**Source: Qualcomm Incorporated (Rapporteur)[[1]](#footnote-2)**

**Title:** **FS\_5GVideo: Permanent document on Open Issues, v0.2.0**

**Agenda Item: 10.7**

# Revision history

|  |  |  |  |
| --- | --- | --- | --- |
| **Version** | **Date** | **Meeting** | **Subject/Comment** |
| 0.0.1 | 2021-04-09 | SA4#113e | Initial Document |
| 0.1.0 | 2021-04-14 | SA4#113e | Status after SA4#113e |
| 0.1.1 | 2021-05-03 | SA4#113p | Status before SA4#113p (1) |
| 0.1.2 | 2021-05-10 | SA4#113p | Status before SA4#113p (2) |
| 0.1.3 | 2021-05-12 | SA4#114 | Status before SA4#114e |
| 0.2.0 | 2021-05-24 | SA4#114 | Status after SA4#114e |

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# 1 Introduction

During SA4#107 the New Study Item on “Feasibility Study on 5G Video Codec Characteristics” in [S4-200309](http://www.3gpp.org/ftp/tsg_sa/WG4_CODEC/TSGS4_107_Wroclaw/Docs/S4-200309.zip) was agreed and afterwards approved in by SA plenary #87 in [SP-200052](https://www.3gpp.org/ftp/tsg_sa/TSG_SA/TSGS_87E_Electronic/Docs/SP-200052.zip).

The objective of the objectives of the study item are primarily to identify relevant interoperability requirements, performance characteristics and implementation constraints of video codecs in 5G services, and to characterize existing 3GPP video codecs, in particular H.264/AVC and H.265/HEVC in order to have a benchmark for the addition of potential future video codecs.

The concrete objectives are as follows:

* Collect a subset of relevant scenarios for video codecs in 5G-based services and applications, including video formats (resolution, frame rates, color space, etc.), encoding and decoding requirements, adaptive streaming requirements, predominantly based on scenarios defined for 5G media streaming as well as for TR 26.925 and TR 26.928.
* Collect relevant and exemplary test conditions and material for such scenarios, including test sequences.
* Define performance metrics for such scenarios with focus on objective performance metrics.
* Collect relevant interoperability functionalities and enabling elements for video codecs in different 5G services such as MTSI and Telepresence (i.e. RTP based conversational communications), or 5G media streaming (e.g. based on DASH/CMAF) supporting the identified scenarios.
* Collect relevant criteria and key performance indicators for the integration of video codecs in 5G processing platforms, taking into account factors such as encoding and decoding complexity in the context of the defined scenarios.
* Characterize the existing codecs H.264/AVC and H.265/HEVC in the context of the above scenarios and document the findings in a consistent manner.
* Identify gaps and deficiencies of existing codecs in such use cases and derive requirements for potential new codecs.
* Collect initial information on how new codecs under development in ISO/IEC SC29 WG11 (MPEG)/JVET (in particular including VVC and EVC) may meet the above criteria based on the characterization results provided for example by ISO/IEC SC29 WG11 (MPEG)/JVET.

The latest version of TR26.955 [1] is available in S4-210871 in version 1.2.0. This document collects the status of the work and identifies the open points.

Also note that the work item has been updated in S4-210956 which will be sent to SA for approval. The time plan is available in S4-210741.

# 2 References

1. 3GPP TR 26.955, "5G Video Codec Characteristics"

# 3 Metrics

Table 3-1 summarizes the identified open issues on Metrics

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-114-4-1 | We need to complete the metrics for Adaptive Streaming metrics. . Input was received during SA4#114e in S4-210731 and S4-210873, but no time to complete this. Please check the discussion in S4-210706 for the latest status. | Thomas, Alexis, others |
| S4-113-3-2 | HDR metrics are not yet implemented in the script | Qualcomm |
| S4-113-3-3 | Do we need the HDR static metadata or any other information for the metrics computation? If no other information is received, we do not use this? | Dmytro |
| S4-114-3-2 | We need to identify the usage of 8 bit sequences for 10 bit codecs whether the 8 bit metrics or the 10 bit metrics apply. Some progress was made on this issue, but final implementation is still pending. | Everyone |

# 4 Reference Sequences

The reference sequences for the anchor generation are provided below.

* Pink: reference sequences are missing
* Yellow: reference sequences are selected, but not yet frozen.
* Green: Reference Sequences are frozen

|  |  |  |  |
| --- | --- | --- | --- |
| **Scenario** | **Clause** | **Reference Sequences** | **Notes** |
| **Full HD Streaming** | 6.2.7 | Reference sequences are still missing. We expect that we re-use 4K-TV sequences. | Input needed. See discussion in S4-210731. |
| **4K-TV** | 6.3.7 | Selected and all uploaded annotated. Final decision will be taken during SA4#114p SWG telco on June 22, 2021. | We have received some minor issues in S4-210732. These need to be addressed. |
| **Screen Content** | 6.4.7 | All sequences uploaded and agreed. | None |
| **Social Sharing** | 6.5.7 | All sequences uploaded and agreed. | They are agreed during SA4#114-e as no issues were raised. |
| **Gaming** | 6.6.7 | All sequences uploaded and agreed. | None |

Table 4-1 summarizes the open issues on Reference Sequences.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-113-4-2 | For each of the HDR sequences we need to check if and of those have assigned HDR static metadata. If no information is provided, no metadata will be assigned   |  |  | | --- | --- | | Life-Untouched | Annex C.3.2.3.1 | | Meridian | Annex C.3.2.3.2 | | Sol-Levante | Annex C.3.2.3.3 | | Cosmos | Annex C.3.2.3.4 | | Elevator | Annex C.3.2.3.5 | | Sparks | Annex C.3.2.3.6 | | Nocturne | Annex C.3.2.3.7 | | Lukasz |
| S4-113-4-4 | The generation of each of the video sequences needs to be added to the json file. | Thomas (started) |
| S4-113-4-5 | The following information is added to the json   * videoFullRangeFlag * chromaSampleLocType * hdrStaticMetadata   + masterDisplay   + maxCLL   + maxFALL   This information still needs to be added to the Technical report.  Create a pCR for this. | Thomas |
| S4-113-4-6 | Reference Sequences for Full HD streaming have not yet been selected. We expect to re-use subset of 4K sequences. See discussion in S4-210731. | Thomas, others (Input for SA4#114-e) |

# 5 Configurations Anchors

The configuration files for the anchor generation are provided below.

* Pink: configurations are missing
* Yellow: configurations are available, but not yet frozen. Comments still welcome
* Green: Configurations are frozen

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **General constraints** | **JM configurations** | **HM configurations** | **Notes** |
| **Full HD Streaming** | 6.2 | under discussion | S1-JM-0X | S1-HM-0X | (see S4-210731 and S4-210873) |
| **4K-TV** | 6.3 | see 6.3.8 | No Anchors | S2-HM-01  S2-HM-02  Included in TR 26.955 attachments | Agreed during SA4#114-e |
| **Screen Content** | 6.4 | see 6.4.8 | S3-JM-01, S3-JM-02  S3-JM-03, S3-JM-04  Included in TR 26.955 attachments. | S3-HM-01, S3-HM-02  S3-SCC-01, S3-SCC-02  Included in TR 26.955 attachments. | JM configurations agreed during SA4#114-e. |
| **Social Sharing** | 6.5 | see 6.5.8 | S4-JM-01, S4-JM-02  Included in TR 26.955 attachments. | S4-HM-01, S4-HM-02  Included in TR 26.955 attachments. | JM and HM configurations agreed during SA4#114-e. |
| **Gaming** | 6.6 | see 6.6.8 | S5-JM-01, S5-JM-02  Included in TR 26.955 attachments. | S5-HM-01, S5-HM-02  S5-SCC-01, S5-SCC-02  Included in TR 26.955 attachments. | JM configurations agreed during SA4#114-e. |

Table 5-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| ~~S4-113-5-1~~ | ~~Implement the configurations for HM for 4K-TV in a consistent manner into the TR~~ | ~~Completed during SA4#114-e~~ |
| ~~S4-113-5-2~~ | ~~Document the used configuration files for Screen content scenario for HM and JM~~ | ~~Thomas/Gaelle~~ |
| ~~S4-113-5-3~~ | ~~Document the used configuration files for Gaming scenario for HM~~ | ~~Thomas/Gaelle~~ |
| ~~S4-113-5-4~~ | ~~Development and integration of configurations files for 4k-TV for HM~~ | ~~Completed during SA4#114-e~~ |
| ~~S4-113-5-5~~ | ~~Development of configuration files for social sharing JM and HM~~ | ~~Completed during SA4#114-e~~ |
| S4-113-5-6 | Development of configuration files for Full HD JM and HM | <open> (input in S4-210731 and S4-210873) |
| ~~S4-113-5-7~~ | ~~Align the JM anchors for Gaming with HM configs~~ | ~~Completed during SA4#114-e~~ |

# 6 Anchors and Metrics

* Pink: anchors definitions are missing
* Yellow: anchors defined, but open for comments
* Cyan: anchor definition frozen, but not yet produced
* Green: anchors available

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **JM anchors** | **HM anchors** | **Notes** |
| **Full HD Streaming** | 6.2.8 | missing | missing |  |
| **4K-TV** | 6.3.8 | No Anchors | Configurations frozen.  Remaining open issues are several test sequences. We have received some minor issues in S4-210732. These need to be addressed. | With completion of reference sequences this will be frozen. Expect for June 22 telco. |
| **Screen Content** | 6.4.8 | Configurations frozen.  Reference Sequences frozen | HEVC anchor streams are provided according to the key system here:  <https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Anchors/Scenario-3>   |  | | --- | | S3-A65-265 | | S3-A66-265 | | S3-A67-265 | | S3-A68-265 | | Additional anchors need to be uploaded. Metrics need to be moved to csv. |
| **Social Messaging** | 6.5.8 | Configurations frozen.  Reference Sequences frozen | Configurations frozen.  Reference Sequences frozen |  |
| **Gaming** | 6.6.8 | Configurations frozen.  Reference Sequences frozen | HEVC anchor streams are provided according to the key system here:  https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Anchors/Scenario-5 |  |

Table 6-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-114-6-1 | Update the scripts based on anchor.csv and reference.csv (initial version already in Annex E | Qualcomm |
| S4-114-6-2 | Provide the anchors for reference sequence S3-17 | Interdigital |
| S4-114-6-3 | Upload anchors for reference sequence S3-17 | Rapporteur |
| S4-114-6-4 | Port metrics to csv and upload for reference sequence S3-17 | Rapporteur |

# 7 Verification Anchors

* Pink: verification missing
* Yellow: verification assigned to someone
* Green: verification done

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **JM anchors** | **HM anchors** | **Notes** |
| **Full HD Streaming** | 6.2 | missing | missing |  |
| **4K-TV** | 6.3 | No anchors | missing |  |
| **Screen Content** | 6.4 | missing | Qualcomm started verifying anchors, see S4-210746. Detailed issues are to be checked |  |
| **Social Messaging** | 6.5 | Missing | Missing |  |
| **Gaming** | 6.6 | missing | Qualcomm started verifying anchors, see S4-210746. Detailed issues are to be checked. |  |

Table 7-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-114-7-1 | Update the scripts based on anchor.csv and reference.csv | Qualcomm (input in S4-210746) |
| S4-114-7-2 | Identify the verified and non-verified anchors | Qualcomm |
| S4-114-7-3 | Start verification as agreed | Qualcomm |

# 8 Configuration Tests

The configuration files for the anchor generation are provided below.

* Pink: configurations are missing
* Yellow: configurations are available, but not yet frozen. Comments still welcome
* Green: Configurations are frozen

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **ETM configurations** | **VTM configurations** | **Notes** |
| **Full HD Streaming** | 6.2 | S1-ETM-0X | S1-VTM-0X |  |
| **4K-TV** | 6.3 | S2-ETM-0X  See also clause 15 | S2-VTM-0X | Please check ETM by July 8, 2021 telco. This will be frozen then. |
| **Screen Content** | 6.4 | S3-ETM-0X  See also clause 15 | S3-VTM-0x, with x = 1, …, 8 | Please check ETM by July 8, 2021 telco. This will be frozen then. |
| **Social Sharing** | 6.5 | S4-ETM-0X  See also clause 15 | S4-VTM-0x, with x = 1, …, 8 | Please check ETM by July 8, 2021 telco. This will be frozen then. |
| **Gaming** | 6.6 | S5-ETM-0X (same as for 6.5)  See also clause 15 | S5-VTM-0x, with x = 1, …, 8 | Please check ETM by July 8, 2021 telco. This will be frozen then. |

Table 8-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-114-8-1 | Provide mapping of VTM cfgs to scenarios | Gaelle |
| S4-114-8-2 | Confirm mapping of VTM cfgs to scenarios | Rajan and Dmytro |
| S4-114-8-3 | Create S2-VTM-0X cfgs | Gaelle and Dmytro |

# 9 Tests

* Pink: test definitions are missing
* Yellow: tests defined, but open for comments
* Cyan: test definition frozen, but not yet produced
* Green: tests available

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **ETM Tests** | **VTM Tests** | **Notes** |
| **Full HD Streaming** | 6.2 | missing | missing |  |
| **4K-TV** | 6.3 | missing | missing |  |
| **Screen Content** | 6.4 | missing | VVC test streams are provided according to the key system here:  https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Tests/VTM/Scenario-3   |  | | --- | | S3-A65-265 | | S3-A66-265 | | S3-A67-265 | | S3-A68-265 | | Additional tests need to be uploaded. Metrics need to be moved to csv. |
| **Social Messaging** | 6.5 | Missing | Missing |  |
| **Gaming** | 6.6 | Missing | VVC test streams are provided according to the key system here:  https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/Tests/VTM/Scenario-5 |  |

Table 6-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-113p-9-2 | Identify the available and missing tests | Qualcomm |
| S4-114-9-1 | Provide the test bitstreams for reference sequence S3-17 | Interdigital |
| S4-114-9-2 | Upload test bitstreams for reference sequence S3-17 | Rapporteur |
| S4-114-9-3 | Port metrics to csv and upload for reference sequence S3-17 | Rapporteur |

# 10 Verification Tests

* Pink: verification missing
* Yellow: verification assigned to someone
* Green: verification done

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | **Clause** | **ETM Tests** | **VTM Tests** | **Notes** |
| **Full HD Streaming** | 6.2 | missing | missing |  |
| **4K-TV** | 6.3 | missing | missing |  |
| **Screen Content** | 6.4 | missing | missing |  |
| **Social Messaging** | 6.5 | Missing | Missing |  |
| **Gaming** | 6.6 | missing | missing |  |

Table 7-1 summarizes the open issues on Configurations.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-113p-10-1 | Create the scripts based on test.csv and reference.csv | Qualcomm (input in S4-210746) |
| S4-113p-10-2 | Identify the verified and non-verified tests | Qualcomm |
| S4-113p-10-3 | Start verification as agreed | Qualcomm |

# 11 Characterization

Table 11-1 summarizes the open issues on Characterization.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| S4-113p-11-1 | Port the BD-Rate function from excel to scripts | Qualcomm (started prio 3) |
| S4-113p-11-2 | Develop consistent reporting scheme | Qualcomm |
| S4-113p-11-3 | Develop consistent graphical representation | Qualcomm |

# 12 Software

<https://github.com/haudiobe/5GVideo.git>

see above actions that relate to the software.

# 13 Online Repository

<https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/>

CSV of all Files are provided here:

https://dash-large-files.akamaized.net/WAVE/3GPP/5GVideo/ReferenceSequences/sequences.csv

All reference sequences are documented.

Table 13-1 summarizes the open issues on Online Repository.

|  |  |  |
| --- | --- | --- |
| Number | Issue | Responsible |
| ~~S4-113p-13-1~~ | ~~Bugfixes for .cfg – unnecessary space included~~ | ~~Done~~ |
| ~~S4-113p-13-2~~ | ~~Upload Life-Untouched~~ | ~~Done~~ |
| ~~S4-113p-13-3~~ | ~~Move configs to scenario~~ | ~~Done~~ |

Other content issues are documented here:

**https://github.com/haudiobe/5G-Video-Content/issues**

# 14 Miscellaneous Issues

Miscellaneous issues are created here for <https://gitlab.com/3gpp-sa4/video/-/issues> and below linked.

The currently open issues are documented below

* [[S4aV210691l] Closed Gop for Scenario 2](https://gitlab.com/3gpp-sa4/video/-/issues/13)
* [[S4aV210691k] Scenario 2 - Temporal filtering](https://gitlab.com/3gpp-sa4/video/-/issues/12)
* [[S4aV210691j] Appropriate coding tools](https://gitlab.com/3gpp-sa4/video/-/issues/11)
* [[S4aV210691i] BD-Rate for more than 4 points](https://gitlab.com/3gpp-sa4/video/-/issues/10)
* [[S4aV210691h] Encoding Complexity](https://gitlab.com/3gpp-sa4/video/-/issues/9)
* [[S4aV210691g] Luma based spatial QP adaptation method](https://gitlab.com/3gpp-sa4/video/-/issues/8)
* [[S4aV210691f] Per frame results](https://gitlab.com/3gpp-sa4/video/-/issues/7)
* [[S4aV210691e] Search window](https://gitlab.com/3gpp-sa4/video/-/issues/6)
* [[S4aV210691d] Encoder Configurations](https://gitlab.com/3gpp-sa4/video/-/issues/5)
* [[S4aV210691c] SEI messages](https://gitlab.com/3gpp-sa4/video/-/issues/4)
* [[S4aV210691b] Referencing Structure](https://gitlab.com/3gpp-sa4/video/-/issues/3)
* [[S4aV210691a] Infinite GOP](https://gitlab.com/3gpp-sa4/video/-/issues/2)

Updates need to be checked.

# 15 EVC Configuration Files

## 15.1 Introduction

Essential Video Coding (EVC) is one of the new codecs being studied in the context Video codec characterization for 5G (FS\_5GVideo). In this document, we propose configuration files for the EVC reference software (ETM) for scenarios 2, 3, and 5 as specified TR 26.955.

We have chosen the configuration parameters to closely match those used by the corresponding HM configuration files. More specifically,

1. The output bit-depth is always set to 10 so that the metrics calculation can be performed at bit-depth of 10.
2. The per frame QP values are specified to align with the settings of the HM anchor.
3. The reference frames are specified to be align with the settings of the HM anchor.

Details that are specific to a particular scenario are described in Section 2. The proposed EVC configuration files are attached to this document.

## 15.2 Scenario 2: 4K-TV

**S2-ETM-01-SDR-encoder\_randomaccess.cfg:**

* Prediction structure:
* GOP size is equal to 16.
* Hierarchical QP structure is used.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* The intra period is set to approximately 1 second (closest multiple of GOP size that is greater than or equal to the frame rate).

**S2-ETM-01-HDR-encoder\_randomaccess.cfg:**

* Prediction structure:
* GOP Size is equal to 16.
* Hierarchical QP structure is used.
* ETM HDR settings specified for MPEG Verification Testing, output document ISO/IEC JTC 1/SC 29/WG 04 N0030.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* The intra period is set to approximately 1 second (closest multiple of GOP size that is greater than or equal to the frame rate).

## 15.3 Scenario 3: Screen Content Scenario

**S3-ETM-01-encoder\_lowdelay\_P.cfg:**

* Prediction structure:
* Hierarchical QP structure is used.
* GOP size is equal to 8. Each P picture refers to up to 4 preceding pictures in display order.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* Only the first picture is intra, the rest of the pictures are of type P.

**S3-ETM-02-encoder\_lowdelay\_P.cfg:**

* Prediction structure:
* The QP value for each frame is constant (equal to the nominal QP value). Each P picture refers to immediately preceding pictures in display order.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* The intra period is set to exactly 1 second (i.e. intra period is equal to the sequence fps value).

## 15.4 Scenario 5: Online Gaming

**S5-ETM-01-encoder\_lowdelay.cfg:**

* Prediction structure:
* Hierarchical QP structure is used.
* GOP size is equal to 8. Each B picture refers to up to 4 preceding pictures in display order.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* Only the first picture is intra, the rest of the pictures are of type B.

**S5-ETM-02-encoder\_lowdelay.cfg:**

* Prediction structure:
* The QP value for each frame is constant (equal to the nominal QP value).
* Each B picture (in L0 and L1) refers to immediately preceding pictures in display order.
* Additional settings (to be specified on the command line):
* QP: [22, 27, 32, 37, 42].
* The intra period of approximately 1 second is achieved (32 for 30fps sequences and 64 for 60fps sequences).

1. Dr. Thomas Stockhammer (Qualcomm Incorporated), tsto@qti.qualcomm.com [↑](#footnote-ref-2)