AMWA Specification
AMWA Application Specification
AS-03 MXF Program Delivery
July 30, 2010 (rev 1.0)

Executive Summary

This document describes a vendor-neutral subset of the MXF file format to use for delivery of finished programming from program producers and program distributors to broadcast stations. AS-03 Files are intended to be delivered in their entirety to be cached before playout.

Contents

1 Scope

This document describes a vendor-neutral subset of the MXF file format to use for delivery of finished programming from program producers and distributors to broadcast stations.

AS-03 Files are intended to be delivered in their entirety to be cached before playout.

It is preferable for AS-03 files to be used by playout servers directly without rewrapping of the MXF data structures, however some servers may perform limited rewrapping into their native format at the time of ingest.

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-04 Language Tagging
AMWA AS-06 Content Integrity

SMPTE 337-2008 through 340-2008 Format for Non-PCM Audio
SMPTE 334-1- and -2-2007 – Vertical Ancillary Data Mapping for Bit-Serial Interface
SMPTE 377M-2004 – Material Exchange Format (MXF) File Format Specification
SMPTE 378M-2004 – MXF Operational Pattern OP1a
SMPTE 379M-2004 – MXF Generic Container
SMPTE 381M-2005 – Mapping MPEG streams into the MXF Generic Container
SMPTE 382M-2007 – Mapping AES3 and Broadcast Wave Audio into the MXF Generic Container
SMPTE 392M-2004 – MXF Operational Pattern OP2a
SMPTE EG42-2004 – MXF Descriptive Metadata
SMPTE 410-2008 – MXF Generic Stream Partition
SMPTE 429-6-2006 – D-Cinema Packaging – MXF Track File Essence Encryption
SMPTE 436M-2006 – MXF Mappings for VBI, and ANCillary Data Packets
SMPTE 2016-2007 – Active Format Description (AFD)

CEA 608 – Closed Captioning Data on line 21
CEA 708B – DTV Closed Captioning
ISO 13818 – MPEG-2
ITU H.264 – Advanced Video Coding (a.k.a. MPEG-4 part 10)
SCTE 35 – Splice Point Markers

4 Overview

4.1 Summary of File Format Requirements

AS-03 Files are intended to be delivered in their entirety to be cached before playout.

The content may be delivered at the ultimate bit-rate, picture format and aspect ratio, or it may be transcoded at the broadcast station to the bit-rates and formats required for particular broadcast channels.

Similar transcoding may be applied to audio and captions; additionally, specific audio and caption tracks may be selected for different broadcast channels.

Transcoding operations may be carried out in advance of broadcast, and the transcoded files may be held in the same cache as the delivered files; or the transcoded files may be staged on a playout server.

It is preferable for AS-03 files to be used by playout servers directly without rewrapping of the MXF data structures, however some servers may perform limited rewrapping into their native format at the time of ingest.

The content may be pre-packaged for broadcast without further splicing or it may be segmented for ease of insertion or replacement of interstitials.

AS-03 files contain defined sets of metadata for identification of content and for verification of content versus progam traffic metadata that is delivered separately. Provision is also made for additional sets of metadata that may be provided for use in program libraries.

4.2 General AS-03 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-03 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 type of programming or programming genres, or they may address requirements of particular broadcast station groups.

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

5 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 377M-2004
- 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-03 applications will use identically

Shims always express stronger constraints than the general specification

5.1 Essence Track Parameters and Constraints

5.1.1 General

AS-03 files shall contain a single programme comprised of Video, Audio services, Closed Captioning and other ancillary data.

5.1.2 Interleaving

Essence in each Generic Container in AS-03 Files shall be interleaved frame-by-frame. Essence shall be frame-wrapped except where custom wrapping is explicitly required by the shim.

5.1.3 Partitions

Essence in AS-03 Files shall be divided into Partitions.

It is recommended that new Partitions shall be started each 1 minute of program time.

Additionally, Partitions shall not be longer than 10 minutes of program time, and new Partitions may be started to meet this requirement.

5.1.4 Index Tables

AS-03 files shall include full MXF Index Tables. The required combination of Index Tables is defined for each Shim.

The full Index Tables shall index every Frame of every Track in the file. Segments of the full Index Table should be positioned in the Partition that immediately follows the Essence they index. 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.

5.1.5 Video

Video shall be MPEG-2 MP or 422P, or H.264, any GOP structure, at bit rates of 5 up to 50 Mbps, in compliance with ISO 13818-2 Elementary Streams.

The video stream shall be carried in a SMPTE 381M-2005-compliant MXF GC Element.

The MXF Picture Descriptor shall include AFD metadata per SMPTE 2016.

If required by a shim, primary text language shall be specified using AMWA AS-04.

5.1.6 Audio

Audio shall be PCM pairs, AC-3 or Dolby E.

PCM Audio shall be 48kHz, up to 16 channels. Each track (mono channel or stereo pair of channels) 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 data shall be frame-wrapped except where custome wrapped data is explicitly required by the shim.

The MXF Sound Descriptor shall include DialNorm metadata.

Audio language and purpose shall be specified using AMWA AS-04.

5.1.7 Closed Captioning

If present, CEA 608 line 21 (CC and XDS) data shall be carried in a SMPTE 334-1- and -2-2007-compliant ANC packet within a SMPTE 436M-2006-compliant VBI/ANC GC Element, using 8 bit encoding.

If present, CEA 708B DTV captioning data shall be carried in a SMPTE 334-1- and -2-2007-compliant ANC packet within a SMPTE 436M-2006-compliant VBI/ANC GC Element, using 8 bit encoding..

Caption language shall be specified using AMWA AS-04.

5.1.8 Other VBI

If present, VBI shall be carried in a SMPTE 334-1- and -2-2007-compliant ANC packet within a SMPTE 436M-2006-compliant VBI GC Element.

5.2 Operational Pattern Parameters and Constraints

5.2.1 Baseline Operational Patterns

AS-03 files shall comply with MXF Operational Pattern OP1a.

AS-03 files shall be labeled as OP1a files in the Operational Pattern property of all Partition packs and the Preface Set.

AS-03 files shall also include a DMS-AS-03 Descriptive Metadata Set within the MXF Material Package that indicates which specific AS-03 shim applies to the file, as described in section 5.4.2 below.

5.2.2 Interleaving

Interleaving of Essence in AS-03 Files shall be in accordance with the specifications for each Shim.

5.2.3 Partitions

Partitioning of Essence in AS-03 Files shall be in accordance with the specifications for each Shim.

5.2.4 Index Tables

Index Tables in AS-03 files shall be compliant with SMPTE 377M-2004.

AS-03 files may contain full index tables that index each frame of the essence, or sparse index tables that index the start of partitions, or both. The required combination of Index Tables is defined for each Shim.

5.2.5 Container

AS-03 Files shall use the MXF Generic Container SMPTE 379M-2004.
The Number of Elements in each GC is defined for each Shim.

5.2.6 System Item

The GC System Item may be present but is not used by AS-03 Files.

5.2.7 Timecode Track

AS-03 Files do not use timecode tracks within the Essence Container, however a Synthetic timecode shall be provided in the Header Metadata.

Timecode mode (drop-frame or non-drop frame) may be specified in each Shim.

5.2.8 Random Index Pack

AS-03 Files (when Closed and Complete) shall contain a Random Index Pack per SMPTE 377M-2004.

5.2.9 KAG Size

AS-03 Files shall employ the default KLV Alignment Grid of 1 – see SMPTE 377M-2004 at Key Alignment Grid.

5.3 Header Metadata Parameters and Constraints

Header Metadata shall be compliant with SMPTE 377M-2004 and with SMPTE 378M-2004 OP1a.

5.3.1 Material Packages

AS-03 files shall contain one Material Package.

5.3.2 File Packages

AS-03 files shall contain one File Package.

5.3.3 Lower Level Source Packages

If present, Lower-level Source Packages shall be compliant with SMPTE 377M-2004.

5.3.4 MXF Tracks

Packages in AS-03 files shall contain exactly the number of MXF Tracks required to describe the Video, Audio, Ancillary and Descriptive Metadata Tracks (including any AS-xx Content Integrity Tracks) contained in the file.

5.3.5 Descriptors

The Descriptors in the File Package of AS-03 files shall be compliant with SMPTE 377M-2004.

Descriptors shall include all properties specifed by SMPTE 377 and specific parametric metadata as required by Video, Audio, Captions tracks (see above).

5.3.6 Timecode

In addition, AS-03 files shall contain one Timecode Track in the Material Package, per SMPTE 377M-2004, defining a synthetic program run time

Timecode mode and starting time may be specified in each Shim.

5.3.7 Package Labelling

PackageIDs in AS-03 files shall be in compliance with SMPTE 330M.

5.4 Descriptive Metadata Track Parameters and Constraints

5.4.1 General

AS-03 files shall include MXF Descriptive Metadata in compliance with SMPTE 377M-2004 and EG42-2004.

Each instance of a Descriptive Metadata Scheme shall be carried in a separate Descriptive Metadata Track.

Each metadata scheme shall be listed in the MXF Preface::DMSchemes property.

5.4.2 DMS-AS-03 Tracks

AS-03 files shall include one Descriptive Metadata Set within a static Descriptive Metadata Track of the MXF Material Package, that indicates which specific AS-03 shim (constraint set) applies to the file.

The Descriptive Metadata Scheme shall be labeled as DMS-AS-03 (UL to be published in the SMPTE Labels Registry).

To provide for addition of Descriptive Metadata, applications should include a KLV Fill of at least 8 kilobytes in length when initially creating an AS-03 file.

DMS-AS-03 shall include the following mandatory properties:
- AS-03 Identifier Kind – an enumerated string value indicating the kind of program identifier
  - e.g. "ISAN"
- AS-03 Identifier – the identifier, as a text string
  - e.g. "ISAN 0000-0001-8947-0000-8-0000-0000-D"

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- AS-03 Shim Name – an enumerated string value
    - e.g. "PBS NGIS HD"
- AS-03 Signal Standard – an enumerated string value indicating the signal standard of video contained in this AS-03 file,
    - e.g. "486/720/59.94i/4:3", "1920/1080/59.94i/16:9", "1280/720/29.97p/16:9"
- AS-03 Intended AFD – an enumerated 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"

ULs for DMS_AS-03 are defined as follows:

Symbol	Type	Use	UL	Description
DMS_AS_03	DM_Scheme		`060e2b34 04010101 0d010401 03000000`	Metadata for AS_03 Delivery Format
DMS_AS_03_Framework	DM_Framework		`060e2b34 04010101 0d010401 03010000`	AS_03 Descriptive Metadata
AS_03_Identifier	UTF16String	required	`060e2b34 01010101 0d010401 03010200`	the program identifier as a text string, e.g. P900000HD
AS_03_Identifier Kind	UTF16String	required	`060e2b34 01010101 0d010401 03010100`	a controlled-vocabulary string value indicating the kind of program identifier, e.g. PBS PackageID
AS_03_ShimName	UTF16String	required	`060e2b34 01010101 0d010401 03010300`	a controlled-vocabulary string value indicating the AS-03 Shim Name, e.g. PBS NGIS HD Playout
AS_03_Signal Standard	UTF16String	required	`060e2b34 01010101 0d010401 03010400`	a controlled-vocabulary string value indicating the signal standard of video contained in this AS-03 file
AS_03_IntendedAFD	UTF16String	required	`060e2b34 01010101 0d010401 03010500`	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
AS_03_SlateTitle	UTF16String	optional	`060e2b34 01010101 0d010401 03010600`	a string that specifies a program title to be displayed to traffic and master control operators, e.g. Sesame Street
AS_03_NOLACode	UTF16String	optional	`060e2b34 01010101 0d010401 03010700`	a string that specifies the program series code and episode number, e.g. SESA 4187
AS_03_Rating	UTF16String	optional	`060e2b34 01010101 0d010401 03010800`	a controlled-vocabulary string that specifies the V-Chip rating of the program, e.g. TV-G
AS_03_Nielsen StreamIdentifier	UTF16String	optional	`060e2b34 01010101 0d010401 03010900`	a string that specifies Nielsen stream identifier for the program

5.4.3 SOM and EOM Pairs

AS-03 files may include Descriptive Metadata Sets within a timeline Descriptive Metadata Track of the MXF Material Package, that indicate specific Start Of Material (SOM) and End Of Material (EOM) pairs within the file.

The Descriptive Metadata Scheme shall be labeled as DMS-Segmentation (UL to be published in the SMPTE Labels Registry).

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 377-1-2009. SOM is inferred from the start position of each DMSegment, and EOM from SOM plus Duration.

SOM and EOM of source material may be described using DMS-Segmentation in lower level source packages within the file.

5.4.4 Other Descriptive Metadata Schemes

AS-03 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 should not repeat metadata elements that are already carried in MXF structural metadata or in DMS-AS-03. In the event of disagreement between metadata items repetition, decoders shall accord highest priority to MXF structural metadata and second priority to DMS-AS-03.

5.4.5 Content Integrity Tracks

AS-03 files may include one Content Integrity Track for each Essence Track in the file. Content Integrity Tracks are constructed as Descriptive Metadata Tracks that include the DMS-Crypto DM Scheme, Cryptographic Frameworks and Cryptographic Contexts per SMPTE 429-6-2006, using AMWA AS-xx Content Integrity

5.5 Other Parameters and Constraints

5.5.1 File Names

The general provisions of the AS-03 specification do not constrain the choice of filenames. Individual shims may constrain file names.

5.5.2 Directory Structure

The general provisions of the AS-03 specification do not constrain the choice of directory names or structures for storage of AS-03 files.

5.5.3 Content Integrity

When permitted by individual shims, AS-03 files may include Content Integrity Tracks, and systems may also store the metadata from Content Integrity Tracks separate from the AS-03 files.

When permitted by individual shims, systems may also calculate overall Content Integrity metadata that form a signature for the whole AS-03 file including Header Metadata (and thus also the Identification data within the Header).

6 Test Material

Test material is provided by AMWA, consisting of Golden files (constructed with engineered test signals) and Silver files (constructed using actual PBS program content and metadata)

7 Tabulation of AS-03 General Parameters and Constraints

This section contains tables listing the general parameters and constraints that apply to all AS-03 files. Any of these parameters and constraints my be tightened by a specific shim. Shims are specified in annexes following this section.

7.1 Picture

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program bitrate	how many bits per second at real time	Gentle	~5Mbps to ~50 Mbps		
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		
Transport Bitrate	how many bits per second in transit	None	N/A		
Picture Essence Schemes	what picture signal schemes (compression or sampling or other) are encountered in programs	Gentle	MPEG2 all GOPs MP or 422P AVC all GOPs		

7.2 Sound

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Sound Essence Schemes	what sound signal schemes	Moderate	PCM AC-3		
Sound Language repertoire	what primary sound languages may be present	None	N/A		
Track Listings	what combinations of picture sound and data tracks are encountered in programs	Strong	1 x Main Sound (stereo or 5.1) 1 x SAP (opt) 1 x DVS (opt) Others opt up to a total 8 pairs PCM pairs shall be used for Stereo programming		

7.3 Captions

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Caption Essence Schemes	what captions signals schemes	Strong	CEA-608 in S436M CEA-708 in S436M		
Caption Languages	what captions languages	None	N/A		

7.4 Operational Pattern

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Segment Duration	what is the range of program items to be covered	Gentle	0:00:01:00 and up		
MXF Structure	MXF-specific Operational Pattern	Strong	OP1A internal		
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables		
MXF Structure (continued)	MXF-specific Partitioning	None	N/A		

7.5 Header Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program identification	what identifiers are required	Gentle	One of: ISAN Ad-ID House (per shim) UUID		
Timecode	What program timecode is supplied	Strong	One timecode track in the Material Package, synthetic and continuous		
Intimate metadata	what metadata must be carried with the program item	Moderate	All of: Program Ident Track Ident Language Code other per shim		

7.6 Descriptive Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-03		
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto DMS-Segmentation		
Shim Name	The value of the Shim Name property	None	N/A		

Annex A AS-03 Shim for PBS NGIS HD Playout

AS-03 files for PBS NGIS HD Playout are intended to be used to carry program material within PBS member stations for playout..

A.1 Picture

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program bitrate	how many bits per second at real time	Gentle	~5Mbps to ~50 Mbps	Strong	25 Mbps (MPEG-2) 18 Mbps (H.264)
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	Strong	1080i 16:9 for HD
Transport Bitrate	how many bits per second in transit	None	N/A	Strong	<35 Mbps
Picture Essence Schemes	what picture signal schemes (compression or sampling or other) are encountered in programs	Gentle	MPEG2 all GOPs MP or 422P AVC all GOPs	Strong	H.264 long GOP MPEG-2 long GOP

A.1.1 Picture Essence

PBS NGIS HD Playout files shall contain MPEG-2 long GOP at approximately 25Mbps or H.264 long GOP at approximately 18 Mbps

A.1.2 MPEGVideoDescriptor

The MPEG2VideoDescriptor shall contain the following properties with the following values:
• All per SMPTE 381M – no exceptions are anticipated

A.1.3 Source Clip

The Video Track of the Material Package shall contain a single Source Clip, whose Source Start Position references the position of the first frame of actual Programme material excluding decoder pre-charge or preroll. The Origin property of the Source Clip shall indicate the number of frames of pre-charge.

A.2 Sound

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Sound Essence Schemes	what sound signal schemes	Moderate	PCM AC-3	-same-	-same-
Sound Language repertoire	what primary sound languages may be present	None	N/A	Moderate	en-us one other ?

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Track Listings	what combinations of picture sound and data tracks are encountered in programs	Strong	1 x Main Sound (stereo or 5.1) 1 x SAP (opt) 1 x DVS (opt) Others opt up to a total 8 pairs PCM pairs shall be used for Stereo programming	Strong	PBS Published Audio Configuration (surround plus 1-4 pairs)

A.3   Captions

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Caption Essence Schemes	what captions signals schemes	Strong	CEA-608 in S436M CEA-708 in S436M	-same-	-same-
Caption Languages	what captions languages	None	N/A	Strong	en-us and one other

A.4   Operational Pattern

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Segment Duration	what is the range of program items to be covered	Gentle	0:00:01:00 and up	Moderate	0:00:05:00 to 3:00:00:00
MXF Structure	MXF-specific Operational Pattern	Strong	OP1A internal (OP2A if splice metadata)	-same-	-same-
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables	-same-	-same-
MXF Structure (continued)	MXF-specific Partitioning	None	N/A	-same-	-same-

A.4.1   Tracks

Material and File Packages in PBS NGIS HD Playout files shall each contain:
- One Video Track
- One to five Audio Tracks, surround, single channel or two channel as necessary.
- Surround programming shall be carried in SMPTE 382M Frame Wrapped generic containers, including SMPTE 337 AC-3 data bursts and sync bursts and padding bytes to achieve data alignment per SMPTE 340
- Stereo programming shall be carried in PCM pairs
- Mono programming shall be carried in mono tracks.
- Zero or more VBI Tracks
- One or more DM Tracks

A.5   Header Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values

Program identification	what identifiers are required	Gentle	One of:
			  ISAN
			  Ad-ID
			  House (per shim)
			  UUID
				Strong	House (PODS)

Timecode	What program timecode is supplied	Strong	One timecode track in the Material Package, synthetic and continuous	Strong	DF starting at 01:00:00;00

Intimate metadata	what metadata must be carried with the program item	Moderate	All of:
			  Program Ident
			  Track Ident
			  Language Code
			other per shim
				Moderate	DMS-NGIS (reqd)
					DMS-PBCore (opt)

A.6   Descriptive Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-03	Strong	DMS-NGIS
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto DMS-Segmentation	Moderate	(optional) DMS-Crypto for Content Integrity CRC-32C (Castagnoli)
	What optional schemes are permitted	Unknown	None	Moderate	(optional) DMS-Segmentation
	What optional schemes are permitted	Unknown	None	Moderate	(optional) DMS-PBCore
Shim Name	The value of the Shim Name property	None	N/A	Strong	"PBS NGIS HD Playout"

A.6.1   Metadata specific to the shim

AS-03 PBS NGIS HD Playout files shall contain a static Descriptive Metadata Track with DMS-NGIS metadata.

The DMS-NGIS metadata scheme augments DMS-AS-03 with the following properties:
- SlateTitle – a string that specifies a program title to be displayed to traffic and master control operators
- NOLACode – a string that specifies the program series code and episode number
- Rating – a string that specifies the V-Chip rating of the program

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- (optional) NielsenStreamIdentifier – a string that specifies Nielsen stream identifier for the program

All properties are optional.

Annex B   AS-03 Shim for PBS NGIS HD Distribution

AS-03 files for PBS NGIS HD Distribution are intended to be used to convey program material from the network operations center to PBS member stations. These files differ from PBS NGIS HD Playout files in that AC-3 data is carried custom-wrapped, with SMPTE 340 padding bytes remove, to optimize distribution bandwidth.

It is intended that PBS NGIS HD Distribution files are converted to PBS NGIS HD Playout files at member stations prior to playout.

B.1   Picture

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program bitrate	how many bits per second at real time	Gentle	~5Mbps to ~50 Mbps	Strong	25 Mbps (MPEG-2) 18 Mbps (H.264)
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	Strong	1080i 16:9 for HD
Transport Bitrate	how many bits per second in transit	None	N/A	Strong	<35 Mbps
Picture Essence Schemes	what picture signal schemes (compression or sampling or other) are encountered in programs	Gentle	MPEG2 all GOPs MP or 422P AVC all GOPs	Strong	H.264 long GOP MPEG-2 long GOP

B.1.1   Picture Essence
PBS NGIS HD Distribution files shall contain MPEG-2 long GOP at approximately 25Mbps or H.264 long GOP at approximately 18 Mbps

B.1.2   MPEGVideoDescriptor
The MPEG2VideoDescriptor shall contain the following properties with the following values:
   •   All per SMPTE 381M – no exceptions are anticipated

B.1.3   Source Clip
The Video Track of the Material Package shall contain a single Source Clip, whose Source Start Position references the position of the first frame of actual Programme material excluding decoder pre-charge or preroll. The Origin property of the Source Clip shall indicate the number of frames of pre-charge.

B.2   Sound

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Sound Essence Schemes	what sound signal schemes	Moderate	PCM AC-3	-same-	-same-
Sound Language repertoire	what primary sound languages may be present	None	N/A	Moderate	en-us one other ?

Track Listings	what combinations of picture sound and data tracks are encountered in programs	Strong	1 x Main Sound (stereo or 5.1) 1 x SAP (opt) 1 x DVS (opt) Others opt up to a total 8 pairs PCM pairs shall be used for Stereo programming	Strong	PBS Published Audio Configuration (surround plus 1-4 pairs)

B.3 Captions

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Caption Essence Schemes	what captions signals schemes	Strong	CEA-608 in S436M CEA-708 in S436M	-same-	-same-
Caption Languages	what captions languages	None	N/A	Strong	en-us and one other

B.4 Operational Pattern

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Segment Duration	what is the range of program items to be covered	Gentle	0:00:01:00 and up	Moderate	0:00:05:00 to 3:00:00:00
MXF Structure	MXF-specific Operational Pattern	Strong	OP1A internal (OP2A if splice metadata)	-same-	-same-
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables	-same-	-same-
MXF Structure (continued)	MXF-specific Partitioning	None	N/A	-same-	-same-

B.4.1 Tracks

Material and File Packages in PBS NGIS HD Distribution files shall each contain:
- One Video Track
- One to five Audio Tracks, surround, single channel or two channel as necessary.
- Surround programming shall be carried in SMPTE 382M Custom Wrapped generic containers, with all padding bytes elided, leaving only SMPTE 337 AC-3 data bursts and sync bursts
- Stereo programming shall be carried in PCM pairs
- Mono programming shall be carried in mono tracks.
- Zero or more VBI Tracks
- One or more DM Tracks

B.5   Header Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values

Program identification	what identifiers are required	Gentle	One of:
			  ISAN
			  Ad-ID
			  House (per shim)
			  UUID
				Strong	House (PODS)

Timecode	What program timecode is supplied	Strong	One timecode track in the Material Package, synthetic and continuous	Strong	DF starting at 01:00:00;00

Intimate metadata	what metadata must be carried with the program item	Moderate	All of:
			  Program Ident
			  Track Ident
			  Language Code
			other per shim
				Moderate	DMS-NGIS (reqd)
					DMS-PBCore (opt)

B.6   Descriptive Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-03	Strong	DMS-NGIS
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto DMS-Segmentation	Moderate	(optional) DMS-Crypto for Content Integrity CRC-32C (Castagnoli)
	What optional schemes are permitted	Unknown	None	Moderate	(optional) DMS-Segmentation
	What optional schemes are permitted	Unknown	None	Moderate	(optional) DMS-PBCore
Shim Name	The value of the Shim Name property	None	N/A	Strong	"PBS NGIS HD Distribution"

B.6.1   Metadata specific to the shim

AS-03 PBS NGIS HD files shall contain a static Descriptive Metadata Track with DMS-NGIS metadata.

The DMS-NGIS metadata scheme augments DMS-AS-03 with the following properties:
- SlateTitle – a string that specifies a program title to be displayed to traffic and master control operators
- NOLACode – a string that specifies the program series code and episode number
- Rating – a string that specifies the V-Chip rating of the program

- (optional) NielsenStreamIdentifier – a string that specifies Nielsen stream identifier for the program

All properties are optional.

Annex C   AS-03 Shim for PBS NGIS SD

C.1   Picture

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program bitrate	how many bits per second at real time	Gentle	~5Mbps to ~50 Mbps	Strong	8-15Mbps
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	Strong	480i 4:3
Transport Bitrate	how many bits per second in transit	None	N/A	Strong	<35 Mbps
Picture Essence Schemes	what picture signal schemes (compression or sampling or other) are encountered in programs	Gentle	MPEG2 all GOPs MP or 422P AVC all GOPs	Strong	ATSC & MPEG 2 long GOP

C.1.1   Picture Essence
PBS NGIS SD Distribution files shall contain MPEG-2 long GOP at between 8 Mbps and 15 Mbps

C.1.2   MPEGVideoDescriptor
The MPEG2VideoDescriptor shall contain the following properties with the following values:
- All per SMPTE 381M – no exceptions are anticipated

C.2   Sound

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Sound Essence Schemes	what sound signal schemes	Moderate	PCM AC-3	Strong	PCM 16 bit
Sound Language repertoire	what primary sound languages may be present	None	N/A	Moderate	en-us one other ?
Track Listings	what combinations of picture sound and data tracks are encountered in programs	Strong	1 x Main Sound (stereo or 5.1) 1 x SAP (opt) 1 x DVS (opt) Others opt up to a total 8 pairs PCM pairs shall be used for Stereo programming	Strong	PBS Published Audio Configuration (1 2 or 3 tracks)

C.3   Captions

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Caption Essence Schemes	what captions signals schemes	Strong	CEA-608 in S436M CEA-708 in S436M	-same-	-same-
Caption Languages	what captions languages	None	N/A	Strong	en-us and one other

C.4   Operational Pattern

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Segment Duration	what is the range of program items to be covered	Gentle	0:00:01:00 and up	Moderate	0:00:05:00 to 3:00:00:00
MXF Structure	MXF-specific Operational Pattern	Strong	OP1A internal	-same-	-same-
MXF Structure (continued)	MXF-specific Index Tables	Strong	Full Index Tables	-same-	-same-
MXF Structure (continued)	MXF-specific Partitioning	None	N/A	-same-	-same-

C.4.1   Tracks

Material and File Packages in PBS NGIS SD Distribution files shall each contain:
- One Video Track
- One, Two or three Audio Tracks, single channel or two channel as necessary. Stereo programming shall be carried in PCM pairs, Mono programming shall be carried in mono tracks.
- Zero or more VBI Tracks
- One or more DM Tracks

The Video Track of the Material Package shall contain a single Source Clip, whose Source Start Position references the position of the first frame of actual Programme material excluding decoder pre-charge or preroll. The Origin property of the Source Clip shall indicate the number of frames of pre-charge.

C.5   Header Metadata

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Program identification	what identifiers are required	Gentle	One of: ISAN Ad-ID House (per shim) UUID	Strong	House (PODS)
Timecode	What program timecode is supplied	Strong	One timecode track in the Material Package, synthetic and continuous	Strong	DF starting at 01:00:00;00

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Intimate metadata	what metadata must be carried with the program item	Moderate	All of: Program Ident Track Ident Language Code other per shim	Moderate	PODS summary (reqd) PBCore (opt)

C.6   *Descriptive Metadata*

Dimension	Description	AS-03 Constraint	AS-03 Values	Shim-specific Constraint	Shim-specific Values
Descriptive Schemes	what schemes are required	Gentle	DMS-AS-03	Strong	DMS-PODS
Optional Descriptive Schemes	What optional schemes are permitted	Gentle	DMS-Crypto	Strong	(optional) DMS-Crypto for Content Integrity CRC-32C (Castagnoli)
	What optional schemes are permitted	Unknown	None	Moderate	DMS-PBCore
Shim Name	The value of the Shim Name property	None	N/A	Strong	"PBS NGIS SD"

C.6.1   PODS-V4

PBS NGIS SD files may include PODS-V4 Descriptive Metadata in a DMS-PODS-V4 Descriptive Metadata Scheme.

If present, this shall be carried in a DMS-PODS-V4 Descriptive Metadata Scheme. This DM Scheme shall contain a minimum number of identifier properties that are extracted from the PODS-V4 data, plus the PODS-V4 data in its entirety carried in a property of type Generic Stream in compliance with SMPTE 410M.

C.6.2   PBCore

PBS NGIS SD files may include PB-Core Descriptive Metadata in a DMS-PBCore Descriptive Metadata Scheme.

If present, this shall be carried in a DMS- PBCore Descriptive Metadata Scheme. This DM Scheme shall contain a minimum number of identifier properties that are extracted from the PBCore data, plus the PBCore data in its entirety carried in a property of type Generic Stream in compliance with SMPTE 410M.