Gilmer & Associates

Tying it All Together

A watershed moment in the Media Industry

By Brad Gilmer

Viewers have seen several step changes in the evolution of television, analog to digital, standard to high definition, and if you go back far enough, monochrome to color.

There have been similar changes on the production side, but those that have had most impact are the changes from film to videotape and analog to digital processing, the introduction of HD, and now the migration to file-based operations.

The migration from physical media to files processed on computer platforms presents opportunities and a new flexibility, but potentially adds complexity. You need systems that work together, and converting to file-based technology only gets you part of the way there.

Agreed file formats are necessary, but not sufficient to build digital facilities. To simplify file-based operations many media companies are adopting a service-oriented architecture. For the future the 'cloud' beckons, abstracting the services from geographical constraints.

The key to reusable services in the cloud lies in agreed standards and specifications that can enable interoperability.

Media Decomposition

Physical media—film and videotape—are being replaced by computer files. As the media business has evolved since the early days of film, the format options have increased, as has the associated metadata.

In the beginning there was film. You had a sequence of pictures captured on the film, and you had sound, which could be a mag stripe or optical. Film came in a metal can. Affixed to the can and the film reel was a paper label which told you pretty much everything you needed to know. All a projectionist at a theater or a telecine operator at a television station had to do was verify that the information on the label matched the movie to be played, load the film, and put the projector in remote so that it could be started at the appropriate time. Later things became a little more complicated as different film formats evolved, but beyond verifying the correct theater/projector setup, things were ready to go.

Next came videotape. As with film, you had a tape in a box. The box and the tape both had a label, and there was usually a piece of paper in the box (sometimes called a rundown) which told you the name of the program, the episode number, how long the program was, and where the black slugs for commercials were located. Once again, all the operator had to do was to verify the label with the information on the log, load the tape machine, and put the machine in remote.

Then along came media files – they were not quite so easy. First the video could be uncompressed, or compressed using a plethora of standard or proprietary codecs. The same applied to the audio tracks. Even

one codec presents a myriad of choices—data rate, constant or variable bit rate, I-frame or long GOP, bit depth, color space, sampling, 4:4:4, 4:2:2, 4:1:1—multiply those up and the possible combinations are endless.

The problem with all these choices is that it presents a major impediment to interoperability. Each equipment manufacturer selects a particular parameter set, which in all likelihood is totally incompatible with other manufacturers.

New terminology

Along with files came some new terminology. We were no longer dealing with a cassette or a reel of film. In fact, there was a separation of the physical media from the content it contained. The essence on the tape became an Asset, Content, Essence, or in some circles, Media. Metadata became a popular topic. We started hearing about data models. These were new concepts, and they took some getting used to.

Fortunately over time, things have gotten much better. For the most part, video engineers now understand how to configure codecs to get reliable results. And manufacturers have done a good job of providing interoperability modes on their codecs which reduce incompatibilities. While the terminology is still new to many of us, we are getting more comfortable with the new vocabulary that files brought with them.

Versions of a movie

Studios produce tens or hundreds of versions of a movie. There are all the different theatrical versions, versions for the home theater. For television, there are restricted or safe-harbor edits, cut-to-clock, versions for different outlets, airline versions, etc. There may be effects tracks, pan & scan data, different show formats, XML data, scripts. For the DVD or Blu-ray release there may be different camera angles, the Director's Cut, outtakes. A movie may have thousands of elements, how can we manage all this? Just keeping track of all the elements is difficult

The industry has come up with a proposal, and that is to bundle all the pieces together into a logical group, and to include some 'recipe' cards to tell you how to make a particular version. A version can be rendered from the bundle of files using the recipe. The Interoperable Mastering Format (IMF) does exactly that.

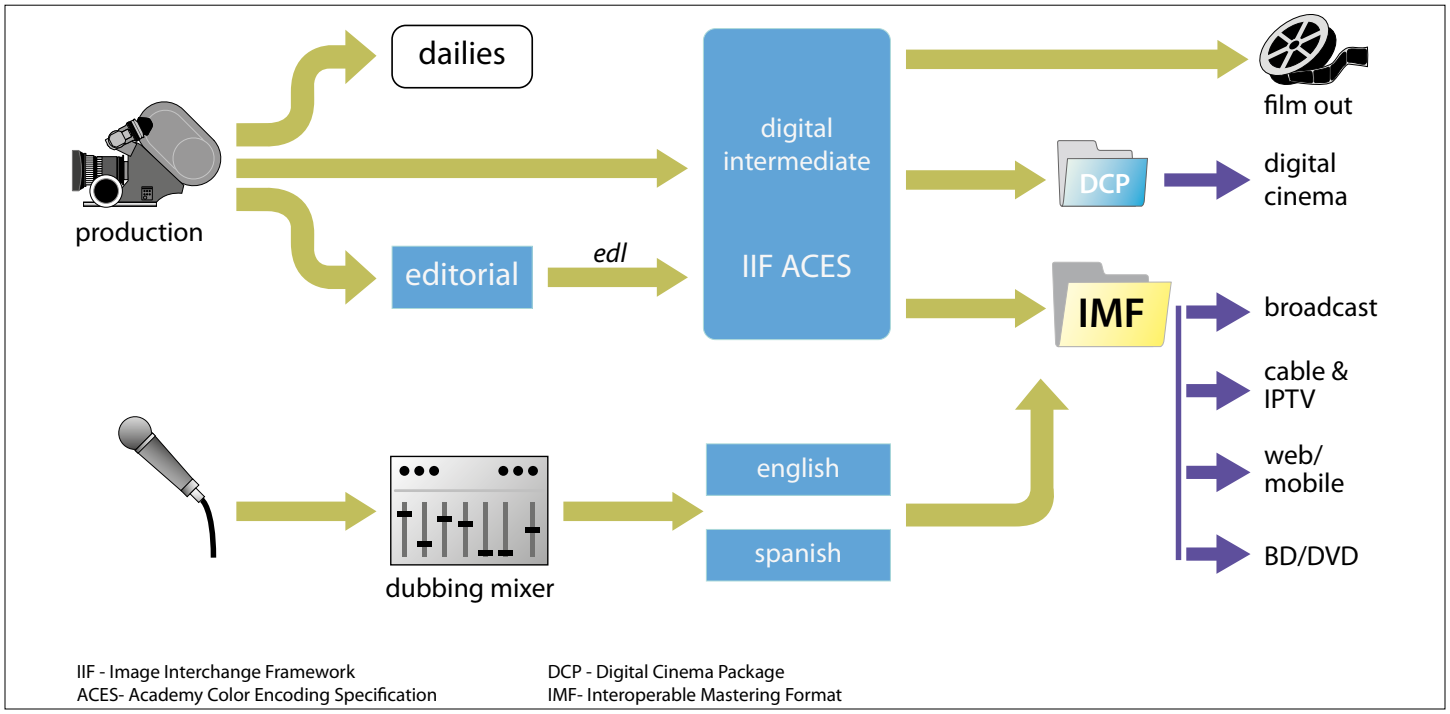
Interoperable Mastering Format

IMF is a specification for a set of master files for the creation of downstream distribution formats that was developed by the Entertainment Technology Center at the USC School of Cinematic Art.

IMF uses AS-02 wrapping to hold the content files together with the recipe or Composition Playlist (CPL), which contains the information to build a version. The format has been taken up as a work item by the SMPTE to create a formal standard (see figure 1).

AS-02 is the AMWA Application Specification, MXF for Versioning.

Figure 1. A typical movie workflow and the Interoperable Mastering Format



What is an Application Specification (AS)?

MXF was designed as a format for professional media. It is gaining wide acceptance, but it is a collection of all the requirements with the consequence that interoperability suffered. The solution is to create a constrained specification for one application domain, like playback, or contribution.

One example, AS-03, came from a requirements from PBS. They wanted a single file format that could be sent out to all the member stations ready for playout from a video server. It carries basic metadata, and when you hit plays, it just plays to air.

The AMWA has developed Application Specifications for different uses:

AS-02 MXF for Versioning
AS-03 MXF for Finished Programs
AS-10 MXF for Production
AS-11 MXF for Contribution Material
AS-12 MXF for Commercial Delivery

Creating an AS, reusing standards

Application Specifications are not new formats but a subset of existing standards. You look at the MXF specification and select the stuff you care about. You may also look at MPEG and W3C specifications. You then say, in this application you use MXF in this way. For example there are five places to put timecode in MXF, you say 'just put it in this place.'

AS-03 only allows the finished program to be put in that file. It has structural constraints, and the metadata is constrained to just what is needed for playout.

In developing AS-12, MXF for Commercial Delivery, the difference between finished program and a commercial is not great. You need some extra metadata—the commercial slate—and you can create AS-12.

Structural variability and metadata variability are just a couple of ways to constrain MXF, there are other dimensional axes like codec variations.

Through the use of common wrapper standards, the film and TV industry workflows can be compatible. Agreed file formats are necessary, but not sufficient to build digital facilities. You need systems that work together, and converting to file-based technology only gets you part of the way there.

The existing stovepipe facilities are not sustainable; M&E companies are finding that they must respond quickly to new demands for serving content. We must lower cost of feeding 'new antennas': the tablets, the smart phones and so on.

A well-established IT methodology, the service-oriented architecture (SOA) may provide the agility we need, but it must be media SOA, generic SOA will not do the job.

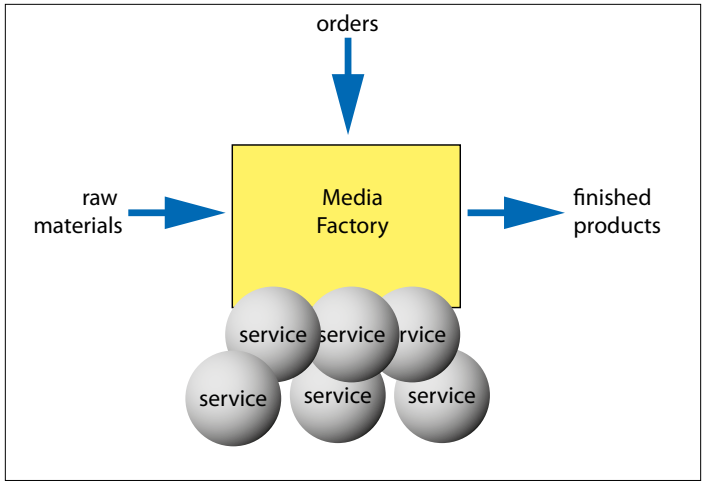


Figure 2. A Media Factory processes inputs using services to produce outputs according to orders. (Figure courtesy of Red Bee Media.)

SOA and the Media Factory concept

Although the work of many facilities is dominated by craft processes, at the heart of the facility is a 'Media Factory' (see figure 2). It takes in raw materials (programs, graphics, scripts etc), it can do things to those raw materials (editing, versioning, subtitling), and it creates finished products based on orders coming in (TV channels, new programs).

The common operations can be abstracted as services, like transcode, QC & digital asset management (DAM). You can take the workflow component out of the DAM into an orchestration layer. In legacy systems services intercommunicate through a complex mesh of direct, often proprietary connections and APIs. In a SOA, services

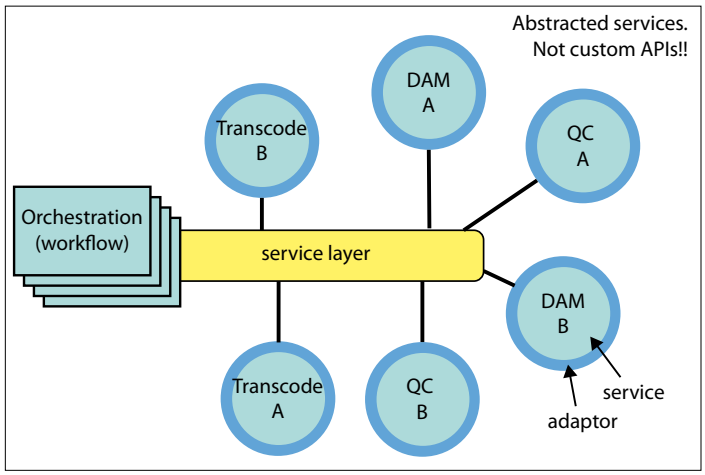


Figure 3. The FIMS framework and common service definitions simplify implementations and extract workflow from DAM systems. (Figure courtesy of Red Bee Media.)

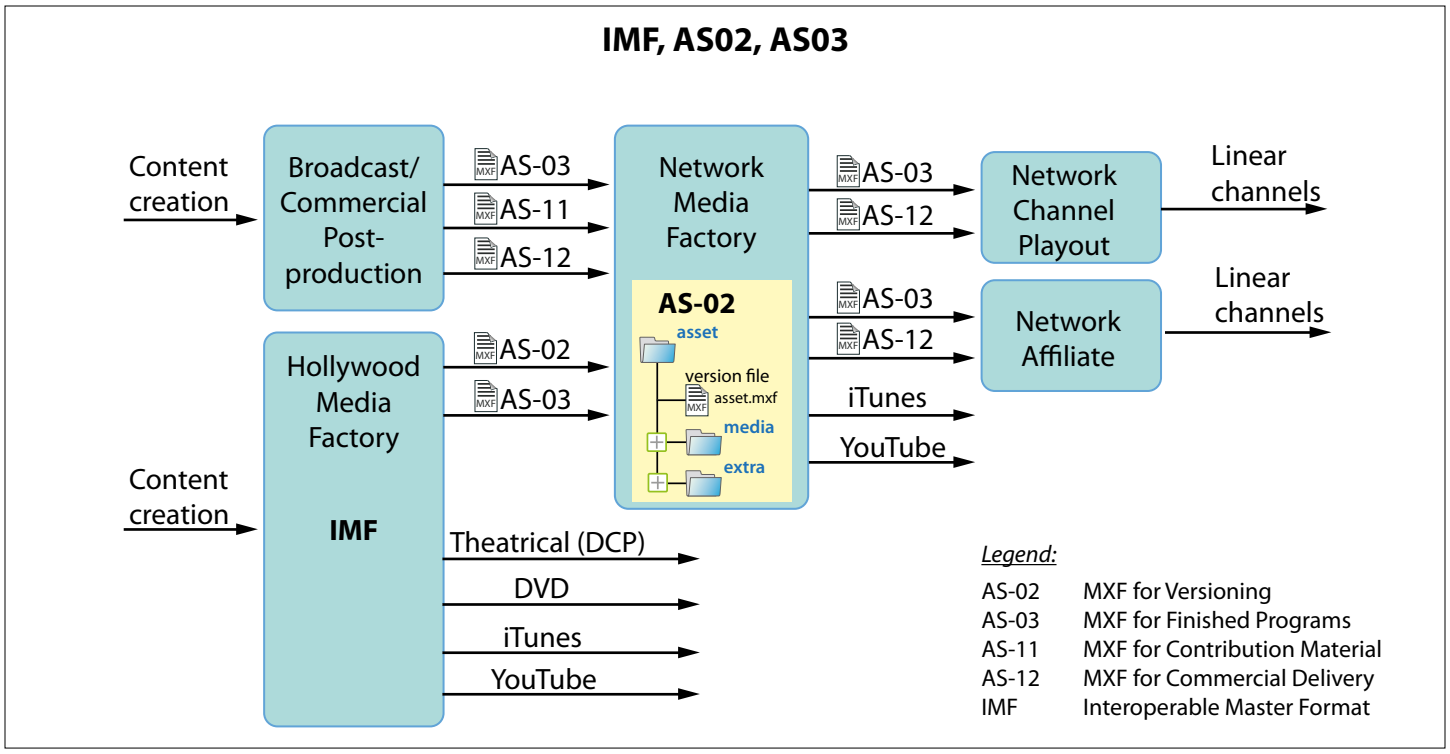


Figure 4. Putting it all together - IMF, AS-02 and AS-03

communicate though a common layer, the service bus. An adaptor wraps the service using a common language (see figure 3).

This coincides with the FIMS (Framework for Interoperable Media Services) initiative. FIMS is standardized approach by a Joint Task Force of the EBU and AMWA to create a framework for media services. The goal is to get from existing tightly coupled stovepipe systems to a position where service can be changed or added much more easily. FIMS is defining interoperable media service interfaces between the orchestration systems and media services.

The Media factory and AS-02

One can imagine a media ecosystem where IMF is used to create finished AS-03-wrapped programs, or where a movie studio is requested to send an AS-02 bundle of a movie to a downstream facility. That downstream facility could then use a media factory to create its own AS-03-wrapped finished programs based upon the AS-02 content it received.

Figure 4 illustrates the complete ecosystem. On the left, content is created either in the broadcast/commercial environment or by the Hollywood creative community. The content then enters post facilities or a Hollywood creative process. Hollywood needs to feed many different sources including theatrical, television, DVD, iTunes, and YouTube. A television network has similar outputs as well. Media factories allow Hollywood and television networks to render finished versions of movies, programs, commercials or interstitials, using harmonized MXF metadata wrapper structures. These files may be exchanged with media partners either wrapped as finished programs, or as individual elements along with instructions about how to render these elements into particular versions.

Application Specifications seem to be increasing interoperability for both essence and metadata. MXF is gaining wide adoption as the preferred interchange format for professional media. Finally, IMF and AS-02 are well aligned at the wrapper level, and there is a commitment to support the vision of media factories in both the film and television environments. In fact, the AMWA has contributed the draft AS-02 specification to the SMPTE IMF group for consideration as an IMF wrapper. The committee will make the ultimate decision as to where AS-02 and IMF are aligned, but there is strong industry consensus that the two wrappers should be similar.

Where is FIMS now and where is it going?

This article has pointed out a number of things which, taken together may contribute to some major changes in how media facilities will look in the coming years. But there is one last item which, when taken together with the items previously discussed, may lead to a watershed moment in media facilities.

Distributed Facilities — the Next Big Thing

There are a myriad of developments in IP networking, which are serving as key enabling technologies for future media facilities. The implications of these developments may be far-reaching. Consider the following points:

- High-speed connectivity is becoming ubiquitous
- Carrier-quality security solutions are becoming widely available
- Media companies now regularly achieve reliability levels required for high-profile professional sports events (NBA, NFL, MLB) on managed private IP networks

The SMPTE 2022 family of standards provides professional transport of live video on managed IP networks. IP networks can be used for just about any application, including professional live streaming, file transfer of very large files, plus they can be used to extend telephone and intercom systems, teleprompter systems, IFB systems, remote camera control, remote monitor walls, etc.

IP network pipes can be divided such that video transmission is absolutely guaranteed, while simultaneously allowing file transfer or other IP traffic on a best-effort basis

Geographically Dispersed Services

Services can be anywhere. It is now realistic to consider offering custom transcode, CGI or rendering services or other media services in a secure way on IP networks (private or public). These services could be located anywhere in the world. It may be surprising to some readers to know that high-speed IP connectivity may be more readily available in smaller countries, compared to some countries in America or Europe

Orchestrators can be anywhere. Consumers of media services could be located anywhere in the world. Potential customers are everywhere

Given these points, one can readily imagine distributed media facilities — facilities which extend far beyond the studio lot or the four walls of a building located in a particular city. In fact, Hollywood studios are already operating this way, and the trend is accelerating.

Put together file-based operations, MXF, Application Specifications, FIMS, and the Cloud, and a new paradigm presents. Consider this; locate services anywhere, orchestrators anywhere, media anywhere, and the applications anywhere. The result—edit from anywhere and on any platform

Tying It All Together

The media business has evolved within the constraints of the physical media that stores the content. With the evolution to the handling of media as data, the best practices of the IT and media sectors can be combined.

MXF is becoming the dominant wrapper format in the media industry and the AAF/MXF data model is gaining acceptance as the dominant representation of metadata.

The concept of media factories is rapidly finding a place in both the Hollywood and television communities. The user requirements are different, but it is possible that a common wrapper solution can be achieved.

Specifications like IMF and AS-02 organize elements into bundles. The media factories can use these bundles to create finished versions of content for many different target platforms.

Interoperable services are the key

Common wrappers are not the end of the story. To tie it all together we need to deploy interoperable media services that can enable the flexible workflows needed for today's multi-platform operations.

But the factories do not exist in isolation. The media business involves cooperation between many dispersed facilities to create the finished product. From VFX houses to subtitling, the sector is accustomed to outsourcing many of the processes needed in the workflow.

IP technology has already resulted in distributed media facilities, but much of the development has been on an ad hoc basis. The concept of the cloud—processing power and data storage on tap—presents one more step on the evolution of the media industry.

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Credits

They say there is no such thing as an original idea, and there is certainly no original thought presented here – only a composition of ideas and technical developments from a great many people in the industry. Here are some specific people who have been involved in the discussion along the way. My friend, if I missed you, it is only because I forgot, not because your contribution was not important.

Phil and the rest of the crew at the BBC, Clyde, Michael, Steve and many, many others at Turner, Ian at Red Bee, Jim at Jim Trainor, Inc., Richard at Portability4Media, Wendy at Warners, Peter and Kojima-san at Sony, Richard, Jim and the guys at Fox, John and Tony at CBC, Hans and Jean-Pierre at the EBU, John at Cognizant, Tim, Al, and the guys at Avid, Oliver and Neil at Metaglue, Bruce and Mark at Amberfin, Howard and Annie at Disney, Chris at Harris, Paul at Harmonic, Mary-Luc and Philippe at Thomson, Pierre at at&t labs, John at Media Links, Michael Bany at DVBLink, Dave Bancroft.