Project

Report

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Recommended Practice
MXF Timing for ARD_ZDF_HDF01a/b

MXF Expert Group

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Content

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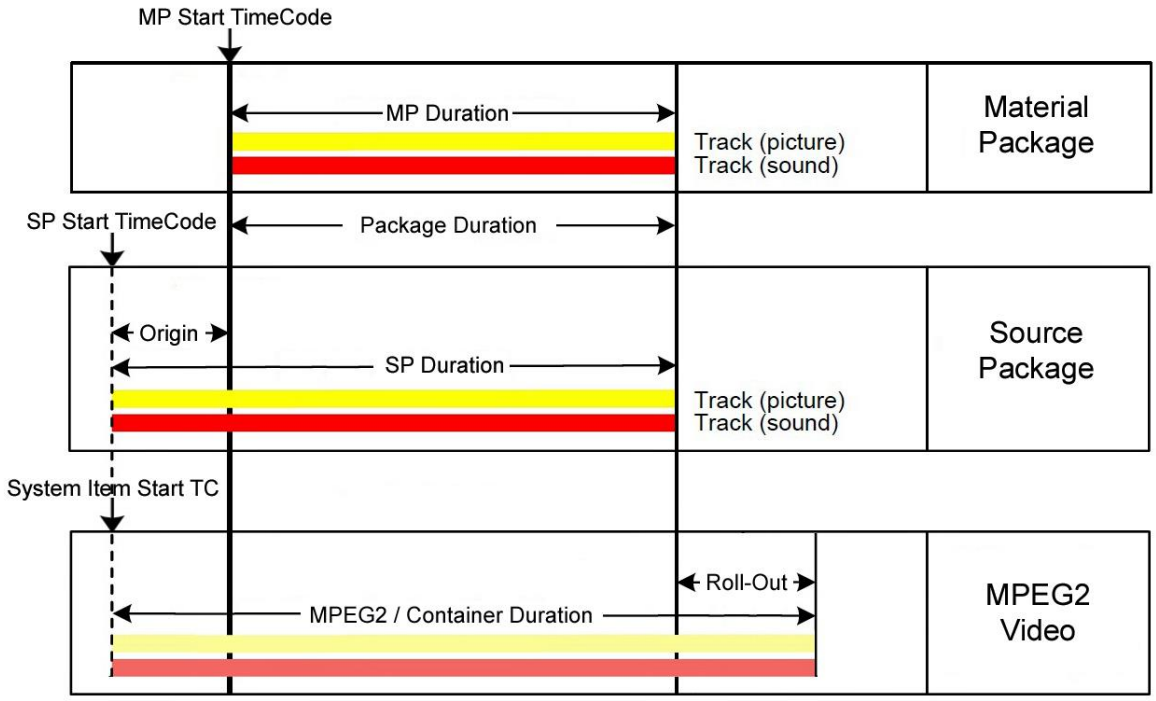
1 Scope

The scope of this document is to provide a guideline for handling different Timecode Tracks in MXF files that contain MPEG2 Long GOP video format. The document is intended to supplement the ARD_ZDF_HDF01 profiles and provide further information on this topic. It reflects the requirements of the broadcasters ARD, ZDF and ORF and is based on their practical experiences.

The recommendation in this document comply to EBU R122.

2 Recommended Practice



2.1 Material Package (MP)

What the viewer is supposed to see is described by the material package. The duration of the MP is also called Package Duration.

2.2 Material Package Start Timecode

The Material Package Start Timecode shall be identical with the timecode of the first visible frame.

2.3 Source Package (SP)

The Source Package (SP) includes the complete MP plus an Origin (PreCharge), if required for technical reasons. Due to the equality of the package length of MP and SP at OP1a, the duration of the MP must always correspond to the duration of the SP minus the value of Origin.
From this it follows that the Source Package Duration shall be the Material Package Duration enhanced by the value of Origin.

2.4 Source Package Start Timecode

The Source Package Start Timecode shall be identical with the Material Package Start Timecode, subtracted by the value of Origin.

2.5 Origin (Precharge)

Precharge in MXF is defined by the Origin metadata. It shall be identical in all Timeline Tracks and shall be zero in Material Package. The origin contains frames which do not belong to the MP but are necessary for decoding. These frames will not be played.
The start TC of all the Timeline tracks contained in the SP must be reduced by the value of the Origin relative to the MP TC, in order for the TC of the MP to be synchronized with the TC in the SP.
Origin belongs to MPEG2 display order. In case of Open GOP, it can be necessary to include more frames than needed for Closed GOP content.

2.6 System Item (SI) Timecode

In order to achieve a synchronous TC, the TC of the first System Item must correspond with the Source Package Start timecode and must be increased by one for each additional frame. From this follows that the timecode of the first played SI must correspond to the start TC of the MP or the start TC of the SP + Origin and must be increased by one for each additional frame.

2.7 System Item "Start Timecode"

The timecode of the first System Item shall match with the Source Package Start Timecode.

2.8 MPEG2/Container Duration

The total length of the essence, the number of frames (Edit Units) of the MPEG2 Stream can be signalized in MXF as Container Duration. If this optional metadata element does not exist, the MPEG2 stream itself has to be measured.

2.9 Roll-Out

The roll-out contains frames which are not part of the MP but are necessary for decoding. These frames will not be played. Such a roll-out is implemented in MXF by extending the total length of the essence by the necessary number of frames without extending SP and MP.

2.10 Index Table Timing Model

To ensure the complete indexing according to ARD_ZDF_HDF profiles, the Index Duration sum of all Index Table Segments shall conform to the sum of all included Edit Units and so correlates with the value of Container Duration.

2.11 Summary

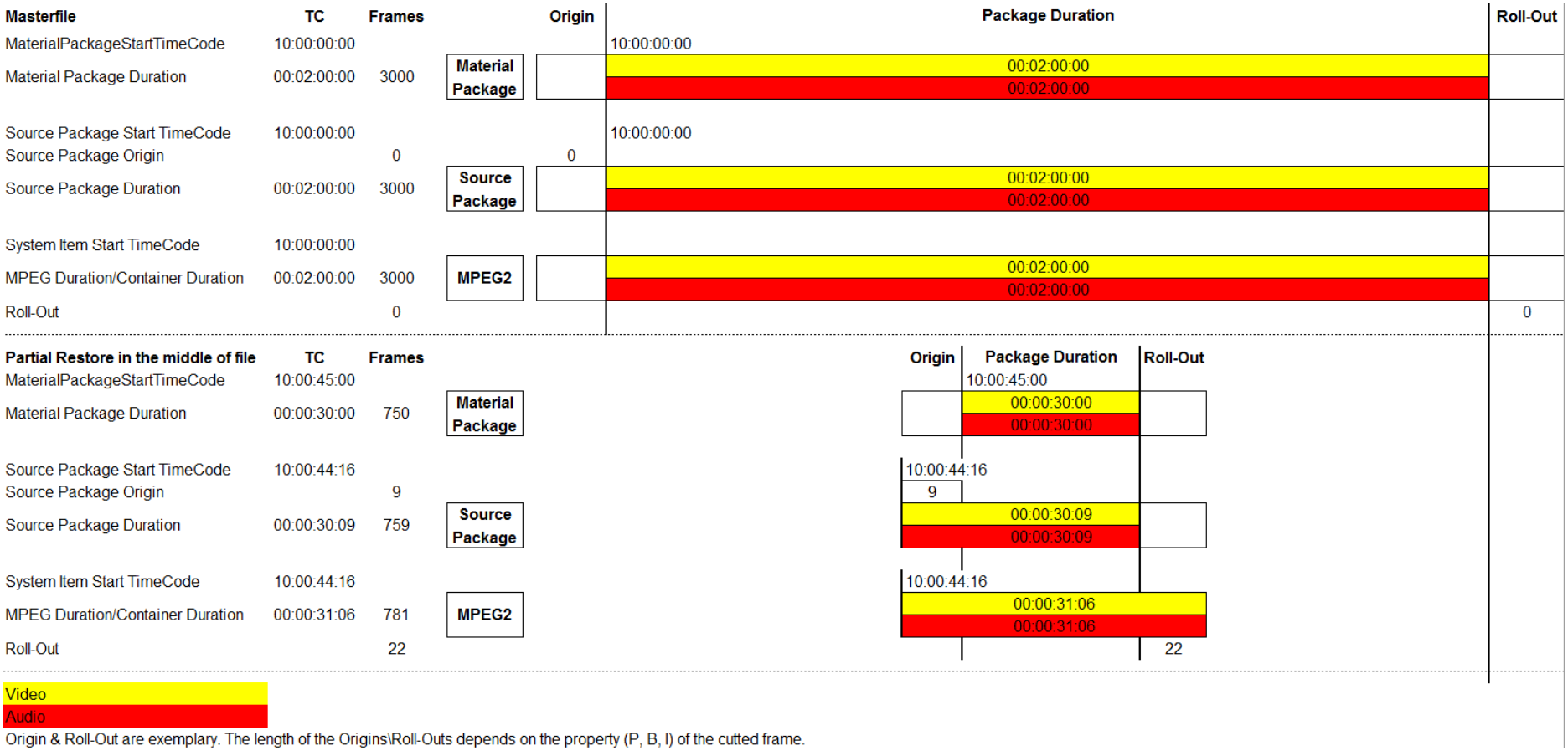
- Start Timecode Source Package = Start Timecode Material Package – Origin
- Timecode 1st System Item = Start Timecode Source Package
- "Rollout" = Container Duration – Component Length Source Package (SP Duration)
- Container Duration = Count of all included Edit Units which is the total length of the essence.
- Index Duration sum over all Index Table Segments = Container Duration

3 Appendix

Sample with different timecodes showing a Partial Restore including the first frame.

Origin & Roll-Out are exemplary. The length of the Origins\Roll-Outs depends on the property (P, B, I) of the cutted frame.

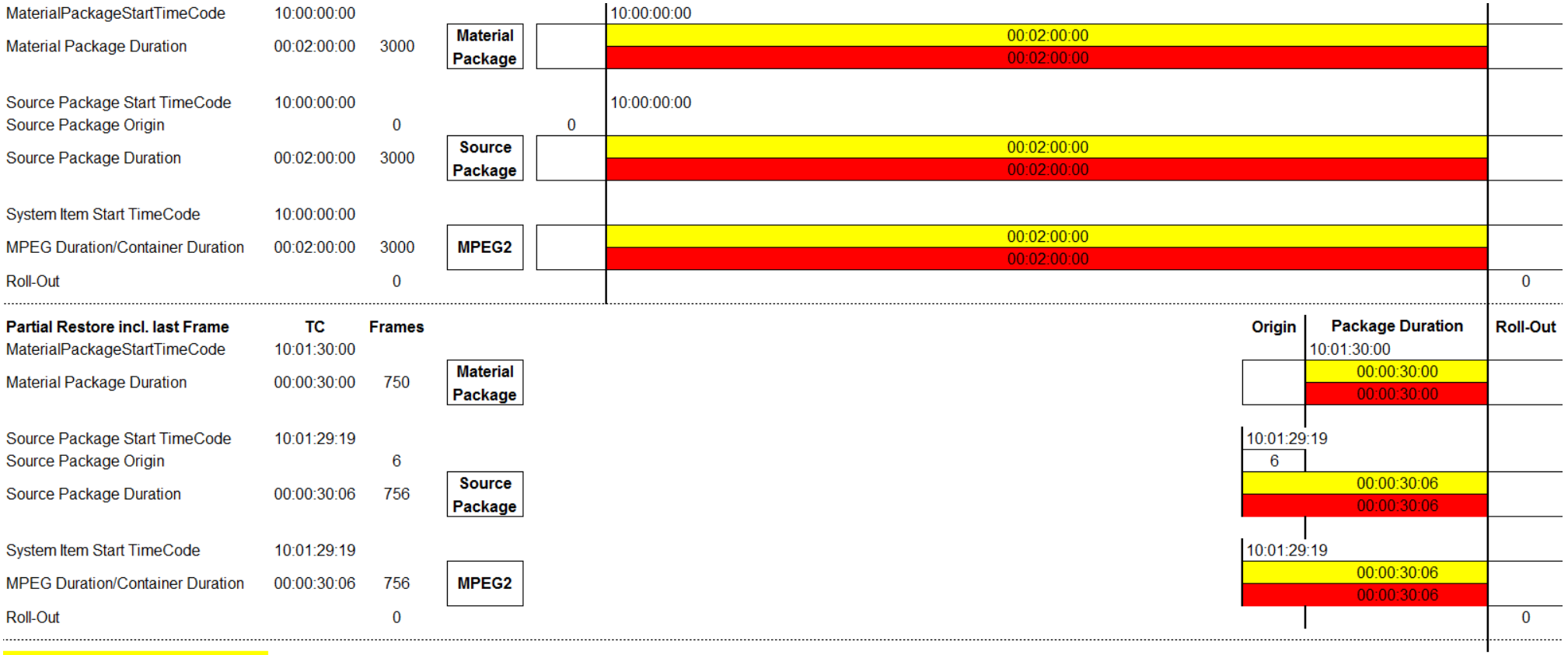
Sample with different timecodes showing a Partial Restore in the middle of the file.



Video
Audio

Origin & Roll-Out are exemplary. The length of the Origins\Roll-Outs depends on the property (P, B, I) of the cutted frame.

Sample with different timecodes showing a Partial Restore including the last frame.



Video
Audio

Origin & Roll-Out are exemplary. The length of the Origins\Roll-Outs depends on the property (P, B, I) of the cutted frame.

4 References

The following excerpts from the documents SMPTE st377-1:2011 and EBU R122-2010 are relevant in the scope of this document and are listed here for the convenience of the reader. Excerpts from SMPTE st377-1:2011 are cited with permission from SMPTE.

4.1 st377-1:2011, 9.4.2 The MXF timing Model, pages 62-63

[…]

1. The value of Edit Rate shall be identical for every timeline Essence Track of the Top-Level File Package. The value of Edit Rate of the timeline Essence Tracks of one Top-Level File Package need not match the Edit Rate of the Essence Tracks of the other Top-Level File Packages.
2. The value of Origin shall be identical for every timeline Essence Track of the Top-Level File Package.

The Origin Property of a File Package Essence Track shall be set to a non-negative value equal to the maximum number of Edit Units of stored Essence before the Zero Point.

[…]

For a Timecode Track with Origin equal 0, the timecode value at the Zero Point of the Track equals the start timecode value of the first Timecode Component. For a Timecode Track with a single Timecode Component and with origin N, where N greater than 0, the timecode value at the Zero Point of the Track equals the start timecode of the Timecode Component incremented by N units. […]

4.2 st377-1:2011, 9.5.3 Material Package, point 5

There shall be zero or one Timecode Track in a Material Package. […]

4.3 st377-1:2011, 9.5.3 Material Package, point 7

The value of the Origin Property of all Essence Tracks and all Timecode Tracks in a Material Package shall be zero.

4.4 EBU R122-2010 (v2.0), MXF Timecode implementation, page 9, point 2d

MXF encoders should generate a timecode track for each material package. For OP1a, OP2a, OP3a and OP Atom files, the default start timecode time address of the material package timecode track should be equal to the timecode time address of the source package position that is referenced by the start of the first material package source clip.

4.5 EBU R122-2010 (v2.0), MXF Timecode implementation, page 11

For generalized operational pattern files with one material package (i.e. OP1a, OP2a, OP3a, OP1b, OP2b, OP3b), the default package for accessing (e.g. playing) shall be the material package.

4.6 EBU R122-2010 (v2.0), MXF Timecode implementation, page 9

For OP1a, OP2a, OP3a and OP Atom files, the default start timecode time address of the material package timecode track should be equal to the timecode time address of the source package position that is referenced by the start of the first material package source clip.

4.7 EBU R122-2010 (v2.0), MXF Timecode implementation, page 13

Partial restore applications should preserve timecode such that [...] the timecode of the material package of the new file is equal to the corresponding timecode of the material package in the original file [...] the timecode of the source package of the new file is equal to the corresponding timecode of the source package in the original file and [...] the timecode in the essence container of the new file is equal to the essence container timecode of the corresponding material in the original file.

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