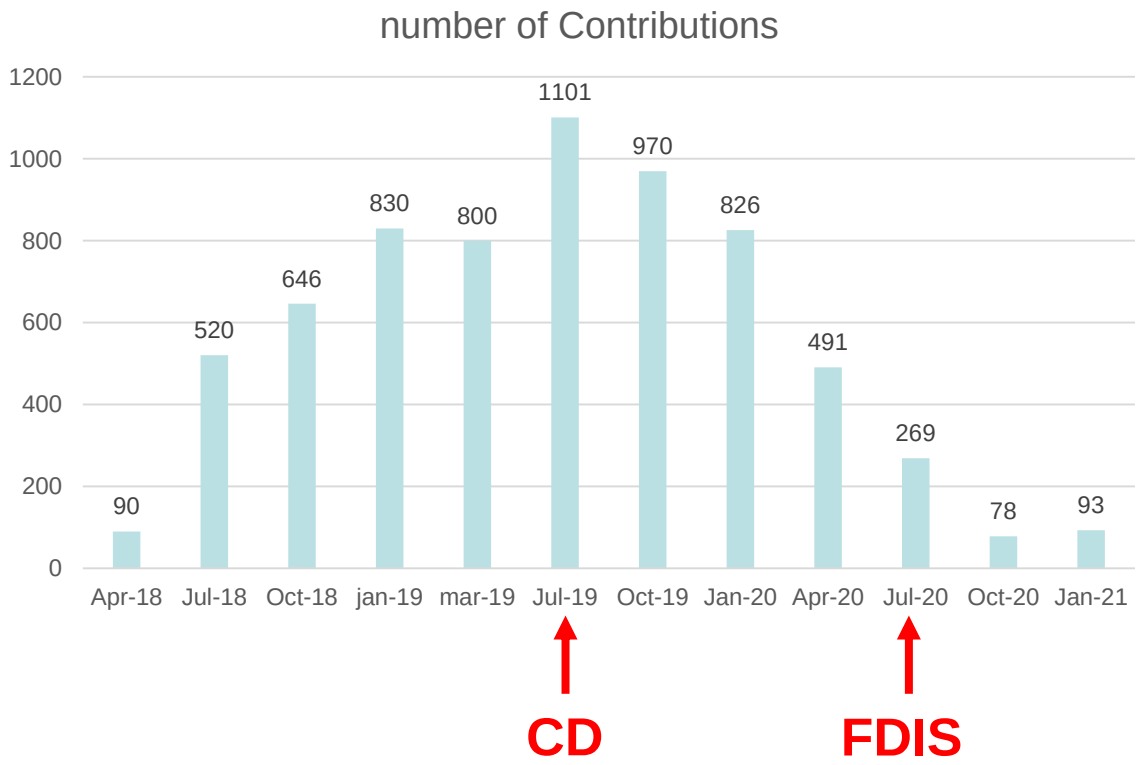
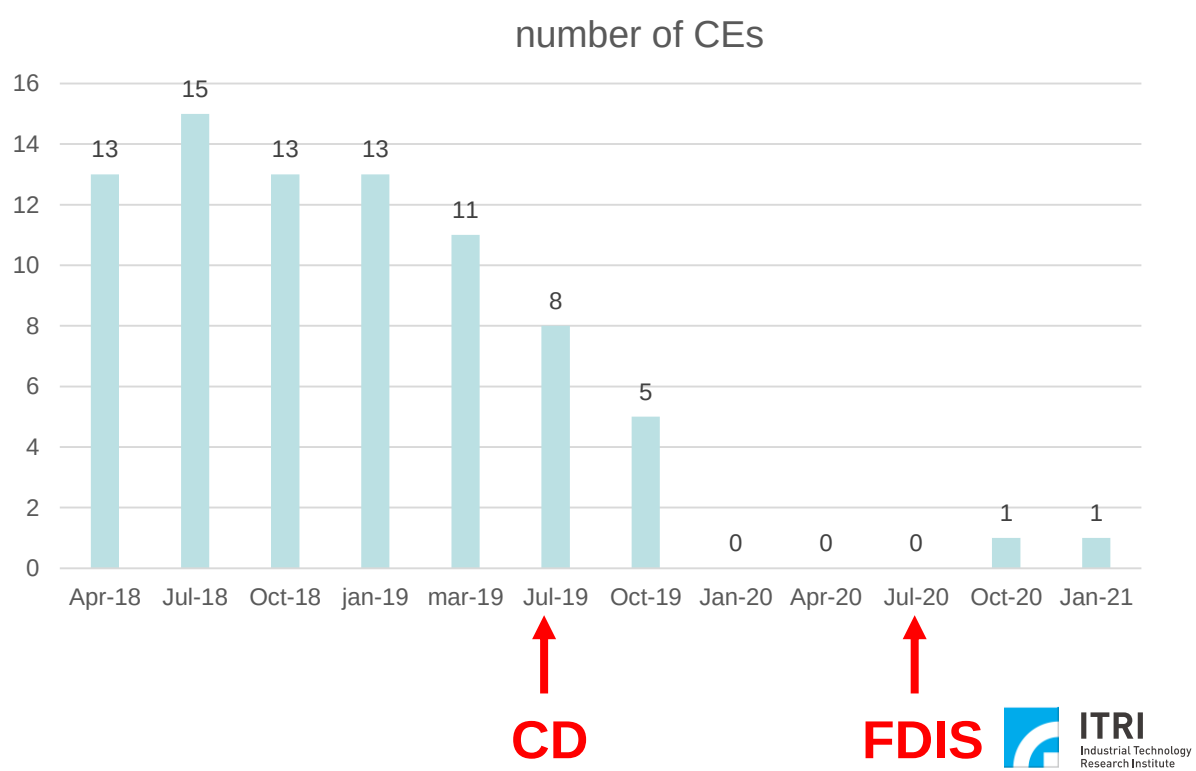
Number of JVET contributions and CEs

- FDIS之後技術提案數量逐漸減少，本次會期僅有78篇提案。
- 本次會期JVET開始著手H.266 extension的制定工作，成立了新的CE，探討high bit-depth與high bitrate相關議題。





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Exploration experiments (1/2)

- on neural network-based video coding technology
  - Primary goal is evaluating and understanding NNVC technology
  - Conditions for testing, training and complexity assessment of NN based video technology have been improved, suitable for both individual coding tools and end-to-end architectures
  - Loop filtering and super resolution methods are subject of investigation
  - Understanding impact of training recognized to be important (selection of training data, loss function, etc.) – new large set of video training data was offered
  - Clarification on reporting alternative metric (MS-SSIM) achieved
  - First remote expert viewing on some selected examples conducted – would be too early drawing conclusions

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Exploration experiments (2/2)

- Exploration experiment on enhanced compression beyond VVC capability
  - Primary goal is studying properties of video coding tools and technology not included in current VVC profiles
  - In first place, restriction to more “conventional” (non NN based), but the relationship with the other EE might become important when maturing
  - Conditions for testing performance and complexity assessment have been defined, mainly based on well-known metrics such as BD rate and “tool on/off” testing
  - Besides standard VTM, a package of tools (from JVET-U0100) can be used as additional reference for testing, software will be provided; tools from this package will also be subject to testing
  - Bilateral filters and intra template matching prediction planned to be investigated additionally

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Performance comparison (1/3)

- VTM 11.0 over HM 16.20

	All Intra Main10				
	Over HM 16.22				
	Y	U	V	EncT	DecT
Class A1	-29.04%	-32.17%	-34.07%	1545%	169%
Class A2	-29.29%	-23.92%	-21.06%	2505%	177%
Class B	-21.73%	-26.96%	-30.76%	2780%	177%
Class C	-22.54%	-18.95%	-22.70%	3886%	192%
Class E	-25.76%	-25.91%	-24.46%	2249%	170%
Overall	-25.06%	-25.37%	-26.85%	2576%	178%
Class D	-18.47%	-13.31%	-13.42%	4414%	182%
Class F	-39.33%	-39.73%	-42.22%	5107%	176%

	Random access Main10				
	Over HM 16.22				
	Y	U	V	EncT	DecT
Class A1	-41.67%	-43.42%	-49.16%	675%	157%
Class A2	-47.76%	-46.20%	-44.93%	752%	170%
Class B	-41.72%	-53.65%	-51.59%	754%	155%
Class C	-34.68%	-37.88%	-39.61%	1033%	163%
Class E					
Overall	-41.04%	-45.91%	-46.58%	802%	161%
Class D	-30.84%	-33.63%	-33.40%	1161%	164%
Class F	-48.00%	-50.91%	-51.69%	572%	137%

	Low delay B Main10				
	Over HM 16.22				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-30.81%	-37.42%	-35.46%	744%	152%
Class C	-29.13%	-22.62%	-22.41%	897%	157%
Class E	-33.35%	-40.13%	-34.22%	357%	125%
Overall	-30.88%	-33.16%	-30.80%	659%	147%
Class D	-26.02%	-16.65%	-15.91%	932%	165%
Class F	-42.80%	-44.57%	-44.66%	489%	130%

	Low delay P Main10				
	Over HM 16.22				
	Y	U	V	EncT	DecT
Class A1					
Class A2					
Class B	-35.15%	-39.91%	-37.83%	691%	168%
Class C	-30.83%	-22.55%	-22.66%	824%	167%
Class E	-36.05%	-43.41%	-37.33%	353%	139%
Overall	-33.93%	-35.00%	-32.65%	619%	160%
Class D	-27.47%	-15.71%	-14.93%	855%	174%
Class F	-42.31%	-43.56%	-44.09%	524%	138%

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Performance comparison(2/3)

- PSNR-based Common Test Conditions BD-Rate savings relative to HEVC reference software (10 bit)

vs HM	AI			RA			LDB			LDP		
	gain	Enc.	Dec.	gain	Enc.	Dec.	gain	Enc.	Dec.	gain	Enc.	Dec.
VTM 1.0	4%	9.6X	1.1X	8%	2.2X	0.8X	8%	1.6X	0.8X	9%	1.5X	0.9X
VTM 2.0	18%	18X	1.6X	23%	3.7X	1.3X	18%	3.2X	1.3X	22%	2.9X	1.3X
VTM 3.0	19%	19X	1.6X	27%	5.3X	1.3X	21%	4.4X	1.2X	24%	3.7X	1.2X
VTM 4.0	21%	22X	1.7X	32%	8X	1.5X	23%	6.6X	1.4X	27%	5.8X	1.5X
VTM 5.0	23%	34X	1.9X	33%	10X	1.9X	25%	7.4X	1.5X	28%	6.9X	1.6X
VTM 6.0	24%	27X	2.0X	35%	10X	1.9X	25%	7.7X	1.7X	29%	7.4X	1.8X
VTM 7.0	24%	27X	1.8X	35%	9.5X	1.8X	29%	6.9X	1.7X	33%	6.4X	1.8X
VTM 8.0	24%	31X	2.2X	35%	10.7X	2X	30%	7.7X	1.7X	33%	7.0X	1.8X
VTM 9.0	25%	27X	2.0X	36%	10X	1.9X	31%	7.5X	1.7X	34%	6.8X	1.7X
VTM10.0	25%	26X	1.7X	36%	8.6X	1.6X	31%	6.6X	1.4X	34%	6.2X	1.5X
VTM11.0	25%	26X	1.8X	41%	8.0X	1.6X	31%	6.6X	1.5X	34%	6.2X	1.6X

Performance comparison (3/3)

- PSNR-based Common Test Conditions BD-Rate savings relative to VTM reference software (10 bit)

	AI			RA			LDB			LDP		
	gain	Enc.	Dec.	gain	Enc.	Dec.	gain	Enc.	Dec.	gain	Enc.	Dec.
VTM 2.0 vs. VTM 1.0	14.5%	1.9X	1.5X	16.1%	1.7X	1.5X	10.8%	2.0X	1.5X	14.1%	1.9X	1.4X
VTM 3.0 vs. VTM 2.0	1.6%	1X	1X	5.8%	1.4X	1X	3.4%	1.4X	0.9X	3.3%	1.2X	0.9X
VTM 4.0 vs. VTM 3.0	2.4%	1.1X	1X	5.5%	1.5X	1.2X	3.6%	1.5X	1.1X	3.6%	1.6X	1.1X
VTM 5.0 vs. VTM 4.2	2.5%	1.6X	1X	2.4%	1.3X	1.1X	1.2%	1.1X	1.1X	1.5%	1.2X	1.1X
VTM 6.0 vs. VTM 5.2	1.4%	0.8X	1X	2.3%	0.9X	1X	0.7%	1.1X	1.1X	1.5%	1.1X	1.1X
VTM 7.0 vs. VTM 6.2	0.2%	1X	1X	-0.1%	1X	1.1X	5.2%	0.9X	1.2X	5.1%	0.9X	1.2X
VTM 8.0 vs. VTM 7.0	-0.4%	1.1X	1.3X	0.2%	1.1X	1.1X	0.9%	1.1X	1.0X	0.2%	1.1X	1.0X
VTM 9.0 vs. VTM 8.1	1.2%	1X	1X	1.7%	1X	1X	1.1%	1.0X	1.1X	1.1%	1.0X	1.0X
VTM10.0 vs. VTM 9.0	-0.01%	1X	1X	-0.03%	1X	1X	-0.13%	1X	1X	-0.13%	1X	1X
VTM11.0 vs. VTM 10.2	0.00%	1X	1.1X	-7.93%	1X	1X	0.00%	1X	1X	0.00%	1X	1X

Video Coding for Machine

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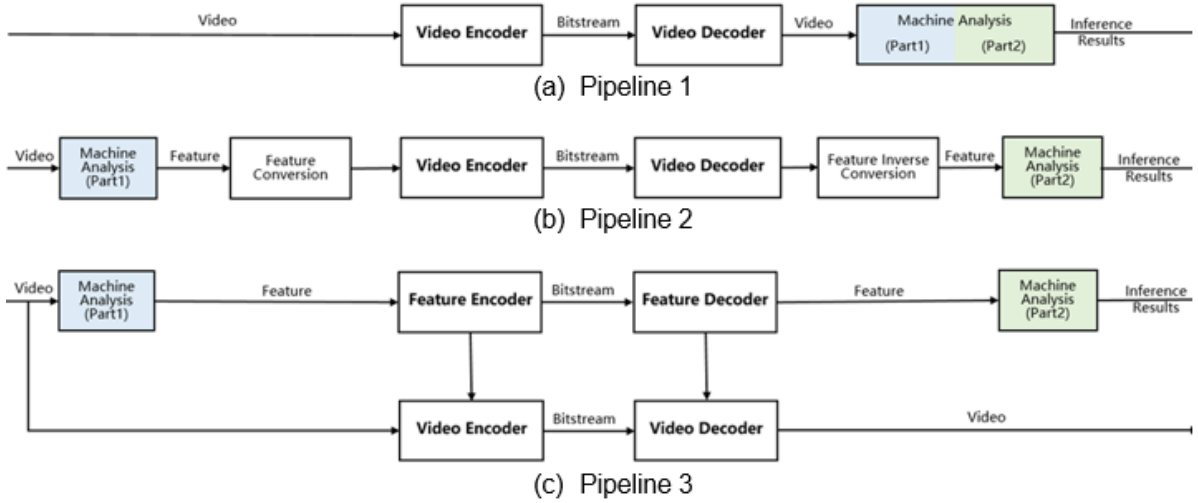
Current status of VCM

- Issued Call for Evidence documanet
- Currently focus on machine consumption video coding
- Clarified license issues of test sets
- Use BD-mAP as performance metrics
- Limit to 3 evaluation datasets due to licensing issue
- Processing pipelines for CfE (initially focus on (a) and (b))



Machine Task	Evaluation Dataset
Object detection	OpenImageV6 FLIR (IR dataset)
Instance segmentation	OpenImageV6
Object tracking	HiEve-10
Pose Estimation	HiEve-10
Action Recognition	HiEve-10

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VCM Participants

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Timeline of CfE

2021-01-15	**Release of Call for Evidence document**
2021-01-31	**Availability of neural networks, test data, and description for the respective use cases.**
2021-03-21	**Registration deadline for intend to response**
2021-04-12	**Deadline for electronic submission of binaries, bitstream results**
2021-04-19	**Deadline for submission of descriptions (MPEG input contribution) of approaches and evaluation results**
2021-04-22~30	**Evaluation of responses - the CfE will be evaluated at the 134th MPEG**

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Point Cloud Compression

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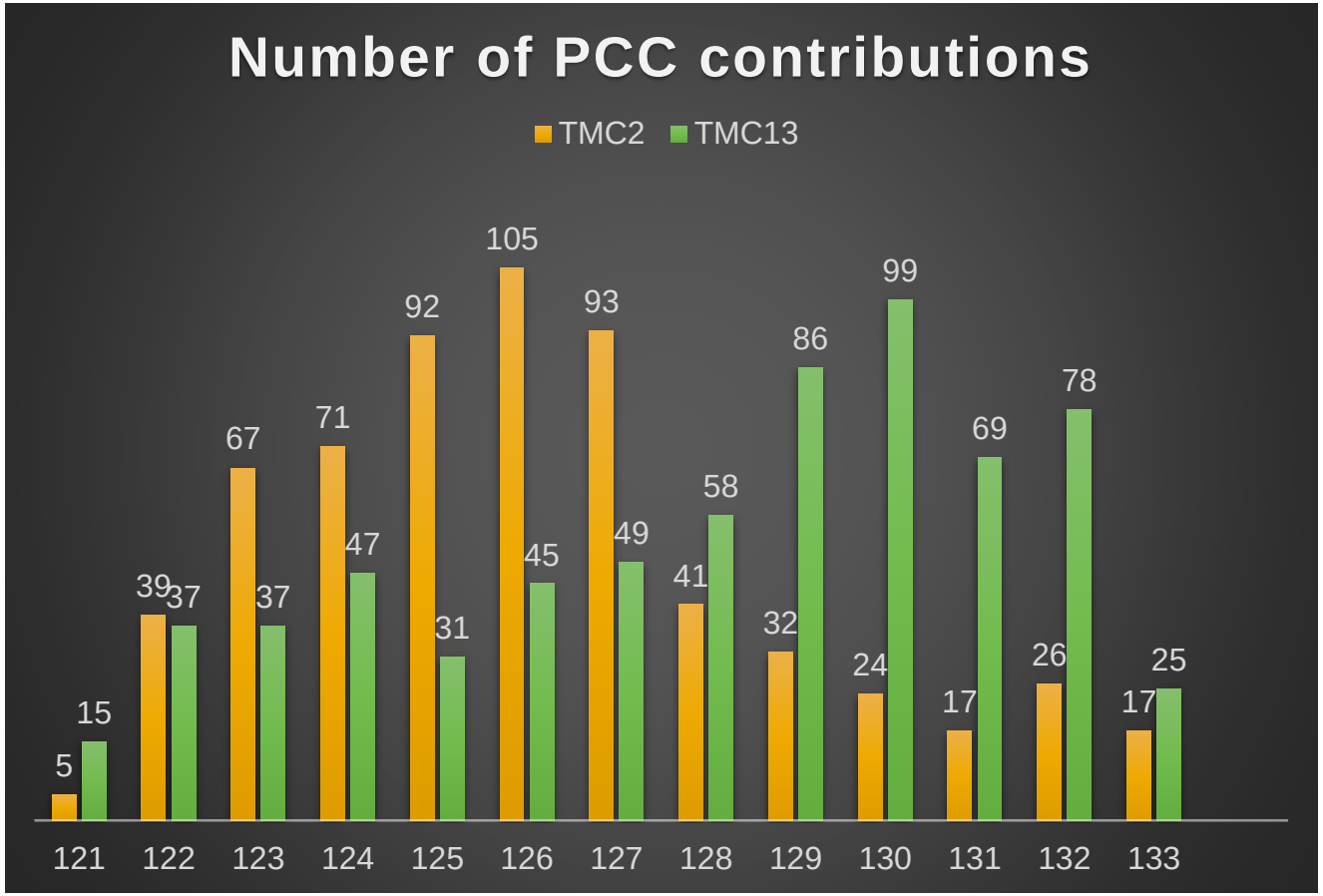
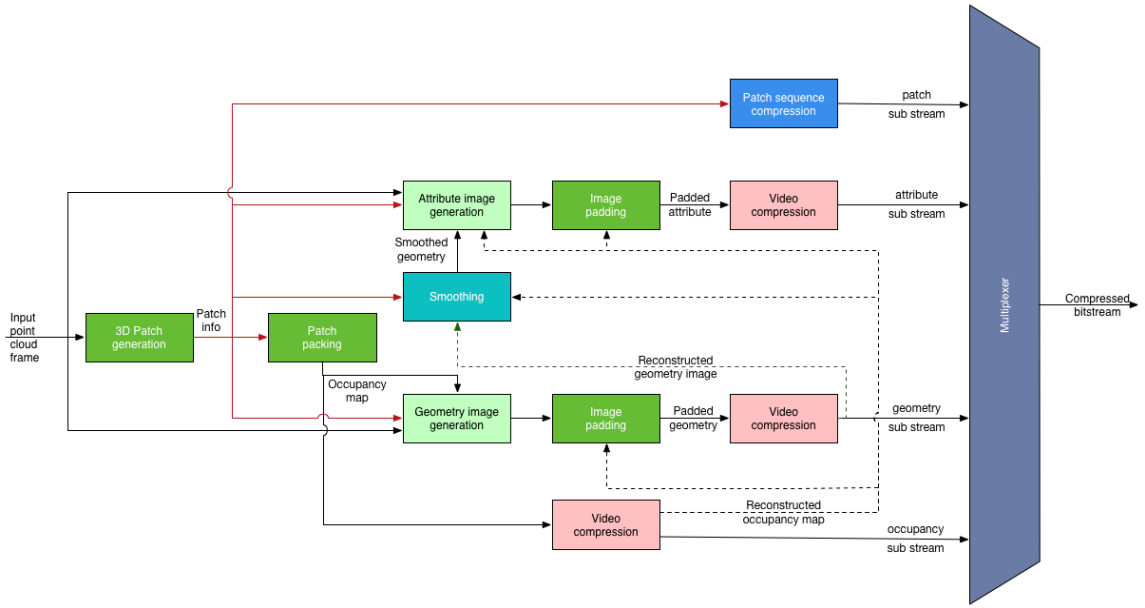
PCC meeting

- 4nd and 5rd F2F Meeting of PCC after DIS
- Date:
  - MPEG133: 20 ~ 24 Apr, 2019
- Approximately 60+ participants



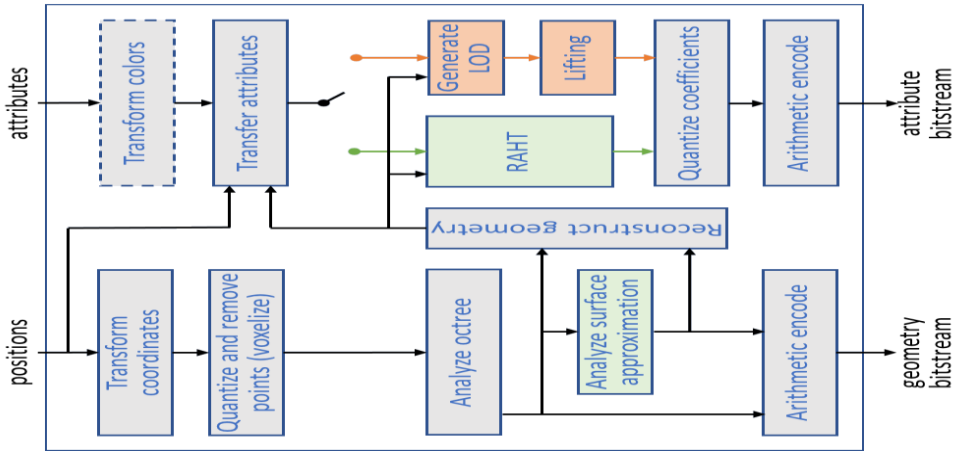
PCC AHGs



V-PCC

Video-based PCC

appropriate for continuous dynamic PC

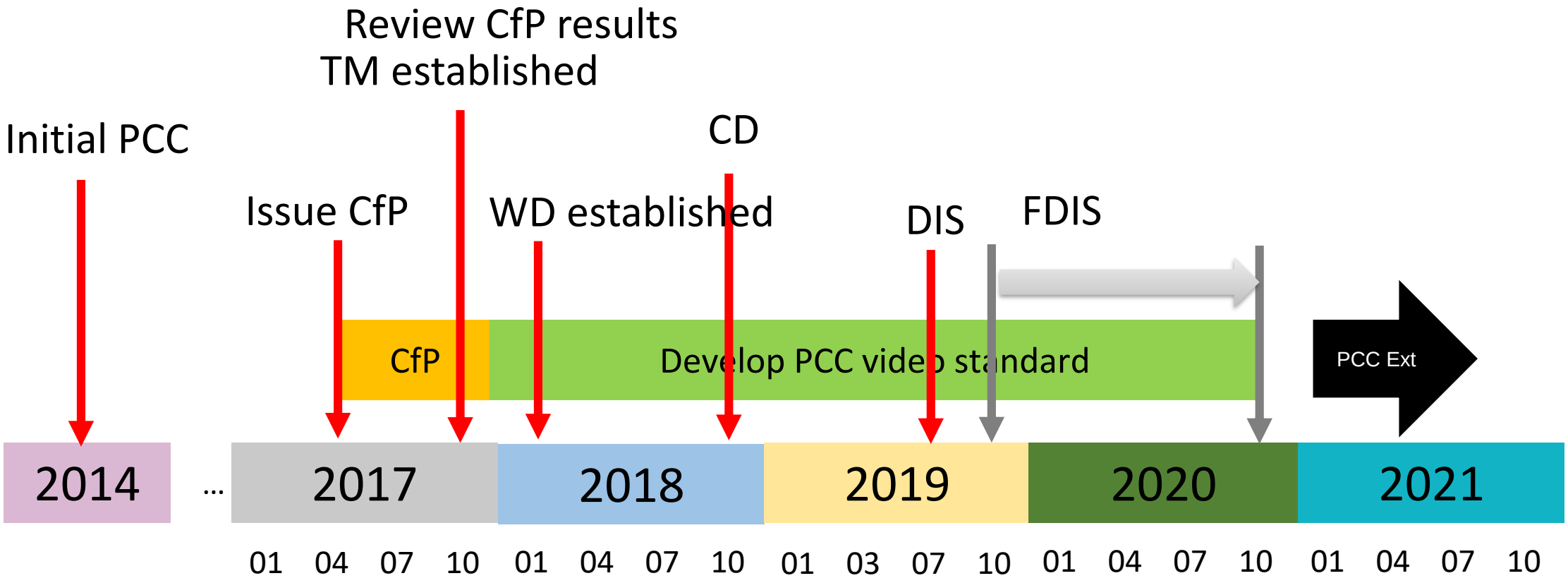


G-PCC

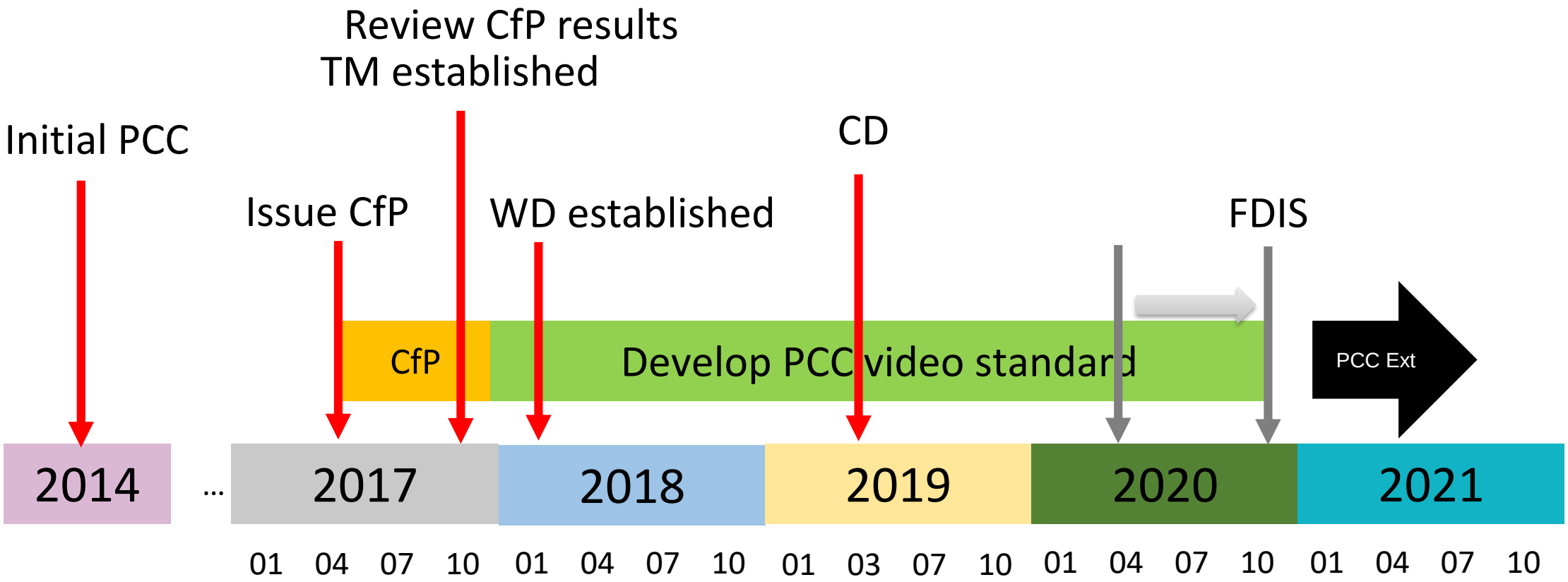
Geometry-based PCC

appropriate for sparse PC

V-PCC Timeline



G-PCC Timeline



PCC related activities

- EE for Multiple video codec integration in V-PCC software
  - Integration of the internal AVC codec
  - Scalable High efficiency Video Coding (SHVC) codec integration in V-PCC software
- EE for G-PCC RDO
- Improvements in TM2 v12.1
- Draft V-PCC White Paper
- Issue new version of the Conformance for V-PCC CD
- Conformance for G-PCC

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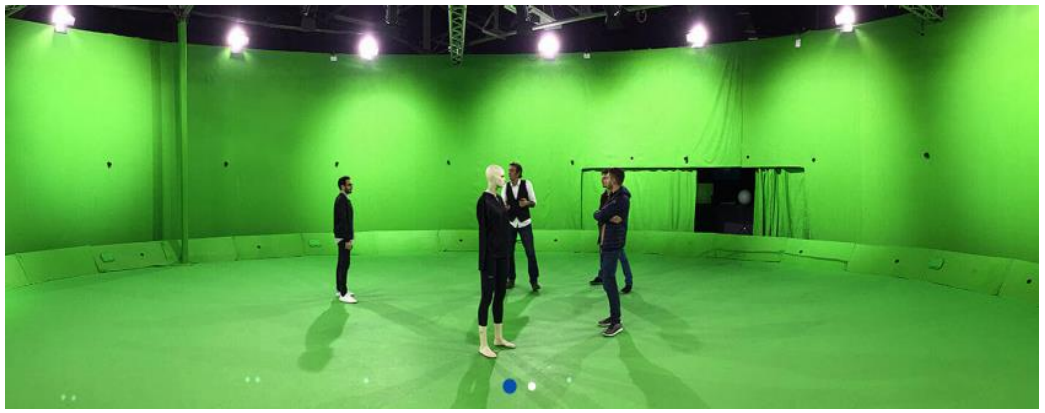
Candidate technologies for V-PCC Ver. 2

- Video-based Dynamic Mesh Coding
  - Dynamic Mesh Coding within the V3C framework
  - Preparation of the CfP: requirements, metrics, anchors, subjective evaluation
  - CfP expected for April
  - New content available (PC and DM)
    - Volucap_T003_ThomasScenic-03 (748 frames @ 25fps)
    - Volucap_T097_Mitch2.1-05 (475 frames @ 25 fps)
    - XD Production “Football player juggling” (+300 frames, @ 25 fps)



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PCC Participants

34 organizations

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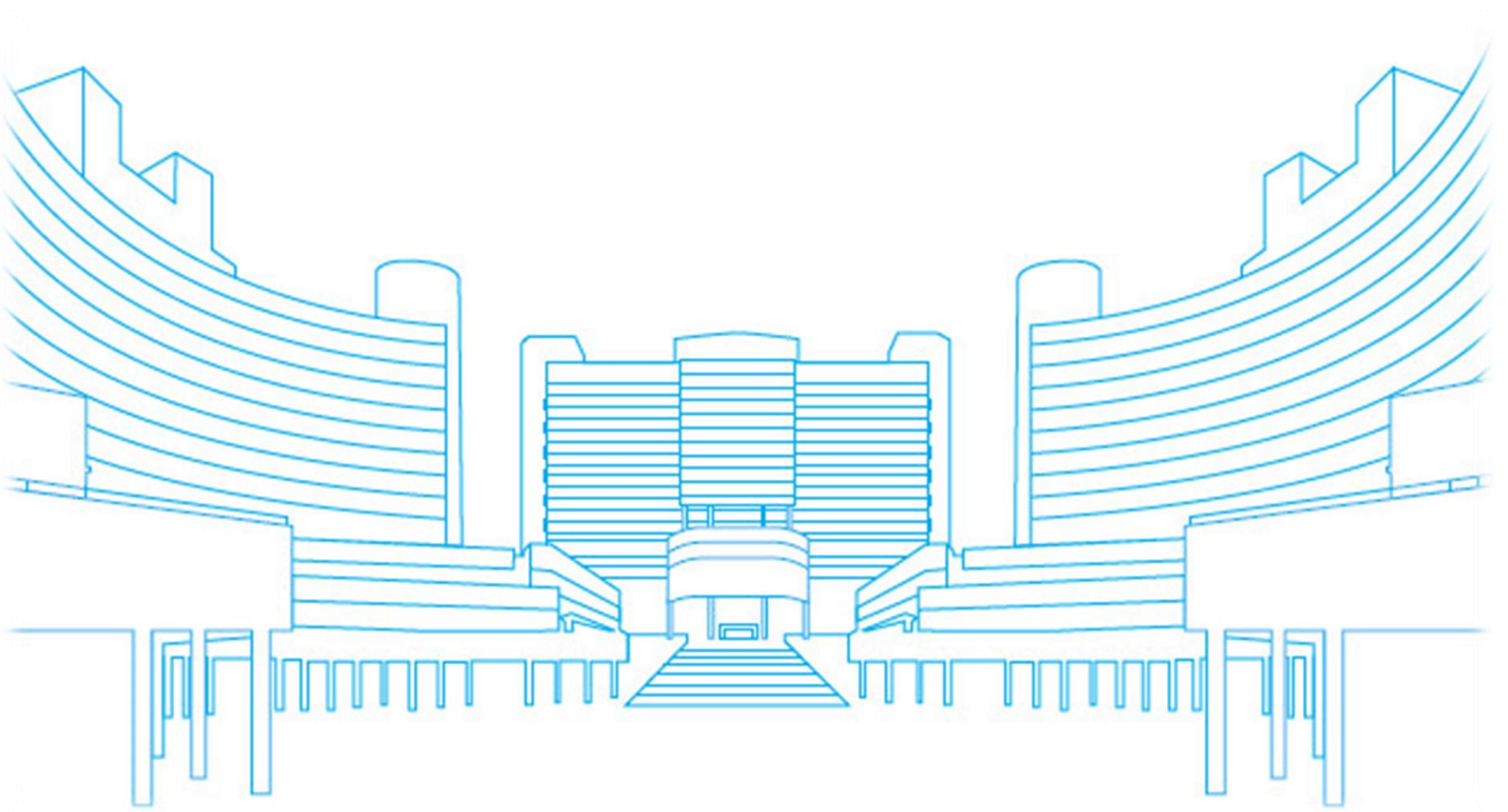

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