

## AN UPDATE ON AS-07: MXF APPLICATION SPECIFICATION FOR MOVING IMAGE ARCHIVING AND PRESERVATION

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### I. FADGI and reformatting

The Federal Agencies Digitization Guidelines Initiative (FADGI) is an inter-agency activity led by the Library of Congress with membership from eighteen U.S. federal government agencies.<sup>21</sup> FADGI includes two working groups. The Still Image Working Group develops guidelines and tools that pertain to the scanning of materials that can be reproduced as still images (often with accompanying texts), e.g., books, photos, manuscripts, and maps. The Audio-Visual Working Group develops guidelines and tools that support the digitization of sound recordings, video, and motion picture film.

This article describes an activity of the FADGI Audio-Visual Working Group: the development of an MXF digital format *Application Specification*<sup>22</sup> dubbed AS-07. The Material eXchange Format (MXF) is a container format (aka *wrapper*) for digital moving image and audio media, standardized by the Society of Motion Picture and Television Engineers (SMPTE). The AS-07 profile will specify a constrained version of MXF, intended to serve as the wrapper for a preservation target format, i.e., the digital format that you digitize or transcode “to” when producing a master file for an archive. Although picture encodings—the other main part of the target format—are not our main thrust, they are referenced in the specification and discussed in this article.

AS-07 and other MXF implementations are essence containers: *files* in the classic sense. Most specialists, however, do not consider MXF files to be members of the more encompassing class called *bundles* or *packages*. As an example, this issue of the *IASA Journal* includes an article about a new and promising bundling format: AXF. BagIt is another familiar bundle or package format, as are less elaborate structures like zip, tar, and even LTFS.<sup>23</sup>

Several FADGI member agencies have ongoing programs to digitize their collections. Significant video collections are held by the Library of Congress,<sup>24</sup> the National Archives and Records Administration,<sup>25</sup> the National Aeronautical and Space Administration,<sup>26</sup> and the Smithsonian Institution (including for example the National Anthropological Archives and Human Studies Film Archives).<sup>27</sup> The agencies’ reformatting efforts are motivated by a desire to provide access and to preserve the underlying content for the long term.

Today, different agencies employ different specifications for their preservation target formats for video. However, there is a strong interest in identifying a common format that will permit the agencies to create identical or at least very similar digital master files. Some agencies reformat in-house, where a specification can guide the purchase of digitizing systems. Other agencies outsource reformatting and a specification will help clarify the contracting process for both agencies and vendors. The AS-07 project is intended to specify a digital target format that would meet the agencies’ collective requirements.

21 See <http://www.digitizationguidelines.gov/>.

22 MXF Application Specifications are profiles, i.e., constrained implementations, of the broad MXF standard. This topic is discussed in more detail later in this paper.

23 See <http://tools.ietf.org/html/draft-kunze-bagit-09>; <http://www.digitalpreservation.gov/formats/fdd/fdd000354.shtml> (zip); [http://en.wikipedia.org/wiki/Tar\\_\(computing\)](http://en.wikipedia.org/wiki/Tar_(computing)); and [http://www.trustto.com/LTFS\\_Format\\_To\\_Print.pdf](http://www.trustto.com/LTFS_Format_To_Print.pdf).

24 See <http://www.loc.gov/rr/mopic/findaid/mpfind.html>.

25 See <http://www.archives.gov/research/formats/film-sound-video.html>.

26 See <http://www.nasa.gov/multimedia/index.html>.

27 See [http://www.nmnh.si.edu/naa/guide/film\\_intro.htm](http://www.nmnh.si.edu/naa/guide/film_intro.htm).

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## 2. Born digital video

Although issues associated with reformatting older videotapes launched our MXF specification effort and have been the central focus to date, we want AS-07 to be an extensible format. Other classes of moving image material—for example, born digital video and (in the future) motion picture film—are also important candidates for preservation treatment. U.S. federal archives are experiencing an influx of born digital video—both file-based and media-dependent—that represents a real and growing problem in terms of preservation. More digital footage is being shot every year. Oral history projects have largely moved to video. In one scientific agency, marine scientists are shooting extensive research footage of the ocean floor, undersea animals, and other subjects. Meanwhile, the technical formats for born digital video often vary from camera to camera and present archivists with one of today's most volatile format categories.

We believe that AS-07 will be useful as a container for some types of born digital video. Some file-based encodings might be candidates for “rewrapping” into MXF, while others may require transcoding as well as rewrapping. Meanwhile, media dependent video encodings may require extraction and/or transformation before wrapping, in which case many archives may treat this content in the same manner as that carried on older types of videotape.

Some features of the AS-07 specification that support reformatted content will also serve rewrapped and/or transcoded video. But MXF can only wrap the limited set of encodings that SMPTE has already mapped or that will be mapped as the SMPTE effort continues. At this writing, the list of completed mappings includes various MPEG and DV types, as well as VC-1 (Microsoft's Windows video), VC-2 (BBC's Dirac format), and a few others. Refining the AS-07 specification to cover these types will require a bit more development from our team and thus lies in the future.

## 3. What got us started?

How did our involvement in all of this begin? A few years ago, three federal agencies—the Library of Congress in their new Packard Campus facility in Culpeper, Virginia; the Smithsonian Institution Archives on the National Mall in Washington DC; and the US National Archives in College Park, Maryland—started using the same reformatting system: SAMMA. The same system is also in use by two national libraries well represented in IASA: Australia and Norway.

SAMMA stands for System for the Automated Migration of Media Archives, developed by Jim Lindner and his Media Matters company, and now manufactured and marketed by Front Porch Digital. One valuable SAMMA feature is the robotic movement of cassettes, which supports impressively high rates of throughput but has nothing to do with digital formats in and of itself.

The formatting of SAMMA's digital output can vary by implementation. Described at a high level, the Library of Congress specification calls for an MXF file that wraps losslessly compressed JPEG 2000 picture data and uncompressed linear pulse code modulated (LPCM) audio. The Library has produced well over 30,000 files since it began using SAMMA in 2007. The source videotapes for virtually all of these files have carried NTSC interlaced video. Meanwhile, other vendors have offered or plan to offer systems that produce files in the same or very similar formats. Examples include OpenCube, from Belgium, and Amberfin, from the UK.

The FADGI exploration of this topic began in 2009 and the group disseminated a background paper in October 2010.<sup>28</sup> As noted above, our examination of born digital content has been limited to date. Our main current concern is the reformatting of older videotapes and—for this class of content—the main picture encoding preferences in our group are for lossless JPEG 2000 or uncompressed.

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28 See [http://www.digitizationguidelines.gov/guidelines/FADGI-AV\\_AppSpecProj\\_Bkgd\\_101007.pdf](http://www.digitizationguidelines.gov/guidelines/FADGI-AV_AppSpecProj_Bkgd_101007.pdf).

#### 4. What have we seen?

The archives that are making the most active use of MXF remain convinced that this standardized, professional wrapper is the best option for their preservation work. There are adopters of the generalized approach beyond the organizations named above, including Libraries and Archives Canada and the British Broadcasting Corporation (BBC).<sup>29</sup> In the mix of users, those who have selected lossless JPEG 2000 encoding have been pleased to see the consistent production of files with size reductions on the order of 2:1 (or a little better) as compared to files with uncompressed picture essences of the same bit depth.

Nevertheless, some issues have emerged during the first years of activity. Files produced by different systems have not always interoperated, i.e., a file made on system A may not play properly on system B, and vice versa. Problems with interoperability were most evident when JPEG 2000 picture encoding was applied to interlaced picture. Our FADGI analysis indicated that the vendors' formats were "different-but-legal" in terms of the standards, which allow for variation. In addition, methods for file validation and compliance checking have not been well established or widely adopted. We also saw that there were some elements in the source content that were not retained or imperfectly retained in the preservation files: legacy timecodes, captions and subtitles, and supplementary metadata. We want to produce complete and authentic copies and do not want to lose that information.

#### 5. What are the relevant standards?

The general approach described here—MXF files that may carry JPEG 2000 or uncompressed picture encoding—relies upon a surprising number of standards, generally falling into four families: (1) SMPTE specifications pertaining to MXF; (2) ISO/IEC standards pertaining to JPEG 2000; (3) a variety of standards (mostly from SMPTE) that govern captions, timecode, metadata, various types of ancillary data, and more; as well as (4) broadcast standards that pertain to uncompressed video. The latter family includes specifications promulgated by SMPTE and the European Broadcast Union (EBU), although the specifics for structuring uncompressed picture into the bytes that are written to file-carrying media are based in what might be called community standards.<sup>30</sup>

The overarching MXF specification document "does not define either the essence container or the descriptive metadata. Instead, it defines the requirements for these components to be added as a plug-in to an MXF file."<sup>31</sup> There are more than thirty additional MXF SMPTE standards, including ST 379, ST 381, ST 383, ST 384, and ST 422 that specify the placement of the essence container in the MXF wrapper and the detailed mapping of selected essences (mainly picture encodings) to the container.

What's the history of MXF? The standard is closely related to the Advanced Authoring Format (AAF), and both specifications took shape during the period 1998–2004, with many of the same companies and individuals participating. (Refinements and extensions to the MXF standard continue to the present day.) The AAF specification was developed and published by the AAF Association, since renamed the Advanced Media Workflow Association (AMWA),<sup>32</sup> a not-for-profit trade organization that publishes industry specifications, including MXF Application Specifications. In contrast, SMPTE is an internationally recognized standards development body that abides by the ANSI and ISO due process for initiating, approving, revising, and removing standards. Thus MXF is a "capital-S" standard, while the Application Specifications estab-

29 See <http://www.bbc.co.uk/rd/publications/whitepaper241>.

30 The reference here is to bytestreams that are associated with the fourcc (four character codes) codes V210, UYUV, YUY2, and others. See <http://www.digitalpreservation.gov/formats/fdd/fdd000351.shtml> and follow the internal links to several related pages with additional information.

31 SMPTE ST 377:2011, *Material Exchange Format (MXF) — File Format Specification (Standard)*.

32 See <http://www.amwa.tv>.

lished under AMWA fall into a “lowercase-s” category. Additional information about the MXF standard and the continuing importance of AMWA is provided later in this paper.

Although all of these standards do specify the structure and coding of wrappers and essence encodings, as noted above, each of them also permits some variation. In the case of JPEG 2000, for example, the ISO/IEC standards describe a dozen or more *profiles*. Amendment 3 to the standard’s part 1 spells out the rules for seven distinct *broadcast profiles*, two of which are for lossless compression.<sup>33</sup>

## 6. The special case of interlaced picture encoded as JPEG 2000

Regarding the interoperability issues for files that carry interlaced picture encoded with JPEG 2000, the governing specification is SMPTE ST 422, *Mapping JPEG 2000 Codestreams into the MXF Generic Container*, originally published in 2006. As the title of the standard suggests, this is where the ISO/IEC JPEG 2000 coding standard intersects with the MXF wrapper standard.

Although JPEG 2000 has gotten off to a slow start in still image applications, it has developed some real traction in moving image implementations. One well-known and well-supported example is digital cinema and, indeed, two digital cinema JPEG 2000 profiles (for 2K and 4K picture) were among the very first published via ISO/IEC. Digital cinema implementations are strictly for progressively scanned images. As the digital cinema specification moved forward, JPEG 2000 picture was mapped to MXF as a part of defining the Digital Cinema Package, the format that is distributed to theaters. This mapping was worked out (in the main) to support progressive scan, however, and the resulting ST 422 specification did not address interlaced picture in a careful way. Thus there was no rulebook to guide the manufacturers who developed the first MXF-oriented video reformatting systems, resulting in some of the interoperability issues we have seen. One expert in the field called this a “standards shortfall.”

This state of affairs came into focus for us as we began our development of AS-07. Fortunately, one of FADGI’s expert consultants, Oliver Morgan of the MetaGlue corporation, is active in SMPTE standards work and also acquainted with many of the key players in the field. We learned that others, notably the Hollywood-based developers of the Interoperable Master Format (IMF),<sup>34</sup> had also identified the problem with JPEG 2000 mapping to MXF. Morgan’s work with us increased his familiarity with the issue and helped motivate him to initiate a revision effort within SMPTE.

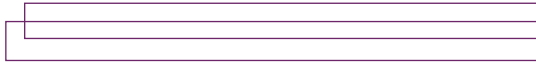
At this writing, a revised version of ST 422 has moved through most of SMPTE’s process steps and publication is anticipated by early 2014. The revision should solve the problem of interlaced picture in JPEG 2000 going forward, but some archives with MXF-JPEG 2000 files produced in years past may decide to migrate those files to the new specification over time.

## 7. AS-07: an MXF application specification

An MXF Application Specification (AS) is a kind of profile that pins down preferred options and reduces the variables for both the MXF wrapper and the essence encodings that it carries. An AS’s well documented constraints are intended to support greater interoperability, increase the comfort level for users, and increase both vendor competition and the creation of open source tools. In the case of AS-07, we hope that these factors will lead in turn to increased adoption and thereby increase the format’s long-term sustainability

33 See ISO/IEC 15444-1:2004/Amd 3:2010, *JPEG 2000 Core Coding Broadcast Profiles*.

34 IMF is being standardized by SMPTE; information about the format and related matters is presented at <http://www.imfforum.com/>, and a very helpful explanatory slide show is offered by a document linked to this shortened URL: <http://bit.ly/1bN2DcD> (the full URL is [http://sas-origin.onstreammedia.com/origin/smpete0109/SMPTE\\_Standards/2012\\_Standards\\_Webcasts/2012\\_Standards\\_IMF\\_Chang-2012-11-27-Nov/SMPTE\\_IMF\\_Webinar\\_Nov2012-v2-handout.pdf](http://sas-origin.onstreammedia.com/origin/smpete0109/SMPTE_Standards/2012_Standards_Webcasts/2012_Standards_IMF_Chang-2012-11-27-Nov/SMPTE_IMF_Webinar_Nov2012-v2-handout.pdf)).



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MXF Application Specifications, as noted earlier, are not *standards* issued by a recognized standards body. In principle, they could be drafted and published by anyone. To date, however, a number of MXF Application Specifications have been developed under the auspices of the Advanced Media Workflow Association (AMWA). AMWA members represent a wide range of broadcast-industry companies and organizations including AVID, BBC, Front Porch Digital, the U.S. National Archives and Records Administration, PBS, SONY, EVS (OpenCube), Discovery Communications, the Library of Congress, the Fox television network, NBC Universal, Turner Broadcasting, MetaGlue, Audiovisual Preservation Solutions, and others. Typically, Application Specifications are accompanied by a reference implementation, including sample files and validation tools.

AMWA has published eight ASes to date, with others (including AS-07) in process.<sup>35</sup> Here's a short list, with the *application* identified. This list has been selected to show how AS-07 makes a good sibling for specifications that apply to other parts of a content life cycle.

- AS-10 for production – for end-to-end digital production workflow (forthcoming)
- AS-11 for contribution – defines the high-end version of a television program contributed by a producer to a television network (published)
- AS-03 for delivery – specifies a reduced-data version of a television program “as sent to the tower for broadcast” (published)
- AS-07 for archiving and preservation (forthcoming)

The AS-07 development team working under AMWA auspices uses an Agile Development approach and has about ten active members while a number of other interested parties follow progress at a distance. Four members of IASA's Technical Committee are part of this group: Chris Lacinak, George Blood, Jörg Houpert, and this writer. Lacinak is the president of Audiovisual Preservation Solutions, provides expert advice to FADGI, and serves as the Agile scrum master for the AS-07 effort.

## 8. What if I prefer some other format?

Practices for the preservation reformatting of video are in a state of flux and a clear community consensus on best practices has not yet coalesced. Today, we see a number of organizations making good use of a range of formats, including some alternate implementations of MXF and some entirely different formats. For example, the BBC has an approach not unlike AS-07 for uncompressed picture wrapped in MXF.<sup>36</sup> Others, including the Austrian Mediathek, have embraced ffv1 lossless encoding in the AVI wrapper.<sup>37</sup> The well-respected Archivemata open-source system employs ffv1 in the Matroska wrapper.<sup>38</sup> In some applications, the source material (e.g., older videotapes) does not carry legacy timecodes (which may be discontinuous), captions, or subtitles—and the preserving archives may not seek to embed specialized metadata—and thus makes a comfortable fit for less feature-rich wrappers such as Audio-Video Interleaved (.avi extension) and Quicktime (.mov extension).<sup>39</sup>

Mindful of these practices, we hope that in addition to looking at AS-07 as a *specification*, other practitioners will also study the underlying issues we are addressing—to be elaborated upon in the following sections—and see how they might be addressed with other formats. We would like our findings to be instructive, even if you choose another approach.

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35 See [http://www.amwa.tv/projects/application\\_specifications.shtml](http://www.amwa.tv/projects/application_specifications.shtml).

36 Op cit., footnote 6.

37 The Austrian Mediathek adopted ffv1 and also developed the DVA open-source software system that supports its use (and other functions); see <http://www.dva-profession.mediathek.at/> and <http://www.dva-profession.mediathek.at/documentation/>.

38 See <https://www.archivemata.org/> and <https://www.archivemata.org/wiki/Video>.

39 Information about Quicktime: <http://www.digitalpreservation.gov/formats/fdd/fdd000052.shtml>. Information about AVI: <http://www.digitalpreservation.gov/formats/fdd/fdd000059.shtml>.

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## 9. What draws people to MXF?

MXF is attractive because it is a bona fide standard from SMPTE, widely adopted in broadcasting and professional media. The format's versatile structure supports elements important to video preservation. When reformatting older videotapes, especially from broadcast-related collections, MXF can be used to produce an authentic copy that retains legacy timecode(s); captions, subtitles and other ancillary data; and multiple audio tracks. The format also permits the embedding of a wide range of metadata.

Some observers feel that MXF is too complex and not widely supported. However, what some call complex, we call *versatile*, permitting the production of authentic copies. We argue that all video formats are complex; you need a lot of elements in order to assemble and present a complete work. Meanwhile, we evangelize in order to build support for greater adoption.

## 10. Timecode

What are the issues regarding timecode? Source recordings may have multiple timecodes: vertical interval timecode (VITC), linear timecode (LTC), and more. Some are present on purpose, others by accident; some may have good integrity and continuity, others may be discontinuous. Any or all of these timecodes may provide forensic help for future researchers. A legacy timecode may be keyed to old documents like tape logs, may provide clues about the older source tapes that were assembled to create the video program you are now preserving, and may (as with footage of NASA space vehicle launches) represent elapsed time that can be correlated to other data streams. In many cases, this is data you do not want to lose. Meanwhile, systems that play back files will benefit from the presence of a high integrity, continuous timecode.

In response to these issues, we have drafted the following requirements. First, AS-07 files must include a freshly recorded, continuous, high integrity *Master Timecode*. (In some contexts, this is called *synthetic timecode*.) We also call for the retention of *Historical Source Timecode*, more or less the EBU term for legacy timecodes.<sup>40</sup> And we have proposed a method for tagging the multiple timecodes in the file that makes novel use of two SMPTE standards.<sup>41</sup> We believe that this tagging will appeal to others and, with luck, will be more widely adopted. AS-07's handling of Historical Source Timecode is detailed in the draft specification; for this article, some explanation is provided by the sketch in figure 1.

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40 The term is used in EBU R 122, *Material Exchange Format Timecode Implementation*: <http://tech.ebu.ch/docs/r/r122.pdf>.

41 ST 385:2012, *Material Exchange Format (MXF) — Mapping SDTI-CP Essence and Metadata into the MXF Generic Container*, and ST 405:2006, *For Television — Material Exchange Format (MXF) — Elements and Individual Data Items for the MXF Generic Container System Scheme 1*. The acronym SDTI-CP stands for the Serial Digital Transport Interface carriage of Content Packages.



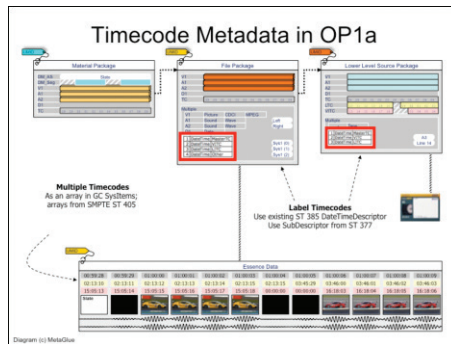


Figure 1. This diagram shows a portion of the structure of an MXF file that includes a continuous Master Timecode and discontinuous Historical Source Timecodes. Three timecodes are shown in the essence container at the bottom and also as tracks in the packages at the top. A proposed set of descriptors and subdescriptors are represented in the red boxes. The AS-07 descriptor set stitches together elements from three SMPTE standards. The terminology *OP1a* refers to MXF *Operational Pattern 1a*, the name for the commonly used file structure that carries a single unit of video content. Diagram courtesy of the MetaGlue corporation.

## 11. Closed captioning and subtitles


Captions and video subtitles are important features of broadcast collections although they are less frequently encountered in other classes of content. Looking back, U.S. broadcast standards have required various flavors of binary-coded closed captioning (CC), first in line 21, right at the boundary between the picture raster and the vertical interval, and then in other places in the stream. For example, there is a specification for packet-carried captions in MPEG digital broadcast streams. Other digital video streams carry CC in packets that meet a different specification. In Europe, there are some parallels, beginning with Teletext and later, EBU subtitles (STL), another binary system.

Today, broadcast authorities on both sides of the Atlantic want to set these binary approaches aside and move toward XML-based Timed Text, derived from the W3C Timed Text standard and very applicable to the Web dissemination of video. Recent Federal Communication Commission (FCC) regulations in the United States name SMPTE ST 2052-1:2010 (Timed Text Format) as a preferred option for Internet presentations.<sup>42</sup> The costs and level of effort required to convert existing systems to full XML capability, however, have led to a certain level of pushback from broadcasters.

Caption and subtitle texts, once extracted and indexed, have clear value for archives, supporting search and retrieval as well as other outcomes. What should we carry in the preservation file? The binary forms will be awkward for future extraction, since this will depend on the continued availability of decoding tools and may require real-time playback. (Nevertheless, we want to retain them in their original forms in our authentic copy.) Meanwhile, easy-to-extract XML Timed Text is very desirable for archives.

42 The most recent version of the W3C recommendation is *Timed Text Markup Language 1 (TTML1) (Second Edition)*, September 24, 2013: <http://www.w3.org/TR/ttafl-dfxp/>. The FCC authority for its regulation is the Twenty-First Century Communications and Video Accessibility Act of 2010, (the "CVAA"). Although Web presentations may use varying approaches to provided accessibility, the FCC rules state that SMPTE's Timed Text format (ST 2052-1:2010) provides broadcasters with a "safe harbor" against litigation. Additional information is provided in this FCC introductory description: <http://www.fcc.gov/encyclopedia/twenty-first-century-communications-and-video-accessibility-act-0>.

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SMPTE MXF and EBU standards both offer multiple options for carriage of caption and subtitle original forms and for Timed Text. We developed our AS-07 approach by consulting SMPTE and EBU standards. If present in the source recording, the original binary CC remains in line 21 in the image raster. The MPEG packets stay where they were (in that stream) while the other type of digital-stream packets are carried in what are called System Items, side by side with picture and sound essences within the file. Finally, XML Timed Text is to be carried in MXF Generic Stream Partitions (more about them in a moment). Since EBU STL, although binary, has generally been handled as a “sidecar” file, AS-07 also calls for STL to be carried in Generic Stream Partitions.

In order to meet this specification, AS07 encoding systems will have to be able to convert the binary text to XML Timed Text. We have our fingers crossed about manufacturers’ willingness to provide this capability. And like a number of the features we are specifying for AS-07, these elements will only come into practice (and manufacturers will only build systems for them) if there is genuine demand from the preservation archiving community.

## 12. Metadata

Our concern with metadata is not about the topic in general, i.e., the issues that every archive faces in terms of overall collection management and the provision of access to researchers. Nor are we concerned with basic information about file characteristics, the data that an application requires to play a file correctly, often referred to as *parametrics* metadata. MXF standards require a reasonable level of parametrics metadata and we simply embrace them. We did, however, draft some sections about what is called Active Format Description (AFD), a special set of codes used by broadcasters (and others) to ensure that aspect ratios, letter-boxing, pillar-boxing, and pan-and-scan are handled correctly.

Our concern for AS-07 pertains to a broad class that we call Supplementary Metadata, meaning *supplementary* in terms of MXF technical requirements. Examples include additional technical metadata, sometimes called *process metadata*, as well as information about the source item, about quality review outcomes, and preservation metadata, e.g., PREMIS. One example of process metadata is provided by the SAMMA system, which provides an XML-encoded, frame-by-frame record of the metrics associated with each tape transfer. We knew that various organizations might want to embed such metadata in their files. And beyond this technical and administrative realm, some archives (there are definite schools of thought here!) also plan to embed relatively complete descriptive (aka *cataloging*) metadata.

Where to carry this Supplementary Metadata? This is another entity that we propose for Generic Stream Partitions, described in the next section.

## 13. Generic stream partitions

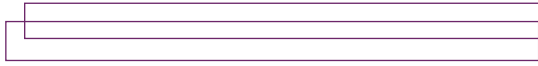
MXF files are structured with partitions of several types. As the name implies, Generic Stream Partitions are designed to carry generic “streams” of various types. In effect, they are boxes into which you can put things. The standard requires each Generic Stream Partition to be accompanied by a small block of metadata that offers a minimal amount of information about what the partition carries.<sup>43</sup> As noted above, we propose using Generic Stream Partitions for Timed Text and Supplementary Metadata, two forms of text-based data.<sup>44</sup>

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43 Generic Stream Partitions are mainly governed by SMPTE ST 410:2008, *Material Exchange Format—Generic Stream Partition*.

44 SMPTE RP 2057:2011, including Am1:2013, *Text-Based Metadata Carriage in MXF*, specifies two methods for the carriage of Timed Text, one of which entails the use of Generic Stream Partitions.





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Generic Stream Partitions can carry binary as well as text-based data. Some FADGI members have expressed interest in using this capability for what we call Associated Materials, e.g., scanned images of such objects as videotape box covers (which sometimes have notes written on them), stray documents that may have been in a box or are otherwise associated with a tape, publicity materials and photographs for television programs, and the like. Earlier this year, we presented ideas about the carriage of Associated Materials on the IASA list for participants in the TC-06 video preservation guideline project. This was followed by a vigorous exchange of views (many voted “no”). We see that some organizations will forbid this practice but we still wanted AS-07 to include this capability.

#### **14. Audio tracks**

This article’s listing of AS-07 features will conclude with a short note on audio tracks and tagging. Video sources to be transferred to AS-07 files may have multiple tracks, and these may represent various types of sound fields (mono, stereo, surround, and probably more), as well as things like language tracks (e.g., German and Italian narration tracks) or even sound effects tracks running in parallel with dialog tracks. Both SMPTE MXF and EBU standards provide specifications for audio track *allocation*, including recommendations for tagging the tracks. The current AS-07 draft has an interim specification based on SMPTE standards. (In contrast, the AS-11 specification, influenced by British players, uses an approach based on EBU standards.) Meanwhile, there is a separate AMWA project to refine audio allocation and tagging and, if ready in time, we plan to embrace this for AS-07.

#### **15. Conclusion**

This report indicates that the bulk of the work on AS-07 entails wrestling with the structure of the wrapper, shaping it to accommodate the complexity of the video content we want to reformat. We have done a little work on encodings, especially regarding interlaced picture as JPEG 2000 and SMPTE standard ST 422. Meanwhile, throughout the process, we have found it valuable to stay in touch with manufacturers and other professionals, and the project’s AMWA auspices have facilitated this line of communication.

FADGI’s initial 2009 video target format specification used the rubric MXF Application Specification for Archiving and Preservation (AS-AP). We began our work with AMWA in March 2012, when that organization’s board gave us general approval to proceed. This was followed in September of the same year by the approval of our project plan by the AMWA Technical Steering Committee. AS-07 team meetings began in November 2012 and we have been steadily at work ever since. We hope that our first real draft and associated sample files will be ready early in 2014, a milestone to be followed by final editing and balloting within AMWA. With luck, AMWA will publish AS-07 during 2014.