Standard

S-2019-009

ACES Clip-level Metadata File Format (ACESclip) Specification

Non-paper

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Summary: The ACES Clip-level Metadata File ("ACESclip") is a 'sidecar' XML file intended to enable communication of metadata for proper viewing of ACES footage. This document specifies use cases for ACESclip files, application support requirements, and the data model and XML tags needed for implementation.

NOTICES

Revision History

Version	Date	Description
1.0	12/19/2014	Initial Version
1.0.1	04/24/2015	Formatting and typo fixes
1.0.2	03/29/2016	Remove version number – to use modification date as UID
1.1.0	08/19/2017	New proposal for “ACESNext” pre-release project
1.1.1	05/03/2019	Walter Arrighetti introduces history (“*color pedigree*”) and clip-file bindings
1.1.2	27/03/2019	Introduction of frame-specific format elements, plus XML signing algorithms

Related Academy Documents

Document Name	Description

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1 Scope

The ACES Clip-level Metadata File ("ACESclip") is a 'sidecar' XML file intended to assist in configuring ACES viewing pipelines and to enable portability of ACES transforms in production. An ACESclip file describes the transforms necessary to configure an ACES viewing pipeline for a moving-picture image sequence (cfr. §4).

ACESclip files may be *enveloping* color transform information such as ASC CDL (`.cc`) or Common LUT Format (`.clf`) files, which would otherwise be described by *detached* XML files. Vice versa, ACESclips may also be *enveloped* by other XML components, like the Sidecar Composition Map (SCM) or the Isochronous Stream of XML Documents (ISXD) used in the Interoperable Master Format (IMF).

ACESclips are suitable archival elements. Together with the finished ACES image files, they form a complete archival record that helps in future-proofing of how image content is intended to be viewed.

ACESclip files do not contain "timeline" metadata such as edit points. Timeline management files such as an Edit Decision List (EDL) or an Avid Log Exchange file (ALE) may reference ACESclips, attaching them to editing events and thus enable standardized color management throughout all stages of production.

2 References

The following standards, specifications, articles, presentations, and texts are referenced in this text:

- Academy S-2014-002, *Academy Color Encoding System - Versioning System*
- Academy S-2014-006, *Academy-ASC Common LUT Format Specification v2.0*
- Academy TB-2014-008, *ASC CDL Application*
- SMPTE ST2065-1:2012, *Academy Color Encoding Specification (ACES)*
- SMPTE ST2065-4:2013, *ACES Image Container File Layout*
- SMPTE ST2065-5:2016, *Material Exchange Format – Mapping ACES Image Sequences into the MXF Generic Container*
- SMPTE ST2067-2:2016, *Interoperable Master Format – Core Constraints*
- SMPTE ST2067-9:2018, *Interoperable Master Format – Sidecar Composition Map*
- SMPTE RDD47:2019, *Interoperable Master Format – Isochronous Stream of XML Documents*
- SMPTE ST2067-100:2018, *Interoperable Master Format – Output Profile List*
- SMPTE RDD15:2007, *Software Scripting Language for Pixel-Based Color Transformations*
- SMPTE RDD30:2014, *ARRIRAW Image File Structure and interpretation supporting deferred demosaicing to a logarithmic encoding*
- ISO 8601:2004, *Data elements and interchange formats – Information interchange – Representation of dates and times*
- ETSI TS-103-171 v2.1.1 (2012-03), *Electronic Signatures and Infrastructures; XAdES Baseline Profile*
- W3C, *XML Signature Syntax and Processing*, version 1.1

3 Terms and Definitions

The following terms and definitions are used in this document.

3.1 Pre-grade

Preliminary color adjustment ("grade") applied after image creation; typically used for balancing exposure and color for later use in production.

3.2 Specific Data Types

This document uses generic XML data types plus a frew additional ones defined in this section (as well as in the XSD schema definition in Appendix A).

3.2.1 `dateTime`

A string representing a timestamp according to the "date-time" profile specified in RFC-3339, i.e. a "*YYYY*-*MM*-*DD*T*hh*:*mm*:*ss*[*offset*]" formatted string, where all *variable* components except [*offset*] are mandatory, and their meaning is:

- *YYYY* indicates the year (e.g. 1996, 2007, 2019, …),
- *MM* indicates the month (00 through 12),
- *DD* indicates the day (00 through 31),
- T (as a *fixed* character) separates the string into a date and a time portion,
- *hh* indicates the hour (00 through 23),
- *mm* indicates the minute (00 through 59),
- *ss* indicates the second (00 through 59),
- [*offset*] *optional* time-zone offset from UTC. It may be either Z (or none) for UTC itself, or either + or − followed by hours-and-minutes' 4-digits offset (e.g. valid values being −08:00 for PST, +00:00 for GMT, +01:00 for CEST, +04:30, and so on).

An example timestamp is thus: 2014-11-20T12:24:13-08:00.

3.2.1 clipName

General term for identifying the original source name of images or image sequences when they were created; often referenced in EDLs/ALEs. Other terms used for this purpose include clip-name, tape-name (CMX EDL format), reel-name, source media ID.

An example clip-name is A004C063 (or slight variations of it), which reads to 63rd clip from magazine №4, from camera "A".

3.2.1 transformID

String identifying either the name of an official ACES transform (according to TB-2014-12) or, more generally in the case of any color transforms encoded in a Color Transformation Language (CTL) file, the value of the TransformID statement at the beginning of the file.

By design for the official ACES transforms, and as a recommended practice for vendor- and user-generated CTL files, the filename (excluding the path ant the trailing .ctl file extension) of a CTL file should match exactly with the value of its TransformID statement, but since that cannot be enforced, a color transform may be referenced also by its transformID. When both a filename (cfr. §6.4.1, §6.4.1) and a transformID are specified, the filename declination has higher priority, whereas transformID is there to externally link a file holding a Color LUT file (or any other non-CTL color transform) to the transformID of the CTL that originally creat

Please see the ACES System Versioning Specification for more information on the format to use for TransformIDs.

3.2.2 transformHash

Unique fingerprint obtained computing the digest of an externally-referenced file by means of SHA-1 hash function (cfr. RFC-3174) and represented as a lowercase hexadecimal string. When specified alone (without a transformID element, cfr. §3.4.1) it just matches with either:

- the value of the optional TransformHash field of a CTL file,
- the value of the optional transformHash element of a CLF file,

the latter being the SHA-1 digest of the whole, externally-referenced file. When referencing CTL files, referral by transformID alone is preferred.

3.2.1 frameSize

Rectangular frame specification where four corner points within source footage raster are pinpointed by specifying a 4-tuple of whitespace-separated, integer-number, 0-based coordinates like "*a b c d*", where

each of `a`, `b`, `c` and `d` numbers can be either positive, `0` or negative and stands for top-left, top-right, bottom-left and bottom-right coordinates, starting from topmost-leftmost point. Negative value(s) indicate progression in the (out-of-frame) opposite direction(s).

4 Use Cases for ACESclip Files

Moving-picture image files are formed at several stages of production:

- on-set from digital motion picture cameras, on-set dailies systems and on-set look management systems
- from film scanners and telecines,
- within visual effects and animation (i.e. computer graphics, CG) departments,
- across post-production departments – mostly in editorial, color-grading, finishing and mastering.

They can be stored in essentially two ways. The former is a "videoclip" representing the ordered sequence of frames in a single file. The latter is a "frame-sequence", i.e. a sequence of multiple files, locally-referenced within the same filesystem directory and sharing a common file format, the same file extension and base of filename. Frames in a frame-sequence are distinguished from one another via an incremental number in the last part of their filenames, where every file stores a single video frame and progressively contiguous files in the ordered sequence represent consecutive frames in the virtual timeline of the corresponding moving picture.

An *ACES image* [*sequence*] is an image [frame-sequence] that has been either generated as, or converted into the ACES Image Container format SMPTE ST2065-4 (a.k.a. "*ACES EXR*"). An *ACES video*, instead, is an ACES image sequence that is wrapped into the MXF Generic Container format SMPTE ST2065-5 (a.k.a. "*ACES MXF*").

Video content does not need to be encoded as either ACES image sequences or ACES videos to be ACES color-managed; it may be encoded in camera-native or other file formats, as long as there is an associated ACES Input Transform ("IDT") so that it may be displayed using an ACES viewing pipeline.

4.1 Camera Image Sequences

Image file sequences generated by a digital motion picture camera and recorded by a digital recorder are generally written in one of two ways:

- as a collection of individual image files to a file directory, generally one directory for each shot or take
- as packaged sequence files using wrappers such as MXF, with one or more sequence files per file directory

An ACESclip file is generated on-set for each collection of individual image files or packaged sequence. Each ACESclip file contains metadata that describes the essential ACES transforms required to properly configure the ACES viewing pipeline for the image files it references:

- The IDT used to convert camera-native image files to ACES2065-1 encoding
- If a Look Management System was used, the ASC-CDL values used for that sequence and the ACES Output Transform used to view the referenced sequence
- The LMT or LMTs for that sequence, if used

ACESclip files are located in the same file directory as the image file collections or sequences that they describe, and they are associated with image file collections or sequences via matched filenames, e.g., `ACESclip.MySequence.xml` is associated with `MySequence001.dpx` through `MySequence.100.dpx`, where the numbers `001` and `100` are the range of frame counts for a 100-frame sequence.

Multiple ACESclip files, image collections and sequences in a single directory are possible by using this associative file naming approach.

Recommendations on naming conventions are outside of the scope of this document. ALE and EDL files generated on-set may reference ACESclip files as an additional method of association.

4.2 Visual Effects and Animation

ACESclip files for image sequences generated by using computerized tools are handled in the same manner as for sequences generated on-set: an ACESclip file is created for each image sequence and populated with the required metadata that describes how that sequence was viewed when it was created. This enables transmission of viewing pipeline information to a subsequent artist or facility so the image sequence may be viewed correctly.

For delivery of ACES image sequences to visual effects and 3D conversion facilities, it is recommended that image sequences be split into individual shots, and that a single ACESclip be present for each shot.

4.3 Post-production

ACES image sequences that arrive at the DI suite with an ACESclip file have all of the information necessary for an ACES-compatible color correction system to automatically configure itself to correctly display the sequence.

4.4 Editorial

Individual ACESclip files may be referred to in an EDL note field to enable application of different LMTs to different parts of an edited sequence. For this reason, it is possible that more than one ACESclip file may be in a directory.

4.5 Production Color Management

The color transforms created in a production may be transferred between users and departments using the ACESclip file together with LUTs in the CLF format, and/or with ASC CDL metadata.

4.6 Clip and Archive Management

ACESclip files that incorporate a ClipID to reference an image sequence are easily re-attached to their image files should they become separated (it is common for related files to become accidentally separated during production). Using the ClipID throughout production also provides additional and useful information to archivists about originating source media.

5 Application and Use of ACESclip Files

5.1 Filename and Correspondence with Images

Transforms are identified with the CTL reference transform filename as defined in the ACES System Versioning Specification. Linking of the metadata about a transform to an actual instance of a transform is supported using ACES TransformIDs and XML id attributes.

ACESclips are named using the format “production naming convention.ACESclip.xml”. The production naming convention may be used to associate an ACESclip file with an image sequence, but this document does not specify an exact file naming convention.

5.2 Saving State of IDT Conversion and Initial Grade

Applications record the IDT used for converting camera-native data to ACES encodings, and include any pre-grade ASC CDL values that were used for the image sequences referenced by an ACESclip file.

5.3 Conversion of Camera Files Using IDTs and Pre-grades

For images not yet in the ACES file format, applications use the metadata for the IDT and ASC CDL pregrade to view images using the ACES viewing pipeline. For images already in the ACES file format, the IDT conversion may be ignored, and only the pre-grade is applied prior to the ACES viewing pipeline.

5.4 Default Configuration of ACES Viewing Pipeline

ACES content must be viewed as intended at any stage of production. Specific viewing pipelines may

require different elements, so the exact viewing configuration used by a user making creative decisions must be recorded prior to shipment to another user. The ACES image sequence shall be displayed in an application with this "last used" viewing configuration, but a user may override the configured settings.

The `aces:Config` XML tag is used to set the viewing pipeline to match the viewing conditions recorded in the ACESclip file. The ODT for the current viewing display may be used instead of the `aces:Config` ODT, but the user should be warned if they are not of the same class of display, e.g. Rec.709 used previously and an HDR display is the current display.

5.5 User Management of the Viewing Pipeline

Users may override an applications ACES viewing pipeline at any time. Applications must manage the conversion between various ACES-compatible images and the user-selected working spaces.

When ASC CDL metadata is used, conversions to and from the ACEScc working space are saved in the `aces:Config` metadata (wherein those particular CDL values must be applied).

5.6 Saving the State of the ACES Viewing Pipeline

The last state of the ACES Viewing Pipeline used to view an image sequence referenced by an ACESclip file must be recorded in the ACESclip file when a clip is closed or exported unless the user overrides this and does not want the clip to be changed.

5.7 Creating an Archive Metadata Link

When an ACES image sequence is created, placing identification traceable to source media in the `aces:clipID` field is recommended.

5.8 Reading and Writing LMTs

The `aces:TransformLibrary` XML element is used to transfer the actual transforms for LMTs to other users and facilities since these often may be custom LUTs. Applications shall read and write the XML structures containing CLF files. An LMT combined with an RRT and ODT can be provided as well as a transform that simply contains the LMT. A stand-alone LMT must be merged with the other transforms in the basic ACES viewing pipeline for a user to look at the image.

5.9 Reading and Writing ACESclip Files

Applications shall support reading and writing of all XML elements described in this document. Recognition of extensions to the ACESclip specification developed by third parties is optional. However, if extensions are present, applications shall preserve them without change.

The ACESclip file may contain any one or all of the top-level XML structures (`aces:clipID`, `aces:Config`, `aces:TransformLibrary`). For any particular XML file, these are listed as optional. However, production requirements determine which structures must be present in an ACESclip file.

6 Data Model

This section describes the data intended for use within the ACES Clip-level Metadata file.

`{string}` are XML attributes

All top level structures shall be tagged as being within the `aces` namespace.

The format of the data in this section represents pseudo-code rather than the XML schema. Indentation of the Tags indicates they are sub-elements of the XML structure just above in indentation.

Here and throughout §6, the use of * after "Required" statement in the summary table of XML elements below means that the prescription for the presence of a specific XML element is a requirement for all the appliances capable of generating one. The element is instead amended and becomes "Optional" only for appliances without the relevant capability, which includes factors like low computational power, the lack of

a synchronized clock or absolute time reference, lack of a multi-user operating system or a TCP/IP stack, etc. Such factors are all, for example, common to ACES-compatible devices like most LUT boxes and some models of cameras and monitors.

6.1 UML Diagram

XXXXX

6.2 Header elements (`acesClip` element)

Description:	Namespace tag for a whole ACESclip	
Prescription:	Required	
Occurrence:	*Min:* 1 *Max:* 1	
Type:	`xs:complexType`	
	Restrictions:	
Relationships:	*Parent(s):*	None
	Children:	`<uuid>`, `<creationDateTime>`, `<modificationDateTime>`, `<acesVersion>`, `<info>`, `<clipID>`, `<acesPipeline>`, `<transformsLibrary>`, `<history>`,
Attributes:	*Required:*	`version`
	Optional:	`xmlns:*` , `xsi:*`

The `acesClip` element is the main container for one ACESclip and it is also its *namespace*, in case ACESclip is to be embedded into, or used as an extension of another XML data structure. It may have XML *namespace* attributes.

Example use-cases for the latter can be found in several components of Interoperable Master Format (IMF) packages, like the SCM (Sidecar Composition Map, cfr. ST2067-9) and either a static XML document (cfr, RDD47) or the individual components of an ISXD (Isochronous Stream of XML Documents, cfr. RDD47).

6.2.1 `creationDateTime` element

Description:	Creation date and time of an ACESclip	
Prescription:	Required*	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:dateTime`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Applications having a clock or other time reference shall use a timestamp when creating a new ACESclip. Applications supporting time-zoning shall use indicate it explicitly in the timestamp as time offset. This element shall not be modified or removed, nor it can be generated at a later time, if not originally present.

6.2.2 `modificationDateTime` element

Description:	Modification date and time of an ACESclip	
Prescription:	Required*	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:dateTime`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`, `<clipID>`
	Children:	None
Attributes:	*Required:*	None

	Optional:	None

Applications having a clock or other time reference shall use a timestamp in the `acesClip` element when modifying an existing ACESclip. Upon generation of a new ACESclip, this timestamp also matches with the one of the `creationDateTime` sibling.

6.2.3 `acesVersion` element

Description:	ACES version number	
Prescription:	Required	
Occurrence:	*Min:* 1 *Max:* 1	
Type:		
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>*`
	Children:	None
Attributes:	*Required:*	`major`, `minor`
	Optional:	`patch`

The major, minor and (optionally) patch version of ACES used shall be used in the `acesVersion` child of the `acesClip` element.

In case *color pedigree* functionality is used and an ACESclip is changed by an application using a different ACES version, the new version is specified in the `acesVersion` child to `acesClip` element, whereas the ACES version of the old ACESclip content is specified by the creation, inside the `acesVersion` child to `history` element, of an `acesVersion` child to the `revision` element where the old ACESclip information are stored.

6.2.4 `sysInfo` element

This element wraps information about the IT system that generated either the most recent ACESclip version (`acesClip` parent), or any previous revisions of it (`revision` parent). In either case, its content is described further in §6.6.1.

6.2.5 `info` element

This element wraps mostly user-generated comments and notes about either the present configuration of the ACESclip (`acesClip` parent), or any previous revisions of it (`revision` parent). In either case, its content is described further in §6.6.1.

6.3 Footage and Filesystem referral (`clipID` element)

Description:	Logical bond between ACESclip and imaging files	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`
	Children:	`<file>`, `<sequence>`, `<Id>`, `<modificationDateTime>`, `<clipName>`, `<metadata>`
Attributes:	*Required:*	None
	Optional:	None

Whenever an ACESclip is to be referenced to a specific picture or video content represented in footage file(s), the `clipID` element is used to describe such link. Each `clipID` element shall contain one child among `file`, `sequence` or `Id`.

6.3.1 Filesystem and path considerations

Within the ACESclip context, four path types are considered as relates to the logical binding between files referenced in ACESclips (*both* content files as related to the rest of §6.3, as well as color-transform files discussed in §6.4) and the actual filesystem. Of the following four path categories, the former three are

system-dependent (i.e. they may vary on a huge number of reasons like show, facility, infrastructure, workflow, hardware, applications, storage, etc.) and, therefore, should never be explicitly written in the text of ACESclip elements, as the systems may reference them.

1. **Content bin** is a set of paths which applications, according to their local and/or workflow-specific configurations, are set to look into for content files specific to that show and/or workflow. Examples are the shared media-content filesystems (SAN, NAS, direct-attached storage, etc.), as well as other folders (e.g. "`Avid MediaFiles`" folders or any paths defined as "bins" within different applications).
2. **Metadata bin** is a set of paths which applications, according to their local and/or workflow-specific configurations, are set to look for metadata and other sidecar files specific. These paths may be either workflow and applications dependent. Examples are media-content paths where ACESclip XML files, or color-transform files (OCIO configurations, custom ColorLUTs including CLFs and CTLs) are located. Some applications may or may not fallback looking files from these folders when relevant files are not found in paths from Content Bin.
3. **System bin** is set of paths which each specific application, according to their facility-wide, general, or factory-default settings, is set to look into for specific configuration files. Examples are the folders where default color-transforms (application defaults or Academy's officially released ACES color transforms – either in CTL or other formats) are stored. These paths may or may not be the fallback when relevant files are not found in paths from the former two categories.
4. **Specific path**(s) are relative paths that may be included in the text of a `file` and `sequence` elements.

ACESclip files should be sidecar files to the content, therefore each ACESclip XML file should be generated, transported, copied and archived in the same filesystem folder where the content it refers to is stored. However, this is not always possible due to a series of reasons, like:

Another case is when the file may be technically stored in the folder as with the content, but applications may still ignore them due to other system constrain (e.g. a MAM system that processes a limited number of non-ACES file formats, ignoring any other file extensions). When this is not possible or optimal, ACESclip files may be moved or copied in other folders (belonging to the metadata bin category), whence they should be processed in an aggregated fashion.

`format` value	File/container format, or package/folder file-structure
`ari`	Arri ARRIRAW image (as per SMPTE RDD30)
`cin`	Kodak® Cineon™ image
`braw`	Blackmagic RAW video
`dng`	Adobe® DNG *or* CinemaDNG™ image
`dpx`	DPX image (as per SMPTE ST268)
`exr`	OpenEXR image
`IMF`	IMF package (as per SMPTE ST 2067)
`jpeg`	JPEG image (as per ISO/IEC 32000)
`mxf`	MXF video (as per SMPTE ST377)
`mp4`	MPEG-4 Part-10 video (as per ISO/IEC 14496)
`mov`	Apple QuickTime video
`png`	PNG image (as per ISO/IEC 15948)
`R3D`	RED® REDCODE™ video
`tiff`	TIFF™ image (as per ISO/IEC 12234)
`3dl`	Autodesk® *Flame*®/*Lustre*® 3D LUT format

`clf`	CommonLUT Format (as per S-2014-006)
`clipster`	R&S *CLIPSTER*® 3D LUT format (`.xml` extension)
`cms`	Digital Vision Color Management System
`ctl`	Color Tranform Language
`ctf`	Autodesk® Color Transform File
`cub`	FilmLight® 33D LUT format
`cube_iridas`	IRIDAS® 3D LUT format
`cube_nuke`	Foundry® 3D LUT format
`dctl`	Blackmagic Design® 3D LUT file format

Table 1 – File formats for ACESclip-referenced files: content clips (upper section); color-tranforms and ColorLUT files (lower section).

The technical mechanism by which the file-format of filesystem objects specified in `file` and `sequence` elements is detected is completely application dependent. However, in case either the application employs association by file extension only, and the referenced filenames have non-standard file extensions, the optional `format` attribute may be used, whose possible values are listed in Table 1; the values match with the default file extension associated to each format, whenever possible.

Elements `file` and `sequence` should not contain any path in their texts but, if they do, those paths logically belong to category 4 (Specific paths) and should be relative paths. Applications looking for such pathnames should first separate the relative path (if present) from the basename, then look the corresponding file among paths the following precedence order as relates to the path categories.

1. **content bin** (if it is content clip which the ACESclip references to by means of a `clipID` element);
2. **metadata bin** (if it is a color transform which the ACESclip references to by means of a `colorPipeline` or `transform` element, or);
3. **system bin** (if it is any file that was not found in any paths from either of the above categories);
4. if the file is referenced in the ACESclip as a pathname and the file alone (without its path) was not found in any two of the above categories (1 and 3 for content, 2 and 3 for color-transforms), then the path is "reattached" to the file and the application may run path conversion or transversal to retrieve the full pathname.

Only after the relevant files have not been not found in any of the above path categories, the application may return a "file not found" / "broken link" error.

Pathnames, if present, conform to UNIX-style convention, i.e. forward-slash '`/`' is used as directory separator and pathnames are case-sensitive. If transitioning to a case-insensitive system the original case as specified in the `file` and `sequence` element is preserved (no uppercasing/lowercasing is applied). This helps in case the files are later processed again in the original case-sensitive filesystems. Pathnames generated on Windows may contain uppercase volume letters (e.g. starting with `L:/`) and UNC paths (e.g. starting with `{\\` and ending with `}`).

The opportunity for including path substitution alternatives (e.g. a `<path key="origPath">alternatePath</path>` syntax) may be considered, although this might be a little bit too system-dependent and out of scope of the ACESclip document.

6.3.2 `file` element

Description:	Filename of a single file reference	
Prescription:	Required (unless `sequence` or `Id` sibling present)	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	Absolute/relative paths should

		be avoided.
Relationships:	*Parent(s):*	`<clipID>`, `<idt>`, `<lmt>`, `<rrt>`, `<odt>`, `<transform>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	`format`

This element specifies the filename of *either* the clip which ACESclip is a sidecar file to (if child to `clipID` element), *or* the file describing a specific ACES color transformation (if grand-child to a `colorPipeline` element). In case it is the ASESclip file was referenced from the content in the same path, the specific content shall be already known to applications processing its ACESclip. In any other cases, the content should be looked for in a series of possibly multiple paths, according to the following precedence order (cfr. §6.3.1):

1. any paths in the Content Bin;
2. local path specified as pathname in the text of this very element.

In case the file format of the file is relevant, the optional attribute `format` may be used to include the file format abbreviation, as per Table 1. Example of relevant case is when the file is actually a container format wrapping one or several essences, each with its own encoding, in which case the `format` attribute specified the encoding used for the video essence, among those specified in Table 1. In case the file belongs to a file format specified in Table 1 and its filename extension is not among those specified in the same table for it, the `format` attribute should be present.

6.3.3 `sequence` element

Description:	Sequence of files (file-per-frame) reference	
Prescription:	Required (unless `file` or `Id` sibling present)	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
	Restrictions:	Absolute/relative paths should be avoided.
Relationships:	*Parent(s):*	`<clipID>`
	Children:	None
Attributes:	*Required:*	`idx`
	Optional:	`format`, `min`, `max`

This element specifies the file sequence of the clip which ACESclip is a sidecar file to. The single character used as a "placeholder", within the `sequence` text, for each digit of the file number is given by the `idx` attribute. By default, it shall be the sharp character '`#`'; however, in case this is used at least once in the rest of the pathname string, any other 7-bits ASCII character may be used, as long as it is neither alphanumeric, nor whitespace, with preference given to characters in the string "`#@$%!£`".

The minimum and maximum file-numbers which the ACESclip refers to within the sequence may be specified by means of `min` and `max` attributes which, in this case, shall be both used. Example: `<seq idx="#" min="1" max="32496">A001C012_######.exr</seq>` to refer to a sequence of OpenEXR frames ranging from `A001C012_000000.exr` to `A001C012_032496.exr`.

The files in a file sequence are always looked according to an order of precedence of paths identical as to those of the `file` element (also cfr. §6.3.1).

In case the file format of the frame sequence is relevant, the optional attribute `format` may be used to include the file format abbreviation, as per Table 1. In case the frame sequence belongs to a file format specified in Table 1 and its filename extension is not among those specified in the same table for it, the `format` attribute should be present.

6.3.4 `Id` element

Description:	Text of the description
Prescription:	Required (unless `file` or `sequence` sibling)

Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	`urn:uuid:[0-9a-f](8)-[0-9a-f](4)-[0-9a-f](4)-[0-9a-f](4)-[0-9a-f](12)`
Relationships:	*Parent(s):*	`<clipID>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

This element specifies the URN UUID of a particular asset in an IMF package (IMP). The UUID shall be defined in *either* the Packing List (PKL, cfr. ST2067-2) *and* the Composition Playlist (CPL, cfr. ST2067-3) components of the IMP.

It is particularly useful when the ACESclip is itself embedded into some components of the same referenced IMP (either original-version or supplemental), like:

- Sidecar Composition Map (SCM, cfr. ST2067-9)
- Isochronous Stream of XML Documents (ISXD, cfr. RDD47)
- Output Profile List (OPL, cfr. ST2067-100).

6.3.5 `modificationDateTime` element

This element relates to the last-modification timestamp of the clip which the ACESclip is a sidecar file to. In case of file sequences (cfr. §6.3.1) either the most recent date among all the files in the sequence, or the date of the highest-numbered file should be used.

6.3.6 `clipName` element

Description:	Clip-name as stored in the clip's internal metadata	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<clipID>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	`format`

Binding to a clip may exploit a production-based name like clip-name, tape-name, clip-ID, or other sort of unique ID. This document lists in Table 1 a limited set of image/video file formats for which one particular metadata supported in each specific format's file header may be referenced by ACESclip as primary internal metadata. When this field is used to reference the clip's unique ID, the `clipName` element is used to logically bind with it. The file format may be inferred from either the file extension (from `file` or `sequence` siblings), or assumed to be MXF file format in case of IMF essence referencing (from `Id` sibling); otherwise, it can be explicated as file-extension string in the `format` attribute (e.g. `exr`, `dng`, `dpx`, `tiff`, `ari`, `R3D`, …).

Example: `<clipName>A001C012</clipName>`.

6.3.7 `metadata` element

Description:	Clip-name as stored in a particular clip metadata	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 32	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<clipID>`
	Children:	None
Attributes:	*Required:*	`key`
	Optional:	None

As per §6.3.4, binding to a clip may exploit a production-based name like clip-name, tape-name, clip-ID, or

other sort of unique ID. In case the clip's file format supports "named" [pre-ordered] metadata, the `key` (string) attribute shall contain the metadata's name [0-based order number] within the file header, whereas the text of the element shall represent the metadata's value.

In case the clip is stored as a frame sequence and the associated metadata is expected to change from frame to frame within the sequence (e.g. TimeCode, KeyKode™, absolute frame number, etc.), the text value of this element shall refer to the one stored in the first frame of the sequence which, in the following order, is either the frame specified in the optional `min` attribute of the `sequence` sibling element, or the file with least index as currently found in the filesystem.

Example: `<metadata key="interim.clip.cameraClipName">A001C012</metadata>`.

6.4 Current Color Pipeline (`acesPipeline` element)

Description:	Description of end-to-end ACES color pipeline	
Prescription:	Required	
Occurrence:	*Min:* 1 *Max:* 32	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`
	Children:	`<idt>`, `<lmt>`, `<rrt>`, `<odt>`, `<inputFrame>`,`<outputFrame>`
Attributes:	*Required:*	None
	Optional:	`name`

This element specifies an ACES color pipeline, as per TB-2014-13, which is "current" if child of `acesClip` element, or part of the historic color-pedigree if child of a `revision` element (inside the `history` element, cfr. §6.6).

A color pipeline is composed by:

- one optional ACES Input Transform (0 or 1 `<idt>` child);
- one or multiple optional Look Modification Transforms (0 or more `<lmt>` children);
- one optional ACES Output Transform, which means
  - one optional Reference Rendering Transform (0 or 1 `<rrt>` child),
  - in case there is a RRT as per above, one ACES Output Transform (1 `<odt>` child).

ACESclip may have more than one pipeline, each of which shall be identified by a string in the `name` attribute, which shall be either an alphanumeric string (no whitespaces or symbols), or a UUID (cfr. RFC-4122).

ACES color pipeline names within the same ACESclip may be reused but only across different parent elements. The color-pipelines under the same parent (either `acesClip` or `revision`) shall have different names.

Modifications to a single color-pipeline ACESclip whose result implies the creation of additional color pipeline(s) to the same ACESclip shall have a means to generate a value for the `name` attribute of the original color-pipeline as well.

6.4.1 `transformID` element

Description:	Name of a CTL or CTL-derived color transform	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	cfr. §6.4.3 for co-existence with `<transformHash>`, `<file>`.
Relationships:	*Parent(s):*	`<idt>`, `<lmt>`, `<rrt>`, `<odt>`, `<transform>`
	Children:	None
Attributes:	*Required:*	None

	Optional:	None

Each element of an ACES color pipeline can defined by a color transform; in case the color transform is a CTL file (or a ColorLUT derived from a CTL file, cfr. §6.4.1) the value of the CTL `TransformID` field is specified here.

The `transformHash` and `file` siblings may also be specified. When `file` sibling is not present, the application shall search for color transforms whose name matches with the text of the `transformID` element. This shall include (and first of all be matched with) color-transforms that may not be supported by ColorLUTs or individual files, like those hard-wired within the application or in its SDK. In such a case, though, only transforms realizing exactly ACES component names, or acting as variations of them (as per TB-2014-012) shall be matched; the applications shall internally match ACES component names with their own naming convention and ensure no ambiguity is left.

In case `transformHash` is also present, `transformID` is used to match with a color-transform's name (e.g. a CTL filename) and, in this case, `transformID` and `transformHash` shall match, otherwise a mismatch error shall be returned. This is exactly the reason why UUID/hashing mechanism may be introduced in color-transform files: to prevent a color pipeline to be broken when applications or unaware users rename color-transforms in an uncontrolled way.

In case of a CTL-originated file (e.g. a ColorLUT generated from a CTL file), it may be used together with `file` sibling to store in the color-pipeline where the ColorLUT is expected to be originating from. In case of any other file (e.g. a ColorLUT not derived from a CTL, a CDL, …) it shall not be used.

6.4.2 `transformHash` element

Description:	Text of the description	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	cfr. §6.4.3 for co-existence with `<transformHash>`, `<file>`.
Relationships:	*Parent(s):*	`<idt>`, `<lmt>`, `<rrt>`, `<odt>`, `<transform>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Each element of an ACES color pipeline can defined by a color transform; in case the referenced color transform is either a CTL or CLF file (or any ColorLUTs derived from them, cfr. §6.4.1) the value of either the CTL's `TransformHash` field or the text of a `<TransformHash>` element in the CLF are respectively matching with this element.

The `transformID` and `file` siblings may also be specified. When `file` sibling is not present, color-transform files whole file-formats support optional UUID metadata fields (like CTL and CLF) are looked for a match with the text of this `transformHeader` element. These color-transform files are searched for in the path categories specified (as per §6.3.1) below in precedence order:

1. the path where the content referenced by the ACESclip file is stored;
2. any paths in the Metadata Bin;
3. any paths in the Systems Bin;

In case `transformID` is also present, `transformID` is used to match with a color-transform's name (e.g. a CTL filename) and, in this case, `transformID` and `transformHash` shall match, otherwise a mismatch error shall be returned. This is exactly the reason why UUID/hashing mechanism may be introduced in color-transform files: to prevent a color pipeline to be broken when applications or unaware users rename color-transforms in an uncontrolled way.

6.4.3 `file` element

As in §6.3.2, this element specifies the filename of the file describing a specific ACES color

transformation. Please also refer to §6.4.1 and §6.4.2. The color-transform shall be parsed from a file specified by the former element. The file will be searched for in the path categories specified (as per §6.3.1) below in precedence order:

1. the path where the content referenced by the ACESclip file is stored;
2. any paths in the Metadata Bin;
3. any paths in the Systems Bin;

Only if no matching is found in the above paths, an exception –either terminating or non-terminating, at application's discretion– may be returned.

When `file` plus either `transformID` and `transformHash` siblings are present the color-transform match by filenames has precedence. For every matched file, in case its format allows a transform name or a UUID/digest, its presence shall matched with texts in either `transformID` and `transformHash`, the application may look for other color-transform files that match with both filename and either name (against `transformID`) and UUID/digest (against `transformHash`). Only in case none of the above matches, a mismatch error will be returned, and this should be terminating.

6.4.4 `param` element

Description:	Parametric specification of an ACES color transform	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<idt>`, `<odt>`
	Children:	`<name>`,`<uuid>`,`<version>`, `<colorspace>`, `<gamma>`,…
Attributes:	*Required:*	None
	Optional:	None

This element is used when a color-transform is referred to as parametric

This is useful to describe settings of a parametric Input (IDT) or Output Device Transform (ODT). The parametric transform may be referred via either its

- `name`, in case of an Academy-provided parametric transforms),
- `uuid`, in case the applications have a maintained database of SDKs or APIs liked to several transforms (indexed by their UUD).

Parameters are specified each via a child element, which depend on the individual parametric transforms. Example child elements may include `version` (version of the transform-implementing SDK or API), `colorspace` (name of input/output color space), `gamma`, `iso`, `temp` (correlated color temperature), etc.

As a general rule, whenever there is more than one element among `transformID`, `transformHash` and `file`, the following preferential behavior is honored:

4. when `file` is present, the color transform is only referenced from a file with that name (either in the same folder as the ACESclip file,

6.4.5 `idt` element

Description:	ACES Input Transform (acr. of Input Device Transform)	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	`<file>`, `<transformID>`, `<transformHash>`, `<param>`
Attributes:	*Required:*	None

	Optional:	None

Specifies the ACES Input Transform (IDT) to use in the color-pipeline. ACES footage which is generated from within an ACES color-managed pipeline (e.g. CG elements) may not need and IDT specification. Inverse ODTs are considered IDTs and shall, therefore, be defined here.

Whatever colorimetry is implied at the ingress of an IDT (cfr. P-2013-001), the egress colorimetry of it shall be ACES2065-1, as per TB-2014-004.

6.4.6 `lmt` element

Description:	ACES Look Modification Transform	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	
Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	`<file>`, `<transformID>`, `<transformHash>`,`<param>`, `<asc-cdl>`, …
Attributes:	*Required:*	None
	Optional:	`pos`, `source`, `target`

Specifies an ACES Look Modification Transform (LMT), as per TB-2014-10. In case the ACES color-pipeline has one LMT the `pos` element should not be present and, if present, its value shall be `"1"`. If the color-pipeline has more than one LMTs, they form an "LMT stack", where the 'lowest' in the stack is to be applied first to the underlying footage. In this case, all the `lmt` elements shall have one `pos` attribute, each valued with consecutive integer numbers, starting upwards from `1` for the lowest LMT in the stack.

In addition to children elements admissible in all other ACES color-pipeline components, the LMT also allows ASC CDL by means of child `asc-cdl` element (whose XML rules and *namespace* are defined in TB-2014-008).

Source LMT color space	Target LMT color space
`ACES2065-1`	`ACES2065-1`
`ACEScg`	`ACEScg`
`ACEScc`	`ACEScc`
`ACEScct`	`ACEScct`
`ADX`	`ADX`

Table 2 – String values for `source` and `target` attributes of `<lmt>` element, cfr. §6.4.6.

The ingress and egress colorimetries of each LMT shall, by default, be ACES2065-1, as per TB-2014-004, unless specified via either `source` and `target` attributes respectively, which shall be valued as strings among those in Table 2. Both attributes also honor the default (trivial) value `ACES2065-1`. When the ingress [egress] LMT color space is different from ACES2065-1 any ACESclip processor shall apply an implicit, reversible ACES color-space conversion before [after] the color transform specified inside the `lmt` element is applied.

6.4.7 `rrt` element

Description:	ACES Reference Rendering Transform	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	

Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	`<file>`, `<transformID>`, `<transformHash>`
Attributes:	*Required:*	None
	Optional:	None

Specifies a Reference Rendering Transform (RRT). Ingress colorimetry of a RRT shall be ACES2065-1, as per TB-2014-004, whereas the egress colorimetry matches an output-referred colorimetry that shall be used as common ingress to any ODTs. If the `rrt` element is present, one `odt` sibling element shall be present as well.

6.4.8 `odt` element

Description:	Output Device Transform (ODT)	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
	Restrictions:	Required if sibling `<rrt>` exists
Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	`<file>`, `<transformID>`, `<transformHash>`,`<param>`
Attributes:	*Required:*	None
	Optional:	None

Specifies an Output Device Transform (ODT) which, together with the preceding RRT component, makes up an ACES Output Transform. It shall exist if a `rrt` sibling element exists.

Borderline cases of footage that is stored or transported without, or before that any pre-set specific viewing pipeline or environment is defined may be associated to an ACES color pipeline without any ACES Output Transforms specified (therefore `rrt` and `odt` elements shall not be present). An example of this shall be an archival system directly connected to camera output or magazines, working right after picture acquisition/recording and before (or independently) of stored footage having been actually viewed.

6.4.1 `inputFrame` element

Description:	Input frame format	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:frameFormat`	
Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Specifies an active area to extract meaningful rectangular area from the linked footage. This is useful when source frame format includes a safety area for VFX and tracking operations, versus the camera's native shooting frame format.

6.4.1 `odt` element

Description:	Output frame format	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:frameFormat`	
Relationships:	*Parent(s):*	`<acesPipeline>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Specifies an active area corresponding to the output-device or projection/screening raster format.

6.5 Library of Transforms (`transformsLibrary` element)

Description:	Once-only collection of all used color-transforms	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`
	Children:	`<transform>`
Attributes:	*Required:*	None
	Optional:	None

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6.5.1 `transform` element

Description:	Container for a single color-transform	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
	Restrictions:	
Relationships:	*Parent(s):*	`<transformsLibrary>`
	Children:	
Attributes:	*Required:*	None
	Optional:	None

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6.6 Historic and Forensic Information (`history` element)

Description:	*Color-pedigree* of past ACESclip configurations	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`
	Children:	`<revision>`
Attributes:	*Required:*	None
	Optional:	None

This element should not be created when an ACESclip is first generated related to content that his not already associated to an ACEScli. Applications that have the capabilities to process a *color-pedigree* shall create this element when, as a consequence of processing some content with an already existing ACESclip, the content of the later is changed (from an ‘older’ to a ‘newer’ revision). In such a case, if no `<history>` element exists, it shall be created.

Applications don’t supporting *color-pedigree* functions shall not create `<history>` elements but, when processing ACESclip files that already have one, leave its XML content unchanged, preserving it across the ACESclip updates.

During such a modification, the whole content of the `<acesClip>` element from the older revision is moved into a newly created `<revision>` child element to `<history>`, whereas the new version of the ACESclip shall be placed inside the `<acesClip>` element.

6.6.1 `revision` element

Description:	Individual past revision of the ACESclip	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<history>`

	Children:	`<revision>`
Attributes:	*Required:*	None
	Optional:	`Compression`

Applications that support *color-pedigree* functionalities shall process the versioning of ACESclip during an modification of its from an older to a newer revision by moving the whole content of the `<acesClip>` element from the older revision into a newly created `<revision>` child element to `<history>`, whereas the new version of the ACESclip shall be placed inside the `<acesClip>` element.

6.6.1 `modificationDateTime` element

This item works as in §6.2.3 and keeps the

6.6.1 `sysInfo` element

Description:	IT configuration that generated/edited the ACESclip	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`
	Children:	`<OS>`, `<vendor>`, `<model>`, `<hostname>`, `<reserved>`, `<upTime>`, `<username>`, `<application>`, `<uuid>`
Attributes:	*Required:*	None
	Optional:	`type`

This element is a container for automatically-gathered information from the hardware and/or software system that either generated or edited the ACESclip. Devices with the capability of exporting such information into ACESclip's shall populate such element tree.

6.6.2 `uuid` element

In case the hardware, firmware or os of the device has its own UUID (and can export it into an ACESclip), this is the element where it is stored as text. Cfr. §6.2.1 for any other usage of this element.

This element writes

6.6.3 `OS` element

Description:	Operating system information	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<sysInfo>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	`version`, `vendor`, `family`, `arch`,

Either the operating system '`uname`' string (or an equivalent of it), or the firmware name fill the text for this element, for those system having a firmware/OS and capable of exporting its name. For systems that allow it, optional attributes can also be used:

- `version` is the version of firmware/OS (even if full version information is already present in the '`uname`' string);
- `vendor` for the hardware/firmware/OS vendor or manufacturer's name (especially the hardware manufacturer if the OS vendor is already described in the '`uname`' string);
- `family` for the family of major OS this particular system belongs to; valid values being '`Linux`', '`Windows`', '`BSD`', '`macOS`', '`iOS`', '`tvOS`', '`Android`'.

- `arch` for the hardware's main CPU architecture; valid values being '`x64`', '`x86`', '`arm`'.

6.6.1 `hostname` element

Description:	Hostname, domain or other computer/device name	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<sysInfo>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

For those computers and devices having either a hostname/domain name or other identifiable device names, this is the element where the text is populated. In the case of higher-level OSs and no hostname set, the default IPv4/IPv6 address (preferably one with a set IPv4 gateway) can be specified here.

6.6.1 `application` element

Description:	Name of the application generating ACESclip data	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	Not used for hardware devices.
Relationships:	*Parent(s):*	`<sysInfo>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	`vendor`

In case the generation or modification of ACESclip is demanded to a specific application (running under, and differentiated from a OS), this element is populated. Optionally the software vendor's name is separated from the application's name string and populates the value of its optional `vendor` attribute.

6.6.1 `username` element

Description:	Text of the description	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<sysInfo>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

If available, username (or UID) which started the application that generated or edited the ACESclip.

6.6.1 `upTime` element

Description:	Time elapsed since the system was powered on	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
	Restrictions:	Syntax is "*`Dd hh:mm:ss`*"
Relationships:	*Parent(s):*	`<sysInfo>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

If available, time elapsed since the system that generated or edited the ACESclip was powered on or started

6.6.1 `info` element

Description:	Generic comments about the associated pipeline	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:complexType`	
Relationships:	*Parent(s):*	`<acesClip>`, `<revision>`
	Children:	`<author>`, `<note>`
Attributes:	*Required:*	None
	Optional:	None

This optional element hosts any other additional, usually manual-input information about the color pipeline which it is a relative of.

6.6.1 `author` element

Description:	Name of the color pipeline creator	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<info>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Where available and exportable into an ACESclip, the full textual name of the author or main user of a specific color pipeline is put in the text of this element. In this context 'author' refers to either the author of the color-pipeline (e.g. a color-scientist or an imaging engineer), a color-look creator (e.g. a colorist).

6.6.2 `note` element

Description:	Any other comments on the color pipeline	
Prescription:	Optional	
Occurrence:	*Min:* 0 *Max:* 1	
Type:	`xs:string`	
Relationships:	*Parent(s):*	`<info>`
	Children:	None
Attributes:	*Required:*	None
	Optional:	None

Any additional descriptive text about the associated color pipeline should go here. Especially when the ACESclip is used for its color-pedigree characteristics, as well as for archival, preservation, or just forensics purposes, it is highly recommended to put a few words describing each particular color-pipeline passage in an ACESclip. Therefore, applications generating ACESclips –especially those on high-level IT systems, with a usable/accessible UI and improved user interaction capabilities– should always include (if not even recommend the usage of) a visible UI element where such comments can be typed in.

6.6.1 `clipID` element

This element, when child to a `revision` element, preserves clip information related to an old color-pipeline. In case the content of the latest `clipID` element –child to the `acesClip` element– has not changed since the last revision the `clipID` child to `revision` is still populated for forensics.

6.6.2 `colorPipeline` element

This element, when child to a `revision` element, stores a full description of a color pipeline used in a past version of a clip. In case the content of the latest `colorPipeline` element –child to the `acesClip` element– has not changed since the last revision the `colorPipeline` child to `revision` is still populated for forensics.

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7 Electronic signed ACESclip

In order to asses both integrity and, possibly, authenticity of an ACESclip, the XML file can be digitally/electronically signed using XAdES-B (baseline) profile electronic signature (BES), further standardized by ETSI in technical specification TS-103-171 (which is also used for European interoperable *qualified electronic signatures* and *seals*, pursuant to Regulation EU № 910/2014 "eIDAS"). At high level, the signing procedure produces an electronic *signature* when the signer is a natural person (or an application acting by explicit will of such a person), whereas it is said to produce a *seal* when the signed is actually a legal person (or any other sort of automatic process). Hereinafter only the former will be used.

The XAdES Baseline profile allows to sign an XML file in three different ways:

- the signature itself is *enveloped* by the signed ACESclip,
- the signature's XML container is *enveloping* the ACESclip,
- the signature is stored in a separate ('*detached*') XML file;

of the above, only enveloped signatures are supported for valid signed ACESclip files.

Reason for signing an ACESclip is usually ensuring that neither human intervention nor automatic procedures manipulate an ACESclip after it has been automatically generated by a professional application (eventually under the supervision of an expert color scientists): in case something is changed in the file, this invalidates the electronic signature. The signature also helps to prevent historical / color-pedigree data in an ACESclip to be manipulated or removed.

Either the whole ACESclip or a top-level element of it are subject to digital signature. Usually only the following elements (described in the above chapters) are subject to digital signature:

- root `acesClip` (which means that the whole ACESclip file was signed) element,
- top-level `transformsLibrary` element,
- top-level `history` element,
- individual `revision` children elements.

An ACESclip can have multiple signed elements inside, including the ACESclip itself (by means of a signed `acesClip` element). In particular, when a signed ACESclip with history is modified, the signature of the previous version of (if present) shall be moved below to become the signature of the corresponding `revision` element the previous color pipeline.

```
001 Clipname V

*ACES ClipXML: myshow LMTnight A0001.xml
```

The file name convention is user-defined.

Applications importing an EDL with such a comment field should set its viewing pipeline based on the `aces:Config` value for a particular marked section of the timeline.

8 External References

The ACESclip file may be externally referenced in an EDL file to assign different ACES pipeline configurations to different segments of a timeline. Use the following comment field in an EDL for this purpose:

```
001 Clipname V

*ACES ClipXML: myshow LMTnight A0001.xml
```

The file name convention is user-defined.

Applications importing an EDL with such a comment field should set its viewing pipeline based on the `aces:Config` value for a particular marked section of the timeline.

Appendix A

(informative)

ACESclip XSD Schema

```
<?xml version="1.0" encoding="UTF-8"?>
<xs:schema targetNamespace="urn:acesMetadata:acesClip:v2.0"
   xmlns:xs="http://www.w3.org/2001/XMLSchema"
   xmlns:acesClip="urn:acesMetadata:acesClip:v2.0"
   xmlns:cdl="urn:ASC:CDL:v1.01"
   elementFormDefault="qualified"
   attributeFormDefault="unqualified">

   <xs:import schemaLocation="ASC-CDL_schema_v1.01.xsd" namespace="urn:ASC:CDL:v1.01"/>

   <xs:element name="acesClip">
      <xs:complexType>
        <xs:sequence>
          <xs:element ref="acesClip:uuid"/>
          <xs:element name="creationDateTime" type="xs:dateTime"/>
          <xs:element name="modificationDateTime" type="xs:dateTime"/>
          <xs:element ref="acesClip:acesConfig"/>
        </xs:sequence>
        <xs:attribute name="version" type="xs:decimal" use="required" fixed="2.0"/>
      </xs:complexType>
   </xs:element>

   <xs:element name="uuid">
      <xs:simpleType>
        <xs:restriction base="xs:string">
          <xs:pattern value="([0-9a-fA-F]{8}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-fA-F]{4}-[0-9a-
          fA-F]{12})|(\{[0-9a-fA-F]{
          <xs:minLength value="0"/>
        </xs:restriction>
      </xs:simpleType>
   </xs:element>

   <xs:element name="acesConfig">
      <xs:complexType>
        <xs:sequence minOccurs="1">
          <xs:element ref="acesClip:acesVersion"/>
          <xs:element ref="acesClip:idt" maxOccurs="1" minOccurs="0"/>
          <xs:element ref="acesClip:lmt" maxOccurs="1" minOccurs="0"/>
          <xs:element ref="acesClip:odt"/>
        </xs:sequence>
      </xs:complexType>
   </xs:element>

   <xs:element name="acesConfig">
      <xs:complexType>
        <xs:sequence minOccurs="1">
          <xs:element ref="acesClip:acesVersion"/>
          <xs:element ref="acesClip:idt" maxOccurs="1" minOccurs="0"/>
          <xs:element ref="acesClip:lmt" maxOccurs="1" minOccurs="0"/>
          <xs:element ref="acesClip:odt"/>
        </xs:sequence>
      </xs:complexType>
   </xs:element>

   <xs:element name="TransformLibrary">
      <xs:complexType>
        <xs:sequence minOccurs="0">
          <xs:element ref="TransformLibrary:Transform"/>
        </xs:sequence>
      </xs:complexType>
   </xs:element>

   <xs:element name="History">
      <xs:complexType>
        <xs:sequence minOccurs="0">
          <xs:element ref="History:Revision"/>
        </xs:sequence>
      </xs:complexType>
   </xs:element>

   <!-- Define next elements -->
```

```
    [...]
</xs:schema>
```

Appendix B
(informative)
Sample elementary ACESclip file

```
<?xml version="1.0" encoding="UTF-8"?>
<acesClip xmlns="urn:acesMetadata:acesClip"
   xmlns:cdl="urn:ASC:CDL:v1.01"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="urn:acesMetadata:acesClip:acesClip:v2.0.xsd" version="2.0"
   id="be6Ec2ea-a6DC-6cBC-ff0D-AfCED5FF3Dd8">
   <acesVersion major="1" minor="0" patch="3" />
   <creationDateTime>2018-12-26T14:57:07-8:00</creationDateTime>
   <modificationDateTime>2018-03-08T14:57:07-8:00</modificationDateTime>
   <ClipID>
      <file>A001_C012_AB0603.braw</file>
      <clipName>A001C012</clipName>
   </ClipID>
   <acesPipeline>
      <idt>
         <transformID>IDT.Acme.Camera.a1.v1</transformID>
      </idt>
      <lmt pos="1" source="ACEScct" target="ACEScct">
         <cdl:SOPNode>
            <cdl:Description>On-set Grade</cdl:Description>
            <cdl:Slope>2.0 2.0 2.0</cdl:Slope>
            <cdl:Offset>0.1 0.1 0.1</cdl:Offset>
            <cdl:Power>1 1 1</cdl:Power>
         </cdl:SOPNode>
         <cdl:SatNode>
            <cdl:Saturation>1</cdl:Saturation>
         </cdl:SatNode>
      </lmt>
      <lmt pos="2" source="ACEScc" target="ACEScc">
         <file>Show_LUT.cube</file>
      </lmt>
      <rrt>
         <transformID>RRT.a1.0.1</transformID>
      </rrt>
      <odt>
         <file>my-favourite-custom-HDR-flavor.clf</file>
      </odt>
   </acesPipeline>
</acesClip>
```

Appendix C

(informative)

Sample ACESclip file with *color-pedigree* for logging and forensics

```
<?xml version="1.0" encoding="UTF-8"?>
<acesClip xmlns="urn:acesMetadata:acesClip:v2.0"
   xmlns:cdl="urn:ASC:CDL:v1.01"
   xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
   xsi:schemaLocation="urn:acesMetadata:acesClip:v2.0 acesClip.xsd" version="2.0"
   id="2ef3acb3-a51a-43b4-b5c1-c1257684586d">
   <uuid>55b3ad92-1377-460e-a193-a31372eb1172</uuid>
   <creationDateTime>2018-12-26T14:57:07</creationDateTime>
   <modificationDateTime>2018-03-11T14:22:36</modificationDateTime>
   <acesVersion major="1" minor="0" patch="1" />
   <info>
      <note>Final HDR Graded master</note>
      <author>Walter Arrighetti</author>
   </info>
   <clipID>
      <seq>movie_r3_hdgrd.master.#######.exr</seq>
      <metadata key="user.productionName">Movie Title</metadata>
      <metadata key="user.reelNumber">3</metadata>
   </clipID>
   <acesPipeline name="previz">
      <lmt pos="1" source="ACEScg" target="ACEScg"><file>compositor_OoG.clf</file></lmt>
      <lmt pos="2" source="ACEScct" target="ACEScct">ShowLUT_02.clf</lmt>
      <rrt><transformID>RRT.a1.0.1</transformID></rrt>
      <odt><transformID>ODT.Academy.RGBmonitor_D60sim_100nits_dim.a1.0.1</transformID></odt>
   </acesPipeline>
   <acesPipeline name="theatre">
      <lmt source="ACEScct" target="ACEScct"><file>ShowLUT_02.clf</file></lmt>
      <rrt><transformID>RRT.a1.0.1</transformID></rrt>
      <odt><transformID>ODT.Academy.Rec2020_ST2084_1000nits.a1.0.1</transformID></odt>
   </acesPipeline>
   <acesPipeline name="master">
      <lmt pos="1" source="ACEScct" target="ACEScct"><file>ShowLUT_02.cube</file></lmt>
      <lmt pos="2" ref="file"><file>ACES2065__HLG.Rec2020.adapt.clf</file></lmt>
      <rrt><transformID>RRT.a1.0.1</transformID></rrt>
      <odt><transformID>ODT.Academy.Rec2020_100nits_dim.a1.0.1</transformID></odt>
   </acesPipeline>
   <transformsLibrary></transformsLibrary>
   <history>
      <revision>
         <uuid>f7b77066-2762-4483-a253-739524337266</uuid>
         <modificationDateTime>2018-03-09T14:11:16</modificationDateTime>
         <clipID>
            <Id>urn:uuid:f7b77066-2762-4483-a253-739524337266</Id>
            <metadata key="Annotation">MovieTitle_FTR-DVis_EN-XX_4K_20190309_VF</metadata>
            <metadata key="ContentTitle">MovieTitle_FTR-DVis_EN-XX_4K_20190309_VF</metadata>
            <metadata key="Creator">Clipster 6.0.0.7 (build 106320)</metadata>
            <info>
               <note>IMF package (App.#2E+) for theatrical distribution</note>
               <author>Mastering orchestrator VM</author>
            </info>
         </clipID>
      </revision>
      <revision>
         <uuid>be6Ec2ea-a6DC-6cBC-ff0D-AfCED5FF3Dd8</uuid>
         <modificationDateTime>2018-03-08T14:57:07</modificationDateTime>
         <clipID>
            <Id>urn:uuid:be6Ec2ea-a6DC-6cBC-ff0D-AfCED5FF3Dd8</Id>
            <metadata key="Annotation">MovieTitle_FTR-ACES_EN-XX_4K_20190308_OV</metadata>
            <metadata key="ContentTitle">MovieTitle_FTR-ACES_EN-XX_4K_20190308_OV</metadata>
            <metadata key="Creator">MIST 2019</metadata>
            <info>
               <note>IMF package (App.#5) for archival</note>
               <author>Mastering orchestrator VM</author>
            </info>
         </clipID>
         <acesPipeline name="theatre">
            <lmt source="ACEScct" target="ACEScct"><file>ShowLUT_02.clf</file></lmt>
```

```
            <rrt><transformID>RRT.a1.0.1</transformID></rrt>
            <odt><transformID>ODT.Academy.Rec2020_ST2084_1000nits.a1.0.1</transformID></odt>
         </acesPipeline>
         <acesPipeline name="master">
            <lmt pos="1" source="ACEScct" target="ACEScct"><file>ShowLUT_02.cube</file></lmt>
            <lmt pos="2" ref="file"><file>ACES2065__HLG.Rec2020.adapt.clf</file></lmt>
            <rrt><transformID>RRT.a1.0.1</transformID></rrt>
            <odt><transformID>ODT.Academy.Rec2020_100nits_dim.a1.0.1</transformID></odt>
         </acesPipeline>
      </revision>
      <revision>
         <uuid>55e4f92b-07bc-427a-8197-a37ed4648064</uuid>
         <modificationDateTime>2014-11-20T12:24:13-8:00</modificationDateTime>
         <sysInfo type="software">
            <OS version="5.0" vendor="FilmLight" arch="x64">FLOS</OS>
            <hostname>romeVMcolor01.lpn.companyname.com</hostname>
            <application version="4.4m1.28957" vendor="FilmLight">Baselight</application>
            <username domain="companyname.com">walter.arrighetti</username>
            <upTime>06:01:59</upTime>
         </sysInfo>
         <clipID>
            <seq idx="#" min="0" max="52532">move_r3_grd.01_#######.exr</seq>
            <metadata key="user.productionName">Movie Title</metadata>
            <metadata key="user.reelNumber">3</metadata>
            <modificationDateTime>2014-11-17T12:49:00-8:00</modificationDateTime>
         </clipID>
         <acesPipeline>
            <rrt><transformID>RRT.a1.0.1</transformID></rrt>
            <odt><transformID>ODT.Academy.P3DCI_48nits.a1.0.1</transformID></odt>
         </acesPipeline>
         <info>
            <note>First day of finishing with the DoP</note>
            <author>DI colorist name</author>
         </info>
      </revision>
      <revision>
         <uuid>1bb960e3-d57c-4903-8e28-e98749173676</uuid>
         <modificationDateTime>2014-11-17T12:29:00-8:00</modificationDateTime>
         <sysInfo type="software">
            <OS version="10.0.17134.523" vendor="Microsoft" arch="x64">Windows</OS>
            <hostname>romeVMcolor03.lpn.companyname.com</hostname>
            <application version="15.2.3" vendor="Blackmagic Design">
               DaVinci Resolve Studio</application>
            <username domain="companyname.com">walter.arrighetti</username>
            <upTime>00:23:18</upTime>
         </sysInfo>
         <clipID>
            <seq idx="#" min="0" max="14134">A001_C012_AE0306_#######.exr</seq>
            <metadata key="uk.ltd.filmlight.Tape">A001C012</metadata>
            <metadata key="interim.clip.cameraClipName">A001C012</metadata>
            <modificationDateTime>2014-11-17T12:24:15-8:00</modificationDateTime>
         </clipID>
         <acesPipeline>
            <lmt post="1" source="ACEScg" target="ACEScg"><file>compositor_OoG.clf</file></lmt>
            <lmt post="2" source="ACEScc" target="ACEScc"><file>ShowLUT_01.3dl</file></lmt>
            <rrt><transformID>RRT.a1.0.1</transformID></rrt>
            <odt><transformID>ODT.Academy.P3D60_48nits.a1.0.1</transformID></odt>
         </acesPipeline>
         <info>
            <note>Render and deBayering for VFX plates (w OoG compositing LUT)</note>
            <author>post-lab imaging scientist</author>
         </info>
      </revision>
      <revision>
         <uuid>0718d872-6d46-4a31-a117-c71721080696</uuid>
         <modificationDateTime>2014-11-17T12:24:13-8:00</modificationDateTime>
         <sysInfo type="software">
            <OS version="10.0.17134.523" vendor="Microsoft" arch="x64">Windows</OS>
            <hostname>romeVMcolor03.lpn.companyname.com</Hostname>
            <application version="15.2.3" vendor="Blackmagic Design">
               DaVinci Resolve Studio</application>
            <username domain="companyname.com">walter.arrighetti</username>
            <upTime>00:18:26</upTime>
         </sysInfo>
         <clipID>
            <file>A001_C012_AE0306.mxf</seq>
            <clipName>A001C012</clipName>
            <modificationDateTime>2014-06-20T12:26:59+02:30</modificationDateTime>
         </clipID>
```

```
      <acesPipeline>
         <idt><param>
            <name>RED</name>
            <version>7.0.0</version>
            <colorspace>RedLog3</colorspace>
            <gamma>RedCine3film</gamma>
            <temp>4250</temp>
            <wb>0 0 0</wb>
         </param></idt>
         <lmt pos="1" source="ACEScct" target="ACEScct">
            <cdl:SOPNode>
               <cdl:Description>On-set Grade</cdl:Description>
               <cdl:Slope>2.0 2.0 2.0</cdl:Slope>
               <cdl:Offset>0.1 0.1 0.1</cdl:Offset>
               <cdl:Power>1 1 1</cdl:Power>
            </cdl:SOPNode>
            <cdl:SatNode>
               <cdl:Description>On-set Grade</cdl:Description>
               <cdl:Saturation>1</cdl:Saturation>
            </cdl:SatNode>
         </lmt>
         <lmt post="2" source="ACEScc" target="ACEScc"><file>ShowLUT_01.xml</file></lmt>
         <rrt><transformID>RRT.a1.0.1</transformID></rrt>
         <odt><transformID>ODT.Academy.P3D60_ST2084_4000nits.a1.0.1</transformID></odt>
      </acesPipeline>
      <info>
         <note>Output Transform for viewing on HLG editorial monitors</note>
         <author>post-lab imaging scientist</author>
      </info>
   </revision>
   <revision>
      <uuid>0718d872-6d46-4a31-a117-c71721080696</uuid>
      <modificationDateTime>2014-11-08T12:24:13-8:00</modificationDateTime>
      <sysInfo type="software">
         <OS version="5.0" vendor="FilmLight">FLOS</OS>
         <hostname>romeVMcolor01.lpn.companyname.com</hostname>
         <application version="4.4m1.28957" vendor="FilmLight">Baselight</application>
         <username domain="companyname.com">walter.arrighetti</username>
         <upTime>03T12:15:26</upTime>
      </sysInfo>
      <clipID>
         <seq idx="#" min="1" max="3">A001_C012_AE0306_###.R3D</seq>
         <clipName>A001C012</clipName>
         <modificationDateTime>2014-06-20T12:24:03+02:30</modificationDateTime>
      </clipID>
      <acesPipeline>
         <lmt pos="1" source="ACEScct" target="ACEScct">
            <cdl:SOPNode>
               <cdl:Description>On-set Grade</cdl:Description>
               <cdl:Slope>2.0 2.0 2.0</cdl:Slope>
               <cdl:Offset>0.1 0.1 0.1</cdl:Offset>
               <cdl:Power>1 1 1</cdl:Power>
            </cdl:SOPNode>
            <cdl:SatNode>
               <cdl:Description>On-set Grade</cdl:Description>
               <cdl:Saturation>1</cdl:Saturation>
            </cdl:SatNode>
         </lmt>
         <lmt post="2" source="ACEScc" target="ACEScc"><file>ShowLUT_01.clf</file></lmt>
         <rrt><transformHash>e5f08d98bf18385e2f26b904cad23c734d530ffb</transformID></rrt>
         <odt><transformID>ODT.Academy.P3D60_ST2084_4000nits.a1.0.1</transformID></odt>
      </acesPipeline>
      <info>
         <note>Basic grade with DoP, 3 days after the shot</note>
         <author>On-set colorist name</author>
      </info>
   </revision>
   <revision>
      <uuid>082fe66f-2768-4211-bb43-73da0fef4e4f</uuid>
      <modificationDateTime>2018-11-05T12:24:13-8:00</modificationDateTime>
      <sysInfo type="hardware">
         <Vendor>AJA</Vendor>
         <Model>the Fabulous LUTbox</Model>
         <UpTime>06:52:25</UpTime>
         <Reserved>other hardware-specific metadata </Reserved>
      </sysInfo>
      <clipID>
         <seq idx="#" min="1" max="3">A001_C012_AE0306_###.R3D</seq>
         <clipName>A001C012</clipName>
```

```
            <modificationDateTime>2014-06-20T12:24:03+02:30</modificationDateTime>
         </clipID>
         <acesPipeline>
            <idt><param>
               <name>RED</name>
               <version>7.0.0</version>
               <colorspace>RedLog3</colorspace>
               <gamma>RedCine3film</gamma>
               <temp>4250</temp>
               <wb>0 0 0</wb>
            </param></idt>
            <lmt source="ACEScct" target="ACEScct">
               <cdl:SOPNode>
                  <cdl:Description>On-set Grade</cdl:Description>
                  <cdl:Slope>2.0 2.0 2.0</cdl:Slope>
                  <cdl:Offset>0.1 0.1 0.1</cdl:Offset>
                  <cdl:Power>1 1 1</cdl:Power>
               </cdl:SOPNode>
               <cdl:SatNode>
                  <cdl:Description>On-set Grade</cdl:Description>
                  <cdl:Saturation>1</cdl:Saturation>
               </cdl:SatNode>
            </lmt>
            <rrt><transformID>RRT.a1.0.1</transformID></rrt>
            <odt><transformID>ODT.Academy.Rec709_D60sim_100nits_dim.a1.0.1</transformID></odt>
         </acesPipeline>
         <info>
            <note>On-set pre-grade done on the camera monitor</note>
            <author>Post-lab imaging scientist</author>
         </info>
      </revision>
      <revision>
         <uuid>d9512db2-88a3-4845-ab16-00ed27638743</uuid>
         <modificationDateTime>2018-11-05T12:19:00</modificationDateTime>
         <sysInfo type="software">
            <OS version="10.13.1" vendor="Apple">macOS</OS>
            <hostname>romewonset12.vpn.companyname.com</hostname>
            <application vendor="YoYotta">YoYotta LTFS</application>
            <username domain="companyname.com">dit-name-surname</username>
            <upTime>03T12:15:26</upTime>
         </sysInfo>
         <clipID>
            <seq idx="#" min="1" max="3">A001_C012_AE0306_###.R3D</seq>
            <clipName>A001C012</clipName>
            <modificationDateTime>2014-06-20T12:24:03+02:30</modificationDateTime>
         </clipID>
         <acesPipeline>
            <idt><param>
               <name>RED</name>
               <version>7.0.0</version>
               <colorspace>RedLog3</colorspace>
               <gamma>RedCine3film</gamma>
               <temp>4250</temp>
               <wb>0 0 0</wb>
            </param></idt>
         </acesPipeline>
         <info>
            <note>First clip ingestion from magazine to on-set station</note>
            <author>D.I.T.</author>
         </info>
      </revision>
   </history>
</acesClip>
```