**3GPP TSG-SA WG4 Meeting #132S4-250810**

**Japan, Fukuoka, 19 – 23 May 2025**

Title: Reply LS on extended market and practical considerations for Next Generation Video Coding

Response to: LS (S4-250763) on Liaison statement on Market and practical considerations for Next Generation Video Coding from ISO/IEC JTC 1/SC 29/WG 2

Source: 3GPP SA WG4

To: ISO/IEC JTC 1/SC 29/WG2

Cc:

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Attachments:

**1. Overall Description:**

3GPP SA4 thanks ISO/IEC SC29 WG 2 for sharing the liaison statement on Market and practical considerations for Next Generation Video Coding. This letter has been shared with the group members so that they can respond directly to this questionnaire.

The latest study completed in 3GPP SA4 on video codec is described in TR 26.955 (Video codec characteristics for 5G-based services and applications). Last update has been published in September 2022. This technical report documents relevant interoperability requirements, performance characteristics and implementation constraints of video codecs in 5G services, and characterizes video codecs, in particular 3GPP defined codecs H.264/AVC and H.265/HEVC in order to have a benchmark for the addition of potential future video codecs.

Five relevant scenarios for video codecs in 5G-based services and applications have been identified:

1. **Full HD Streaming**: distribution of content through DASH/CMAF based streaming. Important aspects considered in this context:
	* Quality and Coding Efficiency:
		+ High and uninterrupted visual quality, taking into account the service constraints.
		+ Any savings can provide significant benefits due to the expected large volume of the traffic either in quality or network utilization.
	* Adaptive Bitrate streaming:
		+ Multiple bit rates are provided, typically with a ladder of 30–50% to permit bandwidth adaptation. The use of constant bit rate (CBR) encoding maximises reuse of a common ladder of encoded representations across multiple distribution networks. The use of capped variable bit rate (VBR) encoding allows the bit rate to be varied according to the difficulty of the source material while maintaining the ability to distribute the encoded representations through distribution networks with fixed capacity. This also maximises reuse of a common ladder across multiple distribution networks.
		+ CMAF Fragments of size typically in the range of 1–6s to permit seamless switching for bit rate adaptation.
		+ Regular Random Access, typically every 1–2 seconds according to TS 26.116. To achieve clean switching in both sound and picture when moving between different encoded representations in the ladder, 3.84 seconds enables video segment boundaries to be aligned with an integer number of audio Access Units, if a 50fps video signal and 48kHz audio signal is used.
	* Encoding in this scenario is typically done as
		+ Live and On-Demand distribution and encoding
		+ Server and Cloud-based Encoding
	* No specific encoding latency constraints
2. **4K-TV**: with the same important aspects than Full HD Streaming but targeting fixed receivers (e.g. TV sets).
3. **Screen Content Scenario**: low latency streaming or conversational. Important aspects considered in this context:
	* Quality and Coding Efficiency:
		+ The ability to compress computer-generated content. Typically, it means the ability to have non perceptible intra refreshes and the ability to maintain stability on low frequency areas (such as uniform backgrounds) as well as maintaining details on high frequencies (particularly for text)
		+ The ability compress YUV 4:2:0 and 4:4:4 content.
	* Considered settings for encoding:
		+ Low-latency settings
	* Encoding in this scenario is typically done as
		+ Real-time encoding
4. **Messaging and Social Sharing**: uploading and uplink streaming into the ISO/BMFF and CMAF container formats. Important aspects considered in this context:
	* Quality and Coding Efficiency:
		+ The ability to compress a video sequence targeting the maximum file size and maintaining high quality.
		+ The ability to compress a video stream in real time to the available uplink streaming resources.
	* Considered settings for encoding:
		+ Regular random access at least every 2 seconds, preferably more often
		+ No specific encoding latency constraints are applicable
	* Encoding in this scenario is typically done as
		+ Real-time encoding for social sharing
		+ Offline encoding for messaging
		+ UE-based Encoding
5. **Online Gaming**: low-latency streaming, typically using UDP/IP based distribution to minimize protocol latencies. Important aspects considered in this context:
	* Quality and Coding Efficiency:
		+ The ability to compress traditional computer-generated content.
		+ The ability to compress photorealistic computer-generated content.
		+ The ability to compress YUV 4:2:0 and 4:4:4 content
	* Considered settings for encoding:
		+ Ultra low latency and Low-latency settings
	* Encoding in this scenario is typically done as
		+ Real-time encoding
		+ Cloud-based encoding

Based on those scenarios, the existing 3GPP codecs H.264/AVC and H.265/HEVC have been benchmarked and evaluated. H.264/AVC clearly lacks compression efficiency and flexibility to address more advanced use cases, such as HDR, gaming sequences and screen content sharing. H.265/HEVC provides, at least for the considered scenarios, a full feature set and is broadly and versatilely applicable.

From the collected scenarios in TR 26.955, no explicit new requirements for new codecs were identified. However, flexibility to different applications, feature coverage and compression efficiency remain key functionalities for a codec in 3GPP. The framework and the initial results for new codecs (VVC, EVC and AV1), while demonstrating coding performance improvements over H.265/HEVC, had not concluded to concrete recommendations at the completion time of the report in September 2022.

In addition to this technical report, 3GPP SA4 is actively working on media services beyond 2D. Notable work includes TR 26.928 (Extended Reality in 5G), which compiles information on eXtended Reality (XR) within the 5G radio and network context, and TS 26.522 (5G Real-time Media Transport Protocol Configurations), focusing on RTP over UDP for XR applications.

SA4 studied in 3GPP TR 26.966 MV-HEVC application for the streaming of stereoscopic content.

Consequently the VOPS (Video Operating Points - Harmonization and Stereo MV-HEVC) Work Item is enhancing 3GPP specifications (e.g., TS 26.265) by integrating various HEVC tools, such as MV-HEVC, to support the delivery of immersive video content for streaming. Additionally, TR 26.956, set for publication at the end of this year, will evaluate and characterize video formats and immersive codecs beyond 2D.

It is important to note the capacity limitations within the 3GPP context, including network constraints that may result in packet loss, as well as device constraints related to processing power and battery life.

In the radio access network context, it is typically challenging to enable high volume and low latency traffic. 3GPP has developed in TS 23.501 (System architecture for the 5G System) a set of standardized QoS characteristics providing priority levels as well as guarantees on maximum packet delay and error rate, that relate to different scenarios including media services for video streaming and conversational video. In addition, in TR 26.926 a framework for simulating the 5G network and resulting video quality in such conditions was developed.

These use cases and requirements remain relevant for next-generation video codecs. However, additional requirements are expected to be developed especially with the initiation of 6G studies planned for this year. Should you be interested in such new requirements, 3GPP SA4 invites for continuous communication on this matter.

**2. Actions:**

**To ISO/IEC SC29 WG 2 group.**

**ACTION:** 3GPP SA4 asks ISO/IEC SC29 WG 2 group to take the above into account and provide feedback if any.

**3. Date of Next SA4 Meetings:**

SA4#133-e 21st - 25th July 2025 Online

SA4#134 17th - 21st November Dallas, US

SA4#135 9th - 13th February India, IN