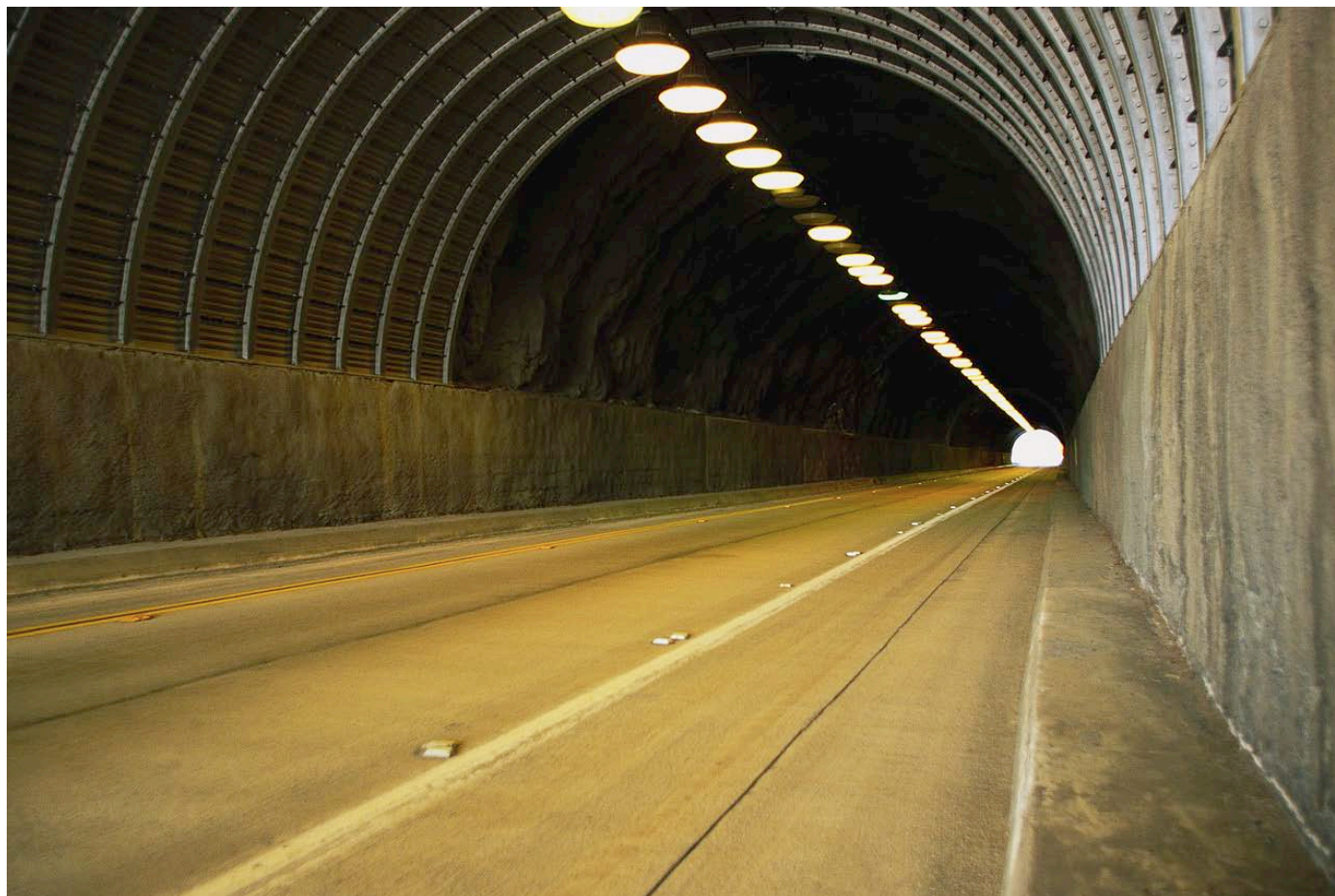# EBU webinar on MXF

Christoph Nufer

IRT, Production Systems Television

Welcome…

Agenda

MXF basics

MXF issues in daily use

MXF work in SP/HIPS

Update on standardisation activities (SMPTE)

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MXF history

EBU/SMPTE task force – final report 1998
User requirements for an open, standardised, flexible and extensible **wrapper format** that supports audiovisual **essence** and **metadata**

First SMPTE standards in 2004
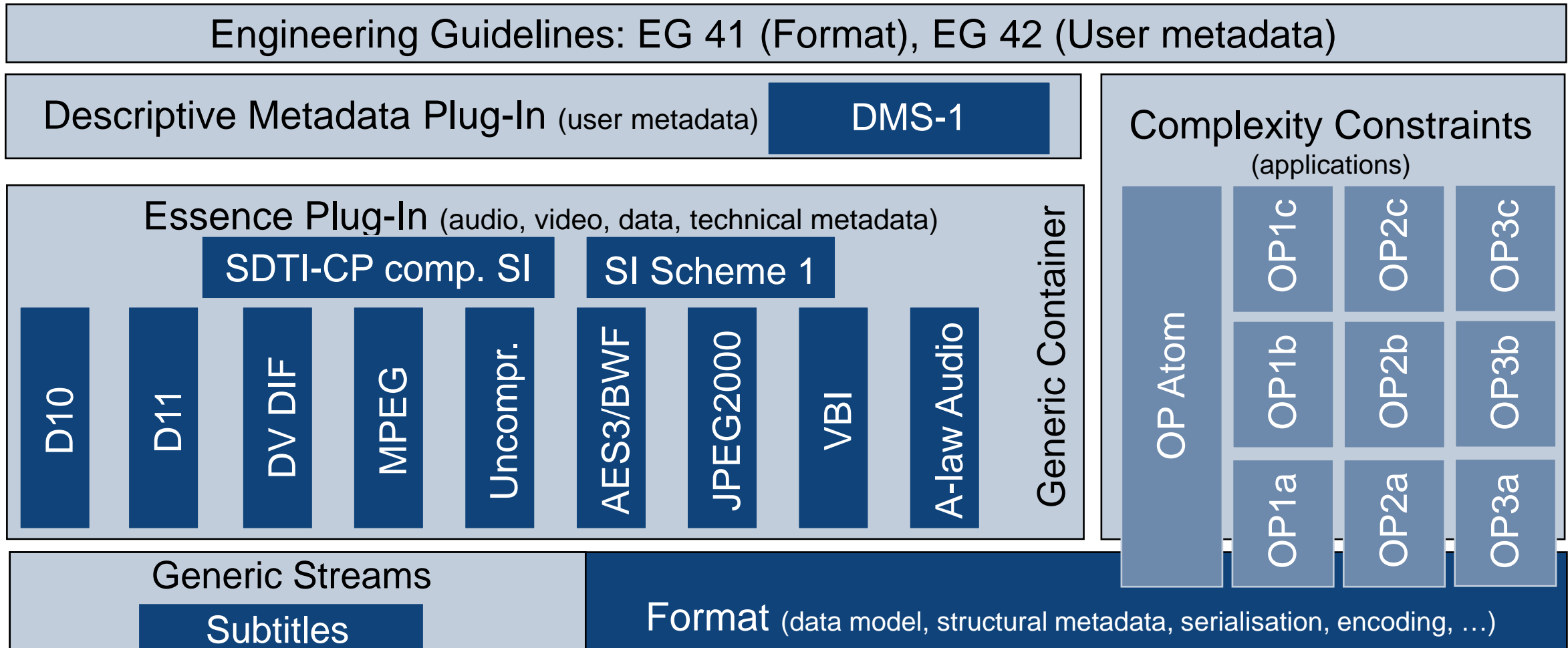New standards are added, old ones are being revised/ammended
Latest developments: http://mxf.irt.de/information/specification/

First products on the market 2003
Camcorder support since 2005
HD in MXF since ~2007

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MXF suite of standards

Engineering Guidelines: EG 41 (Format), EG 42 (User metadata)

Descriptive Metadata Plug-In (user metadata) — DMS-1

Complexity Constraints (applications)

Essence Plug-In (audio, video, data, technical metadata)

SDTI-CP comp. SI — SI Scheme 1

D10 | D11 | DV DIF | MPEG | Uncompr. | AES3/BWF | JPEG2000 | VBI | A-law Audio

Generic Container

OP Atom | OP1c | OP2c | OP3c | OP1b | OP2b | OP3b | OP1a | OP2a | OP3a

Generic Streams

Subtitles

Format (data model, structural metadata, serialisation, encoding, ...)
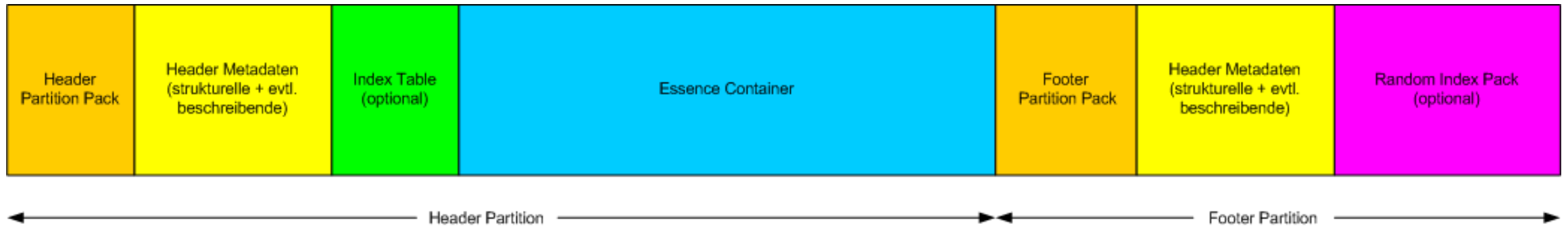
Building an MXF file

An MXF file consists of Essence and Metadata.
The diagram below illustrates the building blocks
of a generic method to generate an MXF file.

MXF Encoder Example

Three components:
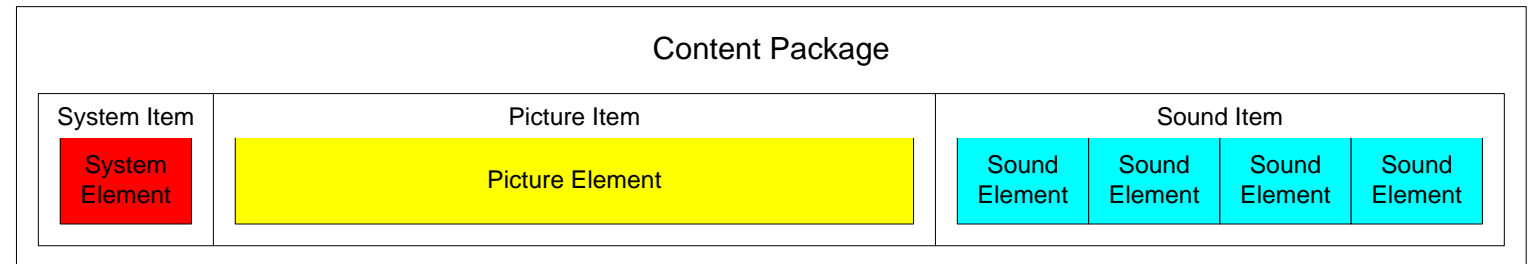 Header Metadata
  Index Tables
  Essence Container

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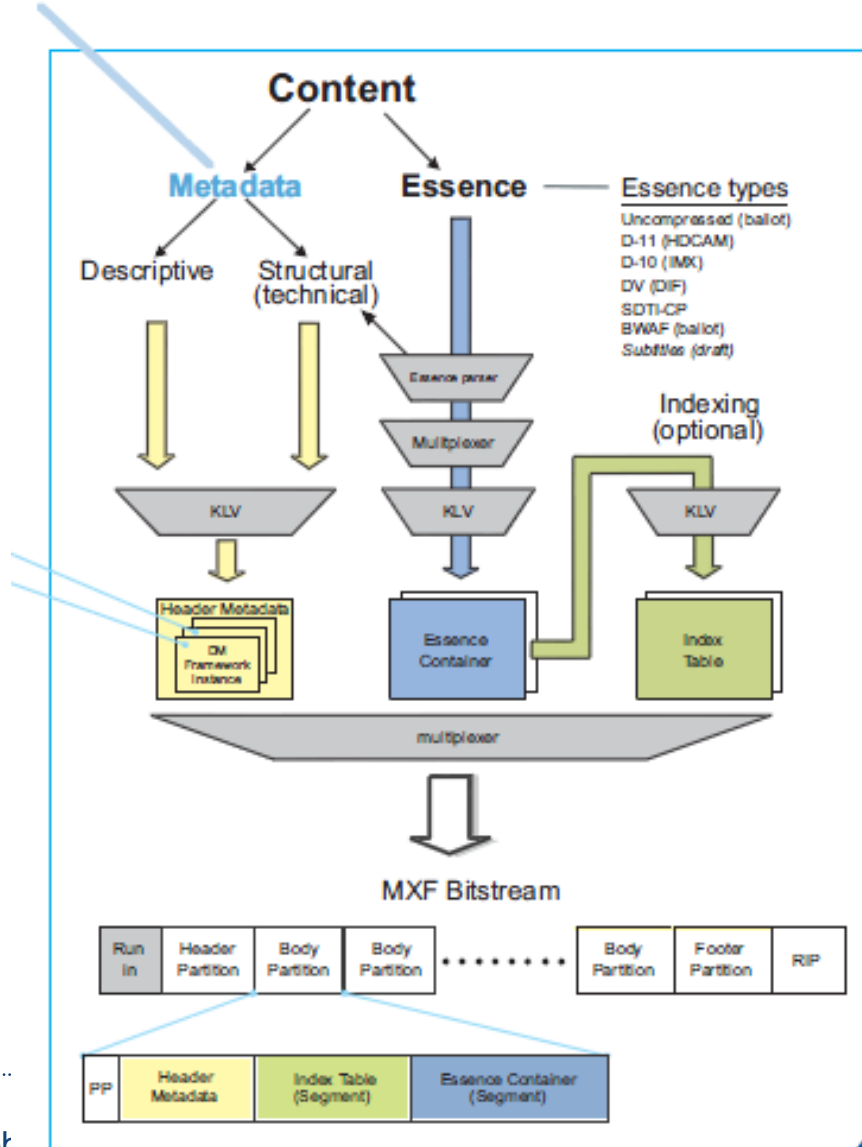
MXF file example

Example of a commonly used and simple MXF file structure.

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What is an Essence Container?

Storage location

internal or external

Content Package		
System Item	**Picture Item**	**Sound Item**
System Element	Picture Element	Sound Element / Sound Element / Sound Element / Sound Element

Structure

Essence Container consists of **Content Packages**
Content Package consists of **Items** (System, Picture, Sound, Data)
Item consists of **Elements** (1 Element = 1 KLV packet when frame wrapping)

System Item

Informationen about the structure of the Content Package
Timecode

Picture / Sound / Data / Compound Item

Picture, audio and data essence
Compound = multiplexed stream (e.g. DIF, MPEG-TS…)
128 elements max

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Excursion KLV encoding

Key Length Value (KLV)
Key (16 Byte) = Identification of packets
Length (4 Byte) = Lengh of payload
Value = the payload itself
Guarantees extensibility
SMPTE 336M

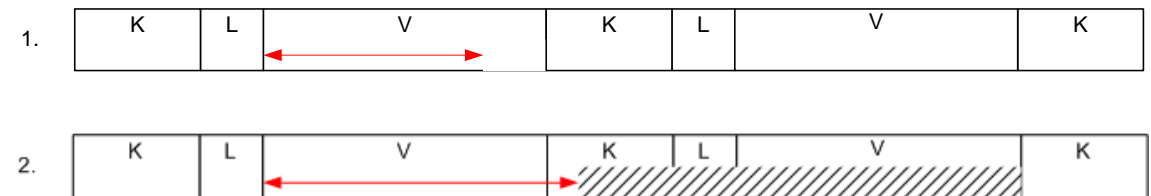**Visualisation**
Case 1) „Length" value is too small

Case 2) „Length" value is too big

„Dark metadata"
KLV key is not known to the MXF decoder
Decoder can skip dark Metadata
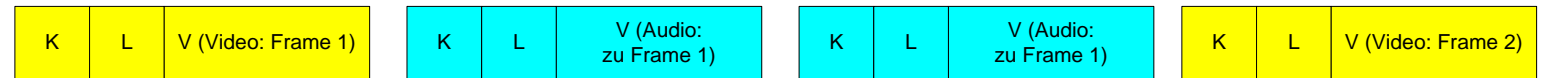Dark Metadata and/or Dark Essence can be
transported transparently

Angegebene Länge
Non-KLV Data

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Frame-based vs. Clips based wrapping

Frame-based wrapping
One frame per KLV packet
e.g. XDCAM

| K | L | V (Video: Frame 1) | | K | L | V (Audio: zu Frame 1) | | K | L | V (Audio: zu Frame 1) | | K | L | V (Video: Frame 2) |

Clip-based wrapping
Complete stream in one KLV packet
e.g. P2

| K | L | V (Video: Frame 1.. n) |

| K | L | V (Audio: zu Frame 1 .. n) |

Custom wrapping
Other fragmentation (e.g. one GOP per KLV packet)

Agenda

MXF basics

MXF issues in daily use

MXF work in SP/HIPS

Update on standardisation activities (SMPTE)

What are the reasons for interop issues?

MXF is a toolbox
(Too) many options in the MXF specifications
It is quite a challenge to build a robust decoder
There are still broken files around
Please help to bug vendors to produce 100% compliant files

Things are getting better
HD in MXF is progressing much faster then SD

Operational issues

Even if the files are interchanged succesfully, there are operational issued to be solved…
3 examples:

Timecode
Subtitles
Multi-channel audio

SP/HIPS is working on them

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MXF issues – Timecode

Timecode is crucial for television production since a long time!
It is an accurate address for frames. Many systems rely on this.

Place (Metadata, System Item, Essence)
Type
    SMPTE 12M – e.g. 10:00:00:00
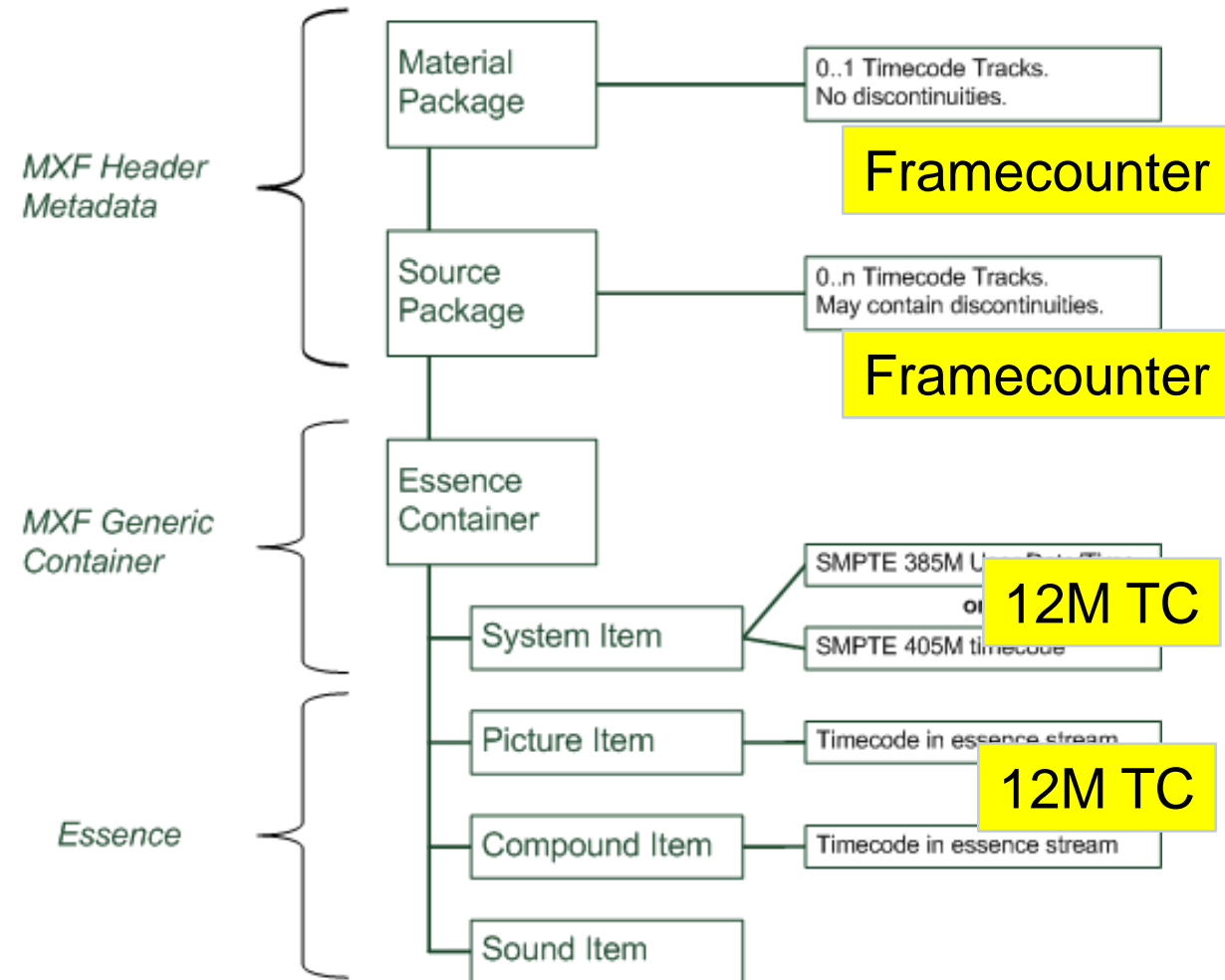   Frame counter – e.g. 900.000 (= 10:00:00:00 @25fps)
Characteristic
    Support for discontinuities?
    Support for user bits and binary group data?

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MXF issues – Timecode

Place
Type
Characteristics

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MXF issues – Timecode

Overview table

	Place	Type	Discontiuities	UG / BGD
Material Package	In Header Metadata	Frame counter	No	No
Source Package	In Header Metadata	Frame counter	Yes	No
System Item	In every edit unit	SMPTE 12M	Yes	Yes
Picture / Compound Item	In every edit unit	SMPTE 12M	Yes	Yes

UG = user groups
BGD = binary group data

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MXF issues – Timecode

Need for clarification and rules
　　In order to reach predictable behaviour
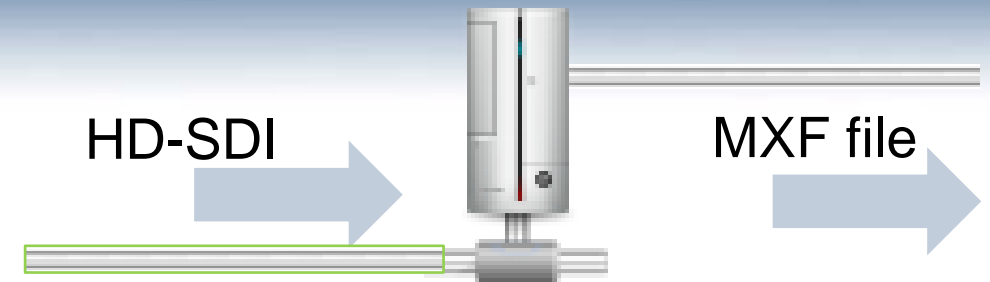　　In order to better interoperability

EBU R122-2007
　　Rules for MXF encoders
　　Rules for MXF decoders
　　Includes a documentation template
　　　　For planning departments, system integrators, manufacturers

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MXF issues – Timecode

HD-SDI

MXF file

Rules for MXF **encoder** (e.g. ingest station)
1. <u>Timecode source</u> must be selectable
    - VITC, LTC, ATC, control TC, preset TC
2. Timecode source must go into…
    - Source Package (frame accurat)
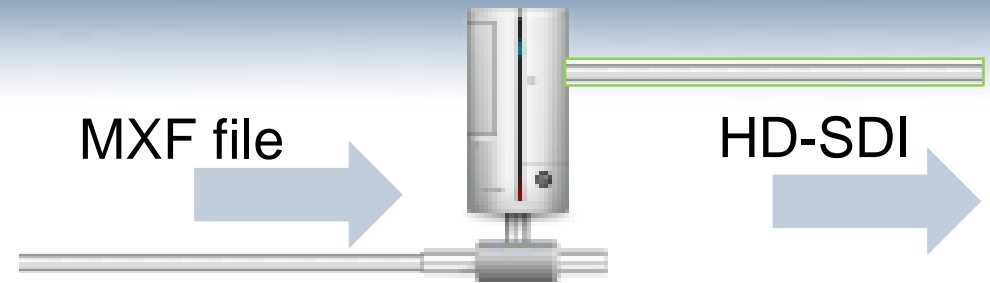   - Material Package (no discontinuities)

For frame-wrapped mapping…
- System Item (frame accurat)
- <u>Not</u> into the essence streams

For clip-wrapped mapping…
- Into the picture essence stream

MXF issues - Timecode

MXF file

HD-SDI

Rules for MXF **decoder** (e.g. playout server)
1. <u>Playable Timecode</u> must be taken from Primary Package
   - Material Package (OP1a)
   - Source Package (OP Atom)

2. Playable Timecode must go into…
   - LTC, VITC, ATC, extra API…

MXF issues - Timecode

Need for an updated version of EBU R122 in 2010

… support for higher framerates (30+ fps)

- Frame counters have no problem (Header Metadata)
- But SMPTE 12M only supports only up to 30 fps

=> Problem in System/Picture Item Timecode

=> use only half the edit rate, e.g. 25 fps instead of 50 fps

=> use of the field mark flag: 10:00:00:00* for SMPTE 12M timecodes

- Adding of HD codecs (AVC-I, DNxHD, MPEG-2 long GOP, J2K…)

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MXF issues – Subtitles

Definitions
- Captions
- Subtitles
- Open vs. closed
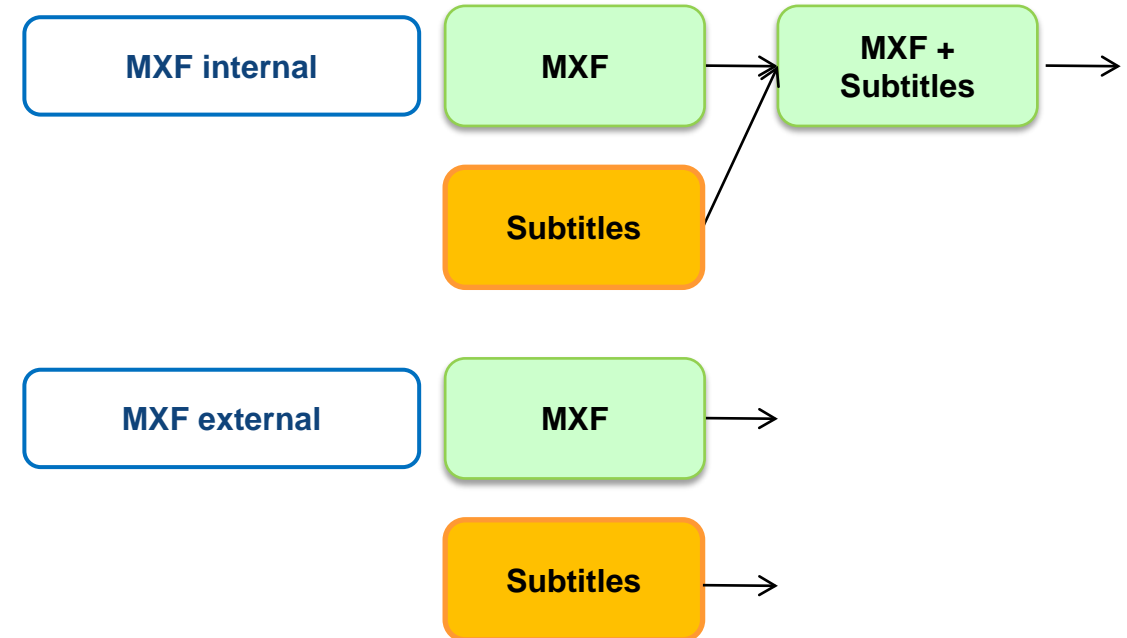- MXF internal
- MXF external

Subtitle formats
- STL (binary, EBU Tech 3264)
- TTML/DFXP (XML-based, EBU profile currently developed)

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Subtitles – MXF internal

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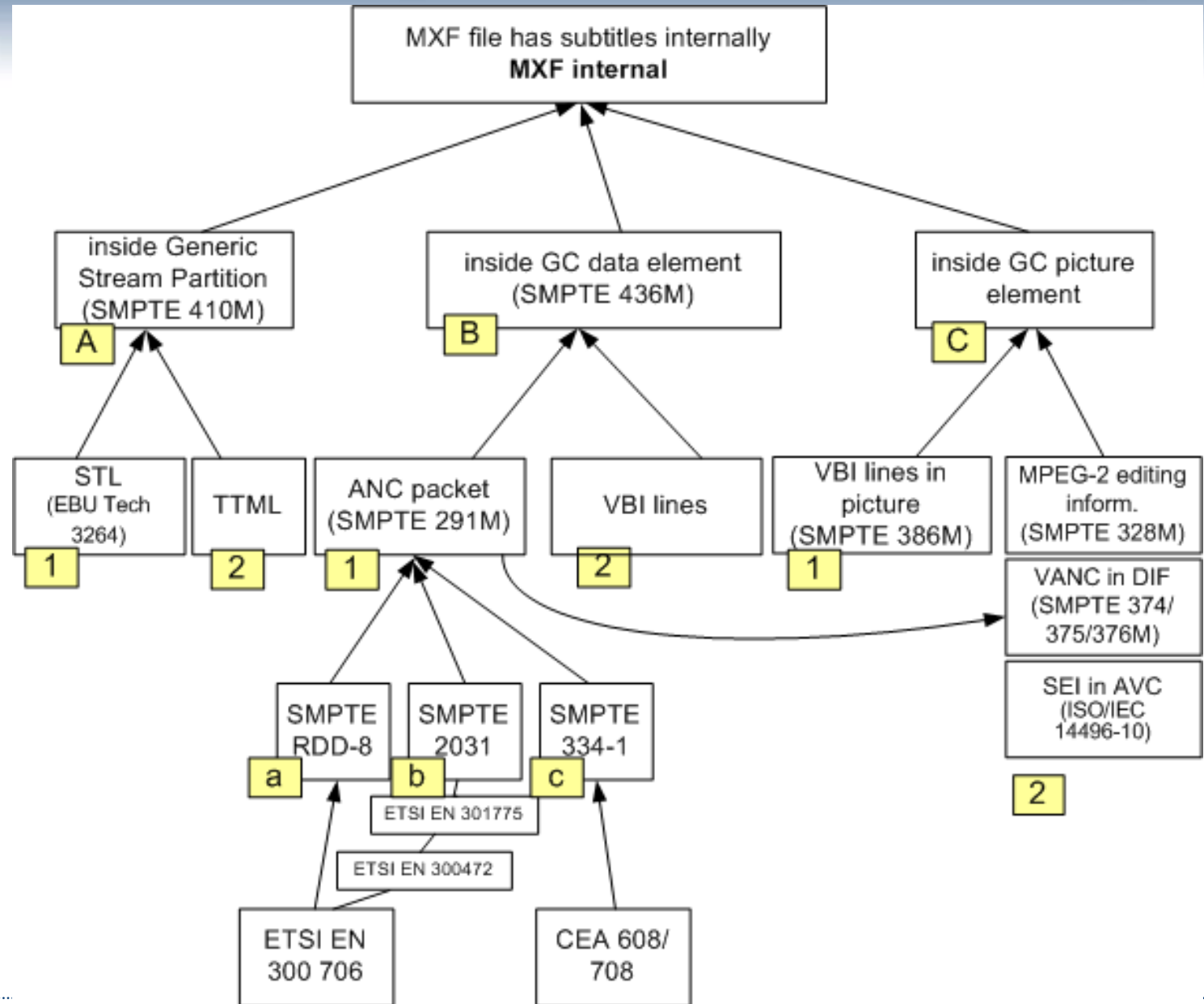
Subtitles – MXF internal

Inside one Generic Stream Partition	Header Partition	Body Partition	Body Partition	Body Partition	Generic Stream Partition holding Subtitle Data

Could be STL or DFXP as <u>one</u> blob

Inside Generic Container Data Elements	System	Picture	Sound	Data	System	Picture	Sound	Data	System	Picture	Sound	Data

ANC packets holding Subtitle data

Subtitles – MXF internal

Use Case	STL in SMPTE 410 (A.1)	TTML in SMPTE 410 (A.2)	SMPTE 436M (B.1)
Partial restore	-	-	+
Streaming	-	-	+
Adding subtitles to growing file	-	-	+
"Low latency" play-back	+	+	+
Editing	+	+	+
Easy to add/remove subtitles	+	+	-
Easy to add multiple languages	+	+	-
Late binding	+	+	-
Migrating from MXF external to MXF internal	+	+	-
Indicating the language	+	+	-

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Subtitles – MXF external

Recommendations
Use TTML/DFXP instead of STL
EC-I-DFXP is currently working
on an EBU DFXP profile

Linking mechanism has to be
established between the MXF
and subtitle file
Links shall be provided by a
central MAM system
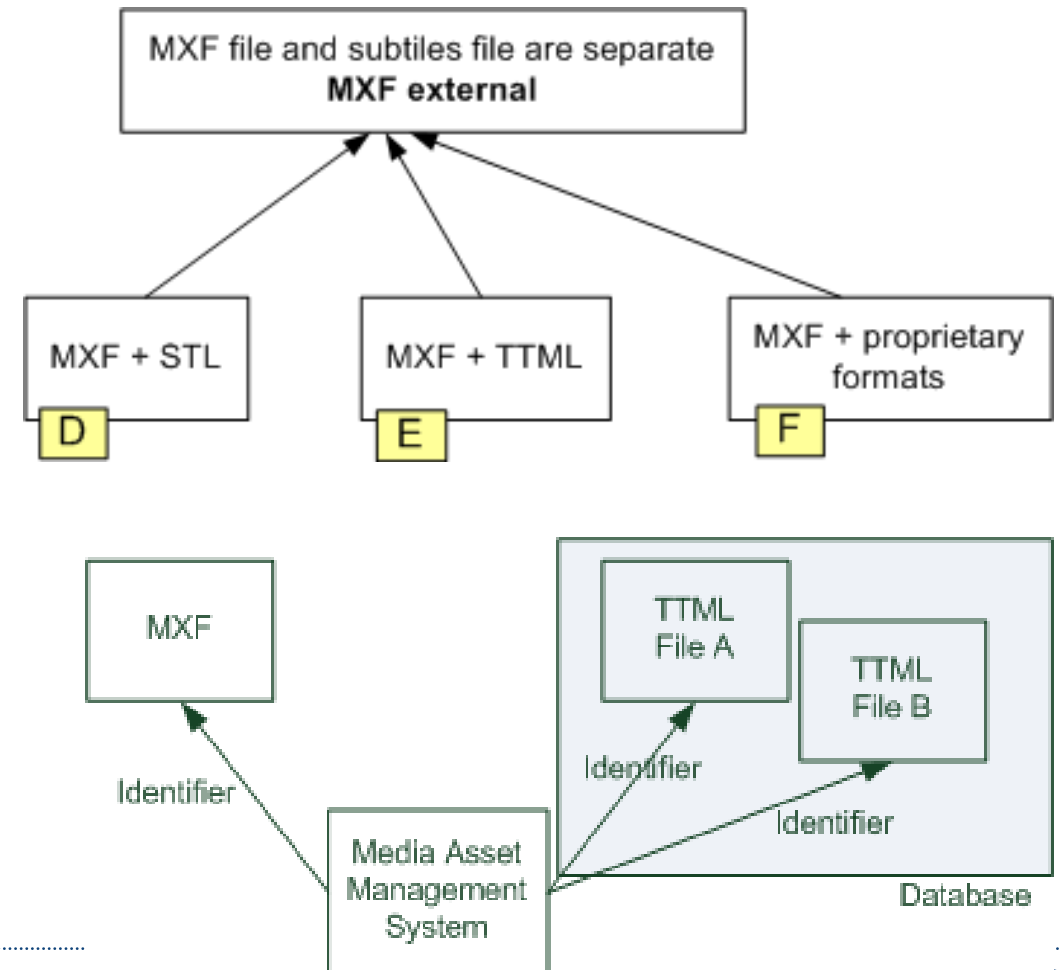
MXF and multi channel audio

There is need for MCA support
   Yesterday 4 channels
   Today 8 channels
   Tomorrow 16+ channels
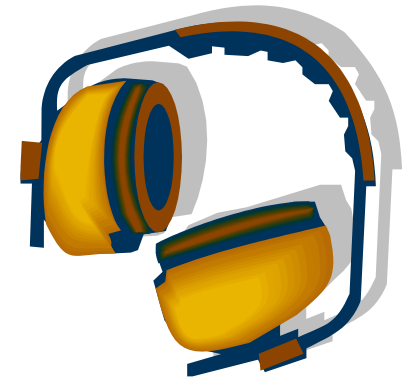MXF is not limited, but there are products…
Pitfalls
   When trancoding (HDCAM SR -> XDCAM)
   When performing audio post processing on a different machine
   When playing out on physical media
   When exchanging files with other broadcasters

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MXF and multi channel audio

What users <u>desperately</u> need:

1. Flexible labeling mechanism for audio tracks inside MXF files. (SMPTE is working on it…)

2. Support for 16+ audio channels in MXF equipment. Especially in post-production / playout / archive

3. Warning and a choice to select a sub-set of audio channels in case of fewer supported audio channels

Current MXF standardisation activities

- Multi Channel Audio in MXF (ongoing)
- STL in MXF (ongoing)
- 3D (stereographic pictures) in MXF (ongoing)
- VC-2 in MXF (started)
- TIFF in MXF (almost done) => Cinema DNG project
- MXF streaming (ongoing)
- SMPTE 377 amendment 1 (complete)
- Numerous 5-year reviews (ongoing)

SP/HIPS work on MXF

- Timecode in MXF – R122 has been updated
- Subtitles in MXF – Recommendation is almost done
- Multi Channel Audio – Communicate user's needs
- Discussion about an EBU MXF profile

- If you are interested in these topics and would like to contribute actively, please join us:
http://tech.ebu.ch/groups/phips_mxf

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For more information…

http://tech.ebu.ch/groups/phips_mxf

http://mxf.irt.de

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Thanks a lot! - Questions?