Introduction

Media organizations face challenges in their distribution delivery strategies due to the ever-increasing number of formats that consumers can access content. MXF format [1] and its OP1a variant [2] are examples of formats that they must support. They have already addressed feeding content into the more traditional delivery channels, perhaps via linear infrastructure, but a myriad of different versions of that content are now required to feed the various direct-to-consumer services. Broadcast centers have simplified their workflows by establishing a common mezzanine or "house format" to which all incoming content is normalized. However, workflows that need to support new HDR video and Next Generation Audio (NGA) technologies require a new mezzanine specification. The Repository File workflow, proposed by Dolby Laboratories, takes advantage of advances in standards for HDR Video, NGA, and IP Transport while offering simplicity and flexibility to this process.

Simplification is achieved by requiring all downstream processes, such as playout or QC, to handle a single format. This reduces the cost of product implementation while also improving reliability. Building on specifications like AS-11[3] and Operational Pattern 1a[2], the Repository File uses the MXF[3] file format as the base container. This solution is particularly valuable for broadcasters and multi-service operators managing complex distribution requirements by simplifying distribution through the utilization of a single asset in the workflow. While requiring initial investment, the Repository File workflow offers long-term operational benefits and quality improvements across the content distribution chain.

What is the Repository File?

The Repository File is a Mezzanine file format, based on MXF[3] supporting both HDR video and NGA. As a specialization of the OP1a[2], content must be directly playable in real-time. A key characteristic of the Repository File is the support for dynamic video and audio metadata. The use of dynamic video metadata helps maintain a consistent experience across consumer devices with varying capabilities while enabling new viewing features. With consumers demanding a more personalized experience, there is a trend towards the separation of audio elements during production to aid in personalization. For example, the separation of dialogue audio elements enables features such as multi-language delivery and dialogue enhancement. Additionally, insertion of metadata on a frame-by-frame basis simplifies switching and editing scenarios needed for these experiences.

Such metadata may change dynamically within a given asset or change periodically as assets are played out on a schedule. New metadata standards such as SMPTE ST 2110-41[5] enable transport of dynamic metadata through a modern media facility. The needs of different media organizations vary considerably, requiring flexible solutions that can be widely adopted and achieve reduced cost through scale. To illustrate this flexibility, three use cases are discussed.

Use Case 1: Matched House and Playout Formats

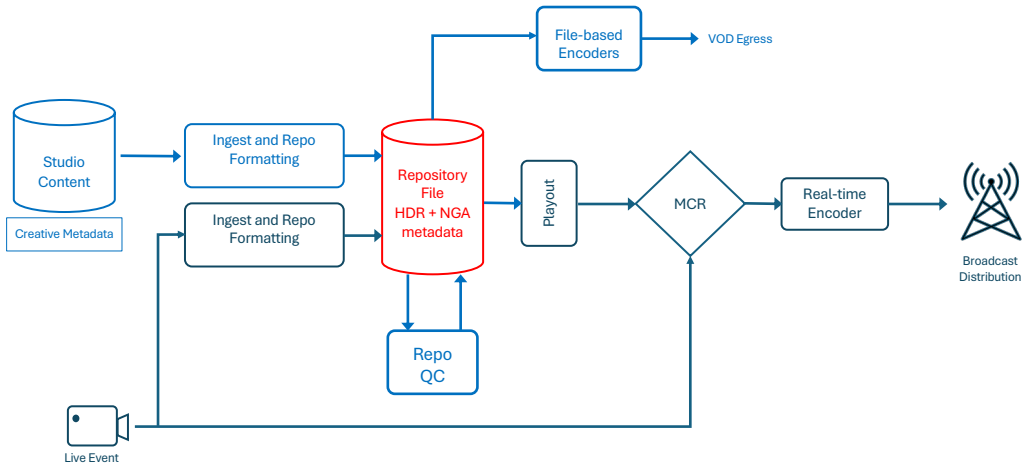

Figure 1. Workflow using matched house and playout formats

The objective of this use case is to reduce mezzanine files, QC cycles, and workflows. A single repository file is used for linear playout and VOD. Typically, linear playout workflows run at higher frame rates, requiring real-time frame rate conversion. The benefits of this approach are the reduction in complexity and processing within the content management system. More specifically, for any title, there is only one proxy created and one QC cycle for both VOD and linear workflows. The main disadvantage of this approach is the unnecessary conversion to the Repository File format for VOD. This is not strictly necessary for VOD assets, as there is no restriction to use a single frame rate, as is typically the case with linear playout.

Use Case 2: Unmatched House and Playout Formats (Playout Repository File)

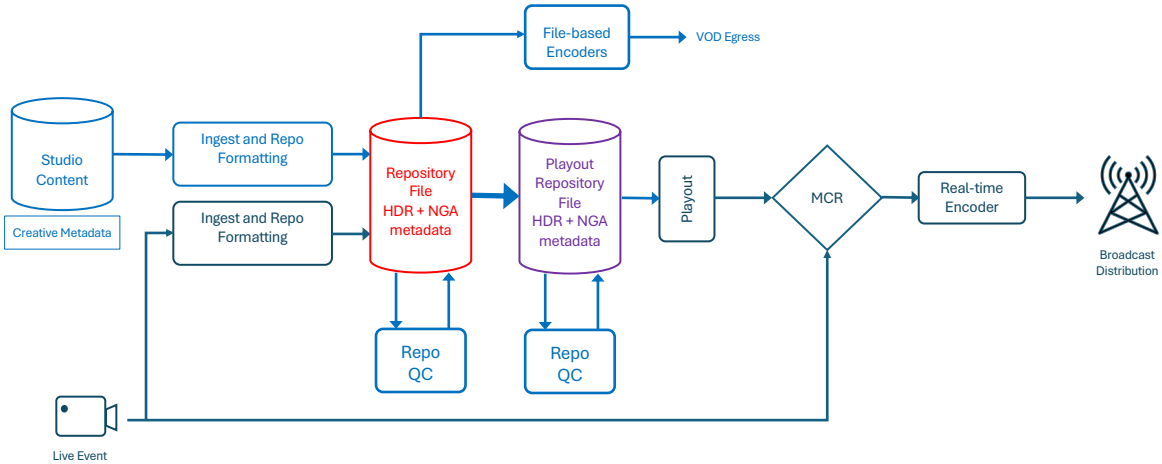

Figure 2. Workflow using unmatched house and playout formats

The objective of this use case is to provide the best quality and reliability for both VOD and Linear. The number of mezzanine files, QC cycles, and per-title workflows exceeds the requirements in case 1. While VOD assets are generated directly from the house repository file, for linear playout, an intermediate file is used. The Playout Repository File is encoded differently according to the requirements of linear distribution, typically at a higher frame rate. This file is temporary according to the time window of the linear scheduling system. The benefits of this use case are video quality and consistency of experience. Distribution of VOD content in its native frame rate results in a better viewing experience. For Live/Linear services, the conversion of audio, video, and associated metadata in the file domain allows for more complex processing than is possible during real-time playout.

Use Case 3. Optimized Master Delivery

Today, studios typically deliver mastered content in either IMF[4] packages, ProRes MOV formats, or other high-quality file formats. While these approaches work well for the delivery of a title to multiple distribution partners, sometimes there is a requirement to deliver a mezzanine for a specific distributor. In such cases, these complex formats require excessive processing that can be avoided. The use of a Repository File enables delivery in a mastered, high-quality format, but without the need for extensive processing.

What are the benefits of the Repository File?

The Repository File concept presents a solution for integration of HDR Video and Next Generation Audio into modern broadcast IP facilities while providing options to balance quality and cost. It combines proven and widely adopted technologies like MXF with new standards like SMPTE ST 2110-41[5] that take full advantage of new IP infrastructure.

References

[1] SMPTE ST 377-1, Material Exchange Format (MXF) — File Format Specification
[2] SMPTE ST 378, Material Exchange Format (MXF) - Operational Pattern 1a (Single Item, Single Package)
[3] AMWA AS-11, MXF Media Contribution File Formats
[4] SMPTE ST 2067, Interoperable Master Format
[5] SMPTE ST 2110-41, Professional Media Over Managed IP Networks — Fast Metadata Framework
[6] Enabling Dynamic Metadata using a Repository File Format and SMPTE ST 2110-41 – AIMS IPShowcase, IBC 2025