 ISO/IEC JTC 1/SC 29/WG 3 N23390

**ISO/IEC JTC 1/SC 29/WG 3**

**MPEG Systems   
Convenorship: KATS (Korea, Republic of)**

**Document type:** Output Document

**Title: Potential improvement of ISO/IEC DIS 23090-9 Redundant encoding and packaging for segmented live media (REAP)**

**Status:** Approved

**Date of document:** 2023-10-29

**Source:** ISO/IEC JTC 1/SC 29/WG 3

# Expected action: ACT

**Action due date:** 2023-10-29

**No. of pages:** 5 (with cover page)

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**Committee URL:** <https://isotc.iso.org/livelink/livelink/open/jtc1sc29wg3>

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**ISO/IEC JTC 1/SC 29/WG 3 N1087**

**Hannover, DE – October 2023**

**Change 1. Potential Improvement 1: improve STS support in packager**

**1.1 Introduction**

Clause 6 figure 2 of DIS 23009-9 introduces the synchronization time stamp (STS) as a configuration parameter of the REaP distribution encoder.

The reasoning is that as the distribution encoder introduces algorithmic delay and input timing may use a different origin, then distribution encoders may need to patch the timestamps it received from the input encoder using the STS configuration parameter.

Clause 6.4 then details how this can be used to deal with delayed inputs and/or mixed inputs.

From practical discussions (see the notes of the 2023 REaP workshop in [1]), there was some concern that applying such patching is not the responsibility of the packager (instead of the encoder). Reviewing the notes of the 2023 REaP workshop [1] some additional comments were raised that asserted that the patching could indeed be a function of the origin/packager.

This document describes signaling STS in I-MPD (by distribution encoder) and D-MPD (by packager) and in addition extend the configuration of STS to origin/packager. The rationale is that indeed in many cases it is much easier to determine the delay introduced by the redundant encoding and packaging workflow at the origination server or packager, instead of at the distribution encoder.

In section 2 of this document the signaling of STS in either the D-MPD or I-MPD using MPD@availabilityTimeStart attribute is described. For HTTP live Streaming Playlists it is not necessary to add extra signaling.



Figure Figure to from DIS REaP

**1.2 Signaling STS using MPD@availabilityTimeStart**

So far the usage of synchronization time stamp STS as a configuration option for the encoder has led to some confusion as there is no way to explicitly signal the STS. The main idea of STS is to map the timing output to values close to the wallclock time (using Unix Epoch), enabling a correct live edge determination.

However, there are 2 drawbacks to this approach.

1. It may be better to preserve the timing from the contribution source in the media as it may, for example, relate to EPG information (i.e. the 8 o’clock news starts at 8).
2. The encoder may not know the overall introduced latency compared to the contribution timing, and may therefore not be positioned to introduce the patching.

Therefore it is proposed to update Figure 1 to also allow configuration of STS at the packager.

Also, it is proposed that @availabilityTimeStart be used to signal the STS in the I-MPD and D-MPD, therefore encoders need not to patch media timing in segments, which can be preserved from the contribution input signal (in case that was already epoch or wall clock time based). This makes the distribution encoder implementation simpler as the mapping from input to output timing will be straight forward for use cases such as EPG guidelines.

Currently REaP requires the MPD@availabilityStartTime to b"1970-01-01T00:00:00Z" for I-MPD or D-MPD. It is proposed to relax this to values close to it such as availabilityStartTime="1970-01-01T00:00:10Z" representing the synchronization time stamp.

In MPEG DASH @availabilityStartTime is used to signal the zero point of the timeline and all Period@start are relative to this time. In Theory all timing in the media segments should be relative to @availabilityStartTime="1970-01-01T00:00:00Z", but the redundant encoding and packaging workflow introduces latency, which would lead to DASH MPD not being able to produce the segments corresponding to the live edge.

The latency introduced by the REaP workflow can thus result in segments close to the live edge not being available in time.

To avoid patching Period timing and/or media segment timing information, an easy way to correct timing for MPEG-DASH is to signal STS in @availabilityStartTime.

In m65234 a live demo illustrating the concept with multiple encoders/packagers used for pseudo watermarking was shown. Two encoders push to two origin/packagers, the output tracks of the distribution encoders use REaP timing (epoch relative timing). To account for the system latency in the workflow the packager sets the @availabilityStartTime "1970-01-01T00:00:10Z" to enable the 10 second shift to account for the latency introduced in the REaP workflow.

1.**3 Proposed changes to REaP Text to implement this improvement**

**Change 5.2.i:** remove “and duration of the distribution encoders”

**Change 6.1:** update figure to add STS configuration at packager,

**Change 6.1: change “**encoder configuration” to configuration

**Change 6.2.2 :** extend first sentence **“**or represents the synchronization time stamp e.g. 10 seconds would be "1970-01-01T00:00:10Z",”

**Change 7.2.2:** add : plus MPD@availabilityStartTime (assuming 1970-01-01T00:00:00Z is zero)

**Add 7.2.5:** Redundant packagers may take into account delayed or mixed input from the distribution encoder as described in 6.4

**Change 7.3.2:** add: plus MPD@availabilityStartTime (assuming 1970-01-01T00:00:00Z is zero)

**Add 7.3.4:** Redundant packagers may take into account delayed or mixed input from the distribution encoder as described in 6.4.

**Add 7.3.5:** Redundant packager mayset MPD@availabilityStartTime to the value of the synchronization time stamp (assuming 1970-01-01T00:00:00Z is zero) may be applied.