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**ISO/IEC JTC 1/SC 29/WG 2**

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# Introduction

Encoder and packager synchronisation are key techniques that allow service providers to deploy stable and robust live video streaming systems. In the case of encoding CMAF, DASH and HLS content, often many representations need to be encoded in parallel. Thus, encoder synchronisation allows for distributing workloads over multiple encoders and/or packagers and to provide redundant workflows. In typical workflows ABR encoders get an input signal that already has some timing information. The main goal is to be able to use this information and other information to encode tracks in parallel and in distributed workflows, both for video on demand and live cases.

MPEG members organized a workshop to solicit feedback and discussion on this topic, this workshop was attended by over 100 members representing different parts of the media streaming industry such as broadcasters, content providers, technology providers and cloud service providers. The notes and web-page of the meeting is available [3]. Based on this workshop requirements and use cases were developed to be used in the standardization effort [2].

Beyond the distributed and synchronised encoding for OTT workflows such as based on Common Media Application Format, also distributed storage of large collection of CMAF/DASH based assets is in scope. Such stored assets may possibly originate from redundant workflows with more than one synchronized encoder and packager.

This Call for Proposal is soliciting proposals to define encoder & packager synchronisation and asset storage framework that addresses the identified use cases and requirements [1]. It aims to be complementary to CMAF, DASH and other MPEG standards and facilitate more robust and efficient content encoding workflows for both live and on-demand cases. Also, cases that involve additional network or cloud-based processing are not pre-cluded.

The Encoder and packager synchronisation framework will define preferred ways of generating content from distributed sources based on existing MPEG standards such as Common Media Application Format, MPEG-DASH and potentially other standards and specifications (for final requirements and use cases see [1]). The goal is to enable redundant live and VoD content generation setups that produce synchronised content and are robust to failures and loss of input in one or more of the components in the setup.

The Encoder and packager synchronisation framework may also define and reference other metadata that can be carried in existing MPEG standards.

The encoder synchronisation and packager framework may also define some API’s and new message exchange formats.

In addition, solutions for storing media assets at scale are solicited, such assets may be generated by setups in the synchronised encoder/packager framework. Efficient and reliable storage with targetted use cases is therefore also in scope of this CfP. The asset storage solution therefore enables live-to-vod and vod-to-live use cases taking advantage of the encoder synchronisation framework.

# Who may participate

Proponents that respond to this call may include any persons whether they are or are not accredited delegates of ISO/IEC JTC1/SC29/WG3. However, all proponents are required to attend the meetings at which their respective proposals are evaluated. The meeting during which proposals are evaluated is identified with an \* in Table 1 and Table 2. A one-time invitation may be extended to proponents to participate in the evaluation process if the proponent is not an accredited delegate of ISO/IEC JTC1/SC29/WG3. If the proponents technology is accepted into the Working Draft of the Standard, then the proponents are required to participate in meetings identified with a † in Table 1 and Table 2. In such a case where the technology is accepted from a proponent who is not an accredited delegate of ISO/IEC JTC1/SC29/WG3, the proponent is expected to initiate the process to join their National Body committees in order to become accredited to participate in subsequent meetings of WGN. Information for how to join National Body committees and to become an accredited delegate for ISO/IEC JTC1/SC29/WG3 is available at [How to Get Involved](https://www.iso.org/get-involved.html).

# Code of conduct and rules of engagement

All participants shall be required to familiarize themselves with relevant [ISO Policies and Procedures](https://www.iso.org/resources.html), including in particular [ISO Code of Conduct](https://www.iso.org/publication/PUB100397.html), [ISO Declaration for Participants in ISO Activities](https://www.iso.org/declaration-for-participants-in-iso-activities.html), [ISO Privacy and Copyright](https://www.iso.org/privacy-and-copyright.html) policy, and [ISO Policy on Communication of Committee Work](https://www.iso.org/publication/PUB100382.html), and to consent to be bound by these policies.

# Source code and IPR

Proponents are advised that, upon acceptance for further evaluation, it will be required that certain parts of any technology proposed to be made available in source code format to participants in the core experiments process and for potential inclusion in the prospective standard as reference software. When a particular technology is a candidate for further evaluation, commitment to providing such software is a condition of participation. The software shall produce comparable results to those submitted to the test. Additionally, submission of improvements (bug fixes, etc.) is encouraged.

• Proponents are encouraged (but not required) to allow MPEG members to have access, on a temporary or permanent basis, to their source code.

• Proponents are encouraged to submit a statement about the programming language in which the software is written, e.g., PHP, Node.js, or Python, and the platform(s) on which the binaries were compiled. Note that low-level programming optimizations such as assembly code/intrinsics and external compression libraries are discouraged.

Furthermore, proponents are advised that this Call is being made subject to the common patent policy of ITU-T/ITU-R/ISO/IEC (refer to [www.itu.int/ITU-T/dbase/patent/patent-policy.html](http://www.itu.int/ITU-T/dbase/patent/patent-policy.html) or Appendix I of [ISO/IEC Directives Part 1](http://isotc.iso.org/livelink/livelink?func=ll&objId=4230455&objAction=browse&sort=subtype)).

# Testing Fee

Participation in the CfP will not be associated with any fee.

# Definitions

The definitions for terms associated with this Call for Proposals are found in [1] and [2].

# Documents of CfP package

The CfP package provided by proponents shall be a zip file including documents for requirements, use cases, test and evaluation procedures, licenses to test content, information for how to access test content, instructions for how to formulate results, forms for providing results including excel spreadsheet with the requirement evaluation, information about methodology for core experiments if planned. The CfP package shall be a complete and standalone package.

A valid proposal should include all listed items in this section as part of the submission.

The following items are required as part of the submission:

* A description of the encoder synchronisation framework and techniques for achieveing encoder and packager synchronization
* The specification of the interfaces and metadata
* A description of the data formats for media data and metadata usage
* Example workflows that depict the usage of the framework, e.g., to realize a selected set of use cases as use cases defined in [2]
* Excel sheet with evaluation filled in based on Annex A

Submissions that are incomplete or delivered late will not be considered.

## Input contribution

Each proposal must be described in an input contribution to the 138th MPEG meeting and should at least include the following elements:

1. A detailed technical description of the proposed technology.
2. A description of how the proposal fulfills the requirements and use cases as listed in the use cases and requirements document [2]**.**
3. A description of which parts of the proposed technology would be standardized by MPEG, preferably accompanied by draft specification text.
4. The package may include source code following requirements as defined in section 4.

# Submission Process

## CfP Time Line table

Each entry in the table is described in a section below. WG 3 is the SC 29 working group WG 3 on MPEG Systems

|  |  |  |  |
| --- | --- | --- | --- |
| **Meeting** | **Date** | **Who** | **Action** |
| 137 | 2021/01/21 | WG 2 | Issue Call for Proposals package |
| 138 | 2022/04/10 | proponents | Registration deadline |
| 138 | 2022/04/17 | proponents | Deadline for submission of description of the proposals |
| 138 | 2022/04/25 – 2022/04/29 | WG 3 | Evaluation of the proposals WD |
|  | 2023/07/XX | WG 3 | Final Draft International standard may be anticipated |

Table 1 – CfP Time Line.

## Envisioned Timeline for Encoder Synchronization standard

It is envisioned that the timetable for progress of the standard will be as follows:

|  |  |  |
| --- | --- | --- |
| **meeting** | **Date** | **Action** |
| 2 | 2022-01-11 | CfP |
| 138 | 2022-04-25 | evaluation |
| 139\* | 2022-07-20 | WD |
| 140† | 2022-10-11 | CD |
| 141† | 2023-01-30 | DIS |
| 143† | 2023-07-01 | FDIS |

Table 2 - Standardization Time Line (\*Indicates attendance at the meeting is required. †indicates attendance is required if technology is selected to be included in the Working Draft.)

## Register your participation

Proponent must register on or before the date shown in the CfP Time Line table above an intention to participate in the CfP. Registering an intent is not binding and registered parties are not required to submit proposals. However, parties that do not register will not be able to submit proposals. Register by sending an email to Dr. YK Lim (Convenor, WG3 MPEG Systems, [yklwhite@gmail.com](mailto:yklwhite@gmail.com)) and cc Dr. Igor Curcio [igor.curcio@nokia.com](mailto:igor.curcio@nokia.com) (Convenor WG2 MPEG Requirements). Email should indicate

* Company name
* Contact name and contact email address
* The envisioned scope of the proposal

After registration, the proponent will receive a “ProponentID” (<Proponent\_ID>) for use in submission.

# Core Experiments and Evaluation

Subsequent to selecting technology and creating a first Working Draft (WD), a collaborative development of the work will occur. If the technology selected from the CfP does not address all requirements, or to the extent that the CfP does not permit evaluation and selection of technology that addresses all requirements, then technology that addresses the remaining requirements shall be incorporated via the Core Experiment process. Currently no recommendations on core experiments are provided, more details may be developed after the call.

The proposals will be evaluated based on their fulfillment of the use cases and requirements. Each proposal shall be evaluated based on each use case and requirement in the use cases and requirements document [2]. An excel sheet for this evaluation is attached as annex to this CfP.

# Call Administrator

For any questions related to this Call for Proposals or associated evaluation procedures please contact:

Dr. Youngkwon Lim

Convenor of ISO/IEC JTC 1/SC 29/WG 3

[yklwhite@gmail.com](mailto:yklwhite@gmail.com)

Dr. Igor Curcio

Convenor of ISO/IEC JTC 1/SC 29/WG 2

Igor.curcio@nokia.com

# Email reflector

The e-mail reflector associated to this call is: [synched-encoding@lists.aau.at](mailto:synched-encoding@lists.aau.at) and registration is possible, registration is possible on https://lists.aau.at/mailman/listinfo/synched-encoding

# Copyright Header for Encoder Synchronization Software

All Reference Software files shall contain the following header:

##########################################################################

This software module was originally developed by

in the course of development of ISO/IEC XXXXX for reference purposes and

its performance may not have been optimized. This software module is an

implementation of one or more tools as specified by the ISO/IEC XXXXX

standard. ISO/IEC gives you a royalty-free, worldwide, non-exclusive,

copyright license to copy, distribute, and make derivative works of this

software module or modifications thereof for use in implementations or

products claiming conformance to ISO/IEC standards incorporating ISO/IEC

XXXXX reference software and which satisfy any specified conformance

criteria of that standard.

Those intending to use this software module in products are advised that its

use may infringe existing patents and that the license in the previous

paragraph grants no licenses under such patents. ISO/IEC have no liability

for use of this software module or modifications thereof.

Copyright is not released for products that do not conform to an ISO/IEC

standard.

<CN> retains full right to modify and use the code for its own purpose,

assign or donate the code to a third party and to inhibit third parties

from using the code for products that do not conform to ITU Recommendations

and/or ISO/IEC International Standards.

This copyright notice must be included in all copies or derivative works.

Copyright (c) ISO/IEC 202X.

# References

1. N0231, “Exploration on encoder and packager synchronization ISO/IEC JTC1/SC29/WG03 MPEG2021/N17502, May 2021, Online <https://www.mpegstandards.org/wp-content/uploads/mpeg_meetings/134_OnLine/w20293.zip>
2. W21299 Use cases and requirements for encoder and packager synchronisation WG 02 MPEG Technical requirements: <https://www.mpegstandards.org/wp-content/uploads/mpeg_meetings/137_OnLine/w21299.zip>
3. Encoder Synchronization workshop <https://sites.google.com/view/encodersyncworkshop/home>
4. Evaluation Excel SHEET

Below are the entries of the evaluation excel sheet to be filled in by a proponent. If more space for explanation is needed a proponent can refer to the respective contribution.

|  |  |  |  |
| --- | --- | --- | --- |
| evaluation form CfP on encoder synchronization |  |  |  |
| **1.1   General Specification requirements** | remark | fulfilled Y/N | explanation |
| 1.      The specification shall be a self-contained document standardized in ISO/IEC containing both guidelines and normative statements to achieve the requirements in this document. | check if spec text exists and if it contains normative statements |  |  |
| 2.      The specification shall emphasize and focus on the use of existing MPEG standards | check if text emphasizes using existing MPEG standards or not |  |  |
| 3.      The specification shall not emphasize and focus on specific protocol related aspects not related to MPEG standards. The assumption is that organisations outside of MPEG will develop such protocol specific aspects. | text may include statements on the protocol, but preferably not normative |  |  |
|  |  |  |  |
| **1.2   Encoder Synchronisation requirements** |  |  |  |
| 4.      The specification shall support cases when there are more than one redundant encoder to synchronize. |  |  |  |
| 5.      The specification shall enable the case when sources to encoders may be delayed relative to each other (e.g., direct fiber vs transcoded satellite feed). | explanation is needed how this can be supported |  |  |
| 6.      The specification shall enable the case when the sources to encoders may be differently encoded. For example, the primary sources may be compressed with a lossless codec such as JPEG2000 or JPEG-XS while the secondary source can be a high-rate HEVC video | explanation how such different inputs would be processed is needed |  |  |
| 7.      The specification shall enable the case when there is not any time signalling present in the (mezzanine) input signal to the encoder | explanation is needed if this is supported |  |  |
| 8.      The specification shall support the case when encoders may fail and restart (re-join) later again, or encoders join or leave a session again. | explanation is needed if this is supported |  |  |
| 9.      The specification shall not require proprietary boxes in the ISO Base Media file format. | explanation is needed if this is supported |  |  |
| 10.  The specification shall enable using multiple redundant inputs without the same presentation time stamp for corresponding frames and/or different presentation times at the segment boundaries. | explanation is needed if this is supported |  |  |
| 11.  The specification shall provide methods for achieving synchronisation of the output of the encoder. | explanation is needed if this is supported |  |  |
| 12.  The specification shall support distributed encoding of parts of a bit-rate ladder or parts of a presentation. | explanation is needed if this is supported |  |  |
| 13.  The specification shall enable the case when segments produced by different encoders for the same interval are not bit-identical. | explanation is needed if this is supported |  |  |
| 14.  The specification shall define methods for identification of segments covering interchangeable content/encodings that are not bit-identical. | explanation is needed if this is supported |  |  |
| 15.  The specification shall define guidelines for synchronisation of audio and video segments, taking into account specific aspects of audio such as support for pre-roll and encoding from different samples introducing different audio encoder/decoder state. | explanation is needed if this is supported |  |  |
| 16.  The specification shall not require exact system clock synchronisation (< 1 ms) of the systems/hardware of the encoder. | explanation is needed if this is supported |  |  |
| 17.  The specification shall enable encoder and packager synchronisation support when the system clock synchronisation is within reasonable bounds; bounds up to at least including +-100ms shall be supported (as this can be achieved in most practical (cloud) setups). | explanation is needed if this is supported |  |  |
| 18.  The specification shall support leap seconds. | explanation is needed if this is supported |  |  |
| 19.  The specification shall define how the media presentation times, based on internal media clocks are calculated with the goal of synchronisation of different tracks and video frames. | explanation is needed if this is supported |  |  |
| 20.  The specification shall support encoder synchronisation on output with frames synchronised based on presentation time stamps and aligned segment boundaries. | explanation is needed if this is supported |  |  |
| 21.  The specification shall support at least a subset of input formats like SDI, HD-SDI, SMPTE 2110, MPEG-2 TS and other such as RTMP, RIST. | explanation is needed if this is supported |  |  |
| 22.  The specification shall enable the case when signals in the input to the encoder arrive from different media and with a different latency (e.g. primary over fiber, secondary over satellite etc...) and the secondary signal is to be used as a backup. | explanation is needed if this is supported |  |  |
| 23.  The specification shall enable both Video on Demand and Live use cases | both VoD and live setups should be detailed in the proposal |  |  |
| 24.  The specification shall enable the recording and storing of encoder output for a live use case | explanation is needed if this is supported |  |  |
| 25.  The specification shall define/support the option to target optimization for the Video on Demand case that do not apply to live. | explanation is needed if this is supported |  |  |
| 26.  The specification shall support the case where the communication between encoders is enabled. | explanation is needed if this is supported |  |  |
| 27.  The specification shall support the case when there is no communication between encoders. | explanation is needed if this is supported |  |  |
| 28.  The specification shall support additional functionality for ad insertion solutions, such as the insertion of splice points, IDR frames and/or segment boundaries. These shall not break the solution for encoder synchronisation. | explanation is needed if this is supported |  |  |
| 29.  The specification shall support segment boundary alignment of different tracks at the output. | explanation is needed if this is supported |  |  |
| 30.  The specification shall support synchronised timed metadata carriage. | explanation is needed if this is supported |  |  |
|  |  |  |  |
| **1.3   Packager Synchronisation requirements** |  |  |  |
|  |  |  |  |
| 31.  The specification shall enable packager synchronisation for geo-distributed setups, where the output manifest and segments of the packagers does not introduce inconsistencies in the timeline or retro-active changes. | explanation is needed if this is supported |  |  |
| 32.  The specification shall support Packager synchronisation when encoder synchronisation is applied. Such simpler packagers that need not rewrite the timestamps are typically more robust. | explanation is needed if this is supported |  |  |
| 33.  The specification shall enable Packager synchronisation when encoder synchronisation is not (fully) applied, and the packager may apply some changes to the timeline. | explanation is needed if this is supported |  |  |
| 34.  The specification shall describe the need for atomic read/write operations and trade-off between consistency, availability and tolerance to partition. Most packagers need to index segments using a segment index or a database, the specification shall describe in detail how such operations may affect packager synchronisation. | explanation is needed if this is supported |  |  |
| 35.  The specification shall enable packager synchronisation for integer and non-integer (e.g., fractional) frame rates. | explanation is needed if this is supported |  |  |
| 36.  The specification shall not preclude additional communication with ad insertion solutions and shall not break client playout of the output formats that target the player in such cases. | explanation is needed if this is supported |  |  |
| 37.  The specification shall support synchronisation and segment boundary alignment of timed metadata and timed text as to provide timed text and timed metadata to clients. | explanation is needed if this is supported |  |  |
| 38.  The specification shall not require strict system clock synchronisation of the system running the packager. Systems shall at least support system clock synchronisation boundaries up to +-100 ms. | explanation is needed if this is supported |  |  |
| 39.  The specification shall support the case where SCTE-35 metadata is packaged, and segments or timelines may need to be altered based on SCTE-35 based information | explanation is needed if this is supported |  |  |
| 40.  The specification shall not require the use of client-side solutions for mitigation upstream failures (e.g., multiple base URL client steering), as these are not implemented consistently throughout devices. | explanation is needed if this is supported |  |  |
| 41.  The specification shall describe specific aspects related to audio/video sync for different audio codecs. This includes sample rate, edit list, pre-roll audio encoder state that may work slightly different as when compared to the video coder. | explanation is needed if this is supported |  |  |
| 42.  The specification shall at least support popular output streaming formats to players such as MPEG-DASH and HTTP Live Streaming. | explanation is needed if this is supported |  |  |
| 43.  The specification shall support cases when inter-packager communication is possible. | explanation is needed if this is supported |  |  |
| 44.  The specification shall support cases when there is no inter-packager communication possible. | explanation is needed if this is supported |  |  |
| 45.  The specification shall support the case when different packagers or origins may have a missing segment in one receiver but not in the other. | explanation is needed if this is supported |  |  |
| 46.  The specification shall support the case when packagers may fail and restart (re-join) later again, or packagers join or leave a session again. | explanation is needed if this is supported |  |  |
| 47.  The specification shall be agnostic to encryption or DRM systems, details on how this is achieved shall be provided in the specification text. | explanation is needed if this is supported |  |  |
| **1.4   Requirements on communication between Encoder and packager/origin** | |  |  |
| 48.  The specification shall support ingest/communication between an encoder and packager/origin based on well-defined existing industry specifications targeting such applications. | explanation is needed if this is supported |  |  |
| 49.  The specification shall enable push-based transmission of media data segment from the encoder to the origin/packager. | explanation is needed if this is supported |  |  |
| **1.5   Requirements for Content storage** |  |  |  |
| The specification shall also meet the following requirements for content storage. |  |  |  |
| 50.  The specification shall support describing content stored for either a VoD or Live presentation using an external file, e.g., a specific manifest | explanation is needed if this is supported |  |  |
| 51.  The specification shall support describing content stored for either a VoD or Live presentation using an internal identifier, e.g., a stream or group identifier | explanation is needed if this is supported |  |  |
| 52.  The specification shall enable both single track per file and single segment per file storage | explanation is needed if this is supported |  |  |
| 53.  The specification shall support sequences of presentations. The specification shall enable linking these tracks explicitly or implicitly. | explanation is needed if this is supported |  |  |
| 54.  The specification shall support directory structure/ organisation of the storage archive. | explanation is needed if this is supported |  |  |
| 55.  The specification shall support storage of timed metadata (both inband emsg and timed metadata track). | explanation is needed if this is supported |  |  |
| 56.  The specification shall support/define the option of signalling or fixing gaps, if content was received with gaps those gaps may either be repaired or explicitly signalled. | explanation is needed if this is supported |  |  |
| 57.  The specification shall support/define the option of repairing, appending, replacing parts of content. | explanation is needed if this is supported |  |  |
| 58.  The specification shall describe in guidelines how support in typical cloud storage systems may work and how the solution fits with existing APIs for cloud-based storage solutions | explanation is needed if this is supported |  |  |
| 59.  The specification shall support efficient and fast indexing of segments and content, for live, VoD and Live-to-VoD cases. | explanation is needed if this is supported |  |  |
| 60.  The specification shall support the recording and storing of encoder/packager output for a live use case. | explanation is needed if this is supported |  |  |
| 61.  The specification for content storage shall be based on existing MPEG specifications to the largest extent possible | explanation is needed if this is supported |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
| Additional Questions/Criteria |  |  |  |
| is this solution supported in commercial products? |  |  |  |
| is this solution supported in open source products? |  |  |  |
| Is the source code/example implementation available |  |  |  |