

Material Exchange Format FAQ

This FAQ outlines how MXF will be used in broadcast and production applications. The promise of networked media has been hindered by a lack of a standard file interchange format. After two years in the making, the MXF exchange format is near to being a SMPTE standard. We expect to see SMPTE endorsement by Fall or late 2002.

What is MXF? How will MXF help our industry? How is MXF related to IMX? Will all media formats migrate to MXF? Are all MXF files interoperable? These and other questions will be answered in this FAQ.

Q1. What is MXF?

A: It's an acronym for Material Exchange Format. The name is suggestive of a format intended for exchanging¹ media and other data types between a source and one or more receivers. It is intended for the exchange of material in the professional broadcast environment. It is classed as a "wrapper" format. Why? Like the ubiquitous AVI format, it is audio/video compression neutral and wraps or carries distinct compressed or uncompressed formats. But MXF goes beyond the simple nature of AVI. For example, MXF was designed to wrap MPEG2 video elementary streams, DV streams, YUV streams, PCM audio, compressed audio, metadata (time synchronous and asynchronous types) to name a few supported formats. The format can simultaneously wrap many different tracks of audio, video and metadata. The format was designed to support both stream and file transfer (see Q8).

Q2: How will MXF help our industry?

A: There is no existing material wrapper format that meets all the needs of modern broadcast and production. So, MXF was developed to meet the most current and forecasted needs of material exchange. We expect to see material exchange between video/audio servers, long and near line archive systems, edit stations, VTRs (equipped with Ethernet or some other link for file movement), streaming devices and more. Most importantly, MXF will allow for cross company exchange without needing to depend on proprietary or de-facto formats.

Q3: Will MXF replace existing file formats already in wide use?

A: Probably not for some time. To paraphrase Isaac Newton, "Objects in motion remain in motion and objects at rest remain at rest unless there is an external force to change their state". Sir Isaac did not have MXF in mind when he penned his famous Law but the spirit of his grand idea also applies to file formats. With literally millions of MPEG Program Stream, AVI, GXF, QT, and DIF (DV) files resting comfortably on hard drives

¹ Even though the word "exchange" implies a swap of some nature, MXF files are normally not literally exchanged as though part of a bidirectional transaction or trade operation. Consider the exchange as a delivery of material to a destination(s).

and tape archives, it will take a mighty force to convert all these to MXF any time soon. MXF will be employed first in new equipment designs, and upgraded versions of A/V servers and NLEs. MXF will be used as an archive format too. But legacy archived formats will need to co-exist until they are completely converted to MXF. So, the diffusion of MXF into a facility will take time.

Q4: Are all MXF file types compatible?

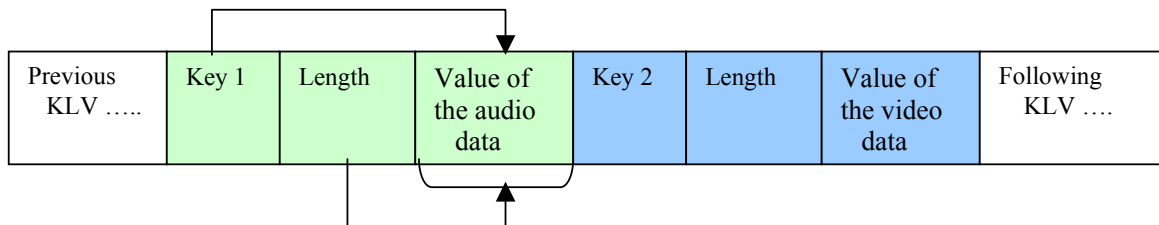
A: No. Because MXF is a wrapper format and not a compression format, there is no guarantee that a received MXF file can be used by any given end point decoder. For example, assume the sender packs “D10 Streaming MPEG2” data into an MXF file and the end point receiver is equipped to decode only DV/25 wrapped by MXF. In this case the received MXF file is non-interoperable. For true interoperability, both the sender and receiver must support the same A/V compression (or uncompressed formats) and metadata formats. MXF specifies Operational Patterns that define what MXF features, compression types and metadata structures are supported. For example one pattern will allow for D10 MPEG and multi-tract audio while another pattern allows for the DV format (SMPTE 314M). Through SMPTE there will be new patterns added as needed by our industry. The main point is this; MXF does not guarantee interoperability but it goes a long way to promoting it.

Q5: How is MXF related to IMX?

A: IMX² is a brand name from Sony and is used to denote their products that support “MPEG D10 format and/or D10 Steaming” (SMPTE 365M and 356M) at 50 Mb/s rates (and 30, 40 Mb/s too for some products). For example, the Sony MSW-2000 series is an IMX branded VTR that supports the MPEG D10 tape format. *D10 Streaming* is a constrained form of *I-frame only* MPEG2 specifying that each I-Frame has the same exact number of bytes of data. The format is very VTR friendly. This MPEG format is also the compression standard carried in SDTI-CP links (SMPTE 331M). IMX is not a file format or a compression format -- it is a brand mark.

Q6: What is KLV as mentioned in relation to MXF?

A: KLV stands for Key, Length and Value. Derived from elementary programming concepts, KLV has been used for years as a way to segment information packets that are joined together as continuous bytes. For example if one wanted to stitch together audio followed by video data in a file, KLV could be used as follows;



So, the KLV packing provides for a way to *separate* user data fields and also *identify* (Key) the user data type. The Length field indicates the length in bytes of the actual user data. SMPTE standard 336M defines how KLV is implemented. The Key is usually a SMPTE Universal Label (298M). So, above, Key 1 would be a UL that identifies the value-type to be audio of a particular nature. MXF is composed of a continuous sequence of KLV

² IMX and Sony are trademarks of the Sony Corporation of Japan.

packets of various kinds – audio, video, index tables, partition headers and metadata of all sorts.

Q7: Do the MXF specifications require that MXF files be stored in a specified way?

A: No. MXF is primarily an exchange format. Although it may be used as an on-disc format, the standard will not require that files be stored in any particular way. The following example shows why storing native MXF may not be advantageous.

Imagine a transferred MXF file with multiplexed audio and video. Imagine too, an NLE end station that is designed to access separate audio and video files from local disc storage. Upon receipt of the MXF file, the end station's MXF data parser will need to locate the audio and video streams and write them as separate files (.WAV for audio and MXF for MPEG2 video for example) to local storage. Select metadata may also be removed from the MXF file and stored into a local metadata registry. So, in this case, pure (as received from a source) MXF on-disc is not an advantage.

One more subtle aspect of on-disc interoperability is the actual segmentation of the MXF partitions. Some file systems demand 4KB (or some other value) block boundaries for optimum R/W disc access into a file. MXF does not enforce a 4KB boundary for partitions. So, for some versions of MXF files stored on disc reduced R/W performance will result.

Having said all this, it may still be an advantage to store to disc all media and metadata as MXF files. The choice will depend on how an individual manufacturer chooses to implement MXF on their system. The main point is this; MXF on disc does not guarantee interoperability between different manufactures equipment. For guaranteed interoperability, exchange MXF as files or streams and agree on the Operational Patterns to be exchanged.

Q8: Does MXF support both stream and file transfer?

A: Yes, stream and file transfer means are both supported for transmitting “content” from one source location to one or more end locations. Both have their application space and will co-exist. Files and streams have distinct pros and cons in terms of usage;

- Files
 - Delivery over non-isochronous networks (ex: Ethernet or LANs)
 - Delivered 100% reliably using protocols such as FTP
 - Asynchronous rates of delivery including slower and faster than “real time”
 - Point to point or point to multipoint delivery
- Streams
 - Material sent as a stream of data “over the wire” at a specified rate to one or more end stations usually over an unacknowledged, unreliable, protocol (Ex: UDP). Although it's possible to stream using the reliable TCP method, this is impractical for many streaming applications.
 - Streams are normally sent with a clock reference allowing for immediate decoding at the end stations.

- Errors in the channel may be corrected using optional ECC or some other form of forward error correcting method.

File transfer has the edge for most applications since it guarantees 100% reliable delivery. Streaming is normally “best effort” and is used when real time delivery is necessary.

Q9: How is MXF related to AAF?

A: AAF is the Advanced Authoring Format. It is a specification designed by members of the AAF Forum. Files created according to the rules of MXF may be opened by applications that support AAF. In addition, MXF files may be embedded into AAF files. AAF goes well beyond the intentions of MXF but it is not a true superset. AAF is designed to carry all the compositional elements of complex authored media pieces.

Q10: What is Pinnacle’s position regarding MXF?

A: We support MXF. We will be offering MXF file import/export on our existing and new products via several means;

- Import/Export of MXF files on a per-device basis using FTP and other means.
- Import/Export via Palladium Exchange (PE). Palladium Exchange is a **conversion gateway** that bridges our Palladium storage system and external devices. For example, via PE users can access files stored on Palladium and receive them (over LAN/WAN) in a variety of formats including MXF. Most conversions occur faster than real time and will not incur a generation loss if no re-encoding is needed.
- To/from near and long term archives.

We will support *D10 Streaming* (the Sony “IMX” MPEG format), long GOP IBP MPEG, compressed and uncompressed audio and other select formats as allowed for by the MXF Operational Patterns. MXF is not a standard yet. We are currently designing MXF features into our products in anticipation of MXF being a stable standard later this year.

For more information on Palladium, see www.pinnaclesys.com and navigate to Broadcast Servers then Networked Storage then White Papers and then select the Palladium White Paper.

May 20, 2002
Al Kovalick