Interoperability and content exchange made easy with IMF

ROHDE & SCHWARZ

Today's electronic media industry is truly international – on a scale that could never have been imagined previously. Whether you are a Hollywood movie studio, a national broadcaster, an independent production facility or a boutique post house, your challenge is the same. You need to operate on a level playing field, where creativity is not crushed by a lack of interoperability and an inability to share content efficiently.

The creation of a set of interoperability and exchange standards has been a commonly held goal for at least the last 10 years. The Society of Motion Picture and Television Engineers (SMPTE) was the first to rise to the challenge. More recently, the organization has teamed up with other standardization pioneers such as the UK based Digital Production Partnership (DPP) to further develop the standard set. This eBook looks at the latest changes to the standards and sheds light on its application in a range of scenarios from cinema to broadcast TV and OTT applications.

Introducing Interoperable Master Format (IMF)

These standards first emerged in the cinema industry some five years ago. The situation in the broadcast industry with its tremendous amount of file formats, codecs and containers for handling digital video data presents a real challenge when it comes to exchanging content. This scenario is caused by the lack of a general standard for the exchange of digital video files to replace tape based transfer with the HDCAM-SR standard.

Additionally, there was no proper solution available for straightforward distribution and transfer of a multitude of master versions, including different languages, subtitles and video inserts, between business partners. To fill this gap, the Interoperable Master Format (IMF) was first published in 2013 by the SMPTE members, which include Rohde & Schwarz and 186 well-known U.S. studios, manufacturers and vendors.

IMF is an SMPTE standard (SMPTE ST2067 group) that is designed around the standards used in digital cinema. It aims to clarify the confusion caused by a myriad of versions and will become the file based successor of the tape based solution. The key feature of IMF is its highly flexible versioning capabilities. This versioning enables storage amounts to be significantly reduced by saving the differences instead of creating additional flattened versions.

IMF is a contribution format aimed at business-to-business users such as content owners, distributors, post production facilities and broadcasters. Content owners can distribute and deliver produced content by using the versioning capabilities to easily create multiple versions as one Interoperable Master Package (IMP).

Distributors are able to create multiple end formats from such an IMP. Broadcasters receiving IMPs with program content, commercials or episodes can easily convert the content to their in-house format.

The structure of an IMP is similar to that of a digital cinema package (DCP). An IMP must contain one (or more) composition play lists (CPL), an asset map and a packing list plus an optional output profile list (OPL). Track files are wrapped into an AS-02 subset. The CPL is comparable to an edit decision list (EDL) or a cut list that includes the information needed to assemble the playback for the given content and refers to various track files. The asset map is a list of all files included in the IMP. The packing list specifies the hash value of all files in the composition and is used to verify if data has been corrupted or tampered with in some way.

The OPL provides details of how the final output should be formatted, such as widescreen broadcast or 4:3 playback on a mobile device. It can contain pan and scan information as well transcoding directives such as data rate, resolution, codec and target bit rate.

Major IMF core framework constraints such as AS-02 wrapping, audio routing and subtitle parameters are resolved by a modular application layer system. These layers create plugin-like applications that fulfill requirements such as a higher compressed codec and specific resolutions or frame rates.

IMF development

Supporting HDR, WCG, 4K, and IMSC1

The first update to IMF, published in 2016, tackled outstanding bugs and introduced new applications that support new features such as:

▪ Wide color gamut (WCG) and HDR imaging through the PQ electro-optical transfer function and display of mastering metadata
▪ 4K imaging through the addition of JPEG 2000 profiles with higher sampling rates and coded bit rates
▪ Worldwide subtitling and captioning using the TTML IMSC1 profile

IMF is continually expanding its reach by introducing new applications that support new essence types and delivery capabilities. For example, in mid-2017, Apple announced that it was documenting the use of the ProRes codec (ProRes being widely used in television content libraries), resulting in the February 2018 release of a new IMF specification:

▪ Application #5 adds support for Academy Color Encoding System (ACES) images, targeting long-term archival use cases

▪ The dynamic metadata for color volume transform (DMCVT) plugin adds support for color volume transform metadata that allows fine control over the conversion of HDR images into narrow dynamic range images
▪ The Sidecar composition map allows arbitrary assets (e.g. QC report) to be associated with a composition for delivery

As more of the entertainment media ecosystem transitions beyond regional HD content, the need for agile interchange master formats such as IMF will grow.

IMF for broadcast and OTT delivery

In mid-2018, there will be a new file format available for facilities, broadcasters and online publishers. Based on the existing IMF, the new specification will be adapted for online delivery rather than the Hollywood studios cinema and archive focus of the original.

SMPTE joined forces with the UK's Digital Production Partnership (DPP) on the project, which will specify the breakdown of different elements — video and audio packages, composition playlists and output profile lists — with references to all relevant SMPTE standards.
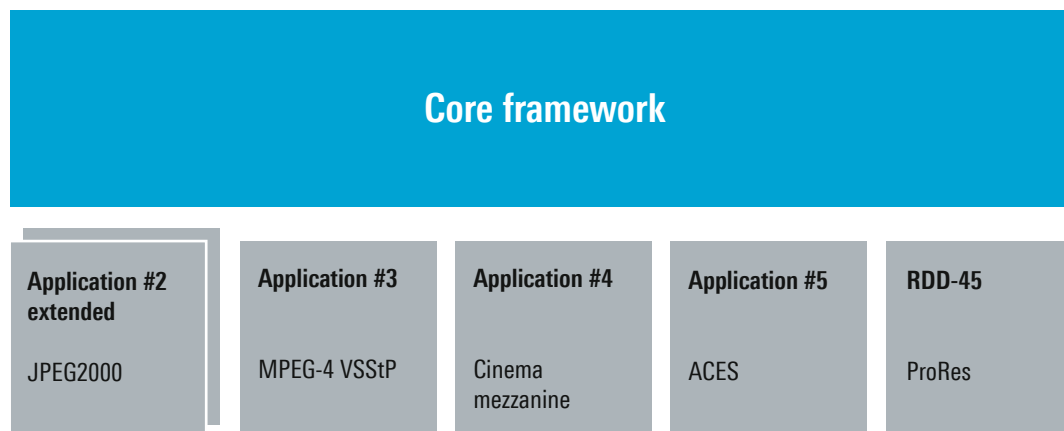

IMF – modular approach

Core framework
▪ Playlists
▪ Major constraints like MXF wrapping
▪ General audio and subtitle parameters

Modular applications
▪ Like "plugin" to the framework
▪ Allow for specific functionality
  · Higher compressed codecs
  · Specific resolutions and parameters
    (4K, high frame rate: 48/60/120 fps)
  · Specific problems can be easily adressed

Core framework

Application #2 extended	Application #3	Application #4	Application #5	RDD-45
JPEG2000	MPEG-4 VSStP	Cinema mezzanine	ACES	ProRes

Broadcasters are looking to target new audiences and territories and to monetize their program assets over a much longer period of time. While doing that, they also need to maintain quality. So the need to keep high-quality files for reversioning new broadcast and online deliveries is more important than ever.

For UK and US broadcasters, there are two primary use cases: incoming, i.e. buying content masters for further compliance processing; and outgoing, i.e. sales mastering. The goal is to implement a system that addresses the myriad metadata requirements of television and OTT while fitting into broadcasters' sizable existing content archives.

Different versions

There isn't that big a difference between the core workflows for IMF version 1 and the broadcast/online version, but there are changes. For instance, a broadcast version will need to transport interruption advertising (interstitials) to support stitching of assets at playout.

The TV community also has additional metadata to describe content genres, audio layouts and identifiers that are not used within the cinema world. There is also a missing unifying aspect to IMF that has prevented it from becoming a true mass-market format. The new version should address this.

IMF delivery standards

Each studio still has its own MXF delivery requirements for both input and output content, and the broader content creation and delivery community feels that IMF is really more like five or six different flavors of a similar standard since they have to make IMF flavor A for Netflix, IMF flavor B for a major studio and IMF flavor C to feed their finishing/transcoding tool.

In addition, component media workflows like IMF are very powerful and drastically simplify operations, but they are very complex in the backend. It requires a good platform and adapted management tools to achieve simple, cost-effective solutions to ingest, manage, search/find/retrieve and transform IMF for the necessary workflows. And very few platforms have developed the data model and toolset.

A key requirement for facilities and broadcasters to meet this requirement is to have a mastering system compliant with IMF. R&S®CLIPSTER from Rohde&Schwarz meets that need. Since version 5.9, it has offered a complete workflow (from mastering, versioning to merging and refining IMF packages) that has been continually improved and augmented up to the current release 6.6. And as a member of the SMPTE IMF group, Rohde&Schwarz actively supports the development of the format.

Linearity with legacy formats

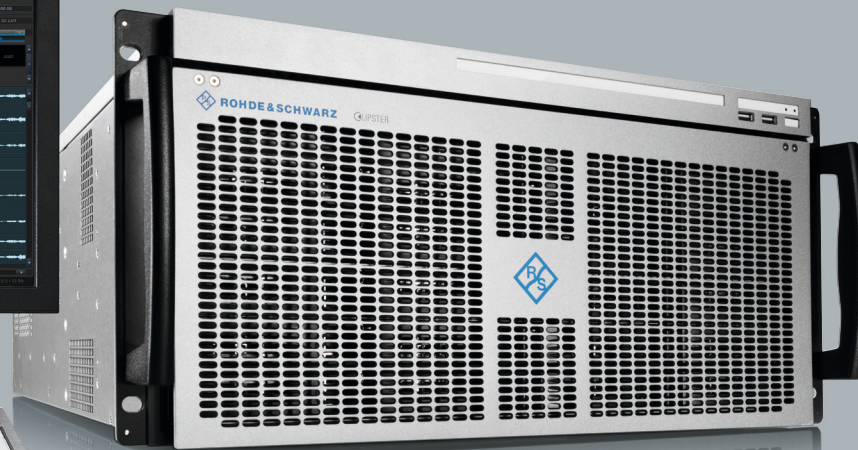
Tape

File — MXF / MOV / …

IMF — XML

Rohde & Schwarz support for IMF

Speeding up workflows with R&S®CLIPSTER

When it comes to versioning a master, IMF will help improve any workflow. R&S®CLIPSTER takes workflow speed to a new level: the mastering station fully supports the IMF standard and 4K content.

R&S®CLIPSTER promotes IMF in the markets and allows the complete workflow, from mastering and versioning to merging and refining IMF packages. Although IMF can store the equivalent of flattened versions as necessary, its key strength is that it can store only the difference between versions, thus minimizing the amount of data needed to be manipulated or sent. A common master consists of a main title, main video, main credits and its main audio. A typical version would contain new audio and several video inserts. Due to versioning, different lengths for censored versions, director's cuts, commercial black insertions/removals, airline edits or modifications are all easily attainable with new CPLs in updated IMPs.

R&S®CLIPSTER enables IMF versioning and inventory management of content for use in multiversion, multilingual, multidelivery media environments. Users can utilize the mastering station to create the required IMF with the respective tracks for file based workflows and file based libraries. R&S®CLIPSTER is ideal for B2B exchange since it supports resolutions of 4K and beyond in the latest IMF applications.

R&S®CLIPSTER allows a smooth transition from tape based workflows to digital file based workflows. Using simple object access protocol (SOAP), users can automate R&S®CLIPSTER to create IMF mezzanine files as output deliverables. The highly customized and intuitive Rohde&Schwarz wizards and tools guide users through every step of the mezzanine workflows, simplifying the processes.

For high frame rates and 4K applications, R&S®CLIPSTER offers faster than realtime encoding of JPEG2000 RGB/YUV file sequences (depending on the JPEG2000 profile).

Several integrated optimizing tools allow unique actions, such as merging the master and the varying IMP versions to obtain one single IMP with multiple CPLs. The integrated merge tool offers users the advantage of merging the individual IMPs created through versioning into one complex deliverable.

R&S®CLIPSTER offers diverse options for the IMP: version it, merge it, thin it out and transform it into other formats. High-speed generation of compressed formats for delivery and archival are also available.

Running the IMF workflow on R&S®CLIPSTER gives users a choice: they can flexibly decide to choose either AS-02, AS-11 or IMF – or even switch between them. Whatever a workflow requires at any given time, users can choose to ingest and outgest either IMF, AS-02, AS-11 or DCP.

Benefits include
ı "Any File, Any Style" delivers flexibility: the mastering formats are interpreted as project files
ı Ease of use thanks to IMF wizard and efficient toolset.
ı SOAP interface provides automated control from third-party applications
ı Sizing control for distribution in various aspect ratios
ı Freely choose between formats like IMF, AS-O2, AS-11 and DCP as ingest and outgest material
ı IMP merging tool to consolidate multiple packages into one

Creating IMF packages

IMF delivery tool
ı Guided step-by-step "wizard"
ı Failsafe creation of valid packages
ı Multi audio out demonstrates workflow optimizations

About Rohde & Schwarz

The Rohde & Schwarz electronics group offers innovative solutions in the following business fields: test and measurement, broadcast and media, secure communications, cybersecurity, monitoring and network testing. Founded more than 80 years ago, the independent company which is headquartered in Munich, Germany, has an extensive sales and service network with locations in more than 70 countries.

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