



Interoperability and MXF Support at Pinnacle Systems

Introduction

The old adage “*A chain is only as strong as its weakest link*” applies increasingly to media systems founded on the merge of traditional A/V connectivity and those using IT methods. As we migrate away from strict video-timed (SDI, Composite...) interconnection in production and broadcast facilities, there comes the need to define new points and methods of interface. New facilities are being constructed with the following features:

- A/V Streams (SDI, IP/Ethernet) and File transfer (Ethernet) support
- Heavy reliance on disc storage rather than tape
- IT infrastructure (IP switching, routing, connectivity, monitoring) replacing some SDI infrastructure
- Reliance on data servers to manage, filter and process A/V data

What new points of interface do we need to comprehend? Figure 1 shows a generic high level view of the five main interop domains (called out as #1 to #5) in a merged SDI/IT platform. There are elements of legacy SDI for I/O, but the majority of A/V processing and connectivity uses IT infrastructure as a means to create media workflows. Our discussion will outline the general principles of interoperability followed by a review of Pinnacle specific MXF implementations.

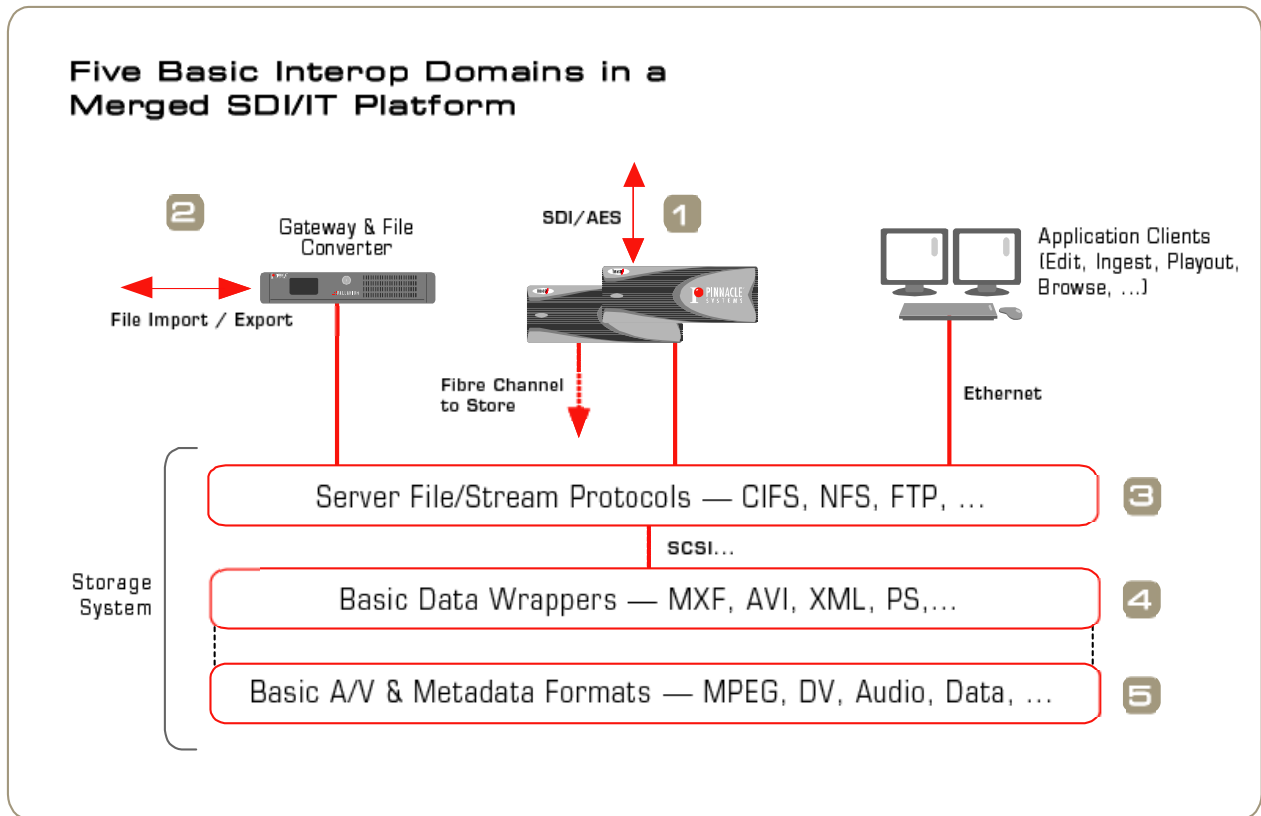


Figure 1

For a general view, the five interop domains are: SDI/AES (1), file import/export using FTP (2), file/stream I/O protocols like CIFS (Common Internet File System) for server access, (3), wrapper formats (MXF, AVI, PS, XML...) (4), and media essence (MPEG, DV, Audio, YCrCb...) (5). Metadata structures reside at the lowest layer.

What protocols do device nodes use to connect to the storage system? The *file import/export point* (2) and the *Media Client attach point* (3) are of main interest. Not discussed are control APIs and disc access protocols like SCSI. Control APIs are in a state of constant flux for our industry. On the other hand, disc interface protocols like the SCSI command set are mature. Let's limit this discussion to interface points 2 and 3.

Interface Points – File Import/Export (2)

Legacy file formats will always be with us. However, over time MXF will reduce the number of different file types. Until then, there exists a need to convert legacy import/export formats (lossless normally) to vendor specific on-disc formats. An imported file type will not likely be the same format as that chosen for the internal on-disc format. Also, there are no SMPTE standards for on-disc formats noting that MXF primarily is a file interchange format. One vendor may store on-disc using MPEG program streams and another may use transport streams or some other format.

Pinnacle offers **Palladium Exchange™** as a conversion gateway for the most general file types – PS, GXF, AVI, DIF, and MXF including audio. In some cases the gateway functionality is embedded into our products, but we also offer it as a standalone device. The gateway supports the industry standard FTP protocol for file transfer.

In this light, we have announced support for direct file import from the Sony XDCAM and the Panasonic P2 Camera. Both of these new camera families are IT friendly and record to disc (Sony) or FLASH RAM (Panasonic) with MXF as the native format.

Interface Points – Media Client Attach (3)

Media clients attach to servers and/or subsequent storage. Clients perform a variety of operations including editing, A/V ingest, A/V playout, browsing, and so on. The attach point is increasingly Ethernet (NAS) with Fibre Channel (SAN) in second place. Clients expect to communicate to servers (with attached storage) using CIFS or other protocols like NFS (popular with UNIX/Linux) or Apple's AFP. If streaming storage access is required, good QOS along the total path to storage is crucial to guarantee a steady stream of Client A/V data. To that end, we offer MASP (Media Access Server Protocol) that works alongside CIFS to provide excellent QOS, Gb/s of access rates and bandwidth management in IP networks.

Attached clients access the data server's file system, typically Windows® based (or at least CIFS compliant). Also clients need to recognize the media and wrapper types as stored on-disc (points 4 and 5). The on-disc media formats are usually formulated as mixed A+V in one wrapper or as separate A and V wrappers. If a client attaches directly to storage using the fibre channel protocol (like Pinnacle Systems' MediaStream™), then the server layer (3) is bypassed.

Pinnacle offers a Clustered File System (CFS) that we brand as the Palladium File System (PFS). It is Windows file system compliant and provides all attached nodes the same image of the files on main storage. It is fault tolerant by design. A CFS is single file system that is shared by all members (servers, other nodes).

Pinnacle's Approach to Interoperability – MXF Compliance

For this section, let's focus on the interop essentials from the perspective of MXF compatibility (points 4, 5). Our guiding light is to create time and resource efficient media workflows in an open IT environment. This required us to set internal company standards so that all engineers sing off the same song sheet.

An overall summary of our MXF workflow goals can be seen in Figure 2.

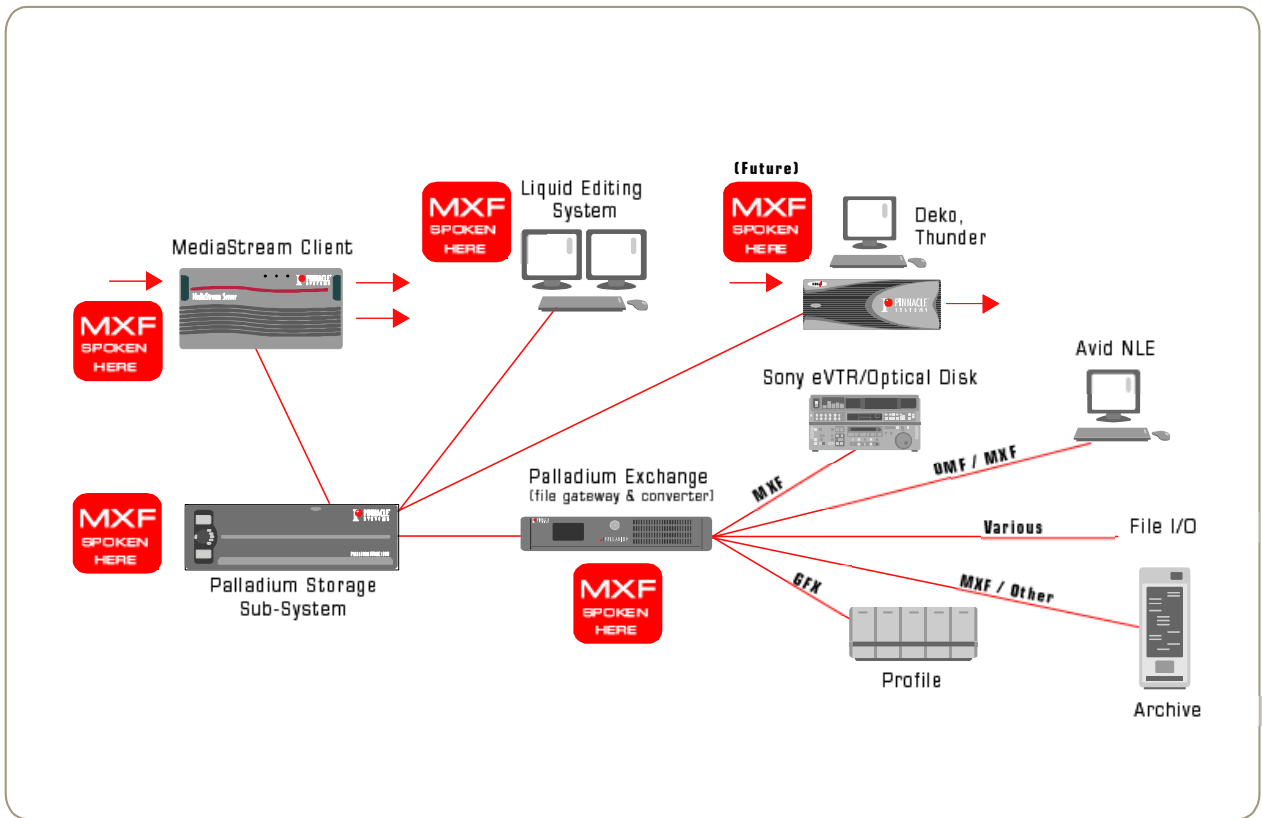


Figure 2

A variety of everyday workflows can be created depending on the selection of client types (MediaStream clients, Pinnacle Liquid™ NLE's, Vortex™ Networked News Systems...) and storage capacity. This model relies on simultaneous real-time access to storage by all nodes. An alternative to this is the file transfer model where nodes import/export files in non real-time from other nodes or from central storage. Both the common storage and file transfer models are increasingly becoming the two choices for creating workflows in the modern A/V facility. For either model, MXF plays a vital role. So, what is the meaning of the “MXF Spoken Here” moniker in Figure 2?

Each of the elements so marked implements various degrees of MXF functionality. MXF is a wrapper format (layer 4) that encapsulates lower layer essence formats (layer 5). It is the only professional format to wrap all relevant A/V compression formats, time synchronous metadata plus an index table for finding frame locations based on timecode.

So, to what extent are the elements in Figure 2 MXF compliant? Well, this depends on how one defines “MXF compliant”. MXF is defined by a suite of 20, sometimes verbose and abstract, SMPTE Standards and Engineering Guidelines. Considering this, we will not support all facets of every associated standard upon our introduction of MXF. No one will.

In principal, we are committed to MXF and it will become the backbone of all our internal and external interop activities. We plan to support a selection of the standards listed in Table 1 in a phased release.

SMPTE 377M is the mother standard for the MXF format. All the others rely on 377M as a basis. The table associates essence formats with standard names. For example, SMPTE 381M defines how to wrap I-only MPEG or Long-GOP MPEG into MXF (SD and HD). Also of value are the Engineering Guidelines EG 41 (MXG Guidelines) and EG 42 (MXF Descriptive Metadata).

As of May 2004, the following MXF support is available for MediaStream (shipping since Aug 2003), Liquid blue/Edition (demonstrated and announced) and Deko 3000 (demonstrated and announced):

- 377M (MXF general format specs)
- 381M (MPEG wrapping)
- 382M (AES and BWAV audio wrapping)
- 378M (Operational Pattern 1a, single A/V clip)

Additionally, we have made the strategic decision to natively store all media files in MXF format on a per product basis. This is not a requirement of any SMPTE standard. However, providing a common repository for client access with a common media format gives us a powerful leverage point to create compelling and flexible workflows. Each client node may access any file (within access rights) since all clients see the same image of the file system. Too, if the file import/export model is implemented then standardizing on one file format – MXF – simplifies work flow.

MXF Documents which are SMPTE Standards¹	
Number	Document
SMPTE 377M	MXF Format Specification
SMPTE 378M	OP1a (Operational Pattern)
SMPTE 379M	Generic Container
SMPTE 380M	Descriptive Metadata Scheme 1 (DMS-1)
SMPTE 381M	MPEG mapping (I-only and IBP)
SMPTE 382M	Broadcast Wave & AES Audio mapping
SMPTE 383M	DV & DV-based mapping
SMPTE 384M	Uncompressed Video
SMPTE 385M	SDTI-CP System Item
SMPTE 386M	D10 mapping (IMX)
SMPTE 387M	D11 mapping (HDCam)
SMPTE 388M	A-law mapping (Audio)
SMPTE 389M	Reverse Play System Element
SMPTE 390M	OP-Atom (carries individual A or V, not both)
SMPTE 391M	OP1b
SMPTE 392M	OP2a
SMPTE 393M	OP2b
SMPTE 394M	GC System Scheme-1
Engineering Guidelines	
EG41	MXF Engineering Guideline (read this first)
EG42	DMS Engineering Guideline
Recommended Practices	
RP210	SMPTE Metadata Dictionary
RP224	SMPTE Labels registry

Table 1

At NAB 2004, Pinnacle's MediaStream 8000 networked storage client was recognized for outstanding new MXF product/system design by the ProMPEG Forum. This association of broadcasters, program makers, equipment manufacturers and component suppliers is the leading body dedicated to broadcast equipment interoperability.

¹ Not every one of these is a SMPTE Standard as of May 2004. However, most are and the remaining ones are slated for adoption in the next few months. The five year effort to make MXF a reality is finally near completion.

Conclusion

Pinnacle is dedicated to providing MXF based media solutions to meet a number of common workflow configurations; ingest and playout, news production, workgroup editing and template graphics playout. We set internal company interop guidelines that define how clients and Palladium Store interoperate. Only by providing consistent internal interop rules can we guarantee external interop interface points. Palladium Exchange provides for rich file import/export. Our powerful clients may be combined to meet the various workflows needs for broadcast and production.

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