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| **ITU – Telecommunications Standardization Sector**  STUDY GROUP 16 Question 6  **Video Coding Experts Group (VCEG)**  69th Meeting: 18-22 July 2022, by teleconference | Document VCEG-BQ01 |

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| Question: | Q.6/SG16 (VCEG) | | |
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| Title: | **Regarding video coding for machines** | | |
| Purpose: | Information | | |

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**Abstract**

This contribution provides brief information on video coding for machines (VCM), and suggests that VCEG follow up with MPEG regarding the potential development of a VCM standard.

1. **Background**

In today’s world, a growing portion of the video traffic is directed toward machine vision and machine analysis tasks, often with only occasional or even no human interventions. This contrasts with the development process of existing video coding standards, which relied on testing conditions that assume the end user of video applications is primarily human (e.g., entertainment, gaming, video conferencing, etc.). As such, when the existing video coding standards are used to code video content that is targeted primarily toward machine vision tasks (e.g., object detection, object tracking, instance segmentation, etc.) rather than human consumption, the compression efficiency in terms of machine vision task performance (e.g. object detection accuracy) may not be optimal.

This leads to the potential need for developing a video coding standard for machine vision tasks, or video coding for machines (VCM). To investigate the achievable compression efficiency advantage compared to existing video coding standards under such a scenario, as well as other VCM-related aspects, an Ad hoc Group on VCM was established by MPEG in 2019, and the VCM AHG has been exploring various aspects related to VCM, including use cases and requirements, coding conditions, evaluation methodologies, and so on. Two important milestones that the VCM AHG has achieved include a Call for Evidence that was issued in 2021, and a Call for Proposal that was recently issued in April 2022, with responses expected in Oct 2022. The timetable for a potential VCM standard is tentatively specified as: CD in Oct 2023, DIS in January 2024, and FDIS in July 2024.

During the exploration, various technical contributions have been made to the VCM AHG. A number of these contributions (e.g. m56634, m56572, m58072, m58846, m56681, m56792) use the latest VVC standard as the underlying core codec, and enhance the core codec with encoder optimization algorithms specialized for machine vision tasks, pre- and/or post-processing, and/or neural network-based residual coding to improve VCM coding efficiency. Other contributions (e.g. m58050, m58165, m58169, m57335, m58760) use learning-based methods as the core codec, and train the entire network in an end-to-end manner to achieve compression performance gain compared to VVC.

1. **Suggestion to VCEG**

VCEG has a long and successful history of developing generations of video coding standards, the most recent one being the VVC standard jointly developed with MPEG in JVET. As more video coding for machines use cases emerge (some of which potentially using VVC), it is suggested that VCEG consider the following aspects:

* Whether VCEG views machine vision use cases to be in-scope for JVET when developing video coding standards.
* What VCEG would view as the key video coding use cases and requirements for machine vision.
* How is VVC’s compression capability in terms of machine vision task performance?
* Are there VVC-based VCM solutions that could enhance coding efficiency in terms of machine vision task performance, e.g., by changing or enhancing aspects of VVC (encoder-only, non-normative, high-level syntax, low-level tools, etc.)? And if so, by how much?
* What are the solutions beyond VVC, and how is their compression capability?

The work already done in MPEG’s VCM activity may be insightful. Therefore, it is suggested for VCEG to seek further information from MPEG regarding their VCM activity. Such could be achieved by holding joint meetings with relevant groups at this meeting (July 2022). In particular, it could be helpful to review MPEG’s use cases and requirements prior to a VCEG discussion on the topic. It is suggested that a joint meeting also be scheduled in the next meeting (Oct 2022), when VCM CfP responses are expected to be evaluated.

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