ACES Metadata File

Handbook

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- Final Review -

1. Introduction

This document is a guide that recommends implementation guidelines and best practices related to the usage of the ACES Metadata File (AMF) in various workflows. These workflows may involve one or more tools that support the AMF specification and this guide attempts to help both implementers and users in order to facilitate interoperability.

1.1. Background

The Academy Color Encoding System (ACES) is a color processing framework that enables the mix of various sources within a standardized color space in order to produce one or more outputs.

While ACES is a living framework and is actively developed and adopted, it also comes with various points that can be configured. These points of configuration are either related to the sources used (Input Transforms), a creative look (Look Transforms), the desired outputs (Output Transforms), or the Version Number (i.e. ACES v1.1) of the core transforms built into the ACES system.

ACES does not specify these configuration points directly or associate them with actual images or shots during production, and this is the very reason why AMF exists.

AMF is the configuration file that allows a precise setup for an ACES pipeline. Besides this basic goal, AMF is also the tool of choice to transmit and exchange configuration parameters in order to ensure consistency within a workflow and across the entire ecosystem of tools that are used within that workflow.

1.2. Target Audience

AMF is a sidecar file specified using the XML markup language, and as such it can be processed by machines and at the same time created/modified by users.

This document targets both AMF users and AMF implementers because both groups need the same level of understanding in order to design AMF-enabled workflows and tools that support those workflows.

2. What is AMF

AMF is an XML specification that describes the configuration of an ACES color pipeline, together with the various input transforms, look transforms and output transforms.

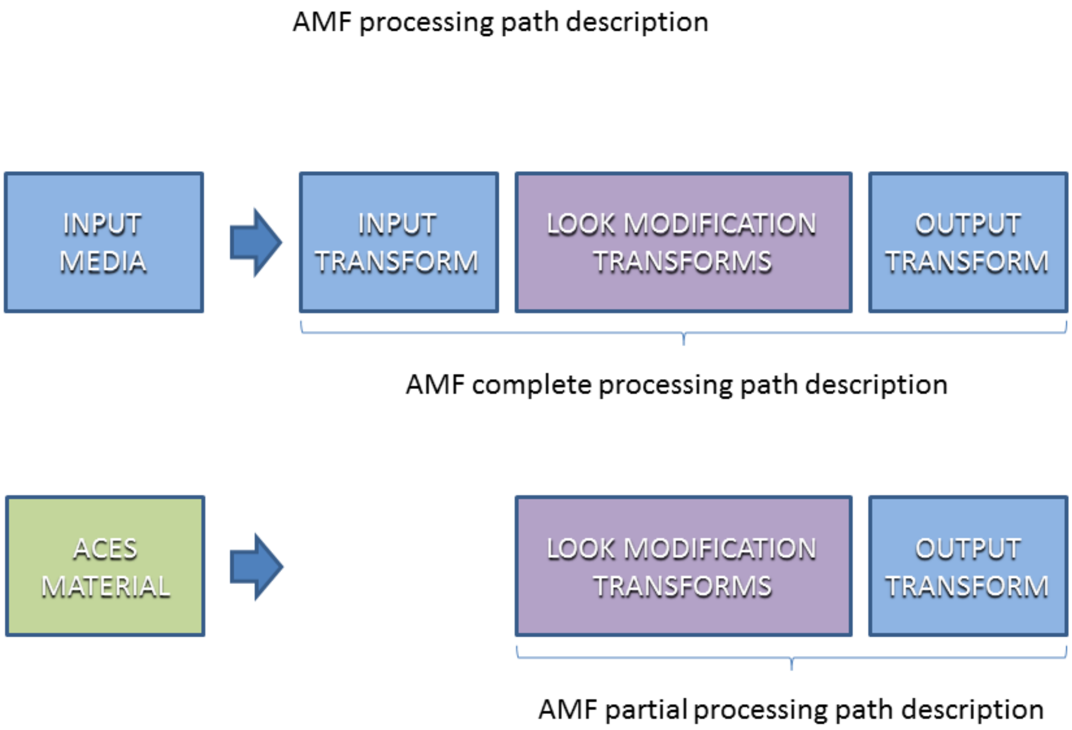
AMF is a "sidecar" element, usually accompanying some visual material such as a video file, a sequence of frames, or a whole timeline. In the case of a timeline, more than one AMF file can be used if the timeline requires different configurations of the ACES pipeline. It is also worth mentioning that several AMF files can reference the same visual material.

The opposite is equally true as all these visual elements can share a single AMF file or a whole set of them. This of course is entirely dependent on the workflow, and tools implementing AMF should be prepared to deal with this flexibility.

In general, the relationship between the visual elements and the AMF files can be described as a "many to many" relationship.

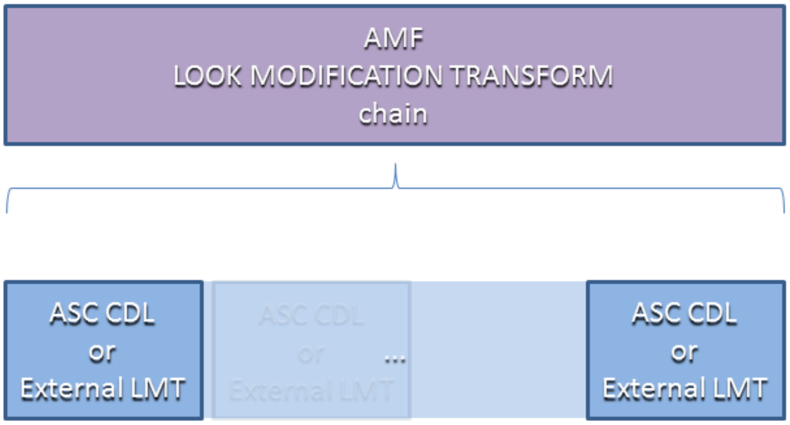
3. Why is AMF needed

The ACES framework is expanding and becoming richer in terms of input, look, and output transforms. AMF describes the exact list of these different transforms, in the order in which they have been or should be applied to obtain the desired result.


AMF processing path description
INPUT MEDIA
INPUT TRANSFORM
LOOK MODIFICATION TRANSFORMS
OUTPUT TRANSFORM
AMF complete processing path description
ACES MATERIAL
LOOK MODIFICATION TRANSFORMS
OUTPUT TRANSFORM
AMF partial processing path description

This is a powerful feature because it can describe both configurations that must be used to create a specific output, or configurations that have been used to create a specific output.

AMF Look Modification Transform Processing Path



Each block in the chain can be an ASC CDL or an external LMT

Blocks can be “enabled” or “disabled”

Finally, another feature of AMF is the ability to document a "change log" in an ACES color pipeline. This is called the "archived pipeline" and will be discussed later in the document.

The “applied” attribute

Each transform in an AMF can be tagged with the attribute called “**applied**” - which indicates whether a transform has ***already been applied*** **(applied=true)**, in which case the transform has already been baked into the image, or if the transform ***has not been applied*** **(applied=false)**, in which case the transform should be loaded as part of the viewing pipeline.

One use case of this might be when using the ACES Gamut Compression transform, which may be baked into SMPTE ST 2065-1 ACES image data, and it is essential to communicate to downstream software that it has already been applied, as to not double-apply the transform, or invert it if necessary.

4. Lifecycle of AMF

This section describes the life cycle of an AMF and how it could be used within each production stage.

4.1. Camera

While on set, AMF could be imported in-camera and used to apply color pipeline settings for video and file output, or exported to a camera card when using a camera's ACES viewing pipeline. See section 7 for more on cameras reading/writing AMF.

4.2. Monitor

Some professional monitors allow import of LUTs to apply looks in-device. AMF could replace proprietary or uncommon LUT formats for improved interoperability.

4.3. On-set live grading

An AMF may be read by on-set live grading software for the purpose of on-set monitoring and color grading within ACES.

If anything is altered within the domain of the pipeline defined in the AMF, a new AMF is created to reflect those modifications. For example, an ACES pipeline is established in an AMF before production, then CDL adjustments are created during production to create an updated AMF accordingly.

4.4. Dailies

In a dailies tool, a pre-created AMF could be read and associated with OCF (Original Camera Files) to apply pipeline settings (for viewing and rendering). This could be done either by manual association or automatically.

In the process of creating the dailies, the color pipeline coming from an existing AMF may be modified and updated. AMFs are written out with media to be passed to editorial software. Commonly used interchange files (e.g. EDL or ALE) can be used to conform AMF files with OCF, see below for more details.

4.5. Editorial

Editorial software can apply pipeline settings provided by AMF(s) when importing media to automatically set up viewing and rendering.

4.6. VFX

Read AMF(s) when importing plates into VFX software and apply pipeline settings for viewing. Given the prevalence of OpenColorIO across VFX software, it is likely that a translation from AMF to OpenColorIO (OCIO) would be required.

4.7. Color Grading

When in color grading, AMF could be conformed to a timeline and associated with OCF to apply pipeline settings (for viewing and rendering). These applications should also allow for look development in ACES and subsequent exporting of AMF.

4.8. Review

Review software could automatically apply ACES pipeline settings for viewing purposes by reading AMF(s) when importing media or by manually applying AMF(s) to imported media.

4.9. Mastering and Archiving

Read AMF(s) when importing media and apply pipeline settings for viewing.

Consolidate AMF(s) to meet specific archival delivery requirements.

5. Considerations on reading/writing AMF

Scenario	***READ*** *An AMF is read when importing media and used to populate a color pipeline for viewing and rendering.*	***WRITE*** *A new AMF is written in order to be passed along to the next production stage. If a new AMF is done from a previous AMF, the previous pipeline might be archived in the <archived> section.*
RAW Clips	AMF does not include any metadata for demosaic settings. Implementations need to ensure that the image is demosaicked to the appropriate color space before the Input Transform defined in the AMF is applied. User input may be required. If software chooses to directly demosaic a RAW image to ACES, the Input Transform defined in the AMF must be ignored.	n/a
Input Transform Conflict	A clip has already been loaded into the software, and an Input Transform is already applied. Default behaviour should be to override that Input Transform with what's specified in the AMF, but the user should be prompted.	n/a
Output Transform Conflict	If the AMF specifies an Output Transform that is in conflict with the respective shot's Output Transform, then this conflict must be handled. The default behaviour should be to stick with the project-wide Output Transform, but it may be useful to indicate a conflict to the user. Example: An AMF is generated from a software platform that uses the	The Output Transform that was indeed used for viewing should be specified in the AMF.

	Rec709_100nits transform, and is then read by a software platform that is using an HDR Output Transform.	
Manual AMF Batch Import/Export	Consider the use of commonly used interchange files (e.g. EDL or ALE) to batch import AMF’s to a timeline. Ideally, the software would allow for a partial import of only the Input, Look, or Output Transforms of a given AMF.	When exporting a batch of AMF’s for an entire timeline, consider exporting commonly used interchange files (e.g. EDL or ALE) to create an association between Clips and the exported AMF files.
Inter-AMF Output Transform Conflict	If AMF’s are batch imported into a single timeline, and at least two of them have different Output Transforms defined, consider prompting the user if this inconsistency exists, and provide appropriate options to address. This has the assumption that the user will only be using one Output Transform at a time for an entire timeline.	n/a
Pipeline Override	If an AMF has already been applied to a shot, or if project/timeline settings apply, and a subsequent AMF is read for that shot, consider prompting the user before overriding pipeline. Ideally, the software would allow for a partial import of only the Input, Look, or Output Transforms of a given AMF.	Consider including multiple AMF transform pipelines by making use of AMF’s **aces:archivedPipeline** element.
Updating Look Transforms	n/a	Local changes to transforms in the AMF should not affect any other transforms if the pipeline structure doesn’t change, e.g. when only updating CDL values, but none of the other transforms change, the AMF structure should not be changed and only the CDL values should be updated. Any changes to the transform pipeline will result in a new AMF and global values, e.g. the

		dateTime element, are therefore expected to change. If CLF(s) are used in the pipeline, consider using CLF UUID and/or its hash to make sure that the CLF has not changed.
Look Transform Support	If an AMF references a Look Transform with a format that the application does not support reading, consider notifying the user that the format is unsupported, so it is clear the error is unrelated to the AMF itself.	When producing a new Look Transform for an AMF export, consider defaulting to CLF, a format that ensures high interoperability,, especially for any operations other than ASC CDL. It's important to consider what to do when using CDL operations vs other grading operations and how these should be reflected in the AMF document: in elaborated pipeline where CDL are "in between" other more sophisticated grading operations, it might be required to let the user identify and decide over what CDL operations should be treated as such and which ones can be baked with other operations into a consolidated CLF
Cameras	Import AMF in-camera and apply pipeline settings for video and file output. An AMF loaded in camera could specify over SDI how to treat the incoming signal (ie Output Transform) *There are reasonable expectations that any in-camera processing, for the foreseeable future, will be done utilizing small 3D LUTs at the highest complexity. Therefore, applications of an ACES pipeline in-camera may be limited in precision.*	*When should a camera generate an AMF?* ***If a camera generates an AMF, where should it be written?*** - #1 Preferred Method: - Embedded in the OCF, e.g. REDCODE RAW R3D - #2 Preferred Method: - AMF should live in the same directory as its associated clip - #3 Preferred Method: - A single folder with all AMF files
Metadata Population	Parse the AMF for its filename and **aces:uuid** and write these to the appropriate metadata fields for each clip.	If the AMF associated with a clip changes, the value relative to the AMF metadata fields within the editorial software should change and adopt the new values. So when writing

		commonly used interchange files (e.g. EDL or ALE) the correspondent values are correct.
Applied Tag	When reading an AMF file that has the “applied=true” attribute for a specific transform, the software should NOT apply the transform to the file, since it has already been applied to the image itself. Consider reporting it to the user if applicable (e.g. a “history” log of the transforms is accessible for each clip)	When exporting AMF’s from a timeline of clips that have not been rendered yet, each transform in the AMF should be tagged as “applied=false”. However, when rendering new files, consider having the ability to export new AMF’s files simultaneously as part of the same deliverable and, in this case, each transform that is actually baked in should be tagged as “applied=true” in the AMF (e.g. the Input Transform if rendering EXR ACES 2065-1 VFX pulls, or everything when exporting 709 proxies for editorial).
Archived Pipelines	Consider allowing the user to toggle between different ACES pipelines that are recorded in the **aces:archivedPipeline** element. Otherwise, **aces:archivedPipeline** elements should be preserved for any new AMF’s subsequently created for the same shots.	If the software is updating a pre-existing AMF, the written AMF should include the appropriate **aces:archivedPipeline** element.

6. Structure of AMF

AMF is a specification based on the XML markup language. It is fully described in Academy Specification S-2019-001 [1]. The specification also comes with an XML Schema that can be used to validate the AMF documents. The XML Schema is publicly available here:

https://github.com/ampas/aces-dev/tree/master/formats/amf

The guidelines and best practices in this document are provided to help both implementers and users to take full advantage of AMF.

It is strongly recommended to use the specification as a reference in order to better understand the concepts described here.

AMF document sections

AMF documents are mainly divided in 3 sections:

- Section 1 `aces:amfInfo` - this section provides descriptive information about the AMF itself.
- Section 2 `aces:clipId` - this section provides a reference to the visual material (OCF or rendered images) that this AMF is applicable for.
- Section 3 `aces:pipeline` - this section describes the actual ACES pipeline configuration.

6.1. General descriptive information

The `aces:amfInfo` element contains various sub-elements that provide descriptive information about the AMF document but also a mechanism to help identification. More specifically two sub-elements deserve some consideration:

- `aces:dateTime`
- `aces:uuid`

The mandatory `aces:dateTime` element contains the creation and modification date. The `aces:uuid` element is optional and is designed to carry a Universally Unique Identifier (also known as Globally Unique Identifier, or GUID on some systems). The Universally Unique Identifier is specified in IETF RFC 4122 as well as other ISO and ITU documents.

Both `aces:dateTime` and `aces:uuid` elements are not filled in by a human operator but rather automatically generated by the tool used to create the AMF document.

6.1.1. AMF naming and identification

In general, the most common method that everyone uses to distinguish between two files is by comparing file names and/or their creation and/or modification date in the file system. However, this method quickly reveals itself ineffective when files are exchanged between various computers and operating systems because these file properties can easily be changed without any sort of warning.

As explained above, AMF files usually come in large numbers and are moved across various systems and processed by various tools during their life cycle. Because of this situation, a better approach is to make good use of the information contained in the document itself.

However, to avoid common pitfalls like overwriting files, the following file naming convention is recommended:

AMF files should conform to the following file naming convention:

`<description> "_" <date> "_" <time> ".amf"`

`<description>` should describe the following, if applicable:

- Purpose: the use case of the AMF file (eg. "dailies", "SDR_709", "VFX-Pull")
- Clip: Clip ID as in the AMF specification
- Show Name: Title or other identifiers of the associated show
- Author: Author of the AMF

`<date>` is the date of creation, using the format YYYY-MM-DD

`<time>` is the time of creation, using the format HHMMSSZ (trailing "Z" indicating "Zulu" time, see below)

Values for `<date>` and `<time>` are determined at the start of the operation that results in the creation of the AMF file and the values are represented using the Coordinated Universal Time (UTC) standard.

Example: `Dailies_ShowName_A002R2EC_2019-01-07_080228Z.amf`

6.1.2. Using date and time mechanism

As mentioned above, the `aces:dateTime` is a mandatory element and it is defined using the standard XML type `xs:dateTime`. Because this definition is very flexible, it is strongly recommended for the tools to always use the most explicit form that includes the year, month and day, the time of the day in hours, minutes and seconds as well as the time zone. This practice ensures that the creation and modification dates and times are giving a good indication on the location where the document was created/modified.

6.1.3. Using the unique identifier mechanism

A more elaborate identification mechanism can also be used, by taking advantage of the `aces:uuid` element. Since this element is optional, one cannot count on its presence, however it is strongly recommended to use it. When doing so, the UUID becomes a much safer tool to distinguish between to AMF documents. UUIDs are automatically generated and they shall never be hand-crafted.

6.1.4. Combining several identification mechanisms

In order to improve the identification mechanism, one can combine both the UUID checks and creation/modification times. This might be helpful if two AMF documents contain the same UUID but have different creation/modification dates.

In practice, when using dedicated tools to create and manage AMF files, such situations should not occur, but AMF files can still be manually altered. If this is the case, further inspection of the AMF documents can help to distinguish them. Such advanced methods will be discussed later in the document.

It is worth mentioning here that there are situations where two or more AMF documents can have the same unique identifier but have different creation dates and time. It is then recommended that tools encountering this situation switch to the most recent version of the AMF document based on the date and time.

6.1.5. Informing the user and logging conflicts

Because of the large number of AMF documents involved in a workflow, it might not be practical to inform the user of every error encountered. However these errors should be logged by the tools using AMF and options should be offered to select the various identification rules, e.g. unique identifier first (if available), then the creation date and time.

6.2. Clip information and association

As described in the previous sections, AMF can be used with different targets, i.e. single file video clips, image sequences, compositions, etc.

This flexibility implies that the AMF specification does not prescribe a specific way to create the connection with the target material. Instead, the specification offers different connection mechanisms via the aces:clipId, an optional structure that in turn contains child elements to help with the handling of the various situations.

The first important observation to make is that the `aces:clipId` element itself is defined as optional. In this context, optional does not mean that the presence or absence of the aces:clipId element does not affect the workflow and how tools that support AMF behave. The term optional must be understood as a switch between two categories of workflow: the first does not connect an AMF file to a specific visual material and the second does connect an AMF file to a specific visual material.

Depending on the workflow in use, an implementation must handle the presence or absence correctly and report errors if necessary. Typically, the XML validation only will not be enough to distinguish between a valid AMF file and an invalid one, since the aces:clipId element is optional.

In other words, the aces:clipId does not dictate how the AMF document is handled. It is the workflow that dictates the behavior.

6.2.1. aces:clipId is not present

The absence of the aces:clipId element is important when the connection between the AMF document and the visual material is handled by a higher level protocol.

6.2.1.1.

The simplest higher level protocol that comes immediately to mind is the use of the file system and some sort of naming convention. For instance, a folder can contain a video clip and the related AMF file like this:

./myVideoClip.mxf
./myVideoClip.amf

In this simple situation, an implementation that can read the the myVideoClip file could also look for a secondary file named myVideoClip.amf and if it is present and if it is a valid AMF document consider that there is a "connection" between the two files and act accordingly.

While this seems to be a natural thing to do, it is certainly something to avoid. First of all, this kind of "connection" would work in a limited number of situations and then it would also prevent more elaborated workflows from existing. Consider the following modified example:

./myVideoClip.mxf
./myVideoClip.mov
./myVideoClip.amf

In this variant, it's impossible to guess if myVideoClip.amf is related to myVideoClip.mxf or to myVideoClip.mov or to both files.

To solve this problem, the `aces:clipId` element must be used to establish the desired connection between the AMF document and the correct targeted visual material.

6.2.1.2.

A single AMF document can be "shared" by multiple video clips or image sequences or even compositions. While it's certainly possible to invent a solution based on the file system naming capabilities via a fixed folder/file structure and naming convention, it is not recommended.

In practice, workflows that involve multiple visual material elements, and one or more AMF documents, shared or not, make use of a control file that acts like a database, describing the complex relationships that may exist.

This handbook defines the use of AMF in conjunction with some popular commonly used interchange files:

1. Avid Log Exchange (ALE)
2. CMX3600 Edit Decision List (EDL)

The AMF Implementation Group explores the use of AMF with higher level protocols as well and those will eventually be described in a future version of this handbook.

6.2.2. aces:clipId is present

As briefly described before, the aces:clipId is a complex element, containing the following sub-elements:

- `aces:clipName`

and one of the following:

- `aces:file,`
- `aces:sequence,`
- `aces:uuid`

All these sub-elements are mandatory when `aces:clipId` is used, but it's important to remember that aces:sequence, `aces:file` and `aces:uuid` cannot coexist. They are mutually excluding each other and therefore are used for specific variants in a workflow.

6.2.2.1. aces:clipName

The `aces:clipName` is used to carry the name of the target visual material element, but not the file name of that element. Typically `aces:clipName` is the same as the file name but without the file extension or the frame number digits in the case of a file sequence.

6.2.2.2. aces:file

The `aces:file` element is used to carry the actual file name of the target visual material element. It can carry the full absolute path and the file name, a relative path and the file name or simply the file name (base name and extension) of the target visual material element.

As it is the case with file names in general, path information and special characters supported or not supported by various file systems must be taken into account. The goal here is not to describe all the possibilities, but rather to recommend some best practices:

- If the path (absolute or relative) is used in the file name, it should be limited to cases when the AMF document is only used within a closed system where the rules can be clearly defined.
- Special characters or Unicode names can be used, but in general they might be a source of problems. While not forbidden, their use should be tested in the context of the desired workflow to ensure that all the tools and operating systems involved correctly support the selected convention.

A good practice however would be to stick with ASCII characters only and avoid using path-like structures in file names.

6.2.2.3. aces:sequence

The aces:sequence is similar to `aces:file`, however it is primarily designed to handle image sequences. Image sequences usually follow a file name pattern and the only difference between two files of the same sequence, is a number which indicates the file's position in the sequence. Moreover, the number is using a fixed number of digits where the unused digits are replaced with zeroes.

`aces:sequence` requires three different attributes to fully define a sequence of files:

- `idx`: a special character that the file name pattern uses to represent digits (e.g. #)
- `min`: a number that represents the first file in the sequence
- `max`: a number that represents the last file in the sequence

In other words, `min` and `max` define a range of frame numbers and they are both part of the sequence (included).

6.2.2.4. aces:uuid

The last method for connecting the AMF document to a visual material element is by using `aces:uuid`. In this particular case, the connection between the AMF document and the actual visual material element is clearly handled elsewhere and not at the file system level.

Various workflows will be described later that make use of the `aces:uuid` instead of `aces:file` or `aces:sequence`. However it's important to note that **using UUID is probably the safest method**, especially when the workflow is distributed across multiple tools, operating systems and even geographic locations.

6.3. ACES pipeline configuration

The ACES pipeline section is a list of ordered elements that define various steps of the ACES color pipeline. The pipeline is described by the aces:pipeline element. In turn, this element contains a list of sub-elements that describe the configuration of the various color processing stages that exist in the ACES color processing framework. Below is the list of sub-elements that can be found in the `aces:pipeline` element:

- `aces:pipelineInfo`
- `aces:inputTransform`
- `aces:lookTransform`
- `aces:outputTransform`

These elements must appear in this exact order.

Although these steps are described separately, this does not imply that a system has to process all pixels in a frame of visual material one step at a time. Some systems might do it while some others might need to crunch the various processing steps into a single transform, typically a 3D Lookup Table (3D LUT). Moreover a system may choose to optimize the processing of the various steps, depending on the given situation. The only constraint is that the color processing must follow the steps in the order described above.

6.3.1. aces:pipelineInfo

The `aces:pipelineInfo` element extends the set of properties found in the AMF document identification by adding an element to define the ACES system version.

The role of this element is to specify the ACES system version targeted by this AMF file in order to produce the correct output. The system version is a crucial piece of information as it allows us to achieve interoperability and archivability.

The `aces:pipelineInfo` element can (and should) be used to validate the AMF document itself. The following sections that describe the use of the input transforms, look transforms and output transforms mention the use of transform identifiers. Transform identifiers are also "tagged" with the ACES system version to ensure a match between the pipeline system version and the various transform identifiers.

The validity of transform identifiers within the scope of a given ACES system version will be described later in a dedicated section.

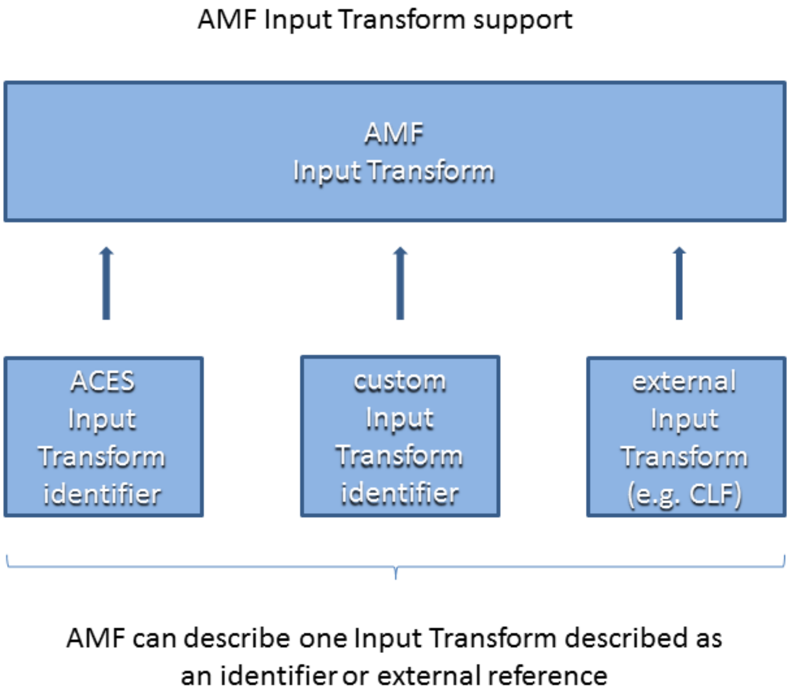
6.3.2. aces:inputTransform

This element defines the input transform that is optionally applied to the source material referenced by `aces:clipId.`

The input transforms can be either standard transforms defined within the ACES framework or custom transforms.

Custom transforms can be referenced by their transform ID or referenced as external files/resources.

Standard transforms can only be referenced by their transform ID.


AMF Input Transform support
AMF
Input Transform
ACES
Input
Transform
identifier
custom
Input
Transform
identifier
external
Input
Transform
(e.g. CLF)
AMF can describe one Input Transform described as
an identifier or external reference

An important observation must be made here: the `aces:inputTransform` is entirely optional. This implies that an AMF document can work in different environments, i.e with sources made of raw material, color pre-processed material and ACES only material. These different use cases will be discussed later in this document.

If an `aces:inputTransform` element is present, then it must also define the "applied" attribute that will allow an AMF-aware tool to know if the input transform is provided for information purposes only or if it needs to be executed.

6.3.3. aces:lookTransform

This element is repeated for every step that defines a custom color processing in the ACES color space (e.g. color grading). There are 3 kinds of look transforms:

1. Standard transforms defined within the ACES framework (such as Gamut Compression)
    - Standard transforms can only be referenced by their transform id.
2. Embedded ASC-CDL transforms
    - Embedded ASC-CDL transforms carry their parameters within the file and do not rely on any external information.
3. External transforms stored in various formats (ASC CDL XML, CLF, etc)
    - External transforms can be referenced by either a unique ID or by a file name, described later in this document.

`aces:lookTransform` elements are optional, and therefore AMF documents do not mandate any color processing beyond the processing provided by the ACES color processing framework.

If an `aces:lookTransform` element is present, then it must also define the "applied" attribute that will allow an AMF-aware tool to know if the look transform is provided for information purposes only or if it needs to be executed.

6.3.4. aces:outputTransform

Finally, this element closes the list and defines both the RRT and ODT (or a combined Output Transform) to use in order to produce a presentable result.

The RRT and ODT can be either specified independently of each other:

```
<aces:outputTransform>
     <aces:referenceRenderingTransform>

<aces:transformId>urn:ampas:aces:transformId:v1.5:RRT.a1.0.3
                </aces:transformId>
     </aces:referenceRenderingTransform>
     <aces:outputDeviceTransform>
           <aces:transformId>urn:ampas:aces:transformId:v1.5:ODT
                .Academy.P3D60_48nits.a1.0.3</aces:transformId>
```

```
    </aces:outputDeviceTransform>
</aces:outputTransform>
```

or combined

```
<aces:outputTransform>

<aces:transformId>urn:ampas:aces:transformId:v1.5:RRTODT.Academy.
          Rec2020_1000nits_15nits_ST2084.a1.1.0</aces:transformId>
</aces:outputTransform>
```

The RRT and ODT (as well as the combined versions) are standard color transforms defined within the ACES framework.

7. AMF & external LMT referencing rules

6.1 Using <aces:file>

The simplest way to reference external LMTs is to use the `aces:file` element. However, some care must be taken, depending on the workflow and also on the system or device generating the AMF document.

The `aces:file` element is defined as an XML standard type called `xs:anyURI`. This type allows a very large set of possibilities by using the Uniform Resource Identifier (URI) syntax: file access on a local or remote file system, HTTP or FTP access and much more. All of these possibilities are identified by a scheme, which is a predefined syntax to allow unambiguous interpretation of the URI. Although there are situations where this might not be possible.This document will mainly focus on the file access on computer file systems or embedded file systems (e.g. in-camera).

File access is accomplished by the use of the file:// scheme as a prefix to the file location. It is assumed that in a file system centric workflow, the omission of the file:// scheme means that the URI is the actual file name of the external resource, i.e. the LMT. This is probably the most common use.

Resolving the file location by the means of the file name may still be problematic, especially because of how various file systems identify disks or volumes. In order to simplify the file name resolution, the following rules are recommended:

1. Avoid the use absolute file names, i.e. file names that contain the full path from the root of the disk or volume

2. Avoid using external LMTs in folders that exist at a higher level in the file system hierarchy than the location of the AMF document
3. Avoid the use of "current path" and "one level up" path segments as they might not be interpreted correctly by the systems and/or devices that need to work with the AMF document and its externally referenced resources.

Example:

For an AMF file with the following location:

C:\MyAMFDocuments\myAMF.amf

The external resources, i.e. LMTs, should be located either at the same level, like this:

C:\MyAMFDocuments\myAMF.amf
C:\MyAMFDocuments\myLookTransform.clf

or in a sub-folder like this:

C:\MyAMFDocuments\myAMF.amf
C:\MyAMFDocuments\myAMFLooks\myLookTransform_First.clf
C:\MyAMFDocuments\myAMFLooks\myLookTransform_Second.clf

In addition to the recommendations listed above, it is also highly recommended to avoid deep hierarchies for the sub-folders as these can easily cause trouble when the files are moved to a file system with limitations on the file path length.

If the external resources cannot be stored in the same folder as the AMF document or in sub-folders relative to the AMF document's location, then the system/device working with the AMF document should provide some user interface means to allow the selection of the location. If automation, without user intervention, is desired, the system/device should provide a configuration file to specify the location.

6.1.1 File name characters

In modern file systems, any available character can be used in a file name, with the exception of the path control and wildcard control characters. However, just like with the file location limitations, it is highly recommended to avoid the flexibility of modern file systems and instead rely on a basic set of characters that would work transparently in an almost universal manner:

1. Consider using ASCII alpha-numeric characters only, i.e. a-z, A-Z, 0-9
2. Consider using “-“ (dash), “_” (underscore) and “.” (period) to replaces spaces and other non-printable characters

6.1.2 File name length

As stated before, modern file systems are very permissive in terms of file naming. Moreover, most systems have either no limit on the file name length or a very large limit that exceeds easily most of the use cases. Taking advantage of these file system features might not be a good practice though. These limitations differ among the file systems in use and migrating files from one file system to another might result in errors or even truncated file names.

In order to avoid problems at the file system level, consider following these rules:

1. Keep files name lengths under 128 characters, file name extension included
2. Restrict the file name extension to 3 characters
3. Use only alphabetical characters for the file name extension
4. Use the native or recommended file name extension for the external resource (e.g. CLF or clf for the Common LUT Format)

6.1.3 File naming conventions

AMF does not impose a strict file naming convention on the external resources. However it is also highly recommended that a proper and meaningful one is adopted when naming those resources.

Proper file naming conventions not only ease the inspection of the files in a file system but also can provide a better reading when displayed in the graphical user interface of the system/device used to manage them. Since these systems/devices can have a limited display room, short names should be considered.

6.1.4 Retrieving external LMTs via HTTP

The resources identified by a URI using the "http" or "https" schemes can be retrieved as the response to a GET request to the URI. When working with CLF-based LMTs, care must be taken to clearly indicate the content type in the HTTP headers. For instance AMF and CLF are XML-based specifications and HTTP allows the content type to signal XML in many different ways. Two popular ones are:

1. text/xml
2. application/xml

These should be preferred in a HTTP transaction when working with AMF and CLF.

HTTP transactions can require authentication in order to access the AMF and the LMTs. Authentication and encryption topics are outside the scope of this document. Nevertheless it's important to consider these issues in a workflow that is distributed around various locations as not all systems/devices support the HTTP security features

6.2 Using <aces:uuid>

CLF ProcessList root element shall have the id attribute set with the sameUUID, e.g:

AMF

```
<aces:uuid>urn:uuid:1258F89C-0ED7-4A79-0E2-36F97E8FF9F1</aces:uuid>
```

CLF

```
<ProcessList
xmlns="urn:AMPAS:CLF:v3.0"
id="urn:uuid:1258F89C-0ED7-4A79-B0E2-36F97E8FF9F1"
compCLFversion="3.0">
</ProcessList>
```

The CLF files can be located anywhere and the product supporting AMF+CLF must provide the configuration options to locate the CLFassets,

or,

search for the CLF files in the local folder for the corresponding CLF files•recursive search in subfolders should be supported (option)

ANNEX

A. Avid Log Exchange (ALE) support

The Avid Log Exchange (ALE) format supports custom metadata elements through the definition of dedicated columns in the ALE table. In order to support AMF linkage through ALE, the following columns are defined:

AMF_UUID
AMF_NAME

These two columns enable the linkage of AMF files, independently for every clip listed in the ALE file. Both AMF_UUID and AMF_NAME are defined as optional. The linkage rules are described below.

AMF_UUID

The AMF_UUID column shall be used to convey the AMF UUID from the amf:Info/uuid element. The format of the column entries must use the canonical textual representation, the 16 octets of a UUID are represented as 32 hexadecimal (base-16) digits, displayed in 5 groups separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 alphanumeric characters and 4 hyphens):

```
afe122be-59d3-4360-ad69-33c10108fa7a
```

The AMF_UUID column is optional.

AMF_NAME

AMF_NAME shall be used to convey the AMF file name located in the same folder as the .ale source file:

```
clip_001.amf
```

The AMF_NAME is optional. When present, it should indicate the file name of the AMF document related to the clip. The AMF file must reside locally in the same folder as the ALE file. No sub-folder structure is permitted.

While AMF files can have any name, it is recommended to follow the restrictions imposed by the ALE Specification, i.e. to use the UNC Path syntax.

Linkage Rules

Since both AMF_UUID and AMF_NAME are optional, there are four possible combinations that can occur:

AMF_UUID and AMF_NAME are both absent:

In this case, no AMF file can be associated with the clip and is treated like a regular ALE file

AMF_UUID is present and AMF_NAME is absent:

In this case the host product must look for the corresponding AMF files into a database, using the UUID as a key to match the AMF file and the corresponding clip. Please note that the word "database" does not imply any specific implementation. This feature many not be supported by the host product

AMF_UUID is absent and AMF_NAME is present:

In this case, the AMF_NAME column contains file names for AMF files that should be located at the same level in the file system (i.e. same folder) as the ALE file, or in a subfolder. The linkage is based on the file name and the UUID of the AMF files (if present) is ignored

AMF_UUID and AMF_NAME are both present:

In this case, the host product can select between the methods described in 2) and 3). **However, it is recommended to rely on the UUID in priority.** The host product can provide an option to select the matching rule (UUID or file name). It is desirable to also provide a matching rule that checks both the UUID and file name.

Remarks

Since the ALE file can reference a large number of clips, it is recommended that the host product presents the issues encountered during the linkage and validation process as a log.

ALE files can carry inline ASC parameters. When using AMF with ALEs, the inline ASC parameters should be absent to avoid confusion, or ignored if present.

AMF files can have an optional aces:clipId element that is used to identify the clip that the AMF is related to. The aces:clipId element can carry a reference using different methods (e.g. file name, UUID, etc). It is strongly recommended that the clip identification method used in AMF correlates with the method used in the ALE files (e.g. file name).

If the same AMF file is shared by multiple clips, it is recommended to avoid the use of aces:clipId or ignore it.

A validation process can log any differences and present the results to the user of the product/tool processing the ALE+AMF files

B. Edit Decision List (EDL) support

The CMX3600 Edit Decision List (EDL) format supports custom extensions through the definition of dedicated directives following the edit statements in the decision list. In order to support AMF linkage through EDL, the following directives are defined:

AMF_UUID
AMF_NAME

These two directives enable the linkage of AMF files, independently for every clip listed in the EDL file. Both AMF_UUID and AMF_NAME are defined as optional. The linkage rules are described below.

AMF_UUID

The AMF_UUID column shall be used to convey the AMF UUID from the amf:Info/uuid element. The format of the column entries must use the canonical textual representation, the 16 octets of a UUID are represented as 32 hexadecimal (base-16) digits, displayed in 5 groups separated by hyphens, in the form 8-4-4-4-12 for a total of 36 characters (32 alphanumeric characters and 4 hyphens):

```
afe122be-59d3-4360-ad69-33c10108fa7a
```

The AMF_UUID column is optional. When present, it should indicate a path to the AMF file that is relative to the folder where the ALE file is located. The path hierarchy MUST not contain the parent folder or local folder distinguished values, i.e. ".." and "." to avoid any confusion.

The path and AMF file name must use characters from the set a-z, A-Z, 0-9, - (dash), _ (underscore) and ".". No path segment shall use more than 128 characters and the total length shall not exceed 1024 characters.

AMF_NAME

AMF_NAME shall be used to convey the AMF file name located in the same folder as the .edl source file:

```
clip_001.amf
```

The AMF_NAME is optional. When present, it should indicate the file name of the AMF document related to the clip. The AMF file must reside locally in the same folder as the EDL file. No sub-folder structure is permitted.

While AMF file can have any name, it is recommended to use the same base name as the clip file that the AMF document relates to. Moreover to ensure portability across file systems and operating systems it is recommended to use characters from the set a-z, A-Z, 0-9, - (dash), _ (underscore) and ".".

The AMF file name should use no more than 1024 characters.

Linkage Rules

Since both AMF_UUID and AMF_NAME are optional, there are four possible combinations that can occur:

AMF_UUID and AMF_NAME are both absent

In this case, no AMF file can be associated with the clip

AMF_UUID is present and AMF_NAME is absent

In this case the host product must look for the corresponding AMF files into a database, using the UUID as a key to match the AMF file and the corresponding clip. Please note that the word "database" does not imply any specific implementation. This feature many not be supported by the host product

AMF_UUID is absent and AMF_NAME is present

In this case, the AMF_NAME column contains file names for AMF files that should be located at the same level in the file system (i.e. same folder) as the EDL file, or in a subfolder. The linkage is based on the file name and the UUID of the AMF files (if present) is ignored

AMF_UUID and AMF_NAME are both present

In this case, the host product can select between the methods described in 2) and 3). **However, it is recommended to rely on the UUID in priority.** The host product can provide an option to select the matching rule (UUID or file name). It is desirable to also provide a matching rule that checks both the UUID and file name.

EDL event example

```
...
010   Clip1 V C 05:40:12:18 05:40:14:09 01:00:29:16 01:00:31:07
* AMF_NAME clip_001.amf
* AMF_UUID afe122be-59d3-4360-ad69-33c10108fa7a
...
```

Remarks

Since each entry in the EDL file can use any of the combinations of AMF_UUID and AMF_NAME described above, it is recommended that the host product presents the issues encountered during the linkage and validation process as a log.

EDL files can carry inline ASC parameters. When using AMF with EDLs, the inline ASC parameters should be absent to avoid confusion, or ignored if present.

AMF files can have an optional aces:clipId element that is used to identify the clip that the AMF is related to. The aces:clipId element can carry a reference using different methods (e.g. file name, UUID, etc). It is strongly recommended that the clip identification method used in AMF correlates with the method used in the EDL files (e.g. file name).

If the same AMF file is shared by multiple clips, it is recommended to avoid the use of aces:clipId or ignore it.
A validation process can log any differences and present the results to the user of the product/tool processing the EDL+AMF files.

Bibliography

[1] S-2019-001 : ACES Metadata File (https://aces.mp/S-2019-001)