# A User's Perspective on MXF and Media

By Clyde Smith

**As a child, I received a plastic, six-transistor radio for Christmas. My older sister was given a metal eight-transistor radio in a leather case. I was infinitely pleased one day when I surreptitiously opened up *her* radio and found that two of the transistors served no function other than marketing value! My radio became my constant companion. Wherever I was, I had "my media access system" with me. This was my first taste of freedom of choice in media. While my radio produced a decidedly low fidelity sound, it allowed me to experience media that my parents would have never chosen. Its later replacement permitted access to the entire world as it had a shortwave band and further expanded my choices. I was still primarily limited to the "push-based" media that were being broadcast. The only "pull-based" media in those years were the 45 record and LP album and those were decidedly not portable or mobile. As you can imagine, based on this experience, in later years I became an early fan of the iPod.**

When I first started working in the media industry—it was the radio and television industry back then—we had one product: It consisted of a continuous stream of programming that we pushed through the atmosphere to people's homes. Most of it was mono, monophonic, and monochrome.

The production and distribution process was largely a series of sequential processes, and for every device in the process there was a skilled technician that operated the device to produce the artistic intent. The creative staff was isolated from the system equipment elements by an abstraction layer consisting of these skilled technicians. The creative staff members' ability to motivate and control this technical staff determined the overall creative value of the programming and was a key factor in productivity as well. Being thus largely concerned with the proper execution of all the staff members' duties, the creative staff's work product was enhanced or hampered not only by their own ability, but by the skills and abilities of all the individuals participating in the show production. Over time, many of the functions of the system equipment became automated and a higher degree of access and control was placed directly in the hands of the creative staff. This was fortuitous for me as I was able to move from the daily setup of studio cameras and videotape machines into thinking about and designing television systems. It was also fortuitous for the creative staff, as they had more direct control and could be more productive on a lower budget. The result for the audience was more media production and more distribution outlets—more choice.

Looking back, it seems as if my entire career has been one of changing and improving the efficiency of production and use of and access to media. Even the years I spent working in the space program at Kennedy Space Center were largely dedicated to making accessible the film and video imagery as well as the data it represented to a broader audience, primarily the scientists and engineers that needed that data to understand and control the performance of the spacecraft and perform support operations.

Today, there are more choices than ever in media, largely due to such increases in productivity, capability, and process automation in media production. Thankfully, this trend shows no sign of stopping. It continues to improve access to media and provide more "mass personalized" choices. I personally look forward to the day when I can have continuous, on-demand access to a wide variety of media on space science and sailing.

My point in sharing this bit of personal media perspective is to create a background for the business drivers behind the adoption of the Material eXchange Format (MXF). The explosion of media production and distribution channels to increasingly targeted and niche audiences is possible only through the continuation of this trend toward enabling creative productiv-

ity, improving efficiencies and automation of versioning, and distribution processes.

In the early days of file-based workflows it was recognized (largely through the work of the SMPTE-EBU joint task force on the "harmonization of standards for the exchange television program as bit streams," which was established at the International Broadcasting Convention (IBC) in 1996) that we needed a method for interfacing systems and exchanging files that was as easy as the then current exchange of baseband media over BNC cables. The task force developed the basic understanding of the standards work that needed to be done, as well as user requirements in the areas of compression, data transport systems, interfaces, file formats, and metadata.

Out of the work of the task force and the vision of users and manufacturers, a host of efforts, some proprietary and others open, were initiated. One of these, through the work of the Pro-MPEG forum, was the Material eXchange Format, which was developed and then submitted to SMPTE's rigorous standardization process. Early on, our chief technology officer, Scott Teissler, and Gordon Castle at Cable News Network (CNN) were supporters of this work. Castle contributed greatly by serving in the Pro-MPEG Forum to more fully develop and document user requirements for MXF. After five years of work by dedicated contributors who are too numerous to give the recognition that they so richly deserve here, MXF was documented in a considerable body of published standards. These standards represent "a toolkit" to enable file-based workflows. The proper selection of which tools to apply and where to apply them, required a considerable additional amount of work, negotiation, and discussion between and among manufacturers and end users. Each new systems implementation has further developed the body of knowledge and, thankfully, end users and manufacturers are contributing knowledge and practices to MXF user groups such as the Advanced Media Workflow Association (AMWA) and the European Broadcasting Union (EBU). The AMWA and EBU, in turn, are participating through the SMPTE standards process to produce further engineering documents that will eventually ease the burden on all of us.

About the time that you may be reading this, the 2008 Olympics will be in progress. If you watch the coverage in the U.S., you will be watching programming that was produced by the National Broadcasting Co. (NBC), utilizing the benefits of MXF standards. This is just the latest in a successful series of implementations completed or under way on large and small scales alike by end users such as the Public Broadcasting System (PBS), the British Broadcasting Corp. (BBC), Discovery, Turner Broadcasting, and others, again too numerous to mention. And yet, I frequently hear the same questions about MXF, its use, and potential benefits. I'll attempt to answer some of them here.

## Why Did You Decide to Use MXF?

The problem with many file-based systems today is that the files are not constructed to be used throughout the production and distribution system. They are largely optimized for the device on which they currently reside. The essence and metadata structures differ from device to device. You can buy products to interface each element of the system and transcode the essence and perhaps even pass all the metadata, although, frequently, it may be lost or corrupted. Each device interface must be treated separately. This simply adds complexity and cost in the form of acquisition and systems implementation. Additionally, it also increases ongoing support costs. To address this problem and many others, we explored solutions and evaluated many options. I mentioned earlier, the depth of documentation that comprises the tools of the MXF standards kit. The people who worked so diligently developing those standards considered the input of many users and their applications needs. To their credit, we have not found any other tool with the power to address all our needs.

## Why Didn't you Choose BXF?

We did. Well we are planning to, but to solve a different problem. BXF is the Broadcast eXchange Format, which is also a SMPTE standard. BXF addresses an entirely different problem space and provides a very elegant solution. It standardizes the communication of three basic types of data exchange: schedules and as-run information, content metadata, and content movement instructions. It provides a mechanism for systems to exchange the business data and metadata that facilitates business functions between log management, traffic, billing, and delivery systems, to name a few. It does not address the problem of space that MXF does.

## Why Do You Need MXF and What are the Benefits?

This goes back to the earlier discussions about the changes and transitions in the industry. The development and implementation of file-based systems have reduced the expense of production and increased access. Early on, the industry realized that, by moving to file-based production, it could escape the serial processing and sequential workflow of linear production and move on to simultaneous parallel functions. Doing so gains speed and the ability to produce specific versions for many distribution channels: web, cellphones, voice-on-demand (VOD), broadcast, internet protocol television (IPTV), podcasts, etc.,—all at once. Versions can also be produced for language variation, cultural and social reasons such as offensive scene editing, time constraints, optimization for display type, or format requirements. The manual production of these versions requires a significant investment in labor and other resources, as well as media management. It also consumes time. With MXF, we are able to automate many of these processes and maintain persistent metadata with the media. The automation of these functions reduces cost, improves time to market, and permits us to specifically serve smaller audiences and maintain our margins. It also allows us to optimize the use of storage and network bandwidth by permitting us to process only the specific elements that we need, when we need them. And in the future, we can

eliminate duplication in storage by representing versions as a series of metadata pointers, storing only the elements that are unique. Imagine calling up the master of an HD movie and its audio files from the archive and transferring them to a server. Later, if you want a different language version, you need only restore the necessary audio tracks and subtitles to play that version, because we can use MXF to maintain relationships between the essence components, their version use, and synchronization. This works today and was demonstrated at NAB 2007 by the AMWA.

### Why Do You Put so Much Emphasis on the Metadata?

There are a myriad of reasons. Let me begin by saying that, "if content is king," then metadata is his crown. Put the king in a crowd, without his crown, and you can easily lose track of him. Without metadata in a consistent context and persistent form, you cannot fully automate processes, ensure persistent association of elements and proper identification, or even accessibility by other devices. More and more programming for entertainment, news, and sports is being delivered by file transfer. With the proper metadata and MXF partitioning, you can read the file while it is still writing, monitor the transfer's progress, and begin using the media while the transfer continues. And that just may help you beat the competition. With the proper metadata, you can do partial file restore and thus reduce wait times, storage, and bandwidth requirements. As I mentioned before, proper metadata enables you to eliminate duplicative storage.

It is becoming increasingly imperative that we maintain a metadata channel that is continuous throughout our contribution, post-production, and play-to-air/distribution systems in order to reach the consumer. It is bad enough to lose metadata internally, but you can frequently find a workaround. As we move from a push-based world of broadcast to a pull-based world, consumer access and knowledge of the media is paramount. Lose the metadata or mis-associate it in this world and you lose the audience. They don't even know the media exists or worse, they know that you have it wrong. As you may know, I love the space program and watch many programs about it. I know that the majority of them are produced without persistent metadata as I frequently see scenes from one mission edited together with scenes from another, or worse yet, scenes from the Mercury or Gemini program edited into the Apollo program. Well, they lose all credibility with me when they do that, and it's the same for news viewers and sports fans or anyone else that closely follows a subject. You lose your credibility with what could have been a very loyal and enthusiastic audience.

### How Do You Justify the Expense to Management?

We have gained their support simply by explaining the benefits in terms that are meaningful to them.

MXF-based systems reduce the complexity of systems design, implementation, and ongoing support. MXF enables your staff or integrator to install systems faster and spend less time configuring and testing, and that saves capital. At the AMWA NAB 2007 MXF demo, for the first time ever, ten manufacturers arrived, uncrated their systems and connected them to build an end-to-end playout system with editing and archiving. They assembled and tested the system in less time than it took to make the presentation, describing it and build consensus on the messaging.

MXF-enabled systems mean fewer software licenses for devices to compatibly interface proprietary systems and they mean you don't have those additional support contracts and aren't running on the endless software maintenance and compatibility treadmill. And that saves operating expense.

MXF-based systems can mean less investment in storing and archiving versions. They also automate version production and produce long-term value in each version you create.

MXF-enabled systems can deliver greatly improved speed and accuracy in news and sports production.

By maintaining the persistent association of correct metadata into the future, MXF makes the difference between hitting your target audience or them not even knowing your product exists. MXF is a key enabler in the transition to efficient production and distribution that is required to access the global market and address mass personalization to serve niche audience interests while maintaining margin.

I could, and frequently do, go into much greater detail, but space here does not permit it. We are indeed the fortunate beneficiaries of the hard work of the many people who supported MXF development and the engineering standards process. I hope that you have found this short article of benefit in thinking about MXF and its applicability to your potential applications.

## The Author

**Clyde D. Smith** is senior vice president of Global Broadcast Technology and Standards for Turner Broadcasting System, Inc. In this capacity, Smith is responsible for the strategic development and planning of new technology, standards and technical practices development, adoption and implementation, to support the Domestic and International News and Entertainment Groups.

A fellow of SMPTE, Smith was a four-time Governor, a former Standards Chairman, and Secretary/Treasurer of SMPTE and program chair for four SMPTE advance-imaging conferences.