

Technical Specification

March 2017

ARD_ZDF_HDF02a
MXF Profile with AVC-I 100, 1080i/25
and 8 mono AES3 audio tracks

Version 1.2

© Publisher:



March 2017

Ständiges ARD-Büro

Bertramstraße 8
60320 Frankfurt/Main
Germany

phone: +49 69 59 06 07
fax: +49 69 155 20 75
e-mail: ard-buero@ard.de

Zweites Deutsches Fernsehen

ZDF-Straße 1
55100 Mainz (Mayence)
Germany

phone: +49 6131 70 0
fax: +49 6131 70 2157
e-mail: info@zdf.de

Österreichischer Rundfunk

Würzburggasse 30
1136 Wien (Vienna)
Austria

phone: +43 1 87878 0
fax: +43 1 87878 12738
e-mail: online@orf.at

ARTE G.E.I.E

Postfach 1980
77679 Kehl

Published on behalf of the above-named broadcast institutions by:

Institut für Rundfunktechnik GmbH (Broadcast Technology Institute)
Floriansmühlstraße 60
80939 München (Munich)
Germany

phone: +49 89 32399 204
fax: +49 89 32399 205
e-mail: presse@irt.de
web site: www.irt.de

Copyright Notice

This document and all its contents are protected by copyright law. IRT reserves all its rights. You may not alter or remove any trademark, copyright, or other notice.

Institut für Rundfunktechnik has granted its client the right to distribute to third parties and to publish (also electronically solely in non-editable and non-copyable.pdf format) this complete and unchanged document.

Translation and modification of any parts of this document as well as the distribution of excerpts requires the prior written permission of Institut für Rundfunktechnik.

ARD_ZDF_HDF02a

MXF Profile with AVC-I 100, 1080i/25 and 8 mono AES3 audio tracks

March 2017

This document defines an MXF Profile with AVC-I 100, 1080i/25 and 8 mono AES3 audio tracks. It reflects the requirements of ARD, ZDF, ORF and ARTE for the use cases “exchange between broadcasters” and “external delivery”.

Contents

1. Introduction	4
1.1 General Remarks	4
2. Conformance Notation	5
3. Specification of MXF file properties	6
3.1 AVC Average Bitrate and AVC Maximum Bitrate	6
3.2 Metadata element “Forward Index Direction”	6
3.3 Handling of Header Metadata	7
3.4 Property Specifications.....	7
4. Recommended practices (informative)	14
4.1 Recommended usage of timecode in ARD_ZDF_HDF02a	14
4.2 Recommended usage of the Identification Set	14
4.3 Audio channel assignment.....	14
4.4 Operational specifications for ARD ZDF and ORF	14
5. Appendix B: Additional Decoder requirements (informative)	15

1. Introduction

The specification provided in this profile was developed within the working group Quality Management (WG QM), a group of the K-Prod/FSBL. The WG QM had the task to investigate and give recommendations on quality management in file based production. In particular, it should provide solutions for interoperability problems with MXF-files.

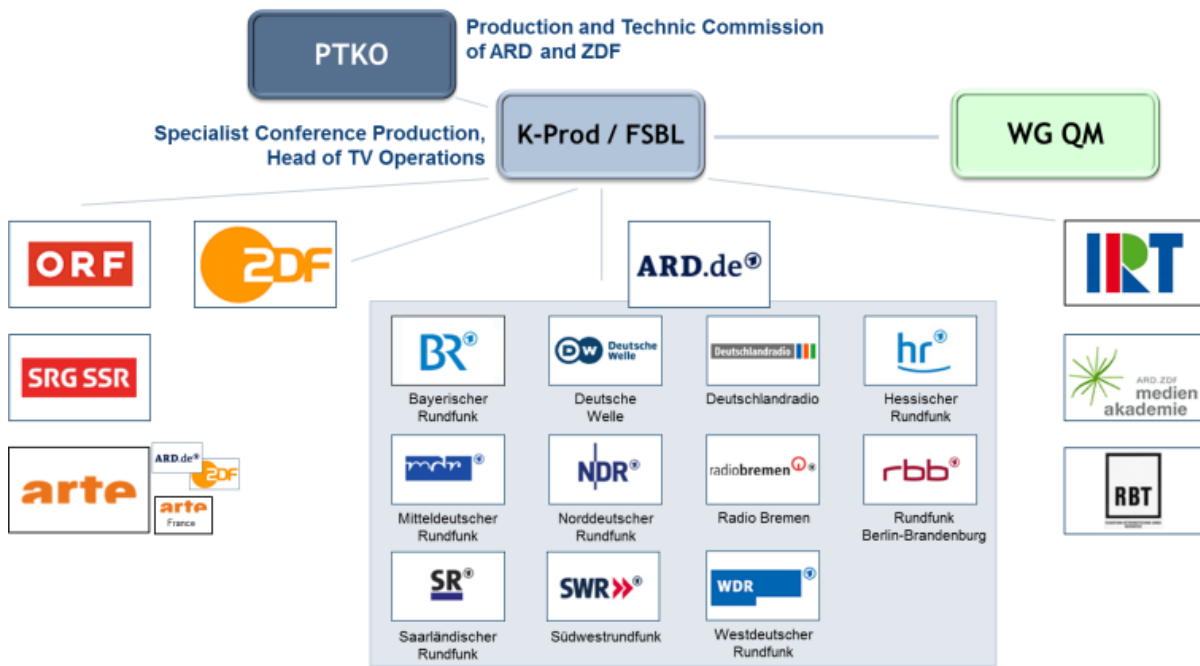


Figure 1 - Organisation of the working group Quality Management.

Findings lead to the specification of profiles for MXF-Files. These MXF-Profiles are the basis for the reduction of interoperability problems and a solid ground for automated quality control using file based QC-Tools.

The scope of this profile comprises the use cases “exchange between broadcasters” and “external delivery”. The profile is in line with the relative user requirements for exchange and external delivery. It additionally matches the relevant aspects from the Technical Production Guidelines (TPRF-HDTV) of ARD, ZDF and ORF.

1.1 General Remarks

- The WG QM publishes the following profiles

ARD_ZDF_HDF01a	XDCAM HD422, 1080i/25, 8 mono AES3 tracks
ARD_ZDF_HDF01b	XDCAM HD422, 1080i/25, 16 mono AES3 track
ARD_ZDF_HDF02a	AVC-I 100, 1080i/25, 8 mono AES3 tracks
ARD_ZDF_HDF02b	AVC-I 100, 1080i/25, 16 mono AES3 tracks
ARD_ZDF_HDF03a	AVC-I 100, 720p/50, 8 mono AES3 tracks
ARD_ZDF_HDF03b	AVC-I 100, 720p/50, 16 mono AES3 tracks

- In this document, the file parameter “Frame Layout” is specified following the common practice in most of the current implementations. The definition of “Frame Layout” in the standard st377-1:2011 was not found to be unambiguous. This may result in different interpretations.

2. Conformance Notation

This document contains both normative text and informative text.

All text is normative except for that in the Introduction, and any section explicitly labelled as 'Informative' or individual paragraphs which start with 'Note:'

Normative text describes indispensable or mandatory elements. It contains the conformance keywords 'shall', 'should' or 'may', defined as follows:

'Shall' and 'shall not': Indicate requirements to be followed strictly and from which no deviation is permitted in order to conform to the document.

'Should' and 'should not': Indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others.
OR
indicate that a certain course of action is preferred but not necessarily required.
OR
indicate that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

'May' and 'need not': Indicate a course of action permissible within the limits of the document.

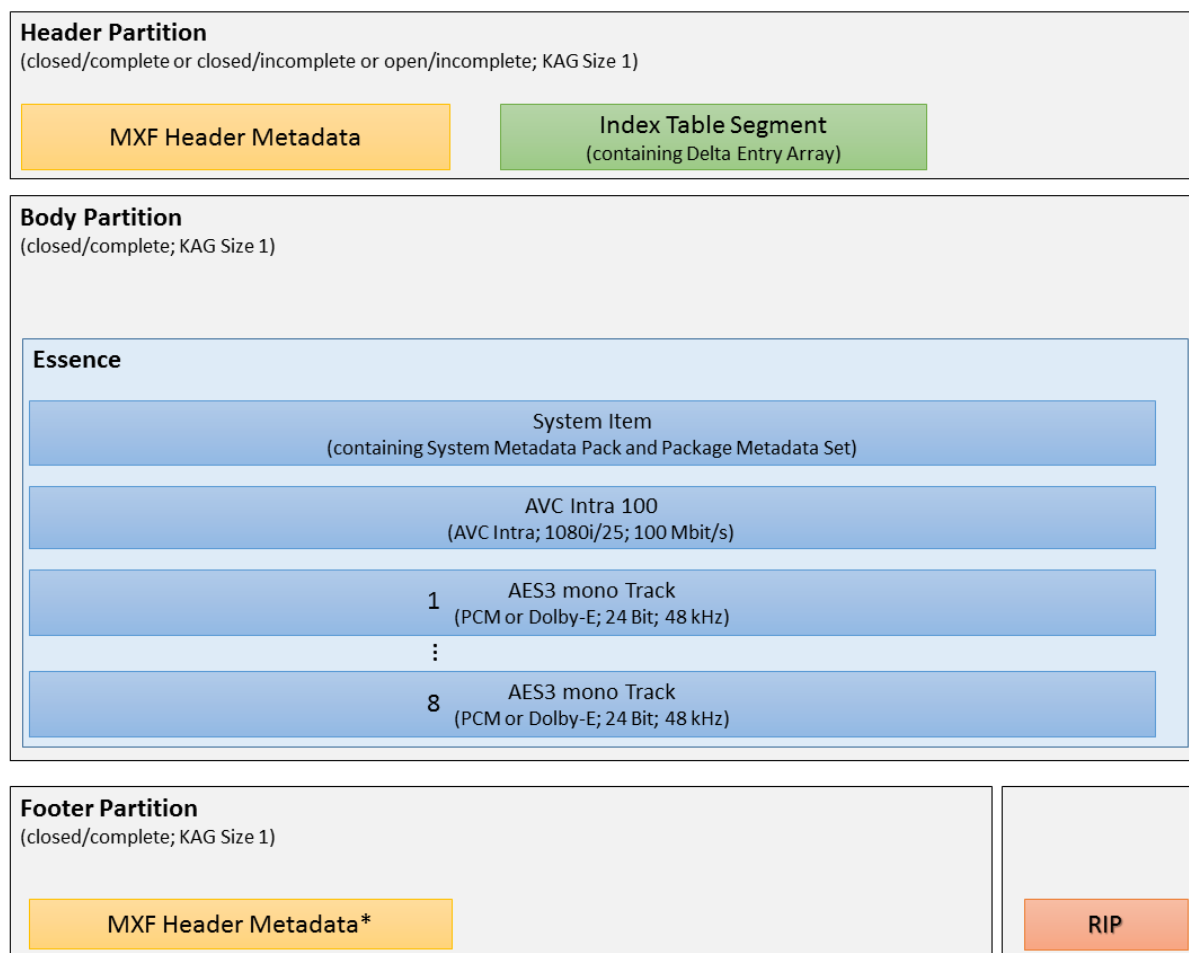
Informative text is potentially helpful to the user, but it is not indispensable and it does not affect the normative text. Informative text does not contain any conformance keywords.

3. Specification of MXF file properties

This section contains the core specification for the MXF profile ARD_ZDF_HDF02a. The MXF profile provides further restrictions to the MXF standards as defined by SMPTE in st377-1:2011, Amendment 2:2012 to SMPTE ST 377-1:2011, st381-2:2011 and st382:2007. These standards always apply if not explicitly stated otherwise.

To match the ARD_ZDF_HDF02a Profile an MXF file shall comply with all parameters specified in this document.

Figure 2 gives an overview of the MXF file structure according to the profile specified by this document.



* if Header Partition Status open/incomplete or closed/incomplete

Figure 2 - Structure of the MXF file according to MXF-Profile ARD_ZDF_HDF02a

Note: Not all specified parameters represent concrete items in the MXF Header Metadata. Thus, some parameters might be difficult to check automatically with Quality Control Tools.

Note: Some parameters specify values that do not restrict the MXF Standards any further. They are listed to express explicitly that all values are supported or that they shall be present.

3.1 AVC Average Bitrate and AVC Maximum Bitrate

In relation to the ARD_ZDF_HDF profiles a tolerance range between 110.000.000 and 115.000.000 Bit/s is accepted for the actual value of AVC Average Bitrate and AVC Maximum Bitrate.

3.2 Metadata element “Forward Index Direction”

The metadata element “Forward Index Direction” signals if “all Index Table Segments that compose one complete Index Table precede Essence Container Segments” (st377-1:2011 Am2:2012).

That is true for the Index Table instance in the Body Partition(s), but false for the optional Index Table instance in the Footer Partition.

In that matter, an MXF file is considered conform to ARD_ZDF_HDF if the following conditions are met:

- When the SID of the Index Table in the Footer Partition differs from the one in the Body Partition(s), it is considered a separate Index Table. That means all metadata must be set separately for each instance of the Index Table. Thus, the value for “Forward Index Direction” in the Footer Partition is “false”.
- When the SIDs of the Index Table in the Footer Partition and the Body Partition(s) are identical, it is considered an Index Table repetition. In that case both variations may be used: Either complete Index Table Segments are copied (including their metadata elements), or metadata is set separately for each instance of the Index Table.

3.3 Handling of Header Metadata

For the avoidance of doubt, it is stated that Header Metadata handling shall be compliant to st-377-1:2011.

In addition to st-377-1:2011, this profile specifies further requirements for Header Metadata:

- Metadata Elements which are defined as “Optional” by st-377-1:2011 (Optional Metadata) but are specified by this profile, shall be present and set with their correct value at latest in the Header Metadata of the Footer Partition.
- Optional Metadata that are present in both Header Partition and Footer Partition shall be consistent (i.e. have the same value) in both partitions.
- Optional Metadata that cannot be written correctly in the Header Metadata of the Header Partition, e.g. because of “on the fly handling”, shall only be present in the Header Metadata of the Footer Partition.
- Metadata Elements that are defined as “Best Effort” by st-377-1:2011 (Best Effort Metadata) may be set to their distinguished value in the Header Partition. Then the status of the Header Partition is “Incomplete”.
- If the status of the Header Partition is “Closed, Complete”, the Header Partition shall also include all Optional Metadata Elements that are specified by this profile.
- The status of the Footer Partition shall be “Closed, Complete”.
- If the status of the Header Partition is not “Closed, Complete”, the Footer Partition shall include all Metadata Elements (i.e. Required Metadata, Best Effort Metadata and Optional Metadata specified by this profile) with their correct values.
- Header Metadata shall not be present in Body Partitions.
- Optional Metadata that are not specified by this profile may be present.
- All Descriptor Metadata Elements that are part of the MXF Header Metadata shall be consistent with the corresponding essence as well as with the corresponding metadata elements in the essence stream(s). Note that some metadata elements that are mandatory in this profile may not be present in the essence stream and thus, may need to be calculated when the MXF file is created.

3.4 Property Specifications

The following table gives an overview of the nomenclature used for the parameter specification.

Type	Description	Example Notations
Concrete Values	Designates those values that directly represent a value in the MXF file, are written in italic letters. Depending on the context, they can be expressed in decimal, hex or binary numbers, or as true or false.	“24”, “060e2b34.04010101.0d010301.02060300”
Description	Descriptions for concrete values are written in round brackets after the value itself.	“130 (= 422P@HL)”
Value ranges	If more than one value is valid in the Profile all possible values are listed in square brackets, separated with a	“[true, false]”, “[1-12]”

	comma. Or they are listed as a range with "-" between the smallest and highest possible value.	
Plain text	Explanation of the corresponding property of the MXF File.	"Shall be present", "8 AES Audio Tracks (containing PCM or Dolby-E)"

The following table contains the MXF file properties specified by this Profile.

The Property Name column includes information about related EBU QC Item ID(s) wherever possible. For further information on EBU QC refer to "<https://ebu.io/qc/>".

Property Name	Property Specification
Profile short description	
Type	MXF OP1a / AVC-I 100
MXF structure [20W]	Header partition, complete Essence in one Body partition, Footer partition
Essence Mapping [19W]	According to SMPTE st381-3:2013 and SMPTE st382:2007
Generic Container [22W]	Frame-based mapping according to SMPTE 379-2:2010
Video Coding Syntax [36F]	AVC-I 100 (according to RP2027:2012, Class 100 Specification using the High 4:2:2 Intra Profile)
Scanning raster [48W, 42W]	1080i/25
Audio	8 AES Audio Tracks (containing PCM or Dolby-E)

General	
File format [252W]	MXF (SMPTE st377-1:2011) - Version 1.3 Major Version: 1 Minor Version: 3 Preface Version: 259
Operational Pattern [25W]	OP1a (SMPTE st378:2004)
Is RIP Present [200W] (Amendment 2:2012 to SMPTE st377-1:2011)	True
Header Partition Status [63W]	Closed, Complete (preferred) / Closed, Incomplete / Open, Incomplete
Body Partition Status [63W]	Closed, Complete
Body partition duration [65W, 150W]	Variable (shall be equal to the duration of the Essence)
Footer Partition Status [63W]	Closed, Complete
KAG Size [151W]	1 (consistent for all Partition Packs)
Header Metadata in Header Partition [117W]	The size of header metadata in Header Partition shall be at least 2 000 000 Byte. The size can be achieved using one or more KLV Fill Items
System Item [152W]	Shall be present (SMPTE st326:2000 and st385:2004) includes System Metadata Pack and Package Metadata Set
Essence location [116W]	No Essence in Header Partition. Complete Essence in one Body Partition.

Index table location [64W, 153W]	The Index Table segment shall be located in the Header Partition (Forward Indexing). The Index Table segment may be repeated in the footer partition.
Header Metadata Location [155W]	Header Metadata shall be present in the Header Partition. Refer to chapter “3.3 Handling of Header Metadata” for further information.
Descriptive Metadata [97W]	Shall not be present
Random Index Pack [118W]	Shall be present
Essence Elements in Essence Container	Shall be in the order: System Item, Picture Item, Sound Item. The Sound Elements within the Sound Item shall be in the order: Audio Essence Element 1, [...], Audio Essence Element 8. ¹
Tracks in Material Package [29W]	The Material Package shall contain 1 Timecode Track, 1 Video Track, 8 Audio Tracks. The track order shall be the same as defined for tracks in the source package. ¹
Tracks in Source Package [30W]	The Source Package shall contain 1 Timecode Track, 1 Video Track, 8 Audio Tracks. The track order shall match with the order of the essence elements in the essence container. ¹
Timecode Material Package [26W]	Shall be present
Timecode Source Package [26W]	The Timecode Track shall contain one Timecode Component Set. The start value shall match with the timecode value of the first System Item.
Timecode System Item [26W]	Shall be present

Index Table Segment Set	
Index Edit Rate [201W]	25 / 1
Index Start Position [202W]	0
Index Duration	Shall either be set to 0 or to the total number of Edit Units in the Essence Container.
Edit Unit Byte Count	Constant (within the MXF file)
Slice Count	0
Single Index Location	True
Single Essence Location	True
Forward Index Direction	[False, True]
Delta Entry Array	Shall be present and complete

Timeline Track	
Edit Rate [211W]	25 / 1
Origin (Pre-Charge) [54W]	0

¹ In order to have the possibility to link an audio track to an external channel assignment (e.g. from Technical Production Guidelines).

Video	
Essence Container Label (Video essence mapping) [212W]	060e2b34.0401010a.0d010301.02106001 (= MXF-GC AVC Byte Stream With VideoStream-0 SID Frame-wrapped)
Picture Element Key [165W]	060e2b34.01020101.0d010301.15010500 (= MXF Generic Container Version 1 SMPTE 381M MPEG Frame-Wrapped Picture Essence)
CDCI Descriptor [157W]	
Picture Essence Coding [105W]	060e2b34.0401010a.04010202.01323102 (= H.264/MPEG-4 AVC High 422 Intra RP2027 Constrained Class 100 1080/50i Coding)
Aspect Ratio [69W]	16 : 9
Sample Rate [42W]	25 / 1
Container Duration [40W]	Shall be present and identical with audio Container Duration
Field Dominance [41W]	1 (= Field 1 is first in temporal order)
Signal Standard [162W]	4 (= HD422 1920x1080, 23.98p/25p/29.97p/50i/59.94i)
Frame Layout [214W]	1 (= separate_fields)
Display Width x Display Height [43W]	1920 x 540
Sample Width x Sample Height [163W]	1920 x 540
Stored Width x Stored Height [70W]	1920 x 544
Stored F2 Offset [161W]	0
Sampled X Offset [161W]	0
Sampled Y Offset [161W]	0
Display X Offset [161W]	0
Display Y Offset [161W]	0
Display F2 Offset [161W]	0
Active Format Descriptor [1W]	binary value: 0000 0100 (= undefined, aspect ratio 16:9) binary value: 0010 0100 (= letterbox, aspect ratio 16:9) binary value: 0100 0100 (= full frame, aspect ratio 16:9) binary value: 0100 1100 (= pillarbox, aspect ratio 16:9)
Video Line Map [159W]	21, 584 (= for Interlace)
Transfer Characteristic / Capture Gamma [83W, 215W]	060e2b34.04010101.04010101.01020000 (= ITU-R BT 709; HD color triangle, gamma etc.)
Image Start Offset	0
Image End Offset	0
Color Siting [217W]	0 (= coSiting as in ITU-R Rec 601)
Padding Bits	0
Black Ref Level [219W]	64
White Ref Level [220W]	940

Color Range [221W]	897
Horizontal Subsampling [34W, 222W]	2 (= 4:2:2)
Vertical Subsampling [34W, 223W]	1 (= 4:2:2)
Component Depth [32W]	10 bit
SubDescriptor	Reference to AVC Sub Descriptor (see below)
AVC Sub Descriptor (st 381-3:2013) [157W]	
AVC Decoding Delay	0
AVC Coded Content Kind	Shall be present
AVC Identical GOP Indicator	True
AVC Maximum GOP Size	1
AVC Maximum B Picture Count	0
AVC Maximum Bitrate	ca. 112 000 000 Bit/s (according to RP 2027:2012)
AVC Average Bitrate	ca. 112 000 000 Bit/s (according to RP 2027:2012)
AVC Profile	122 (= High 4:2:2 Intra)
AVC Profile Constraint	<i>binary value: 0001 0000</i> (signals conformance to the "High 4:2:2 Intra" encoding profile and it's constraints. See ISO-IEC 14496-10 2010)
AVC Level	41 (= Level 4.1)
AVC Sequence Parameter Set Flag	<i>binary value: 1010 0000</i> (= is present in every frame)
AVC Picture Parameter Set Flag	<i>binary value: 1010 0000</i> (= is present in every frame)

Audio	
Essence Container Label [212W] (Audio essence mapping)	<i>060e2b34.04010101.0d010301.02060300</i> (= MXF-GC Frame-wrapped AES3 audio data)
Sound Element Key [166W]	<i>060e2b34.01020101.0d010301.1608030x</i> (= MXF Generic Container Version 1 SMPTE 382M AES Frame-wrapped Sound Essence, "x" depends on the audio track)
Audio channels per Sound Element [164W]	One channel per AES Sound Element.
Audio Descriptor (AES3AudioEssenceDescriptor, st382:2007) [157W]	
Sound Essence Coding [230W] / Sound Essence Compression	PCM: <i>060e2b34.0401010A.04020201.01000000</i> (= PCM) Undefined: <i>060e2b34.04010101.04020201.7f000000</i> (= Uncompressed Sound Coding, Undefined Sound Coding) Dolby-E: <i>060e2b34.04010101.04020202.03021c00</i> (= Dolby-E Compressed Audio)
Sample Rate	48000 / 1

Container Duration [9W]	Shall be present and identical with video Container Duration
Audio sampling rate [13W]	48000 / 1
Locked/Unlocked [231W]	1 (= locked)
Dial Norm	If available the correct gain to be applied to normalize perceived loudness of the clip, defined by ITU-R BS.1770-4:2015
Audio Ref Level	If the value is known, it shall be present
Channel Count [164W]	1
Quantization bits [3W]	24
Block Align [234W]	3 (= 24 Bit)
Average Bytes per Second (AvgBps) [235W]	144 000 Byte/s
Channel Status Mode (Byte Pattern) [236W]	00 00 00 01 00 00 00 01 02 (= standard) 00 00 00 01 00 00 00 01 01 (= minimum, for PCM only) ²
Fixed Channel Status Data (for PCM Audio) [146W]	00 00 00 01 00 00 00 18 85 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 60 (= standard mode, Professional Use, Linear PCM, No Emphasis, 48kHz Sampling, the CRCC value: 60) 00 00 00 01 00 00 00 18 85 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 (= minimum mode, Professional Use, Linear PCM, No Emphasis, 48kHz Sampling)
Fixed Channel Status Data (for Dolby-E) [164W]	00 00 00 01 00 00 00 18 83 00 04 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 39 (= Professional Use, Non-PCM, No Emphasis, 48kHz Sampling, No indicated Channel Mode, No User Information indicated, Max. Audio Sample Word Length: 24 bit, Encoded Audio Sample Word Length: not indicated, CRCC value: 39)

Ancillary Data	
Data content (EssenceContainers) [93W]	Shall not be present

² It is recommended to always use standard mode. In minimum mode only an audio sample word length of 20 Bit can be signalled which does not match the specification in this document.

Other	
Dark Metadata [114W]	Private user data (Metadata Class 14) shall not be present. Only SMPTE Metadata Classes 1-7 and 13 are allowed.

4. Recommended practices (informative)

4.1 Recommended usage of timecode in ARD_ZDF_HDF02a

The MXF format supports different locations for carrying timecode information, including the System Item, the Material Package and the Source Package. In order to allow for decoders to generate output timecode consistently, the EBU published a recommendation for an encoding of source timecode into MXF files (EBU R122 Version 2.0, November 2010). The specification ARD_ZDF_HDF02a refers to the guideline provided by EBU R122.

R122 states that ‘the source timecode track should contain a frame-accurate representation of the source timecode time addresses’ [EBU R122, section 2c]. In case of a discontinuous timecode source this is achieved by creating multiple Timecode Component Sets. However, in scope of ARD_ZDF_HDF02a the usage of a single Timecode Component Set was found to be more applicable (refer to “Source Package Timecode”, section 3). Thus, in ARD_ZDF_HDF02a, a frame-accurate representation of the source timecode is only present in the System Item Timecode.

4.2 Recommended usage of the Identification Set

The Identification Set can be very useful for a user especially for error tracing. For example, in cases of interoperability problems it can provide information that helps the user to locate the cause.

The Identification Set contains basic information about the system that was used to create or modify the MXF file. According to ST377-1:2011 an Identification Set must be written every time an MXF File is created or modified. In case of modification a new Identification Set is appended to the existing one(s). However, some of the information, like product version number, is optional.

Due to its relevance in practical use it is recommended that all values in the Identification Set are filled (if applicable). If an MXF SDK is used in the product the SDK name should be included in addition to the product name. Software version numbers of the product and SDK should be included as well.

4.3 Audio channel assignment

Information about the audio channel assignment is not included in the MXF file itself. Instead ARD, ZDF and ORF defined channel assignments for different use cases which are published in the “Technical Guidelines – HDTV” (refer to section 4.4). The information which channel assignment is used in a particular file has to be provided separately (e.g. in form of a sidecar metadata file).

The mapping between the audio tracks in the MXF file and the sidecar information is based on the stored order of Audio Tracks in the Essence Container. That means the first stored Audio Track is considered as audio channel 1, the second Audio Track as audio channel 2 and so on. Thus, the stored order of Audio Tracks within the Essence Container must not be altered unintended by any application.

4.4 Operational specifications for ARD ZDF and ORF

Since many years ARD, ZDF and ORF define Technical Guidelines for all high-definition (HD) program material delivered or supplied to, exchanged with or broadcast by ARD, ZDF, or ORF. They reflect the requirements for all production related issues including standards of quality and workflow definitions. The “Technical Guidelines – HDTV” (TPRF-HDTV) are updated regularly and are essential for the compatibility of (MXF) files with the broadcaster’s internal workflows.

It is out of the scope of this Profile to define all technical and operational requirements for a particular production. These can be found in the latest version of TPRF-HDTV or depend on agreements with the respective broadcaster. The latest version can be found here:

<https://www.irt.de/en/publications/technical-guidelines/kostenfreie-richtlinien/>

5. Appendix B: Additional Decoder requirements (informative)

The following table is a collection of common MXF file properties that differ from the ARD_ZDF_HDF02a Profile. A decoder should be able to handle these properties.

Property Name	Additional Decoder requirements
Profile short description	
Essence Mapping	According to SMPTE st381-2:2011, st382:2007
Audio	2, 4 or 16 audio tracks

General	
File format	MXF (SMPTE st377-1) - Version 1.1 / Version 1.2
Is RIP Present	Metadata Field may be missing, even if the file contains a Random Index Pack (RIP).
Header Metadata Location	May be located in other partitions
KAG Size	512
Descriptive Metadata	May be present
Tracks in Material Package	2, 4 or 16 audio tracks Optional ANC data track
Tracks in Source Package	2, 4 or 16 audio tracks Optional ANC data track
Timecode Material Package	May be absent
Timecode Source Package	May be absent If present, TC can be different from System Item
Timecode System Item	May be absent If present, TC can be different from Source Package

Index Table Segment Set	
Single Index Location	Metadata Field may be absent.
Single Essence Location	Metadata Field may be absent.
Forward Index Direction	Metadata Field may be absent.

Video	
CDCI Descriptor	
Container Duration	May be absent
Active Format Descriptor	Optional (including all values)
Color Siting	4 (= Siting in accordance with ITU-R Rec 601)

Audio	
Audio Descriptor (AES3AudioEssenceDescriptor)	
Sound Essence Coding / Sound Essence Compression	Optional
Sample Rate	25 / 1
Quantization Bits	16 and 20
Block Align	2 for 16 Bit and 3 for 20 Bit
Average Bytes per Second (AvgBps)	96 000 Byte/s for 16 Bit; 120 000 Byte/s for 20Bit
Fixed Channel Status Data (for Dolby-E)	00 00 00 01 00 00 00 18 83 00 (= Professional use Non-Linear PCM No Emphasis 48kHz Sampling; Non-PCM data)

Ancillary Data	
Data content (EssenceContainers)	May be present. If present, a non-constant size of ANC Metadata affects the index table which is then no longer constant.

Other	
Dark Metadata	May be present



Institut für Rundfunktechnik
(Broadcast Technology Institute)
Floriansmühlstraße 60
80939 München (Munich)
Germany
www.irt.de
phone: +49 89 32399 – 204
fax: +49 89 32399 – 205
presse@irt.de

Registry Court Munich Entry Department
B Vol. 65 No. 5191