



FADGI Application Specification AS-AP (rev 1.k) MXF Archive and Preservation Format

October 5, 2012 ₂

Document Status

This MXF Application Specification for Archive and Preservation (AS-AP) is a document-in-progress drafted by the Audio-Visual Working Group of the Federal Agencies Digitization Guidelines Initiative (FADGI; <http://www.digitizationguidelines.gov/audio-visual/>). At this writing, the Working Group is launching a process to refine and finalize AS-AP, with the new identifier *AS-07*, under the auspices of the Advanced Media Workflow Association (AMWA; <http://www.amwa.tv/>). Some aspects of finalization depend upon the resolution of technical matters highlighted in the explanatory notes within this specification and also in the accompanying document *Preservation Video File Format Issues and Considerations* (http://www.digitizationguidelines.gov/audio-visual/documents/FADGI_MXF_ASAP_Issues_20110815.pdf).

This document has been drafted in the style of other AMWA application specifications (http://www.amwa.tv/projects/application_specifications.shtml). It includes elements borrowed from AS-02, AS-03, and a November 2011 draft of AS-11. Not all of these borrowed elements have been carefully reviewed. Several elements from AS-11 have been tagged to highlight the need for additional review.

This draft includes nine appendixes. Appendix D is the most important at this time. It provides the proposed specifications for the AS-AP CoreShim, intended to serve the main memory institution use case: the reformatting of existing videotapes in their collections. The CoreShim is also intended to serve memory institutions (and others) who may be acquiring digital video ingested via serial interfaces, e.g., congressional high definition video transferred to the Library of Congress via HD-SDI or its equivalent. In both of these CoreShim use cases, memory institutions wish to archive the highest possible quality of image and sound (uncompressed or losslessly compressed), and wish to embed metadata that will support authentication and management of the content for the long term.

The remaining eight appendixes are placeholders that remain to be drafted or, if deemed unnecessary, deleted.

Executive Summary

This document describes a vendor-neutral subset of the MXF file format to use for long-term archiving and preservation of moving image content and associated materials including audio, captions and metadata. Archive and Preservation files (AS-AP files) may contain a single item, or an entire series of items. Various configurations of sets of AS-AP files are discussed in the Overview.

AS-AP files are intended to be used in combination with external finding aids or catalog records. At the same time, AS-AP files may stand alone, and thus also contain baseline catalog records that could be used to regenerate external finding aids when needed.

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1 Scope

This document describes a vendor-neutral subset of the MXF file format to use for long-term archiving and preservation of moving image content and associated materials including audio, captions and metadata.

Archive and Preservation and files (AS-AP files) may contain a single item, or an entire series of items.

AS-AP files are not intended for direct online access, however they may include renditions intended for viewing without further processing.

AS-AP files are intended to be used in combination with external finding aids or catalog records. The external finding aids are used for day to day access to the archive collection. At the same time, AS-AP files must stand alone, so they would retain their value even if they were the only extant copy of an item.

2 Conformance Language

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:"

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

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

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword "reserved" indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword "forbidden" indicates "reserved" and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that includes all mandatory provisions ("shall") and, if implemented, all recommended provisions ("should") as described. A conformant implementation need not implement optional provisions ("may") and need not implement them as described.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition; Tables shall be next; followed by formal languages; then figures; and then any other language forms.

3 Reference Documents

The following standards contain provisions which, through reference in this text, constitute provisions of this recommended practice. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this recommended practice are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

AMWA AS-02	MXF Versioning
AMWA AS-03	MXF Program Delivery
AMWA AS-04	Language Tagging
AMWA AS-xx	Content Integrity
AMWA AS-11	MXF Contribution Format

AS-AP MXF Format for Archiving and Preservation for Archiving and Preservation

EBU R 48	Allocation of audio tracks on digital television recorders
EBU R 123	Audio Track Allocation for File Exchange
EBU R 122	Material Exchange Format Timecode Implementation
EBU 3264	Subtitling data exchange format
EBU 3299	High Definition (HD) Image Formats for Television Production
SMPTE EG 42:2004	Material Exchange Format (MXF) — MXF Descriptive Metadata
SMPTE RP 2008:2011	Material Exchange Format — Mapping AVC Streams into the MXF Generic Container
SMPTE RP 2027:2011	AVC Intra-Frame Coding Specification for SSM Card Applications
SMPTE 12-1:2008	Time and Control Code
SMPTE ST 298:2008	Universal Labels for Unique Identification of Digital Data
SMPTE ST 330:2004	Unique Material Identifier (UMID)
SMPTE ST 331:2011	Element and Metadata Definitions for the SDTI-CP
SMPTE ST 334-1:2007	Vertical Ancillary Data Mapping of Caption Data and Other Related Data
SMPTE ST 334-2:2007	Caption Distribution Packet (CDP) Definition
SMPTE ST 337:2008	Format for Non-PCM Audio and Data in an AES3 Serial Digital Audio Interface
SMPTE ST 338:2010	Format for Non-PCM Audio and Data in AES3 — Data Types
SMPTE ST 339:2008	Format for Non-PCM Audio and Data in AES3 — Generic Data Types
SMPTE ST 340:2008	Format for Non-PCM Audio and Data in AES3 — ATSC A/52B Digital Audio Compression Standard for AC-3 and Enhanced AC-3 Data Types
SMPTE ST 356:2001	Type D-10 Stream Specifications — MPEG-2 4:2:2P @ ML for 525/60 and 625/50
SMPTE ST 365:2001	12.65-mm Type D-10 Format for MPEG-2 Compressed Video — 525/60 and 625/50
SMPTE ST 377-1:2011	Material Exchange Format (MXF) — File Format Specification
SMPTE ST 377-4:2012	MXF Multichannel Audio Labeling Framework
SMPTE ST 378:2004	MXF Operational pattern 1A (Single Item, Single Package)
SMPTE ST 379-1:2010	MXF Generic Container
SMPTE ST 379-2:2010	MXF Constrained Generic Container
SMPTE ST 381-1:2005	Mapping MPEG Streams into the MXF Generic Container
SMPTE ST 382:2007	Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container
SMPTE ST 384:2005	Mapping of Uncompressed Pictures into the MXF Generic Container
SMPTE ST 386:2004	Mapping Type D-10 Essence Data to the MXF Generic Container
SMPTE ST 391:2004	MXF Operational Pattern 1b (Single Item, Ganged Packages)
SMPTE ST 392:2004	MXF Operational Pattern OP2a
SMPTE ST 408:2006	MXF Operational Patterns 1c, 2c, and 3c
SMPTE ST 410:2008	MXF Generic Stream Partition
SMPTE ST 422:2006	Mapping of JPEG 200 Codestreams into the MXF Generic Container (Revision expected in 2013)
SMPTE ST 429-6:2006	D-Cinema Packaging – MXF Track File Essence Encryption
SMPTE ST 436:2006	MXF Mappings for VBI Lines and Ancillary Data Packets
SMPTE ST 2016-1:2009	Format for Active Format Description and Bar Data <i>[Editor's note: Do we want to cite "-1"? And also "-2" thru "-5"?)</i>
CEA 608E	Closed Captioning Data on line 21
CEA 708E	DTV Closed Captioning
ISO 13818 (several parts)	MPEG-2
ISO 15444-1:2004	JPEG 2000 Core Coding
ISO/IEC 15444-1:2004/Amd 3:2010	JPEG 2000 Core Coding Broadcast Profiles
ITU H.264	Advanced Video Coding (a.k.a. ISO 14496-10 MPEG-4 part 10)
SCTE 35	Splice Point Markers

4 Acronyms and Terms

Editor's note: This glossary has been derived from AS-11 and awaits careful review and amendment.

Acronym or Term	Description
AES3	Professional digital audio transport standard (Audio Engineering Society 3).
AFD	Active Format Description.
Ancillary Data	Any Essence data other than Video or Audio that may be embedded in a bit stream that carries Video and Audio and may be contained in the AS-11 file. Not to be confused with <i>Associated Essences</i> .
Associated Essences	Essences like copies of still images, documents, scripts that are unrelated to the timeline or that are unevenly distributed along the timeline and that will be stored in Generic Stream Partitions (SMPTE ST 410-2008).
Audio	Essence data of any type contained in the AS-11 file that contains audio data.
AVC-Intra	A video compression standard that is compliant with H.264 but uses intra-frame only coding.
Closed Caption	Text transcription or description of the audio/video data. Synonymous with subtitling.
Descriptive Metadata	Generic term used for descriptive data stored in MXF files whose purpose is to describe Essence data.
Descriptive Metadata Track	An MXF Track that contains Descriptive Metadata.
Digital provenance metadata	See <i>Process Metadata</i> and <i>Sampling Metadata</i> .
DM	See <i>Descriptive Metadata</i> .
DM Scheme Label	The value stored in an MXF file's Preface:DMSchemes property. See SMPTE EG 42:2004.
DM Segment	An MXF structure used to generically contain Descriptive Metadata on a Track. See SMPTE ST 377-1:2011.
Dolby E	Professional audio encoding standard developed by Dolby Laboratories.
D-10	A video compression standard that is compliant with MPEG-2 but uses intra-frame only coding.
EBU STL	EBU R 3264 subtitling specification.
Essence	The bit streams that contain Video, Audio, or Ancillary data.
Essence Partition	An MXF file Partition that is dedicated to storing Essence data.
Filler	An MXF structure used to describe empty space on a Timeline Track. See SMPTE ST 377-1:2011.
Essence Element	An Essence stream within an Essence Container.
Generic Container	MXF data structure used to store Essence data in an MXF file. See SMPTE ST 379-2:2010.
Hard-Parted Program	A type of Segmentation.
Header Metadata	MXF data structures that collectively describe the data in the Essence data in an MXF file. See SMPTE ST 377-1:2011.
Header Partition	The MXF file Partition that contains the Header Metadata.
Index Partition	An MXF file Partition that is dedicated to storing an Index Table.
Index Table	A structure in an MXF file used to efficiently access Essence data. See SMPTE ST 377-1:2011.
KLV Fill	Refers to the well-defined means of inserting empty, "fill", data in an MXF file. See SMPTE ST 377-1:2011.
Late Delivery	Refers to the requirement for AS-11 files to commence playout by a broadcaster before the entire file has been transferred by the provider.
Logging metadata	See <i>sampling metadata</i> .
Material Package	An MXF data structure that contains Tracks and identifiers that describe the file's content. See SMPTE ST 377-1:2011.

Acronym or Term	Description
Metadata	Data about data. See <i>Descriptive Metadata</i> , <i>Descriptive Metadata Track</i> , <i>Metadata Scheme Definition</i> , <i>Process Metadata</i> , and <i>Sampling Metadata</i> .
Metadata Scheme Definition	A term that generically describes the definition and application of a collection of Descriptive Metadata for a particular well defined purpose in an AS-11 file.
MPEG-2	ISO/IEC 13818 video compression
Operational Patterns OP1a, OP1b, OP2a and OP3c.	Constrained applications of MXF. See SMPTE ST 378:2004, SMPTE ST 391:2004, SMPTE ST 392:2004, and SMPTE ST 408:2006
Package	See Source Package and Material Package.
Partition	A division that exists in MXF files to divide and separate Essence data, Index Table data, or Header Metadata. See SMPTE ST 377-1:2011.
PCM	Pulse Code Modulation audio encoding.
Picture Track	An MXF Track that references Video essence.
Process Metadata	Metadata that documents the general facts about the system, settings, facility, and operator when a video signal is transferred, e.g., in a reformatting (tape to file) activity. Often produced in conjunction with <i>sampling data</i> . In the digital library community, this is part of <i>digital provenance metadata</i> .
Sampling Metadata	Metadata that documents the flow of data or events when a video signal is transferred, e.g., in a reformatting (tape to file) activity. Often produced on a frame-by-frame or even sample-by-sample basis. May be called <i>logging metadata</i> . In the digital library community, this is part of <i>digital provenance metadata</i> .
Segmentation	The description of regions in a program's Essence data that contain non-program content or points where the program content may be interrupted to insert non-program content at broadcast time
Segmentation Track	An MXF Track that contains Segmentation metadata.
Shim	An application specific constraints set that constrains an Application Specification in order to tailor the general specification to a specific purpose.
Single-Part Program	A type of Segmentation.
SMPTE 12M Timecode	Traditional timecode as specified by SMPTE 12-1:2008.
Soft-Parted Program	A type of Segmentation.
Source Essence	Essence data referenced by a Source Package.
Source Package	MXF data structure that describes source video, audio, or ancillary Essence data in an MXF file. See SMPTE ST 377-1:2011.
Synthetic Timecode	A generic reference to timecode represented using MXF Structural Metadata, specifically using a Timecode Track.
Timecode Component	An MXF structure that stores timecode information. See SMPTE ST 377-1:2011.
Timecode Track	An MXF Track that stores one or more Timecode Components.
Timeline Track	A specialized MXF track that describes a timeline by specifying an origin and rate. See SMPTE ST 377-1:2011.
Track::TrackNumber	A property in an MXF Timeline Track. See SMPTE ST 377-1:2011.
Track	MXF data structure used to describe the content structure. See SMPTE ST 377-1:2011.
Track::TrackName	The property that is the descriptive name of a Track. See SMPTE ST 377-1:2011.
Universal Label	Unique identifiers for metadata items. See SMPTE ST 298:2008.
Video	Essence data of any form contained in the AS-11 file that contains video data.

5 Overview

5.1 Summary of File Format Requirements

5.1.1 General

Archive and Preservation and files (AS-AP files) may contain a single item, or an entire series of items.

AS-AP files may include one or several renditions of the items. Different renditions may arise from different original sources of the item; different renditions may also be created from multiple encodings of the original source using different image compression or encoding schemes. AS-AP files are not intended for direct online access, however they may include renditions intended for viewing without further processing.

AS-AP files may be grouped together into "bundles" in which individual files contain single items, and the bundle represents an entire series or a collection of items. File bundles may also include metadata-only files for preservation of metadata records pertaining to the series or collection.

5.1.2 Metadata

AS-AP files may contain metadata in several locations: in the MXF header, in DM tracks, in the form of closed captioning (or other forms of timed text) and/or other ancillary data, and as text-stream metadata in Generic Stream Partitions.

For many archiving organizations, the metadata embedded in AS-AP files will have a dynamic relationship to external metadata resources, e.g., databases associated with digital asset management (DAM) systems, external archival finding aids in machine-readable form, or library catalog records in a searchable cataloging system. Often, the metadata extracted from AS-AP files, e.g., at the time of ingestion, will populate elements or fields within the DAM databases, finding aids, or catalogs. Meanwhile, the external databases, finding aids, and catalogs support day-to-day access to items in the archived collection and may also provide additional or updated metadata elements to be inserted or appended in AS-AP files in the archival storage system.

At the same time, the AS-AP specification will permit files to stand alone, for the archives that choose to embed a full set of metadata in the file. For such implementations, AS-AP files will retain their full informational value even if they were the only extant copy of an item, and in against the catastrophic loss of an archive's other metadata resources.

The metadata in AS-AP files will often represent information as it existed at the time of ingest or subsequent refresh of the item, including a reference to the source of the metadata and an audit trail of modifications to the metadata. The metadata in the files will often include an identifier that links to the external metadata, which in some cases will be more current than the embedded metadata. In some circumstances, as noted in the preceding paragraph, the embedded metadata could be used to regenerate external databases, finding aids, or catalog records when needed.

Editor's note: Need to add:

> Information about the "precedence" of metadata: what to do when there might be conflict between different metadata chunks within the file and also discuss how archives foresee the relationship and precedence of metadata between "the database" and "the file."

> Should metadata chunks receive "date stamping" of some kind, to help track their provenance?

> Options for long-term management. For example, at the Library of Congress, there are emerging plans to employ media-migration actions (e.g., when data tapes are obsolescent, every 5-10 years) as the moment to also update the embedded metadata.

> Regarding the general class of technical metadata: the MXF specification requires parametric metadata (compare to Class 4 in SMPTE RP-210) "in any case." Additional technical metadata for AS-AP falls into two categories: Process Metadata (general facts about the system, settings, facility, and operator when a video signal is transferred) and Sampling Metadata (documents the flow of data or events when a video signal is transferred). For an example of Process Metadata, see the NARA reVTMD schema: <http://www.archives.gov/preservation/products/reVTMD.xsd>

5.2 General AS-AP and Shims

To maximize commonality across applications, this specification is divided into general provisions that apply to all applications and specific constraint sets (called “shims”) that apply to defined applications.

General provisions apply to all AS-AP files and thus represent the maximum required capability of cache and playout servers and transcoder operations.

Each shim provides a further set of constraints that reduce the range of variability that may be needed in well-defined categories of applications. These categories may address particular types of sources (such as films, analog videotapes, born-digital media), or they may address requirements of particular archive collections and uses (which may, for instance, dictate specific encoding formats or specific metadata).

5.3 Use-cases for Shims

The purpose of a Shim is to describe the content that may be present in a particular variant of AS-AP files. This knowledge has several practical applications in archival systems, for example:

- To guide encoding equipment as to how to convert and condition original sources as they are prepared for submission, or after time has passed, as they are migrated to new formats for dissemination or continued preservation
- To guide quality assurance equipment that is used to verify input submissions or, as time passes, to monitor file integrity or other aspects relevant to long-term content preservation
- To guide cataloguers (both archivists and automated scanners) as to what metadata to expect in examining an input submission, and to indicate which types of metadata to expect as embedded in the file

5.4 Derivation of Shims

Shims do not add new capability to the general provisions. They are constraints on the general provisions. Thus, the general provisions are intentionally non-restrictive in some areas.

Shims may express stronger constraints than the general specification by strengthening the conformance language, e.g. strengthening “should” to “shall”. Shims may also constrain parameter values to a set of permissible values that is a sub-set of those defined in the general specification. Shims may directly constrain the general provisions, or they may add further constraints to other less specialized shims.

For example, within the general AS-AP there might be a Shim that describes preservation of analog videotape and dictates the use of either an uncompressed or J2K-lossless-compressed picture essence together with the provision of metadata for signal quality metrics.

For ease of use, Shims list the less-specialized Shim from which they are derived. Shims can only add constraints to or remove choices from the Shims from which they are derived; they cannot relax constraints or provide alternative parameters.

5.5 Combinations of Shims

In some cases an application needs to permit several different kinds of content, each with their own sets of constraints. Shims may express this by declaring an explicit choice between different, less-specialized Shims.

For example, within the general AS-AP there might be a Shim that describes preservation of film sources. This might dictate the use of uncompressed image sampling and the provision of metadata for spatial parameters, illumination and color grading. A second Shim might be declared for an archive that could contain items derived from videotape and items derived from film.

6 Parameters and Constraints

Each provision within the general specification and within each individual shim is categorized as one of the following:

- Unconstrained - everything permitted by SMPTE 377-1:2011 Material Exchange Format (MXF) — File Format Specification
- Gently constrained - a range of values (for example, bit rates) or choices (for example, DMS or Essence types) is stated by the general AS-03, that individual shims may further restrict

- Strongly constrained - a set of values or choices is listed that individual shims must choose between
 - Most constrained - a single choice or parameter value that all AS-AP applications will use identically
- Shims always express stronger constraints than the general specifications from which they are derived.

Some parameters may define the allowed presence of content elements. This is expressed using narrative conformance terms (“shall”, “shall not”, “may”) and numerical parameters “minOccurs” and “maxOccurs” (as in XML Schema).

6.1 Essence Track Parameters and Constraints

6.1.1 General

AS-AP files shall contain a single program consisting of moving image content (“video”), audio services, associated essences (still images, scripts, etc.), metadata (other than DMS), closed captioning and other ancillary data.

Incidentally, if a multi-program Transport Stream is received by an organization, the presumption is that each program in the Transport Stream will be converted to another encoding (e.g., uncompressed video or JPEG 2000 frame images) and each of these converted programs will assume the role of primary essence in their own MXF file. Organizations may choose to retain the original Transport Stream as an associated essence. The Manifest (6.5.1) will list everything in a given file.

6.1.2 Interleaving

Essence in each Generic Container in AS-AP Files may be interleaved or non-interleaved frame-by-frame. Interleaving or non-interleaving of Essence in AS-AP Files shall be in accordance with the specifications for each Shim. Essence may be framewrapped or clipwrapped, except where custom wrapping is explicitly required by the shim. Interleaving and wrapping shall be declared in KLV metadata keys as part of the essence container syntax.

Associated essence (e.g., still images) shall not be interleaved.

Editor’s note: Most if not all primary AS-AP essence (e.g., a digitized videotape) will be interleaved, i.e., the video/audio/captions will be frame-wrapped.

Interleaving normally implies frame-wrapping, and interleaving with clip-wrapping would only apply to imported essence like MPEG TS or DV DIF, so is uncommon (and DV DIF is usually represented in a different way: “compound items”). See section 6.1.10.5 (Retain Source Encoding as Acquired) for discussion of imported picture essences.

As noted, Associated Essences shall not be interleaved. In addition, a possible future shim for slide shows with narration would probably not be interleaved, with the audio clipwrapped.

Other essence types will vary:

- (a) audio-only essence is often clipwrapped*
- (b) a slide show with narration would probably be non-interleaved with the audio clipwrapped and, in general, still picture essences will be frame-wrapped*
- (c) associated essences (e.g., still images, transcripts, etc.) will probably not be interleaved.*

6.1.3 Partitions

Essence in AS-AP Files may optionally be divided into Partitions. If Partitions are employed, the recommended practice is that new Partitions shall be started at the following intervals: each 1 second, 10 seconds, or 1 minute of program time. Additionally, Partitions, if used, shall not be longer than 10 minutes of program time, and new Partitions may be started to meet this requirement.

The Header Partition shall be marked closed and complete.

6.1.3.1 Essence partition strategy

Editor’s note: This is a placeholder adapted from AS-11.

Dimension	Description	AS-AP Constraint	AS-AP Values
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Essence Partition Strategy	Defines whether the essence is a single partition or divided into multiple partitions. Values: single, multiple.		
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6.1.4 Generic Stream Partitions

AS-AP Files may include Generic Stream Partitions (SMPTE ST 410-2008), structured as Text-based Metadata (SMPTE RP 2057:2011), used to contain specific classes of data streams, e.g., data streams are either (a) Associated Essences, defined as essences that are unevenly distributed along the timeline (or unrelated to the timeline, e.g., still images, documents, scripts) or (b) extensive blocks of metadata that cannot suitably be stored as Header Metadata, or (c) closed captions, subtitles, or other timed text, stored as a separate [*blob*] [*block of data*] and marked up or tagged to include time offsets or timecodes to relate to the main program (see also section 6.1.12.1).

Editor's note: Extensive blocks of metadata (b, above) include such examples as library bibliographic records, extracts from archival finding aids, and specialized technical and/or preservation metadata. For an example of such technical metadata, see <http://www.archives.gov/preservation/products/reVTMD.xsd>.

As stated in notes associated with section 6.4.1 (General information about Descriptive Metadata or DMS), the Federal Agencies Working Group proposes a "main" a DMS-AS-AP DM track as a part of the MXF header that is simple, offering less information than found in, say, an AS-11 file's main DMS track. We propose leaving more complete representations of descriptive, administrative, and technical metadata to the text-based streams in Generic Stream Partitions, where each partition-based metadata stream will be linked to identificatory DM tracks labeled as DMS1, DMS2, etc., in the MXF header.

The SMPTE recommended practice RP 2057:2011, Text-Based Metadata Carriage in MXF, defines how to carry text-based metadata with a specified text MIME type encoded using either Unicode UTF-8 or UTF-16 character encoding (such as XML) in a MXF file. One of the two methods of text-based metadata carriage in the recommendation concerns the carriage of text-based metadata using the MXF Generic Stream Partition defined in SMPTE ST 410. RP 2057:2011 specifies the Generic Stream Partition Pack for several text-based metadata formats including the KLV coding of the Generic Stream Data Element and DM Schemes.

6.1.5 Index Tables

If AS-AP files use Partitions, then they shall also include full MXF Index Tables, compliant with SMPTE ST 377-1:2009. The required combination of Index Tables will be defined for each Shim. If used, the full Index Tables shall index every Frame of every Track in the file.

At each partition point in a given frame wrapped Essence component file, the Index Partition shall either lead (i.e. precede) or follow the Essence Partition that it indexes. This shall be specified by the Shim.

The last segment of the full Index Table shall be placed in a Body Partition with no essence (the Footer Partition contains the sparse Index Table, when present). Encoders shall place all Segments of Index Tables in isolated Partitions, that is, Partitions that do not contain any Header Metadata or Essence. The zero position of the Index corresponds to the start of actual program including pre-charge. Therefore, the first IndexTableSegment shall indicate an IndexStartPosition equal to zero. Enumeration and description shall be in the Manifest (6.5.1).

Editor's note: Generic stream partitions are generally not indexed. Associated essences may or may not need indexing, although they should always be enumerated and described ("as objects") in Packages in Header Metadata.

Editor's note: The following was borrowed is from AS-11 is it needed in AS-AP?.

The zero position of the Index corresponds to the start of the essence including pre-charge (see SMPTE ST 377-1:2011, section 11 - Index Table). Therefore, the first IndexTableSegment indicates an IndexStartPosition equal to zero.

6.1.5.1 Index strategy frame

Editor's note: Placeholder adapted from AS-11.

Dimension	Description	AS-AP Constraint	AS-AP Values
Index Strategy Frame	Defines the position of the index tables in the MXF file.		

6.1.6 Container

AS-AP Files shall use the MXF Generic Container SMPTE ST 379-2:2010. The number of Essence Elements in each Generic Container may be defined by a Shim.

JPEG 2000 broadcast-profile codestreams (ISO/IEC 15444-1:2004/Amd 3:2010) shall be carried in a SMPTE 422M-compliant GC Element, mapped as specified in 6.1.10.3.1 (below), except for lossless JPEG 2000 "legacy data" created prior to the publication of AS-AP and further described elsewhere in this document.

Editor's note: The following is from AS-11; is it needed in AS-AP?

AS-AP Files that encode standard definition D-10 shall map Essence into the MXF Generic Container as specified by SMPTE ST 386:2004 "Mapping Type D-10 Essence Data to the MXF Generic Container".

6.1.7 System Item

Editor's note: The following is from AS-11; is it needed in AS-AP?

The GC System Item may be present but is not used by AS-AP Files.

6.1.8 Random Index Pack

Editor's note: The following is from AS-11; is it needed in AS-AP?

AS-AP Files (when closed and complete) shall [optional?] contain a Random Index Pack per SMPTE ST 377-1:2011.

6.1.9 KAG Size

Editor's note: The following is from AS-11; is it needed in AS-AP?

AS-AP Files shall employ the default KLV Alignment Grid of 1 unless this requirement conflicts with an underlying essence container specification. When a conflict exists, the value in that essence container specification shall be used.

For ST 386:2004 "Mapping Type D-10 Essence Data to the MXF Generic Container", the KLV Alignment Grid is 512.

6.1.10 Picture Essence Encoding

6.1.10.1 Broad Range of Picture Essences Possible

Moving image picture content may be uncompressed, lossless compressed, or lossy compressed. Uncompressed moving image content may be in any raster up to 8Kx8K, in any bit depth, color mode or space, and interlaced or progressive. Different variants of this component may be selected by different Shims.

Editor's note: For the Federal Agencies Working Group, the first shim to be drafted is titled Core Shim, presented as appendix D in this version of this Application Specification. The Core Shim represents the priority work within the agencies: the reformatting of older analog and digital videotapes and, at a few agencies, the encoding and packaging of "live" video streams. (For example, the Library of Congress will be receiving, processing, and archiving high definition streams from congressional venues.)

AS-AP CoreShim files are for single items derived from baseband video, understood to encompass both analog baseband and uncompressed digital video. AS-AP CoreShim files are intended to contain a single rendition of a single source item. In these instances, a baseband (uncompressed) signal is input to an MXF-file production system. As specified in appendix D, the preferred picture

encodings are those described in sections 6.1.10.3 (JPEG 2000 picture encoding) and 6.1.10.4 (uncompressed picture).

An additional priority, anticipated for the second shim, concerns the agencies' desire to package and archive content items in their generally lossy acquisition encodings, e.g., MPEG-2, DV, and the like. Such picture encodings are described in section 6.1.10.5 ("retain lossy encoding as acquired").

Additional future shims will focus on moving image content that results from film scanning or digital theatrical motion picture production and these will also include MXF essences in such forms as JPEG 2000 and uncompressed. Thus the descriptions of picture formatting options in sections 6.1.10.3, 6.1.10.4, and 6.1.10.5 extends to types and levels generally associated with digital cinema and related formats.

6.1.10.2 AMWA AS-02 Special Labeling in Picture Essence Tables

In order to increase support for automation in the production or use of MXF files constrained by Application Specifications and their shims, AMWA proposes tagging or identifying content elements beyond the level provided by SMPTE ST 377-1, *Material Exchange Format (MXF) — File Format Specification*. Although not fully realized and specified, the proposed AMWA "shim parameter" tags *picture_family*, *picture_format*, and *picture_bitrate*, and are employed in the following tables and in the shims presented as annexes to this specification.

6.1.10.3 Picture Essence – JPEG 2000 Compressed (Lossless or Lossy)

This parameter is typically selected by an archive that prefers to store a reduced-data file, and that is formatting or reformatting content as a part of its own pre-ingest or ingest activity, e.g., transferring content from a videotape carrier, or scanning film.

Dimension	Description	AS-AP Constraint	AS-AP Values
picture_family	Picture signal schemes (compression or sampling or other)	Gentle	From ISO/IEC 15444-1:2004/Amd 3:2010; JPEG 2000 Core Coding Broadcast Profiles: Profile levels 6 and 7 (lossless) and levels 1 through 5 (lossy). From ISO/IEC 15444-1:2004/Amd 1:2006; JPEG 2000 Core Coding Profiles for digital cinema applications: Profiles for 4K and 2K (lossy) [Other JPEG 2000 profile tbd, possibly including legacy formats] Color space and bit depths as specified in JPEG 2000 profiles
picture_format	Picture raster and aspect ratio	Moderate	480i 4:3, 576i 4:3, 576i 16:9, 720p 16:9, 1080i 16:9, 1080p 16:9, 2K, 4K, 8K
picture_bitrate	Bits per second in real	Gentle	Up to 3 Gbps

	time		(Respecting SMPTE 424M) <i>Editor's note: Is this high enough?</i>
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6.1.10.3.1 JPEG 2000 Essences and SMPTE ST 422

All JPEG 2000 essences shall be carried in a SMPTE ST 422-compliant GC Element. Interlaced picture data in JPEG 2000 encodings shall be formatted in accordance with one of the structures specified in SMPTE ST 422 as revised during 2012-13. The two preferred options from ST 422 (under revision at this writing) are, in order of preference:

- Interlaced Frame Wrapping, 1 field per KLV Element. An essence container that wraps JPEG 2000 compressed interlaced data with one field per KLV Element and one frame per Content Package shall comprise one or more pairs of KLV triplets each of which shall contain one JPEG 2000 codestream. (Section 5.5 in the April 2012 draft revision of ST 422.)
- Interlaced Frame Wrapping, 2 fields per KLV Element. An essence container that wraps JPEG 2000 compressed interlaced data with two fields per KLV Element and one frame per Content Package shall comprise one or more KLV triplets each of which shall contain two JPEG 2000 codestreams. (Section 5.4.)

In addition, ST 422 (under revision) includes a third option:

- Field Wrapping, 1 field per KLV Element. An essence container that wraps JPEG 2000 compressed interlaced data with one field per KLV Element and one field per Content Package shall comprise one or more KLV triplets each of which shall contain one JPEG 2000 codestream. (Section 5.6.)

Carriage of JPEG 2000 essences in a GC Element shall also employ SMPTE ST 422-compliant tagging of the component (YCrCb) ordering sequence. Regarding adherence to SMPTE ST 422 (as revised in 2012 or 2013), note that an exception is made for lossless JPEG 2000 "legacy data" created prior to the publication of the standard [*and to be further described elsewhere in this document -- forthcoming.*]

6.1.10.4 Picture Essence – Uncompressed

This parameter is typically selected by an archive that prefers to store an uncompressed file, and that is formatting or reformatting content as a part of its own pre-ingest or ingest activity, e.g., transferring content from a videotape carrier, or scanning film.

Dimension	Description	AS-AP Constraint	AS-AP Values
picture_family	Picture signal schemes (compression or sampling or other)	Gentle	Uncompressed carried in a SMPTE ST 384-compliant GC Element X'Y'Z' 10 – 16 bpp
picture_format	Picture raster and aspect ratio	Moderate	480i 4:3, 576i 4:3, 576i 16:9, 720p 16:9, 1080i 16:9, 1080p 16:9 2K 4K
picture_bitrate	Bits per second in real time	Gentle	Up to 2 Gbps

6.1.10.5 Picture – Retain Source Encoding as Acquired

This parameter is typically selected by an archive that judges the native encoding to be reasonably stable, or that has other reasons to retain content in the form in which has been received, and wishes to wrap and store that encoded "native" bitstream in a standardized manner.

Dimension	Description	AS-AP Constraint	AS-AP Values
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picture_family	Picture signal schemes (compression or sampling or other)	Gentle	Limited to schemes for which there is an SMPTE MXF Generic Container mapping Illustrative examples: MPEG-2 MP or HP H.264 DV Others TBD
picture_format	Picture raster and aspect ratio	Moderate	Per input format
picture_bitrate	Bits per second in real time	Gentle	Up to 200 Mbps

MPEG-compressed picture information shall be MPEG-2 MP or 422P, or H.264 (any profiles and levels), any GOP structure, at any bit rate, in compliance with ISO 13818-2 Elementary Streams and ISO/IEC 14496-10 Advanced Video Coding, with the video stream carried in a SMPTE 381M-2005-compliant MXF GC Element.

Other lossy compressed picture information is limited to encodings for which a SMPTE MXF GC Element has been published, and the picture data must be carried in such a GC Element.

6.1.10.6 Picture – Associated Still Images

This parameter is intended to permit the inclusion of image-based corollary materials associated with content that an archive is reformatting, e.g., documents or pictorial items stored with a source videotape.

Dimension	Description	AS-AP Constraint	AS-AP Values
picture_family	Picture signal schemes (compression or sampling or other)	Gentle	Illustrative examples: TIFF JPEG 2000 JPEG PDF
picture_format	Picture raster and aspect ratio	Moderate	Per input format
picture_bitrate	Bits per second in real time	Gentle	N/A

6.1.11 Audio Essence Encoding

6.1.11.1 Multiple encodings and wrappings permitted

Dimension	Description	AS-AP Constraint	AS-AP Values
sound_family	Sound signal schemes (compression or sampling or other)	Moderate	PCM 96 kHz 24 bit PCM 48 kHz 24 bit PCM 48 kHz 16 bit Other MPEG schemes, e.g., layer 2 or layer 3 (MP3), or AAC
sound_language_repertoire	Primary sound languages may be present	None	
track_listing	Combinations of picture sound and data tracks are encountered in programs	Strong	Main Sound (1,2 or 6 channels)
[AS-11 uses			Secondary Audio

"track_allocation"]	<i>Editor's note: AS-11 uses this wording: "The set of permissible EBU R 48 and EBU R 123 track allocation names."</i>		Program (SAP; 0, 1, or 2 ch) Descriptive Video Service (DVS; 0, 1, or 2 ch) PCM pairs shall be used for Stereo programming
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Audio shall be PCM pairs, AC-3, or Dolby E. The number of channels is unlimited, and as many tracks shall be employed as needed to represent the number of channels. PCM Audio can have any values up to 192kHz at 24 bit word length. Each PCM track (mono or stereo pair) shall be carried in a SMPTE 382M:2007-compliant MXF GC Element within a BWF Container (not AIFF container). AC-3 and Dolby E tracks shall be carried within a SMPTE 337/338/339/340 container in a SMPTE 382M:2007-compliant MXF GC Element. This audio data shall be interleaved, non-interleaved, framewrapped, or clipwrapped to permit synchronization with the picture information it accompanies, except where custom wrapped data is explicitly required by the shim.

6.1.11.2 Audio Track Allocation

Editor's comments:

> *This has been drafted to give primacy to SMPTE ST 377-4:2012. SMPTE ST 2035:2009 is also mentioned; continued review of this document will clarify how the requirements in terms of these two standards should be expressed.*

> *There is a related topic concerning the labeling of primary audio language and purpose. This topic is under development as a part of AMWA's MXF AS-04 and a corollary language tagging effort in the SMPTE 31FS10 Working Group on Multichannel Audio in MXF. Note that IETF RFC 5646 is also an important reference.*

Audio track allocation shall be identified to conform to the labeling framework for multichannel audio essence as specified in SMPTE ST 0377-4:2012 (MXF Multichannel Audio Labeling Framework). The entails the use of a registered list of channel symbols. Relevant information is provided in SMPTE ST 2035-2009 (Audio Channel Assignments for Digital Television Recorders).

Editor's note: other authorities and documents like AS-11 (November 2011 draft version) reference EBU wording more or less as follows. The initiators of AS-07 would like to support adoption in nations beyond the United States. Does this mean that some version of the following ought to be included in AS-07?

Audio track allocation shall be identified using one of the track allocation templates specified by EBU R 48 or EBU R 123. The track allocation name, as specified by EBU R 48 or EBU R 123, is stored in the AS_AP_Audio_Track_Layout metadata item. A shim may further restrict the set of acceptable track allocations to a subset of the EBU R 48 and EBU R 123 track allocation templates.

If the audio is encoded using one MXF Timeline:Track for each track of audio then the track number value specified by EBU R 48 or EBU R 123 shall map to the MXF Timeline:TrackNumber specified in the AS-11 file's Material Package. Note, this case applies to all audio encodings except AES3.

If the audio is encoded as an AES3 stream referenced by a single Material Package track then the track number value specified by EBU R 48 or EBU R 123 shall map to the AES3 channel number. The AES3 channel numbering is from 1 (essence bits value 0) to 8 (essence bits value 7).

6.1.11.3 Other provisions

NICAM audio (when encountered in historical recordings) shall be clipwrapped. If the input to the MXF-file production system includes DialNorm metadata, this DialNorm data shall be included in the MXF Sound Descriptor GenericSoundEssenceDescriptor:DialNorm.

6.1.12 Closed Captioning, VBI, and other ancillary data (ANC)

Editor's note: We view SMPTE ST 436:2006 (Television - MXF Mappings for VBI Lines and Ancillary Data Packets) as the first class captioning-and-ancillary-data interchange format and thus better suited to preservation archiving than RP 2052-11:2-011. ST 436:2006 describes the carriage of VBI data and all ANC packets (HANC and VANC) in an MXF file. In contrast, we feel that the SMPTE Timed Text Recommended Practice 2052-11 pertains to "output" formatting more than to "interchange" or preservation formatting. RP 2052-11 builds on the W3C Timed Text Markup Language (TTML) specification and carries the title Conversion from CEA-708 Caption Data to SMPTE-TT. Part 11 describes the tunneling of 708 and 608 compatibility bytes in SMPTE-TT in a non-proprietary manner. The remainder of RP 2052-11 describes how to translate 708 into SMPTE-TT xml.

We note that other aspects of closed captioning and text-based metadata are under development in efforts such as EBU STL (subtitles) and RP 2057:2011 "Text-Based Metadata Carriage in MXF." More will be coming from SMPTE 31-FS. NOTE that provisional wording has been provided in 6.1.12.2 below.

The sections that follow are limited to captions and for the most do not provide detailed guidance for the broader extent of the ancillary data that may be found in a video stream. These are also important and there may be a need to enhance this section with additional guidance about ancillary data beyond captioning.

Are there adjustments here that would benefit non-U.S. archives?

6.1.12.1 Closed Captioning

Dimension	Description	AS-AP Constraint	AS-AP Values
caption_presence	captions in this file (y/n)	??	y/n
caption_essence_scheme	captions signal schemes	Strong	CEA-608 in SMPTE ST 436:2006 CEA-708 in SMPTE ST 436:2006
caption_languages	captions languages	None	N/A

The presence of Closed Caption (subtitling) data in an AS-AP MXF file shall be indicated by the value of the AS_AP_Closed_Captions metadata item. If Closed Caption data is present in the file then the optional AS_AP_Caption_Language and AS_AP_Closed_Captions_Type metadata items shall be set.

The following provisions shall apply except when using ST 386:2004 "Mapping Type D-10 Essence Data to the MXF Generic Container." If either CEA 608 line 21 (CC and XDS) data or CEA 708B DTV captioning data are present, they shall be carried as specified below:

- In a SMPTE ST 334-1/-2:2007 compliant ANC packet within a SMPTE ST 436:2006-compliant VBI/ANC GC Element, using 8 bit encoding.
- [placeholder] As may be specified by the SMPTE ST 2057 process in the future.
- Stored as a separate [blob] [block of data] in a Generic Stream Partition, marked up or tagged to include time offsets or timecodes to relate to the main program. Indexes into such [blobs] [blocks of data] may be binary (similar to MXF index tables), or textual, like xml @id or html #fragment identifiers.

If required by a shim, primary text language shall be specified using AMWA AS-04 and/or SMPTE ST 377-4:2012 (Multichannel Audio in MXF). (IETF RFC 5646 is also an important reference).

6.1.12.2 SMPTE Timed Text and EBU STL Recommendations (provisional)

AS-AP does not currently support SMPTE-TT Timed Text standards (ST 2052-0:2010, ST 2052-1:2010, and RP 2052-10:2010); members of this family are being published during the period 2010-12. Also, AS-AP does not currently support EBU STL subtitling data. AS-AP implementers that need to use EBU STL subtitling data should not embed it in the AS-AP MXF file. The AS_AP_Closed_Captions metadata item value should be set to the value "false".

AS-AP implementers are advised that a future version of the AS-AP specification may include support for SMPTE Timed Text and EBU STL subtitling data. That support is expected to specify that AS-AP files should comply with the proposed (in-progress, unpublished) SMPTE "Mapping EBU STL into the MXF Generic Container" specification.

6.1.12.3 VBI data tagging (provisional)

Editor's note: AS-02 included some tags for shim parameter tagging for VBI, including the following that pertain to legacy VBI or VANC data that may appear in an AS-02 bundle. In one instance, the term AS-AP has been substituted for AS-02; otherwise the text has not been changed.

When specified for a shim, the following tags shall be used:

VBI_data_essence - A list of supported data essence types including specific parameters such as VBI lines supported.

VBI_custom (Boolean) - When true, VBI data shall be encapsulated in the video essence using a defined method (e.g. carriage in MPEG picture user data) as well as being present in a separate VBI essence component file.

VBI_render (Boolean) - When true, VBI data shall be encoded as active video within the video image. This data should also be placed in a separate VBI essence component file. Usually, this is only true for SD images that are coded as "tall MPEG" (i.e. the VBI area is in the active picture).

ANC_data_essence - A list of supported data essence types including specific parameters such as ANC packet types supported.

ANC_custom (Boolean) - When true, ANC data shall be encapsulated in the video essence using a defined method (e.g. carriage in MPEG picture user data) as well as being present in a separate ANC essence component file.

ANC_render (Boolean) - When true, VBI data shall be encoded as active video within the video image. This data should also be present in a separate ANC essence component file.

data_component_limit - When a number is given, specifies the maximum number of VBI or VANC files that can be merged when decoding an AS-AP bundle. Note: This parameter allows a facility to document the capacity of their decoding devices, such as playout servers.

data_separation (Boolean) - When true, indicates that all data essence component files for VANC and VBI data shall be split into separate files. When set to false, all VANC and VBI data is merged into a single essence component file. Note: This specification does not permit a mixture of approaches.

6.1.13 Active Format Description (AFD)

Editor's note: This is somewhat provisional with borrowings from AS-11.

If the input picture data includes AFD metadata per SMPTE 2016, then this shall be carried over and included in the MXF Picture Descriptor; if no AFD is present, it is an option for an MXF-file production system to add AFD to the MXF Picture Descriptor. The MXF Picture Descriptor is only used if AFD is constant throughout a picture element. When AFD is used, then AS-AP files shall have constant AFD for the duration of the Picture Track. AFD shall be signaled according to SMPTE ST 377-1:2011 using the Active Format Descriptor element. Note: SMPTE ST 377-1:2011 describes compliant encoder and decoder behavior with respect to SMPTE ST 2016-1:2009. AS-AP implementers are directed to SMPTE ST 377-1:2011 paragraph G.2.5.

All AFD values specified in SMPTE ST 2016-1:2009, Table 1, are permitted, however a shim may limit the permissible AFD values to a subset of the values specified in SMPTE ST 2016-1:2009.

Note that AS-AP files may also carry AFD frame-by-frame as required by SMPTE ST 436 (MXF Mappings for VBI Lines and Ancillary Data Packets).

6.1.13.1 Permitted AFD set (provisional)

Editor's note: This is a placeholder adapted from AS-11.

Dimension	Description	AS-AP Constraint	AS-AP Values
Permitted AFD Set	The subset of permitted AFD values drawn from the full set of AFD values specified by SMPTE ST 2016-1:2009, Table 1.	<i>Constraint to be provided</i>	<i>Values to be provided</i>

6.2 Operational Pattern Parameters and Constraints**6.2.1 Baseline Operational Patterns**

AS-AP files shall comply with MXF Operational Pattern OP1a (SMPTE ST 378), OP1b (SMPTE ST 391), OP2a (SMPTE ST 392), or OP3c (SMPTE ST 408). AS-AP files shall be labeled as OP1a, OP1b, OP2a, or OP3c files in the Operational Pattern property of all Partition packs and the Preface Set. AS-AP files shall also include a DMS-AS-AP Descriptive Metadata Set within the MXF Material Package that indicates which specific AS-AP shim applies to the file, as described in section [to be identified] below.

Editor's note: Archiving and preservation files produced when reformatting videotapes will generally be simple in form, with a single picture essence and a single sound essence and, thus, OP1a. For files that include associated essences (e.g., still images, documents, transcriptions), the normal MXF categorization would be multi-essence files in pattern OP1b. These two Operational Patterns (most often OP1a) will occur in AS-AP CoreShim files (appendix D).

OP1b patterns will also be expected for files containing essences in a related series. Meanwhile, OP2 patterns are normally applied to segmented essences, e.g., reels within a movie or clips that are cut together into a composite reel, although it is also common for such segmented units to be indicated by cut-list metadata (aka DMS-Segmentation). This entire topic is being influenced by the increasing importance of parallel efforts like the European Broadcasting Union Subtitling Data Exchange Format (EBU STL; <http://tech.ebu.ch/docs/tech/tech3264.pdf>). The OP3c pattern is proposed for collections of items.

Different variants of this component may be selected by different Shims.

6.2.2 Operational Pattern – Item

Item means a single content item.

Dimension	Description	AS-AP Constraint	AS-AP Values
MXF Structure	MXF-specific Operational Pattern	Strong	OP1a, OP1b, or OP2a internal
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables
MXF Structure (continued)	MXF-specific Partitioning	None	N/A

6.2.3 Operational Pattern - Bundle

Bundle means a collection of content items.

Dimension	Description	AS-AP Constraint	AS-AP Values
MXF Structure	MXF-specific Operational Pattern	Strong	OP3c external
MXF Structure (continued)	MXF-specific Index Tables	Strong	No Index Tables

MXF Structure (continued)	MXF-specific Partitioning	None	N/A
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6.2.4 Operational Pattern Labeling

AS-AP files shall be labeled with the appropriate OP designation in the Operational Pattern property of all Partition packs and the Preface Set.

6.3 Header Metadata Parameters and Constraints

Header Metadata shall be compliant with SMPTE ST 377-1:2011 and with SMPTE ST 378:2004 OP1a; SMPTE ST 391:2004 OP1b; SMPTE ST 392:2004 OP2a; and SMPTE ST 408:2006 OP1c, OP2c, and OP3c.

Dimension	Description	AS-AP Constraint	AS-AP Values
Program identification	Required identifiers	Gentle	One of: ISAN UUID archive-specific
Timecode	Program timecode supplied	Strong	One timecode track in the Material Package, synthetic and continuous; see also section 6.3.6 below
Intimate metadata	Metadata must be carried with the program item	Moderate	All of: Program Ident Track Ident Language Code other per shim
Signal condition	Signal condition metadata	Moderate	Standardized measured signal parameters

6.3.1 File Packages

Editor's note: This is a placeholder adapted from AS-11.

AS-AP files shall contain *nnnn?* File Package(s).

6.3.2 Lower Level Source Packages

Editor's note: This is a placeholder adapted from AS-11.

If present, Lower-level Source Packages shall be compliant with SMPTE ST 377-1:2011.

6.3.3 MXF Tracks

Editor's note: This is a placeholder adapted from AS-11.

Packages in AS-AP files shall contain exactly the number of MXF Tracks required to describe the Video, Audio, Ancillary and Descriptive Metadata Tracks contained in the file.

Note, in the case of mapping AES3 audio, a single MXF Track is used to reference the interleaved AES3 audio Essence.

6.3.4 Descriptors

Editor's note: This is a placeholder adapted from AS-11.

The Descriptors in the File Package of AS-AP files shall be compliant SMPTE ST 377-1:2011.

Descriptors shall include all properties specified by SMPTE ST 377-1:2011 and specific parametric metadata as required by Video, Audio, and Closed Captions tracks (see above).

6.3.5 Package Labeling

PackageIDs in AS-AP files shall be in compliance with SMPTE ST 330:2004.

6.3.6 Timecode

6.3.6.1 Timecode Track

AS-AP Files may contain many types of timecode, and these shall be placed in the unified architecture offered by the MXF specification (SMPTE ST 377-1).

The synthetic timecode is required, shall be provided in the Header Metadata (related to the Timecode Track), and shall be primary. The synthetic timecode shall be used for the canonical representation of references into the essence from descriptive metadata. The synthetic timecode representation in AS-AP files shall be continuous. Timecode mode (drop-frame or non-drop frame) may be specified in each Shim.

Note: AS-AP files require a continuous, authoritative timecode representation so that facilities do not have to support multiple, possibly conflicting, representations. AS-AP files use timecode represented by MXF metadata using an MXF Timecode Track. This timecode representation is referred to as Synthetic Timecode because the representation is purely in the form of MXF metadata and not in the form of a SMPTE 12M Timecode bit stream associated with audio and video Essence data in an Essence Container.

6.3.6.2 Additional Timecodes

When AS-AP Files contain multiple instance of timecode, any and all that are not established as synthetic timecode shall be placed in the non-Header Metadata elements in the unified timecode architecture offered by the MXF specification (SMPTE ST 377-1). *[Editor's question: Where exactly? ". . . system item?"]* As noted above, the synthetic timecode is primary and shall be provided in the Header Metadata (related to the Timecode Track).

Editor's note: Multiple (often conflicting) instances of timecode may be encountered in recordings that represent content that has been reformatted from other sources, e.g., videotapes. AS-AP Files may contain the following types of timecode:

- (1) synthetic timecode is required and shall be provided in the Header Metadata*
- (2) LTC timecode that may be inherited from the source recording is to be retained if present*
- (3) VITC timecode that may be inherited from the source recording is to be retained if present*
- (4) SMPTE 12M timecode that records the actual studio time when the MXF file is being produced (optional)*
- (5) GC Sys timecode (one example is the array of SMPTE 12M timecodes representing the VITC and LTC timecodes read off the video tape)*
- (6) ANC timecode*
- (7) timecode inside 334 CDP inside ANC*

Future iterations of (or successors to) AS-AP may take advantage of new time label technologies that follow principles from an EBU-SMPTE Task Force, to include Time Related Label (TRL) types, not expected to be ready until 2013 at the earliest. It is also worth noting the potential fit to AS-AP of keycodes or edgcodes for content reformatted from motion picture film.

6.3.6.3 EBU R 122 Timecode Compatibility

Editor's note: This is a placeholder adapted from AS-11.

AS-AP files shall be compatible with the recommendations of EBU R 122. Note, AS-AP implementers are advised to pay particular attention to the EBU R 122 section titled "Recommendations for MXF encoders", part 2.

6.3.6.4 Default Timecode Value

If there is no source of program timecode, then the Material Package start timecode should use the Default Timecode Value that may be specified by the shim.

6.3.6.5 Table of shim values for timecode

Editor's note: This is a placeholder borrowed from AS-11, which featured the following tags for shim parameter tagging.

Dimension	Description	AS-AP Constraint	AS-AP Values
synthetic_timecode_mode	Drop- or non-drop frame.	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_type (repeating element)	Type of additional (beyond synthetic) timecode	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_mode (repeating element)	Drop- or non-drop frame	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_note (repeating element)	Narrative comment on the additional timecode	<i>Constraint to be provided</i>	<i>Values to be provided</i>

6.4 Descriptive Metadata Track Parameters and Constraints

6.4.1 General

Editor's note: At this writing, the federal agencies group proposes a "main" DMS-AS-AP DM track as a part of the MXF header that is simple, offering less information than found in, say, an AS-11 main DMS track. We propose leaving more complete representations of descriptive, administrative, and technical metadata to the text-based streams in Generic Stream Partitions (SMPTE ST 410-2008); see 6.1.4. These partition-based metadata streams will be linked to identificatory DM tracks labeled as DMS1, DMS2, etc., also in the MXF header. AS-AP files also must contain parametric metadata; a discussion of this is foreseen for an appendix to the specification (empty appendix C is a placeholder). See also the introductory notes about metadata in section 5.1.2 above.

AS-AP files shall include MXF Descriptive Metadata in compliance with SMPTE ST 377:2011 and EG 42:2004.

AS-AP defines several descriptive metadata schemes that may be included in an AS-AP MXF file. A "scheme" is a defined set of metadata items that are grouped together in the MXF file and associated with the audio and video essence in the file. AS-AP defines a required metadata scheme that shall be present in all AS-AP files. The required metadata scheme is referred to as the AS-AP Core Descriptive Metadata Scheme. Other metadata schemes may be present as prescribed by an AS-AP shim.

Each metadata scheme used in the file shall be identified by the use of a DM Scheme label contained in the MXF Preface::DMSchemes property. Each metadata scheme has an associated specialized DM Framework that shall be contained by a dedicated Descriptive Metadata Track.

All keys used to identify AS-AP DM Scheme labels, their associated specialized DM Framework, and individual metadata items, shall be SMPTE ST 298:2008 Universal Labels and shall be published in the SMPTE metadata registry (<http://www.smpete-ra.org>).

6.4.2 Table of DMS elements

Dimension	Description	AS-AP Constraint	AS-AP Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-AP
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto DMS-Segmentation DMS-PBCore Other per shim
Shim Name	The value of the Shim Name property	None	N/A

6.4.3 DMS Tracks

AS-AP files shall include one Descriptive Metadata Set within a static Descriptive Metadata Track of the MXF Material Package, that indicates which specific AS-AP shim (constraint set) applies to the file. The Descriptive Metadata Scheme shall be labeled as DMS-AS-AP (UL to be published in the SMPTE Labels Registry). To provide for addition of DMS metadata, applications should include a KLV Fill of at least [n] kilobytes in length when initially creating an AS-AP file. DMS-AS-AP shall include the following mandatory properties:

- (a) AS-AP Identifier Kind – an enumerated string value indicating the kind of program identifier, e.g. “ISAN”
- (b) AS-AP Identifier – the identifier, as a text string, e.g. “ISAN 0000-0001-8947-0000-8-0000-0000-D”
- (c) AS-AP Shim Name – an enumerated string value
- (d) AS-AP Signal Standard – an enumerated string value indicating the signal standard of video contained in this AS-AP file.

In addition, DMS-AS-AP may also contain an indicator of the Intended AFD – an enumerated string value indicating the intended display format for the program, per SMPTE ST 2016-1 table 1 a3 a2 a1 a0 with optional informative appended text, e.g. “1001 Pillarbox”, “0100 Letterbox.” ULs for DMS_AS-AP are defined as follows:

PROVISIONAL DMS_AS-AP TABLE

Editor's note: This table has many borrowings from AS-03. Note, however, that AS-11 places this type of information in its first two appendixes. For illustrative purposes these two appendixes (A and B) are also included in this draft. The best location for the DMS_AS-AP table will be reviewed as specification development continues.

Symbol	Type	Use	UL	Description
DMS_AS-AP	DM_Scheme		tbd	Metadata for AS-AP Archiving and Preservation Format
DMS_AS-AP_Framework	DM_Framework		tbd	AS-AP Descriptive Metadata
DMS_AS-AP_MainIdentifierValue	UTF16String	required	tbd	for the main identifier; details tbd
DMS_AS-AP_MainIdentifierType	UTF16String	required	tbd	controlled-vocabulary string value identifying the type of identifier
DMS_AS-AP_MainIdentifierComment	UTF16String	optional	tbd	free text comment pertaining to the identifier
DMS_AS-AP_AdditionalIdentifierValue	UTF16String	optional	tbd	UL for additional identifiers; often a repeating element; details tbd
DMS_AS-AP_AdditionalIdentifierType	UTF16String	optional	tbd	controlled-vocabulary string value identifying the type of additional identifier
DMS_AS-AP_AdditionalIdentifierComment	UTF16String	optional	tbd	free text comment pertaining to the additional identifier
DMS_AS-AP_ShimName	UTF16String	required	tbd	a controlled-vocabulary string value indicating the AS-AP Shim Name, e.g., Derived-from-video-serial-interface
DMS_AS-AP_SignalStandard	UTF16String	required	tbd	a controlled-vocabulary string value indicating the signal standard of video contained in this AS-AP file
DMS_AS-AP_IntendedAFD	UTF16String	optional	tbd	AFD present if inherited from source content or added in production (optional); a string value indicating the intended display format for the program, per SMPTE 2016-1 table 1 a3 a2 a1 a0 with optional informative appended text e.g. 1001 Pillarbox, 0100 Letterbox, 1000 FullHD
DMS_AS-AP_SlateTitle	UTF16String	optional	tbd	present if inherited from source content or added in production (optional); a string that specifies a program title of the type that broadcasters display to traffic and master control operators, e.g. Sesame Street

Symbol	Type	Use	UL	Description
DMS_AS-AP_NOLACode	UTF16String	optional	tbd	present if inherited from source content or added in production (optional); a string that specifies the program series code and episode number, e.g. SESA 4187
DMS_AS-AP_Rating	UTF16String	optional	tbd	present if inherited from source content or added in production (optional); a controlled-vocabulary string that specifies the V-Chip rating of the program, e.g. TV-G
DMS_AS-AP_NielsenStreamIdentifier	UTF16String	optional	tbd	present if inherited from source content or added in production (optional); a string that specifies Nielsen stream identifier for the program
<i>DMS_AS-AP MoreToCome</i>				

Editor's note:

Regarding the local identifiers, see the explanatory description and examples from the Federal Agencies Working Group, ideas about identifiers in "Embedding Metadata in Digital Audio Files" (http://www.digitizationguidelines.gov/audio-visual/documents/IdentifiersTypesCharacteristics_20111121.pdf). See also the Working Group's recommendation for the Broadcast WAVE bext element "Description," on pages 4-5 in "Embedding Metadata in Digital Audio Files: Guideline for Federal Agency Use of Broadcast WAVE Files" (http://www.digitizationguidelines.gov/audio-visual/documents/Embed_Guideline_20120423.pdf).

6.4.4 SOM and EOM Pairs

AS-AP files may include Descriptive Metadata Sets within a timeline Descriptive Metadata Track of the MXF Material Package. If present, these Descriptive Metadata Sets will indicate specific Start Of Material (SOM) and End Of Material (EOM) pairs and/or a Mark-In and Mark-Out object pair within the file. In such instances, the Descriptive Metadata Scheme shall be labeled as DMS-Segmentation (see explanatory comment that follows). The timeline track shall be constructed of a sequence of DMSegments (or subclasses thereof) or Fillers, following the MXF timing model as described in SMPTE ST 377-1:2009. SOM or Mark-In are inferred from the start position of each DMSegment, and EOM or Mark-Out from SOM or Mark-In plus Duration. SOM and EOM or Mark-In and Mark-Out of source material may be described using DMS-Segmentation in lower level source packages within the file.

Editor's note: This optional element is provisional as approaches for segmentation evolve. DMS-Segmentation is not yet well defined in SMPTE standards. In the interim, some producers prefer to use operational patterns in the OP2 and OP3 families in order to accommodate segmentation. Segmentation and SOM/EOM pairs will not be used by minimal systems.

6.4.5 Other Descriptive Metadata Schemes

AS-AP files may contain other Descriptive Metadata Schemes as permitted or required by the specific shim. Each added metadata scheme shall be carried in a separate Descriptive Metadata Track, and the scheme shall be listed in the MXF Preface::DMSchemes property. Added metadata schemes may repeat metadata elements that are already carried in MXF structural metadata or in DMS-AS-AP. In the event of disagreement between metadata item repetition, decoders shall accord highest priority to MXF structural metadata and second priority to DMS-AS-AP. See also 6.4.1 above.

Editor's note: For an example of a technical metadata schema, instances of which would be carried as "other descriptive metadata" in a Generic Partition as an XML text stream: <http://www.archives.gov/preservation/products/reVTMD.xsd>

6.4.6 Redundant Metadata

Editor's note: This is a placeholder adapted from AS-11. The Federal Agencies Working Group foresees that AS-AP metadata beyond DMS will take the form of XML texts in a Generic Partition that is unlikely to be acted upon by, say, a file player. Thus it is hard to predict the impact of a file for which metadata may be in conflict.

Custom metadata included in an AS-AP file by a shim should not duplicate metadata elements that are already carried in MXF Structural Metadata or are already part of the AS-AP Core Metadata Scheme. In the

event of disagreement between redundant, duplicate, metadata items present in an AS-AP MXF file, decoders should accord the highest priority to MXF Structural Metadata and AS-AP Core Metadata Scheme, and lowest priority to the redundant shim-specified metadata.

6.4.7 KLV Fill

Editor's note: This is a placeholder adapted from AS-11.

To provide for the addition of metadata to existing AS-AP MXF files, implementations should include a KLV Fill of at least 8 kilobytes in length following the header partition.

6.4.8 Static Descriptive Metadata Requirements

Editor's note: This is a placeholder adapted from AS-11.

AS-AP files shall conform to the descriptive metadata track structure described by SMPTE EG 42:2004. AS-AP descriptive metadata tracks shall use the following subset of the MXF structure described in SMPTE EG 42:2004:

- A Static Track contained by the single Material Package in the AS-AP MXF file.
- A Sequence object contained by the Static Track.
- A single DM Segment object contained by the Sequence.
- A DM Framework instance contained by the DM Segment. The DM Framework instance type must map to one of the schemes defined in Preface:DMSchemes.

6.5 Other Parameters and Constraints

6.5.1 Manifest

AS-AP files shall be accompanied by a manifest that provides an inventory of the file's essences and expresses the relationships between them, as well as providing summary information about the essence item and its provenance. This manifest shall follow the specification in section 9 of AS-02 (*MXF Versioning*; available at http://www.amwa.tv/downloads/specifications/AMWA-AS-02-10-2011-11-18_MXF_Versioning.pdf).

Editor's note (1): The manifest is an excellent potential location for content integrity metadata (6.5.2). Details remain to be worked out.

Editor's note (2): AS-AP interest in a manifest is intended to be respectful of other structures that have been developed with the same intended function:

- section 6 of the AS-01 Edit Protocol (aka AAF Edit Protocol; <http://www.amwa.tv/downloads/specifications/aafeditprotocol.pdf>)*
- the Bag-It specification from the digital library community (<http://tools.ietf.org/html/draft-kunze-bagit-06>)*
- the Interoperable Master Format Packing List, from version 1.0 of the IMF specification (http://www.etcenter.org/wp-content/uploads/mailchimp-downloads/IMF_Specification_V1.0.pdf, February 2011). The Interoperable Master Format Packing List is defined as, "A list describing the files and providing a means for authentication of the files as delivered in a package."*

6.5.2 Content Integrity and Metadata

When permitted by individual shims, AS-AP files may include Content Integrity Tracks, and systems may also store Content Integrity metadata within the Manifest (6.5.1) or separate from the AS-AP files. When permitted by individual shims, systems may also calculate overall Content Integrity metadata that form a signature for the whole AS-AP file including Header Metadata (and thus also the Identification data within the Header).

Editor's note: Content Integrity metadata consists of hash values. When embedded in an AS-AP file, it should be in the Manifest (6.5.1) and/or an MXF Track. External carriage will vary but it is worth noting some emergent and compatible practices. Developers of the Digital Cinema Package (DCP) and the Interoperable Master Format (IMF) favor both the embedding of content integrity metadata at the essence or included-file level, as well as placing a copy in the "outer package wrapper." The same approach has been recommended for users of the SMPTE Archive eXchange

Format (AXF), an outer wrapper (or package) tailored to work well in an asset management environment. Similar essence-level and package-level content integrity metadata redundancy is available for files that conform to the MXF AS-02 specification. In contrast, MXF AS-03 and AS-11--specifications that do not include manifests--call for content integrity metadata to be placed only in the MXF Track.

6.5.3 File Names

The general provisions of the AS-AP specification do not constrain the choice of filenames. Individual shims may constrain file names.

6.5.4 Directory Structure

The general provisions of the AS-AP specification do not constrain the choice of directory names or structures for storage of AS-AP files.

6.5.5 Program Segmentation Requirements (provisional)

Editor's note: This has been copied more or less wholesale from AS-11 and has not been reviewed in this AS-AP context. DMS-Segmentation is not yet well defined in SMPTE standards and this optional element is provisional. Nevertheless, segmentation may be useful to archives, e.g., if a content asset is a complete movie, and there is enough info to know where the reels start and stop, then an archive might create a DMS Segmentation track to include that metadata. Another example is the film strip genre, where the timing and linkage to the sound track could be described as DMS Segmentation. Editor's note: In the interim, some producers prefer to use operational patterns in the OP2 and OP3 families in order to accommodate segmentation. Segmentation will not be used by minimal systems.

Program Segmentation refers to the presence of regions in the program's Essence data that contain non-program content or points where the program content may be broken (interrupted) to insert non-program content at broadcast time. Program segmentation is described by descriptive metadata contained in a Segmentation Track. AS-AP files may include a Segmentation Track as prescribed by a shim.

6.5.5.1 Segmentation Track

Program segmentation in AS-AP shall be represented using an MXF Timeline track in the file's Material Package, which is referred to as the Segmentation Track. The Segmentation Track's descriptive metadata shall be constructed in accordance with the recommendations of SMPTE EG 42:2004. Source Package objects in AS-AP should not have a Segmentation Track.

The Segmentation Track shall contain a Sequence object that is composed of Filler and DM Segment objects. The DM Segment objects shall contain a DM_AS_AP_Segmentation_Framework. The MXF files's Preface:DMSchemes property shall contain a DM_AS_AP_Segmentation_Scheme label that indicates the presence of segmentation descriptive metadata in the file.

An AS-AP file shall contain zero or one Segmentation Track. The Segmentation Track shall be identified by the presence of DM_AS_AP_Segmentation_Framework objects in DM Segment objects on a Timeline track.

The MXF Timeline Track:TrackName property shall be assigned the value "AS_AP_Segmentation".

Filler objects in the segmentation track shall represent, and align with, regions of non-program content in the Source Essence (e.g. black, ident, clock, etc). DM Segment objects (that contain DM_AS_AP_Segmentation_Framework objects) shall represent, and align with, program content regions.

Note that the start and end timecodes for program regions, commonly referred to as start of material (SOM) and end of material (EOM), may be determined based on the location of DM Segment objects on the Segmentation Track relative to the adjacent Timecode Track in the MXF Material Package that contains the Segmentation Track.

6.5.5.2 Single/Hard/Soft-Part Program

A Single-Part Program is one that has optional non-program run-in followed by uninterrupted program content. This is represented using a single DM Segment on the segmentation track.

A Hard-Parted Program is one that has optional non-program run-in followed by program content that is interrupted by non-program content. This is represented using multiple DM Segment objects that are separated by Filler objects on the segmentation track.

A Soft-Parted Program is one that has optional non-program run-in followed by uninterrupted program content that includes optional break points where a broadcaster may insert non-program content. This is represented using DM Segment objects that are not separated by Filler objects on the segmentation track. DM Segment objects that are adjacent to each other on a segmentation track shall always be considered soft. A broadcaster may nominate alternative break points, or ignore break points, in the Soft-Parted case.

6.5.5.3 DM_AS_AP_Segmentation_Framework

The DM_AS_AP_Segmentation_Framework extends the generic MXF DM Framework class. It contains the segment's part number and the total number of parts in the program. These metadata items represent part numbers of the form "1 of 3", "2 of 3", "3 of 3". Refer to Appendix B for the complete definitions of DM_AS_AP_Segmentation_Framework and DM_AS_AP_Segmentation_Scheme.

ILLUSTRATIVE SEGMENTATION FRAMEWORK DIAGRAM FROM AS-11

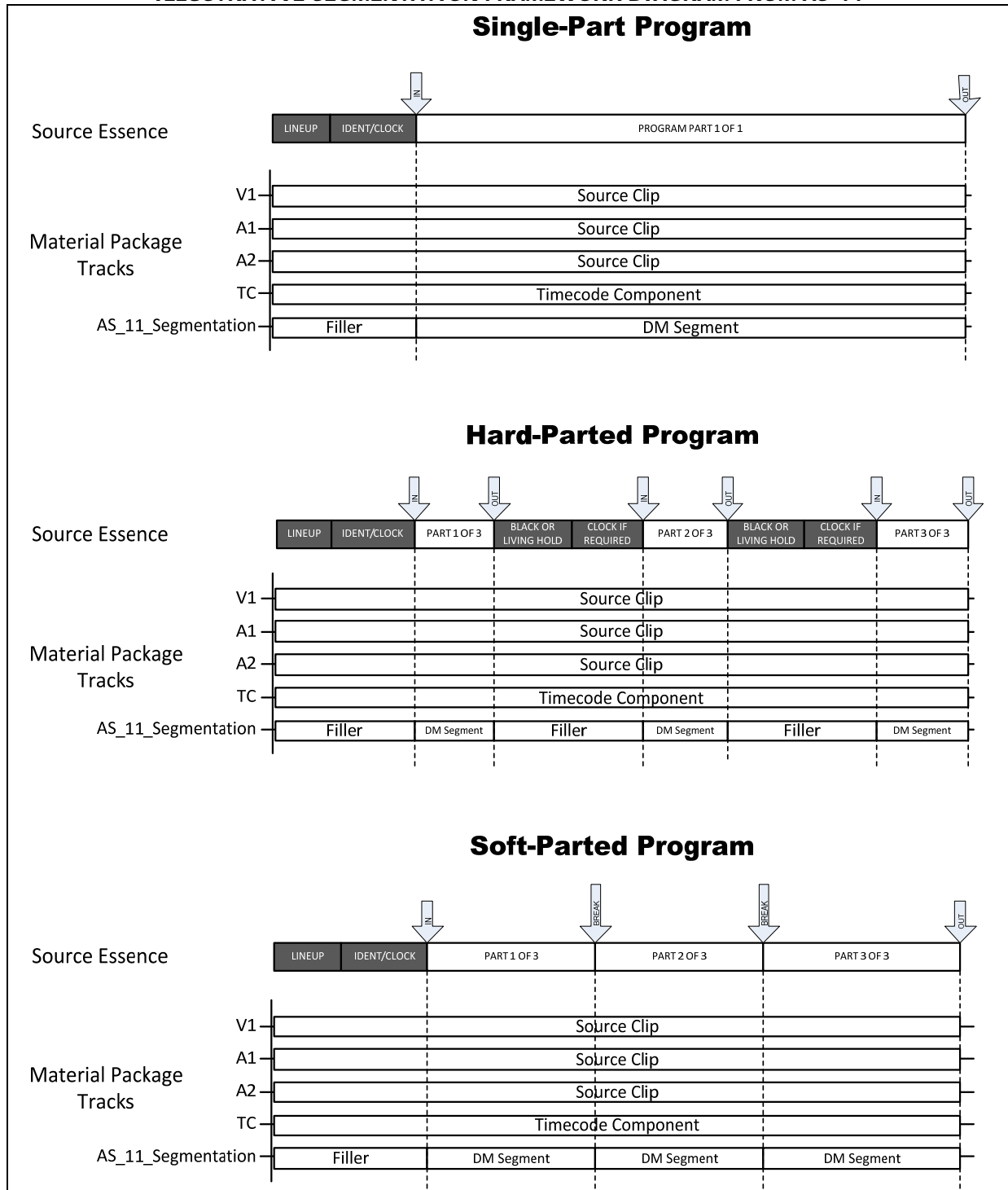


Figure 1 – Three program segmentation cases: i) a single-part program that has run-in followed by a single program segment, ii) a hard-parted program that has run-in, and regions of black and clock where a broadcaster must insert non-program content between program segments, and iii) a soft-parted program that is uninterrupted but has identified break points where a broadcaster may interrupt the playback of the program in order to insert non-program content. The broadcaster may nominate alternative break points in the soft-parted case.

6.5.5.4 Program segmentation element table for shims

Editor's note: Placeholder taken from AS-11.

Dimension	Description	AS-07 constraint	AS-07 values
Program segmentation	Whether a segmentation track is required, not required (i.e., should or should not be present), or optional	<i>Constraint to be provided</i>	<i>Values to be provided</i>

6.5.6 Machine-readable shim

Editor's note: Placeholder for this concept, to be developed as part of AMWA's AS-08.

7 AS-AP Shim Parameters and Constraints

AS-AP shims shall specify a value, as described, for each of the following shim parameters. Shims describe additional constraints that make sense within the context of the general AS-AP requirements. A shim may describe constraints that tighten the conformance language that appears in the general specification (e.g. change should to shall).

Editor's note: The following table is taken from AS-11, supplemented by information from stray sections in this and earlier versions of AS-AP.

Shim Parameter	Description
Picture	
picture_family	The permissible picture formatting category and detail.
picture_format	Description of raster [and other facts]
picture_bitrate	The permissible maximum [average?] bitrate
Sound	
sound_family	Sound signal schemes
sound_language_repertoire	Primary sound languages may be present
track_listing [track_allocation?]	Combinations of picture sound and data tracks are encountered in programs <i>Editor's note: For comparison, here is the AS-11 wording: The set of permissible EBU R 48 and EBU R 123 track allocation names.</i>
Closed Captioning	
caption_presence	Whether the presence of closed captioning is required, not required (i.e. should not be present), or optional.
caption_essence_scheme	Caption signal scheme, e.g., one of CEA 608, CEA 7088. Note, future revisions of this specification may permit EBU-STL.
caption_languages	[to be provided]
Timecode	
synthetic_timecode_mode	Drop- or non-drop frame.
other_timecode_type (repeating element)	Type of additional (beyond synthetic) timecode
other_timecode_mode (repeating element)	Drop- or non-drop frame
other_timecode_note (repeating element)	Narrative comment on the additional timecode
Header metadata	
program_identification	What identifiers are required
timecode	What program timecode is supplied

	<i>Editor's note: How would this be correlated with preceding timecode metadata?</i>
intimate metadata	What metadata must be carried with the program item
??? name?	Signal condition metadata
Additional Descriptive Metadata Schemes	The names of additional metadata schemes that must be included in the file (each on a dedicated Descriptive Metadata Track).
Program Segmentation	Whether a Segmentation Track is required, not required (i.e. should not be present), or optional.
Index Strategy Frame	Defines the position of the index tables in the MXF file.
Essence Partition Strategy	Defines whether the essence is a single partition or divided into multiple partitions. Values: single, multiple.
Permitted AFD Set	The subset of permitted AFD values drawn from the full set of AFD values specified by SMPTE ST 2016-1:2009, Table 1.

8 Test Material

Placeholder statement: Test material [will be] provided by AMWA, consisting of Golden files (constructed with engineered test signals) and Silver files (constructed using actual program content and metadata).

APPENDIXES

Appendix A – AS-AP Core Descriptive Metadata Scheme (placeholder)

Editor's note: Where should the DMS specification be located? Published AMWA Application Specifications offer two different locations: in the main body (see section 6.4.3) and in an appendix like this one (see the November 2011 draft of AS-11). In this draft of AS-AP, we have placeholders in both locations. To be reviewed.

The Core scheme defines the required metadata that is included in all AS-AP files.

Symbol	Type	Description
DM_AS_AP_core	DM Scheme	Metadata for AS-AP archiving format.
DM_AS_AP_core_framework	DM Framework	AS-AP descriptive metadata framework.

Complete definitions of the Core scheme and framework and the individual metadata items that comprise the Core framework are documented in the Detailed Metadata Dictionary in Appendix F.

Appendix B – Segmentation Descriptive Metadata Scheme (placeholder)

Editor's note: placeholder taken from AS-11.

The Segmentation scheme defines the metadata that describes individual program parts on a Segmentation Track.

Symbol	Type	Description
DM_AS_AP_segmentation	DM Scheme	AS-AP segmentation metadata.
DM_AS_AP_segmentation_framework	DM Framework	AS-AP segmentation metadata framework.

Complete definitions of the Segmentation scheme and framework and the individual metadata items that comprise the Segmentation framework are documented in the Detailed Metadata Dictionary in Appendix F.

Appendix C - Parametric Metadata (placeholder)

To be developed.

Appendix D – AS-AP CoreShim: Single Items from Baseband (Uncompressed) Video

AS-AP CoreShim files are for single items derived from *baseband* video, understood to encompass both analog baseband and uncompressed digital video. AS-AP CoreShim files are intended to contain a single rendition of a single source item. This represents the priority use case for the Federal Agencies Working Group: the reformatting of older analog and digital videotapes and, at a few agencies, the encoding and packaging of "live" content streams. (For example, the Library of Congress will be receiving, processing, and archiving high definition digital streams from congressional venues.) In these instances, a baseband or uncompressed digital video signal is input to an MXF-file production system.

NOTE: In this working draft, the sections in Appendix D have been numbered to match the numbering of section 6 in the main AS-AP document. This has been done to permit readers to easily compare sections in Appendix D with those in the main document.

D.6 Parameters and Constraints

[Introductory wording from main AS section 6 applies unchanged.]

D.6.1 Essence Track Parameters and Constraints

D.6.1.1 General

[Specification unchanged from main AS section 6.]

D.6.1.2 Interleaving

[Specification unchanged from main AS section 6.]

D.6.1.3 Partitions

[Specification unchanged from main AS section 6.]

D.6.1.3.1 Essence partition strategy

[Specification unchanged from main AS section 6.]

D.6.1.4 Generic Stream Partitions

[Specification unchanged from main AS section 6.]

D.6.1.5 Index Tables

If AS-AP CoreShim files use Partitions, then they shall also include full MXF Index Tables, compliant with SMPTE ST 377-1:2009. If used, the full Index Tables shall index every Frame of every Track in the file.

[Editor's question: WHICH REQUIREMENT IN THE NEXT SENTENCE DO WE WANT IN THIS SHIM?]

In AS-AP CoreShim files, At each partition point in a given frame-wrapped Essence component file [?], the Index Partition shall [lead (i.e. precede)] [follow] the Essence Partition that it indexes.

The last segment of the full Index Table shall be placed in a Body Partition with no essence (the Footer Partition contains the sparse Index Table, when present). Encoders shall place all Segments of Index Tables in isolated Partitions, that is, Partitions that do not contain any Header Metadata or Essence. The zero position of the Index corresponds to the start of actual program including pre-charge. Therefore, the first IndexTableSegment shall indicate an IndexStartPosition equal to zero. Enumeration and description shall be in the Manifest (6.5.1).

Question for experts: We do allow for Partitioning and that seems to generate the need for Index Tables. The CoreShim is limited to uncompressed and JPEG 2000 compressed video ("Constant Bytes per Entry," CBE). Does this have any effect on how the Index Table spec is stated?

The zero position of the Index corresponds to the start of the essence including pre-charge (see SMPTE ST 377-1:2011, section 11 - Index Table). Therefore, the first IndexTableSegment indicates an IndexStartPosition equal to zero.

D.6.1.5.1 Index strategy frame

[Specification unchanged from main AS section 6.]

D.6.1.6 Container

[Specification unchanged from main AS section 6. Note that the paragraph devoted to D-10 essence data does not apply to the CoreShim.]

D.6.1.7 System Item

[Specification unchanged from main AS section 6.]

D.6.1.8 Random Index Pack

[Specification unchanged from main AS section 6.]

D.6.1.9 KAG Size

[Specification unchanged from main AS section 6. Note that the paragraph devoted to D-10 essence data does not apply to the CoreShim.]

D.6.1.10 Picture Essence Encoding

D.6.1.10.1 [omitted]

[This explanatory section is omitted from the CoreShim.]

D.6.1.10.2 [omitted]

[This explanatory section is omitted from the CoreShim.]

D.6.1.10.3 Picture Essence – JPEG 2000 Compressed (Lossless or Lossy)

This parameter is typically selected by an archive that prefers to store a reduced-data file, and that is formatting or reformatting content as a part of its own pre-ingest or ingest activity, e.g., transferring content from a videotape carrier, or scanning film.

Dimension	Description	AS-AP Constraint	AS-AP Values	CoreShim Constraint	CoreShim Values
picture_family	Picture signal schemes (compression or sampling or other)	Gentle	<p>From ISO/IEC 15444-1:2004/Amd 3:2010; JPEG 2000 Core Coding Broadcast Profiles: Profile levels 6 and 7 (lossless) and levels 1 through 5 (lossy).</p> <p>From ISO/IEC 15444-1:2004/Amd 1:2006; JPEG 2000 Core Coding Profiles for digital cinema applications: Profiles for 4K and 2K (lossy)</p> <p>[Other JPEG 2000 profile tbd, possibly including legacy formats]</p> <p>Color space and bit depths as specified in JPEG 2000 profiles</p>	<i>Constraint to be provided</i>	<i>Values to be provided, probably will omit digital cinema 2K and 4K profiles</i>

picture_format	Picture raster and aspect ratio	Moderate	480i 4:3, 576i 4:3, 576i 16:9, 720p 16:9, 1080i 16:9, 1080p 16:9, 2K, 4K, 8K	<i>Constraint to be provided</i>	<i>Values to be provided, probably will omit 2K, 4K, and 8K</i>
picture_bitrate	Bits per second in real time	Gentle	Up to 3 Gbps (Respecting SMPTE 424M) <i>Editor's note: Is this high enough?</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.1.10.3.1. JPEG 2000 Essences and SMPTE ST 422

[Specification unchanged from main AS section 6.]

D.6.1.10.4 Picture Essence – Uncompressed

This parameter is typically selected by an archive that prefers to store an uncompressed file, and that is formatting or reformatting content as a part of its own pre-ingest or ingest activity, e.g., transferring content from a videotape carrier, or scanning film.

Dimension	Description	AS-AP Constraint	AS-AP Values	CoreShim Constraints	CoreShim Values
picture_family	Picture signal schemes (compression or sampling or other)	Gentle	Uncompressed carried in a SMPTE ST 384-compliant GC Element X'Y'Z' 10 – 16 bpp	<i>Constraint to be provided</i>	<i>Values to be provided</i>
picture_format	Picture raster and aspect ratio	Moderate	480i 4:3, 576i 4:3, 576i 16:9, 720p 16:9, 1080i 16:9, 1080p 16:9 2K 4K	<i>Constraint to be provided</i>	<i>Values to be provided, probably will omit 2 and 4K</i>
picture_bitrate	Bits per second in real time	Gentle	Up to 2 Gbps	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.1.10.5 [omitted]

[This section omitted from CoreShim.]

D.6.1.10.6 Picture – Associated Still Images

This parameter is intended to permit the inclusion of image-based corollary materials associated with content that an archive is reformatting, e.g., documents or pictorial items stored with a source videotape.

Dimension	Description	AS-AP Constraint	AS-AP Values	CoreShim Constraint	CoreShim Values
picture_family	Picture signal schemes (compression or sampling or	Gentle	Illustrative examples: TIFF JPEG 2000	<i>Constraint to be provided</i>	<i>Values to be provided</i>

	other)		JPEG PDF		
picture_format	Picture raster and aspect ratio	Moderate	Per input format	<i>Constraint to be provided</i>	<i>Values to be provided</i>
picture_bitrate	Bits per second in real time	Gentle	N/A	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.1.11 Audio Essence Encoding

D.6.1.11.1 Multiple encodings and wrappings permitted

Dimension	Description	AS-AP Constraint	AS-AP Values	CoreShim Constraint	CoreShim Values
sound_family	Sound signal schemes (compression or sampling or other)	Moderate	PCM 96 kHz 24 bit PCM 48 kHz 24 bit PCM 48 kHz 16 bit Other MPEG schemes, e.g., layer 2 or layer 3 (MP3), or AAC	<i>Constraint to be provided</i>	<i>Values to be provided, prob limited to PCM</i>
sound_language_repertoire	Primary sound languages may be present	None		<i>Constraint to be provided</i>	<i>Values to be provided</i>
track_listing [AS-11 uses "track_allocation"]	Combinations of picture sound and data tracks are encountered in programs <i>Editor's note: AS-11 uses this wording: "The set of permissible EBU R 48 and EBU R 123 track allocation names."</i>	Strong	Main Sound (1,2 or 6 channels) Secondary Audio Program (SAP; 0, 1, or 2 ch) Descriptive Video Service (DVS; 0, 1, or 2 ch) PCM pairs shall be used for Stereo programming	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main AS</i>

Audio shall be PCM pairs, AC-3, or Dolby E. The number of channels is unlimited, and as many tracks shall be employed as needed to represent the number of channels. PCM Audio can have any values up to 192kHz at 24 bit word length. Each PCM track (mono or stereo pair) shall be carried in a SMPTE 382M:2007-compliant MXF GC Element within a BWF Container (not AIFF container). AC-3 and Dolby E tracks shall be carried within a SMPTE 337/338/339/340 container in a SMPTE 382M:2007-compliant MXF GC Element. This audio data shall be interleaved, non-interleaved, framewrapped, or clipwrapped to permit synchronization with the picture information it accompanies, except where custom wrapped data is explicitly required by the shim.

D.6.1.11.2 Audio Track Allocation

[Specification unchanged from main AS section 6.]

D.6.1.11.3 Other provisions

[Specification unchanged from main AS section 6.]

D.6.1.12 Closed Captioning, VBI, and other ancillary data (ANC)

[The editor's note from the main AS section 6.1.12 applies unchanged.]

D.6.1.12.1 Closed Captioning

Dimension	Description	AS-AP Constraint	AS-AP Values	CoreShim Constraint	CoreShim Value
caption_presence	captions in this file (y/n)	??	y/n	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main AS</i>
caption_essence_scheme	captions signal schemes	Strong	CEA-608 in SMPTE ST 436:2006 CEA-708 in SMPTE ST 436:2006	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main AS</i>
caption_languages	captions languages	None	N/A	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main AS</i>

The presence of Closed Caption (subtitling) data in an AS-AP MXF CoreShim file shall be indicated by the value of the AS_AP_Closed_Captions metadata item. If Closed Caption data is present in the file then the optional AS_AP_Caption_Language and AS_AP_Closed_Captions_Type metadata items shall be set.

If either CEA 608 line 21 (CC and XDS) data or CEA 708B DTV captioning data are present, they shall be carried as specified below:

- In a SMPTE ST 334-1/-2:2007 compliant ANC packet within a SMPTE ST 436:2006-compliant VBI/ANC GC Element, using 8 bit encoding.
- [placeholder] As may be specified by the SMPTE ST 2057 process in the future.
- Stored as a separate [blob] [block of data] in a Generic Stream Partition, marked up or tagged to include time offsets or timecodes to relate to the main program. Indexes into such [blobs] [blocks of data] may be binary (similar to MXF index tables), or textual, like xml @id or html #fragment identifiers.

If required by a shim, primary text language shall be specified using AMWA AS-04 and/or SMPTE ST 377-4:2012 (Multichannel Audio in MXF). (IETF RFC 5646 is also an important reference).

D.6.1.12.2 SMPTE Timed Text and EBU STL Recommendations (provisional)

[Specification unchanged from main AS section 6.]

D.6.1.12.3 VBI data tagging (provisional)

[Specification unchanged from main AS section 6.]

D.6.1.13 Active Format Description (AFD)

[Specification unchanged from main AS section 6.]

D.6.1.13.1 Permitted AFD set (provisional)

Editor's note: this is a placeholder adapted from AS-11.

Dimension	Description	AS-AP Constraint	AS-AP Values	Shim-specific Constraint	Shim-specific Values
Permitted AFD Set	The subset of permitted AFD values drawn from the full set of AFD values specified by SMPTE ST 2016-1:2009, Table 1.	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.2 Operational Pattern Parameters and Constraints

D.6.2.1 Baseline Operational Patterns

AS-AP CoreShim files shall comply with MXF Operational Pattern OP1a (SMPTE ST 378) or OP1b (SMPTE ST 391). AS-AP CoreShim files shall be labeled as OP1a or OP1b files in the Operational Pattern property of all Partition packs and the Preface Set. AS-AP CoreShim files shall also include a DMS-AS-AP Descriptive Metadata Set within the MXF Material Package that indicates which that AS-AP CoreShim applies to the file, as described in section [to be identified] below.

D.6.2.2 Operational Pattern – Item

Item means a single content item.

Dimension	Description	AS-AP Constraint	AS-AP Values	Shim-specific Constraint	Shim-specific Values
MXF Structure	MXF-specific Operational Pattern	Strong	OP1a, OP1b, or OP2a internal	<i>Constraint to be provided</i>	OP1a or OP1b
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables	<i>Constraint to be provided</i>	<i>Values to be provided</i>
MXF Structure (continued)	MXF-specific Partitioning	None	N/A	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.2.3 [omitted]

[This section omitted from CoreShim.]

D.6.2.4 Operational Pattern Labeling

[Specification unchanged from main AS section 6.]

D.6.3 Header Metadata Parameters and Constraints

Header Metadata shall be compliant with SMPTE ST 377-1:2011 and with SMPTE ST 378:2004 OP1a and SMPTE ST 391:2004 OP1b.

Dimension	Description	AS-AP Constraint	AS-AP Values	Shim-specific Constraint	Shim-specific Values
Program identification	Required identifiers	Gentle	One of: ISAN UUID archive-specific	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main A</i>
Timecode	Program timecode supplied	Strong	One timecode track in the Material Package, synthetic and continuous; see also section 6.3.6 below	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main A</i>
Intimate metadata	Metadata must be carried with the program item	Moderate	All of: Program Ident Track Ident Language Code other per shim	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main A</i>
Signal condition	Signal condition metadata	Moderate	Standardized measured signal parameters	<i>Constraint to be provided</i>	<i>Values to be provided, prob same as main A</i>

D.6.3.1 File Packages

[Specification unchanged from main AS section 6.]

D.6.3.2 Lower Level Source Packages

[Specification unchanged from main AS section 6.]

D.6.3.3 MXF Tracks

[Specification unchanged from main AS section 6.]

D.6.3.4 Descriptors

[Specification unchanged from main AS section 6.]

D.6.3.5 Package Labeling

[Specification unchanged from main AS section 6.]

D.6.3.6 Timecode

D.6.3.6.1 Timecode Track

[Specification unchanged from main AS section 6.]

D.6.3.6.2 Additional Timecodes

[Specification unchanged from main AS section 6.]

D.6.3.6.3 EBU R 122 Timecode Compatibility

[Specification unchanged from main AS section 6.]

D.6.3.6.4 Default Timecode Value

If there is no source of program timecode, then the Material Package start timecode should use the Default Timecode Value of [nn:00:00:00].

[What should "nn" be?]

D.6.3.6.5 Table of shim values for timecode

Editor's note: This is a placeholder borrowed from AS-11, which featured the following tags for shim parameter tagging.

Dimension	Description	AS-AP Constraint	AS-AP Values	Shim-specific Constraint	Shim-specific Value
synthetic_timecode_mode	Drop- or non-drop frame.	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_type (repeating element)	Type of additional (beyond synthetic) timecode	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_mode (repeating element)	Drop- or non-drop frame	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>
other_timecode_note (repeating element)	Narrative comment on the additional timecode	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.4 Descriptive Metadata Track Parameters and Constraints

D.6.4.1 General

[Specification unchanged from main AS section 6.]

D.6.4.2 Table of DMS elements

Dimension	Description	AS-AP Constraint	AS-AP Values	Shim-specific Constraint	Shim-specific Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-AP	TBD	TBD
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto DMS-Segmentation DMS-PBCore Other per shim	TBD	TBD
Shim Name	The value of the Shim Name property	None	N/A	TBD	TBD

D.6.4.3 DMS Tracks

[Specification unchanged from main AS section 6.]

D.6.4.4 SOM and EOM Pairs

[Specification unchanged from main AS section 6.]

D.6.4.5 Other Descriptive Metadata Schemes

[Specification unchanged from main AS section 6.]

D.6.4.6 Redundant Metadata

[Specification unchanged from main AS section 6.]

D.6.4.7 KLV Fill

[Specification unchanged from main AS section 6.]

D.6.4.8 Static Descriptive Metadata Requirements

[Specification unchanged from main AS section 6.]

D.6.5 Other Parameters and Constraints

D.6.5.1 Manifest

[Specification unchanged from main AS section 6.]

D.6.5.2 Content Integrity and Metadata

[Specification unchanged from main AS section 6.]

D.6.5.3 File Names

[Specification unchanged from main AS section 6.]

D.6.5.4 Directory Structure

[Specification unchanged from main AS section 6.]

D.6.5.5 Program Segmentation Requirements (provisional)

[Specification unchanged from main AS section 6.]

D.6.5.5.1 Segmentation Track

[Specification unchanged from main AS section 6.]

D.6.5.5.2 Single/Hard/Soft-Part Program

[Specification unchanged from main AS section 6.]

D.6.5.5.3 DM_AS_AP_Segmentation_Framework

[Specification unchanged from main AS section 6.]

D.6.5.5.4 Program segmentation element table for shims

Editor's note: placeholder taken from AS-11.

Dimension	Description	AS-07 constraint	AS-07 values	Shim-specific constraint	Shim-specific values
Program segmentation	Whether a segmentation track is required, not required (i.e., should or should not be present), or optional	<i>Constraint to be provided</i>	<i>Values to be provided</i>	<i>Constraint to be provided</i>	<i>Values to be provided</i>

D.6.5.6 Machine-readable shim

[Specification unchanged from main AS section 6.]

Appendix E – AS-AP Shim for “Born Digital” Single Items (future phase)

AS-AP files for single items are intended to be used to contain a single rendition of a single source item. This shim is intended to answer the federal agencies' desire to package and archive content items in their acquisition encodings, generally lossy, e.g., MPEG-2. The picture encodings are described in section 6.1.10.5 (“retain lossy encoding as acquired”). This type of MXF packaging does not entail the serial transmission of the video signal as an input but rather more of a “wrapping and enhancing metadata” activity.

To be developed.

Appendix F – AS-AP Shim for Single Items derived from Film (future phase)

AS-AP files for single items derived from film are intended to be used to contain a single rendition of a single source item. The input for this shim will be the output of film scanning or digital theatrical motion picture production. Like the shim described in appendix C, the essences in these cases will include JPEG 2000 and uncompressed, to the levels associated with digital cinema and its related mastering and post-production processes.

To be developed.

Appendix G – AS-AP Shim for Single Items “Film Strip” (future phase)

To be developed.

Appendix H – AS-AP Shim for Collections (future phase)

To be developed.

Appendix I – Detailed Metadata Definitions (placeholder)

The following table [to be drafted] provides detailed specifications for the AS-AP Core and Segmentation metadata schemes [as well as other user-specific metadata schemes]. Note that a shim can define an additional Descriptive Metadata Scheme that does not appear in this table. In that case, the shim specification should include a similar table that defines the metadata scheme. This table is also available in a separate spreadsheet file.

To be developed.