4:3 vs. 16:9 Video Aspect Ratio Correction

Solution Brief

1) Problem Description

When 16:9 video was introduced as anamorphic PAL (and NTSC) video servers that have been used for ingesting from tape or recording of live feeds have not been prepared for this new situation. They've simply ignored any aspect ratio or wide screen signaling within the SDI signal. As consequence they have not writing any aspect ratio information into the file headers.

Today, years later many early adaptors have been building up huge archives of wrongly flagged video files. Most often the content recording happened within MXF-wrapped files. Within such files the aspect ratio is stored as meta data within the MXF essence header and within the MPEG-2 video stream.

As the 16:9 aspect ratio information was not stored at any place there is no simple technical way to detect it and restore it to all relevant locations within a video file.

2) Solution Overview

Obviously the only indication of the aspect ratio within such files is given by the actual video content. An approach to the problem would be using picture recognition methods that can detect whether all objects are strangely squeezed. The downside of this approach is the uncertainty of the detection result. Correcting an archive with a rate of 95% may be not enough for many use cases.

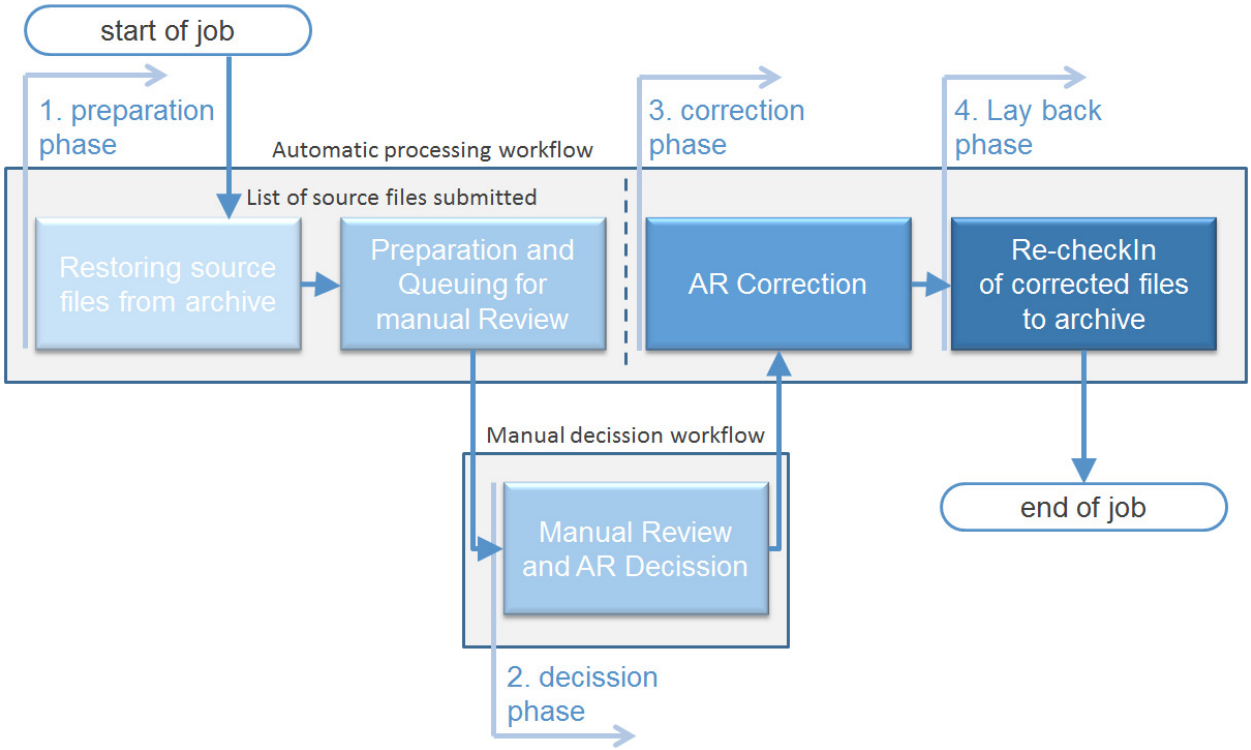
Thus a more accurate detection requires manual human intervention. But a huge archive requires some automating on the other hand. Consequently a widely automated but human assisted file handling, reviewing and correction makes sense.

x-dream-media has developed a flexible end-to-end solution for customers with a need to review and process files. One use case is the correction of video archives. x-dream-media's Workflow Manager is used for retrieving the files from the archive, for the correction and for the re-check-in into the archive. A simple web browser based graphical user interface displays one after the other video file from the archive to the human operator and requests just one action: The decision 16:9 or 4:3. Depending on the infrastructure in place the operator can review the original MXF file or a proxy video. In case no proxy video is available within the archive the Workflow Manager will have a transcoder preparing a short sequence from the original file in question.

The heart of the solution is x-dream-medias Workflow Manager in conjunction with x-dream-medias MXF video file player for any web browser. The Workflow Manager can drive either x-dream-media's MXF correction tools or third party products.

3) Workflows

The following diagram gives a rough overview of the steps to perform to correct one or multiple files from the archive.



The four phases are composed from the following steps:

1. **<u>Preparation Phase</u>**

    a. Queuing to Workflow Manager:

    The Workflow Manager either polls the archive in place via its API for files being archived (all files or files that match a certain criteria) or the Workflow Manager gets the files to process loaded via its API or user interface.

    b. Restoring source files from Archive:

    As next the Workflow Manger fetches a (configurable) number of files from the archive. For each file it generates a “review and correction job.”

    c. Preperation and Queuing for manual Review:

    In case the infrastructure does not allow the operator to access the original files from the archive the Workflow Manager makes use of a transcoder to generate a low-res proxy clip. This clips is not of full length but containts just a (configurble) part of the original clip. As next the job is placed into a queue for an operator to review and decide on the aspect ratio.

2. Decision Phase

d. An human operator gets one video in question after the other served to make a decission on the aspect ratio of such video content. He can play or scrub the video. He gets some basic technical metadata displayed. Based on a configuration he is accessing the original video file or the low-res proxy clip.

   The action to perform is limited to press either a 16:9 or a 4:3 button. This triggers passing on the job within this workflow and a next video to check gets loaded.

3. Correction Phase

e. For the correction itself x-dream-media offers various options:

   Remember: The aspect ratio is stored at least within the MXF file Header (e.g. “File Descriptor”) and within the Header of the Video Essence Container track but also within the Sequence Header of MPEG-2 video stream itself.

   i. x-dream-media MXF Header SDK

   Based on this SDK x-dream-media can quickly implement a slim executable that manipulates the MXF structures as needed for the type of files in question. In the particular case of aspect ratio correction such a tool patches the MXF file Header and the Header of the Video Essence Container. This process takes seconds only. But the Sequence Headers within the MPEG-2 essence get’s not touched this way.

   The Workflow Manager executes the MXF Header Patching Tool and handles errors.

   ii. x-dream-media MXF Re-Wrapping Tools

   x-dream-media offers various tools for MXF re-wrapping. One is specialized to handle the Sony XDCAM HD format. Another is more generic an handles MXF OP-1a, MXF D10, AS-02, AS-11, Avid MXF OP-Atom for instance. The advantage of using a MXF re-wrapping tool is given by the fact that the complete MXF structure is rewritten and a guaranteed standard compliancy is achieved. Usually the Sequence Headers within the MPEG-2 essence are corrected that way as well. But descriptional meta data (if any exists) can get lost that way.

   The Workflow Manager directly calls the MXF re-wrapping tools and handles errors.

   iii. Cube-Tec MXF Legalizer

   x-dream-media has interfaced its Workflow Manager with Cube-Tec’s MXF Legalizer. That way correction tasks can be queued to the MXF Legalizer. The advantage of the MXF Legalizier is that it does not only correct the aspect ratio but checks and corrects the entire MXF structure. That way descriptional meta data would be preserved.

   The Workflow Manager monitors this process, waits for completion and handles errors.

   iv. Transcoding

   x-dream-media has interfaced its Workflow Manager with all major transcoding tools, e.g. Telestream Vantage, Harmonic WFS and Carbon, Dalet/Amberfin iCR as well as Capella Systems FTC and FTC Cluster. Obviously a transcoding causes a complete rewrite of the video file. This allows not only to correct meta data but also to adjust coding settings.

   The Workflow Manager monitors this process, waits for completion and handles errors.

4. Lay back Phase

f. The way how the resulting files is stored back into the archive highly depends on the capabilities of the archive software. Two cases can be given:

i. update

Some archive software may offer the capability to update a file within the archive. In that case the original file gets replaced with a new one that has the identical file name as the original one.

The Workflow Manager moves the file to the archive and triggers the update process. It also monitors this task and handles errors.

ii. dearchive and rearchive

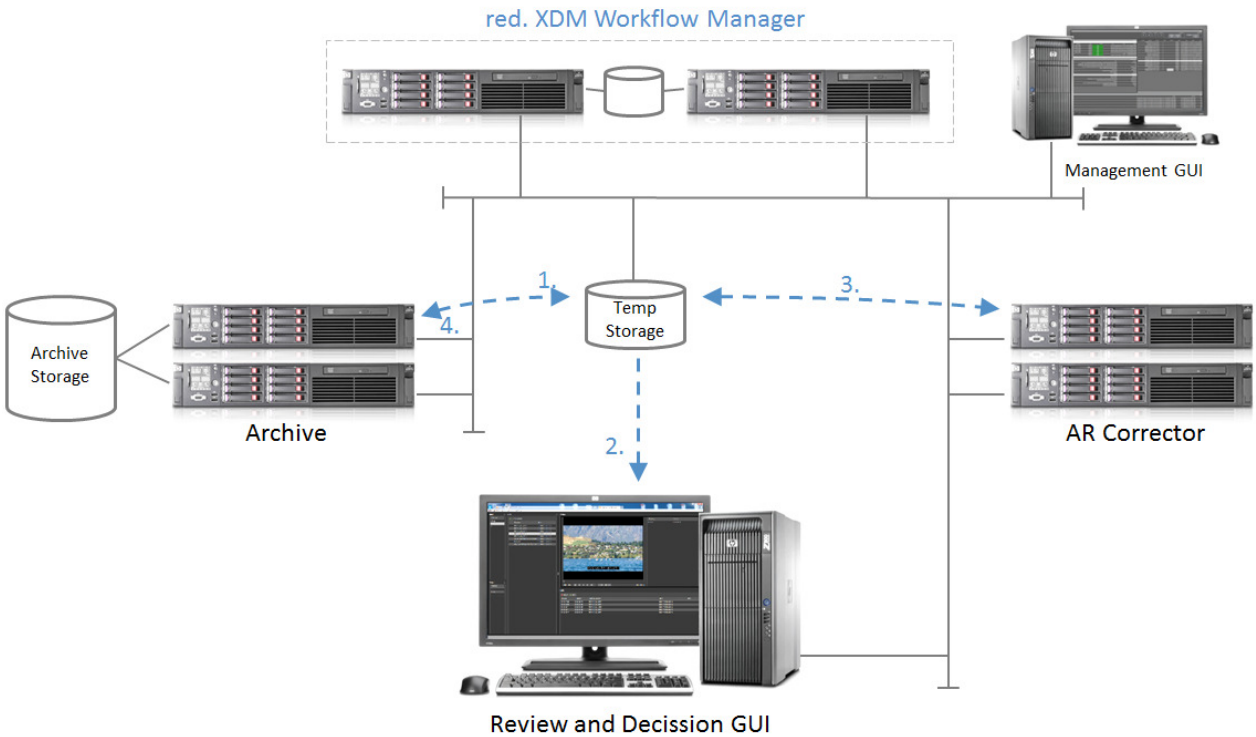
Other archive software may not be able to update files within the archive. In that case the original file gets dearchived and rearchived.

This means the Workflow Manager reads the complete data set (incl. meta data) from the archive and deletes it. Right afterwards it generates a new data set within the archive, writes all meta data to this data set, moves the file into the archive and triggers the archiving process. In addition the Workflow Manager needs to update the surrounding systems in this case as their reference to the archive got broken now.

Again the Workflow Manger monitors all tasks and handles errors.

4) Solution Architecture

The following diagram gives a rough overview of the involved systems.



- The **Workflow Manager** runs the end-to-end workflow. It generates, queues and executes the review and correction jobs. It moves the files, drives all other products APIs and serves the GUIs.

- The **Review and Decision GUI** is served by the Workflow Manager. It gives access to either the original source video from the archive or alternatively to a browsing proxy from the archive or from an earlier transcoding.

- The **AR Corrector** is a placeholder for the actual engine that brings things right. It's either:
  - **x-dream-media's MXF Header Patching Tool**
  - **x-dream-media's MXF Re-Wrapping Tool**
  - **Cube-Tec's MXF Legalizer**
  - a **Transcoder**

- The **Management GUI** is used to configure, manage and monitor the end-to-end system.

- The **Temp Storage** holds the dearchived original source video files, in case the transcoded browsing proxy files and the corrected video files.

Not shown here are the transcoders for generation the transcoded browsing proxy files.

5) Considerations

The most important question to answer is what technology to use for correcting the video files. This can be either patching MXF file Headers only, re-wrapping of the MXF files (incl. correcting the Header of the Video Essence Container or transcoding of the MXF files.

As next it must be clarified how the corrected files are moved back to the archive. Best case the archive software allows an update. Otherwise a dearchiving and rearchiving (incl. updating all surrounding systems) is required.

Also quite relevant is to define what way the files from the archive are sent to the review and correction. Best case either the archive system or a surrounding MAM system can send the complete catalogue or parts of is to the Workflow Manager. Otherwise a rule needs to be defined that is used by the Workflow Manager to poll the relevant files from the archive.