



ONTOLOGY FOR MEDIA CREATION
PART 3: ASSETS
ANNEX A: CAMERA METADATA
VERSION 1.0

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1 Introduction

Picture and sound are not the only valuable data captured on a set. Metadata that tells how the picture and sound were captured is equally important and is used to help the interpretation of that data downstream of the set. Camera Metadata is a type of Digital Asset.

For image data, the camera metadata describes, among other things, the shooting configuration of the camera. For example, whether the camera was set to record log or linear color. This is necessary for the correct interpretation of the data. If log curve images are interpreted as linear color, the result is a very “flat” image. Correctly interpreting log color requires knowledge of the log curve¹ that was used in the camera when the image was recorded.

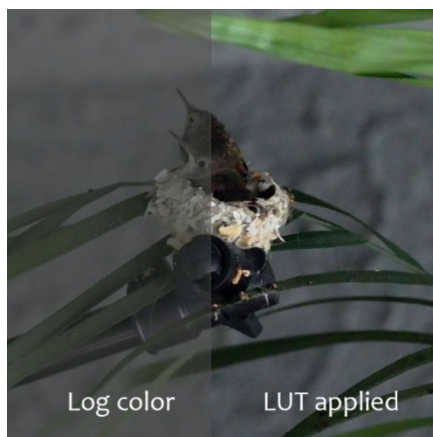


Figure 1-1 Camera metadata is used to determine the LUT² to apply to a log image

Historically, much of the useful metadata about the camera configuration has been passed on in the notes from the camera operator. However, cameras in use today record metadata, including their settings. In the case of the image above, the camera metadata indicated it was set to log and the version of the log curve, information that was used to “develop” the image.

Camera metadata often contains information about other parts of the capturing system. Some lenses are equipped with a means for the camera to read the settings such as aperture and focus distance. Metadata from the recorder is also important as is external inputs such as timecode.

¹ For an explanation of how log curves work, see <https://www.rocketstock.com/blog/tips-for-log-color-space-compositing/>

² Look Up Table – see Terms section

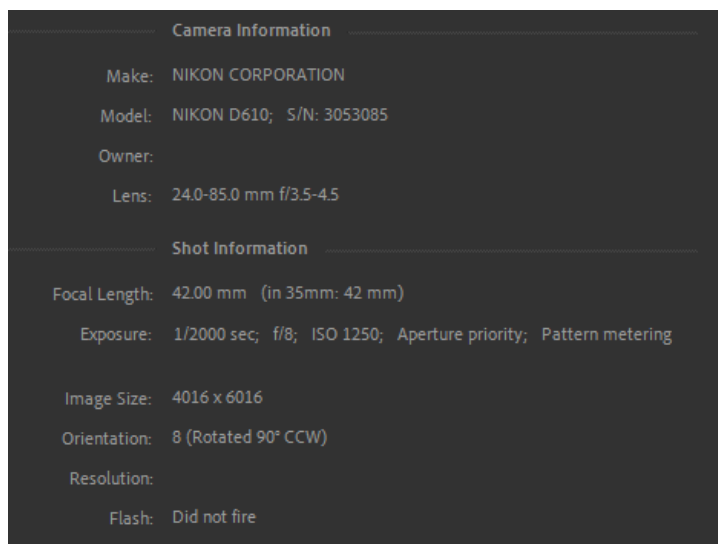


Figure 1-2. Example of camera metadata captured by a DSLR³

Figure 1-2 shows the metadata recorded by a Nikon DSLR. The camera model, serial number and lens are recorded along with metadata specific to that shot.

This document provides some definitions of common terms and classes to represent metadata from the camera system. It also describes how some other components of the Ontology can be used to provide input to the camera and how metadata from the camera system is used by other components of the Ontology.

1.1 Scope

This document defines a set of camera metadata that is required in downstream processes including dailies, VFX, and finishing.

It is not a definitive list. Some of the metadata created by the cameras is either specific to the camera model or expressed in terms that are specific to the camera model. Color is an example of this. This document defines metadata terms for tint, white balance, saturation, and slope. However, ARRI cameras and RED cameras, for example, both have a richer set of metadata available for color, but the expression of the color parameters is specific to each camera maker. This document does not include camera metadata used only in broadcast environment.

1.2 Notational Conventions

In documents generally:

- The definition of a term included in the Dictionary is in bold, followed by the definition, e.g., **Creative Work**: A uniquely identified production.

³ With still images, the metadata is often stored in the image file.

- When a defined term is used in the text of a document, it is capitalized, for example in “The Production Scene is usually derived from a numbered scene in the Script,” Production Scene and Script are defined in the Ontology. (Note, a word that is part of defined term may sometimes be capitalized by itself as a shorthand, e.g., “Scene” may be used to indicate “Narrative or Production Scene.”)
- References to other Ontology Documents are in ***bold italic***, e.g., ***Part 3: Assets*** or ***Part 3A: Camera Metadata***

For Sample Attributes In the concept documents:

- If a data field or attribute is formally defined in this ontology or a connected ontology, it is italicized, e.g., *Setup* as an attribute refers to a defined concept.
- Attribute [...] indicates an attribute can appear more than once, e.g., Unstructured Data [...]
- →Thing means that an attribute is expressed as a relationship to a Thing, e.g., →*Script*
- A combination of the two indicates that the concept can have relationships to a set of things, e.g., →Components [...]

2 Terms of Art

Cinematography uses many words, terms, and acronyms. This section gives some of the most common ones and their definitions.

Term	Terse Definition	Notes
Camera	Motion picture camera	Digital unless otherwise noted as a film camera
LUT	Look up table	A look up table is an array, either two or three dimensional, that changes the way an image looks. For example, a LUT can be used to transform an image from one color space to another
ISO	The rating of the sensitivity of film or a camera sensor to light.	The higher the ISO value, the more sensitive the film or camera imager is to light. Digital cinema cameras are often rated at 800. "ISO" is a reference to the standards body that codified the scale.
EI	Exposure index	Where ISO is the rating of the film or sensor, EI is the rating at which the exposure was made. For example, if we have a camera rated at 800 ISO and we are shooting in subdued light, we might choose to expose the image as though the imager was 1250 ISO. The EI is then used when the image is "developed" to correct for the difference.
Shutter angle	A measure of the exposure time of an image relative to the frame rate. $0 < \text{shutter angle} \leq 360$	Film cinema cameras use a rotating mechanical shutter that is a disc with a sector cut out and rotated one turn per frame. When the cut out passes over the film, the film is exposed to light. The most common shutter angle is 180 degrees which exposes the film for 50% of the time. If the frame rate is 24 fps, a 180-degree shutter angle would mean the exposure is 1/48 th sec. This measurement is used with digital cameras although, with one exception, digital cameras have electronic shutters.
Timecode	A linear sequence of numeric codes generated at a regular interval and usually recorded in the format <i>hour:minute:second:frame</i>	
Mag	Magazine	Originally, the detachable part of a film camera that held the film. With digital cameras, it means the container that holds the recording media when it is inserted into the camera or the recorder.
Reel	Synonymous with mag	Historically, a reel of film.

Term	Terse Definition	Notes
f-stop or f-number	The size of the lens aperture.	Ratio of the focal length to the diameter of the aperture. The smaller the f-stop, the larger the aperture.
T-stop	The f-number adjusted to account for light transmission efficiency	The T-stop is the f-stop corrected by a manufacturer for actual light transmission of all the lens elements, rather than the nominal aperture opening size.
FPS	Frames per second	The frequency at which consecutive images (frames) are recorded or played back.
Frame rate	Synonymous with FPS	
Lens	A device containing a series of curved glass elements used to focus light on the camera imager or film.	
Recorder	A device to record to media the images captured by the camera.	The media is, for example, a solid-state disk (SSD) or CFast ⁴ media. May be integrated into the camera.

⁴ <https://en.wikipedia.org/wiki/CompactFlash#CFast>

3 Metadata

A digital camera is a complex piece of equipment, and has multiple components: the Lens, the Camera, and either a Recorder and Mag or just a Mag. The Lens and Camera have device-specific information (make, model, etc.) and information about a particular capture. The Recorder has device-specific information and an identifier for any removable storage media (the Mag).

All of the classes have fields for both structured and unstructured representations of data not covered by the standard attributes.

3.1 Camera Metadata

Camera Metadata: Capture-specific details and information about the Camera itself.

Sample Attributes

Name	Definition
Recording FPS	The number of individual images captured per second. Metadata
Playback FPS	The number of individual images per second of the intended playback speed.
Timecode	A linear sequence of numeric codes generated at a regular interval and usually recorded in the format: <hour>:<minute>:<second>:<frame>
Timecode start	Timecode when recording ⁵ started
Timecode end	Timecode when recording stopped
<i>Shutter angle</i>	A measure of the exposure time of an image relative to the frame rate. 0 < shutter angle ≤ 360
<i>ISO</i>	The (manufacturer's) ISO rating of the camera. See above.
Exposure index	Exposure index is the ISO rating used to determine exposure when the recording was made.
Reel Name	A name assigned to a sequence of recorded images
Camera make	The manufacturer or vendor of the camera
Camera model	The manufacturer's name for the camera model. For example, the name of the camera family followed by the name of the variant.

⁵ "Recording" is a term of art for camera operators and so I used here, rather than the more general "capture"

Name	Definition
Camera UID	An alphanumeric code that uniquely identifies the camera among all cameras from all vendors
Camera serial number	An alphanumeric code assigned by the manufacturer to a camera
Camera firmware version	An alphanumeric code that that identifies the firmware installed in the camera at the time of recording
Camera label	Human readable ID assigned by the camera department to each production camera.
Frame width	The height of the intended image in pixels. This may or may not be the height of the recorded image or the sensor
Frame height	The width of the intended image in pixels. This may or may not be the width of the recorded image or the sensor
Pixel aspect ratio	Describes how the pixels are to be interpreted to correctly display the image.
Flip - X	The flip-X factor indicates whether the image is flipped horizontally.
Flip - Y	The flip-Y factor indicates whether the image is flipped vertically.
LUT UID	An alphanumeric code that uniquely identifies the LUT loaded into the camera and applied to the monitor output during shooting.
Tint	Defines the R/B white points against the green channel.
White balance	The color temperature of white expressed in degrees Kelvin
Saturation	The saturation of the LUT used when the image was recorded
SOP	The slope of the LUT used when the image was recorded
Tilt	The angle of a camera off its pitch axis, measured in degrees when the camera is level
Roll (Dutch)	The angle of the camera off of the roll axis, measured in degrees when the camera is level
Camera Roll	Identifier for a group of events captured together on the same camera.
Circle Take	Indicates whether a capture is considered a candidate for use.
Unstructured Camera Attributes	A string representing any information not included in the above attributes.

Name	Definition
Structured Camera Data	As above, but represented as a camera-specific data structure.

Notes:

The Director or some other person makes the decision on setting Circle Take. It can be manually entered on the camera, or the script supervisor will make a note of it elsewhere.

3.2 Lens Metadata

Lens Metadata: Capture-specific details and information about the Lens itself.

Sample Attributes

Name	Definition
Aperture	The T-stop setting of the lens.
Focus	The distance at which the lens was focused at the time the image was captured.
Focal length	The actual focal length of the lens, in millimeters, when the image was captured. With a zoom lens this may be change frame by frame.
Lens make	The lens manufacturer or vendor
Lens model	The lens model identifier assigned by the lens manufacturer or vendor
Lens squeeze	The lens squeeze factor is set to display visual correct pixel aspect ratio of images recorded with anamorphic lenses.
Lens serial number	A number unique to each lens from the same manufacturer or vendor and of the same model
Unstructured Lens Attributes	A string that contains lens metadata not specified in other predefined attributes (such as aperture, focus, focalLength, lensMake, lensModel, lensSerialNumber)
Structured Lens Data	As above, but represented as a lens-specific data structure.

3.3 Recorder Metadata

Recorder Metadata: Information about a Recorder and the recording media.

Sample Attributes

Name	Definition
Recorder firmware version	An alphanumeric code that identifies the firmware installed in the recorder at the time of recording
Recorder make	The recorder manufacturer or vendor
Recorder model	The recorder model identifier assigned by the lens manufacturer or vendor
Recorder serial number	A number unique to each recorder from the same manufacturer or vendor and of the same model
Storage Media UID	An alphanumeric code that uniquely identifies the storage media (i.e., mag) the footage was captured on.
Unstructured Recorder Attributes	A string representing any information not included in the above attributes.
Structured Recorder Data	As above, but represented as a recorder-specific data structure.

4 Interaction with Other Parts of the Ontology

Some of the data recorded by the Camera system is equivalent to information defined elsewhere in the Ontology. The flow of information goes in both directions. For instance, information about the Creative Work, such as its Director and Title, can be entered into many cameras. In the other direction, some of the information provided by the Camera is used in the Slate.

4.1 Creative Work

These are taken from the Creative Work being filmed.

Name	Use
<i>Creative Work Title</i>	The Title of the Creative Work can be input into a Camera. This can be a code name or in the case television a series and episode number.

4.2 Slate-related

The following fields of Slate (see **Part 2: Context**) are often provided in the Camera Metadata.

Name	Definition
<i>Slate UID</i>	An alphanumeric code that uniquely identifies a single clip by combining the Scene Descriptor, Setup, and Take. (Provided by some Cameras.)
Scene Number	A number tied to the Slugline when a Script is locked.
<i>Shoot Date</i>	The date of capture.
Camera Unit	A group of Participants responsible for shooting some element of a Scene, e.g., Main Unit or Second Unit.

Some components of the Slate UID (See **Part 2: Context**) are provided by some Cameras. See the Appendices for camera-specific mappings.

<i>Slate UID</i>	An alphanumeric code that uniquely identifies a single clip by combining the Scene Descriptor, Setup, and Take.
<i>Scene Descriptor</i>	An alphanumeric reference to the Production Scene.
<i>Setup</i>	The unique camera configuration which encompasses a cameras geo-location, positioning, lens or other camera settings.
<i>Take</i>	A discrete capture event with a specified beginning and end.

4.3 Location

Production Location is found in **Part 2: Context**.

Name	Definition
<i>Production Location</i>	A real place that is used to depict the narrative location or used for creating the production. (Provided by some Cameras.)

4.4 Participant

These are all defined in **Part 4: Participants** and can be entered on some Cameras.

Name	Definition
<i>Director</i>	The Camera Unit's director
<i>Cinematographer</i>	The Camera Unit's cinematographer
<i>Camera Operator</i>	The operator of the camera that recorded the footage

4.5 Infrastructure

Camera, Lens, and Recorder are defined in **Part 8: Infrastructure** and have attributes that relate solely to the Camera, excluding metadata related to a particular capture.

Appendix A Mappings to Select Cameras

This mapping to the metadata produced by select cameras is informative and accuracy cannot be guaranteed. Furthermore, a camera’s metadata is controlled by the camera maker and is subject to change. Empty entries do not mean the absence of a mapping.

A.1 Camera

Term	ARRI	RED	Sony Venice
Recording FPS	timecodeRate (?)	Record FPS	Capture FPS
Playback FPS	Project FPS (?)		formatFps (?)
Timecode	timeCode		
Timecode start		Abs TC	Start
Timecode end		End Abs TC	End
Shutter angle	Shutter Angle	Shutter (deg)	ShutterSpeedAngle
ISO	isoSpeed	ISO	ISO Sensitivity
Exposure index	Exposure Index	Exposure	Exposure Index
Reel Name	reelName (or labroll?)	CamReelID	labroll
Camera make			manufacturer
Camera model	Camera Product	Camera Model	modelName
Camera UID	cameraldentifier		
Camera serial number	Camera Serial Number	Camera_serial	serialNo
Camera firmware version		Firmware Revision + Firmware Version	
Camera label		Camera	
Frame width	FrmLn1AWidth	Frame Width	Resolution
Frame height	FrmLn1AHeight	Frame Height	Resolution
Pixel aspect ratio	pixelAspectRatio	Aspect Ratio	Pixel Aspect Ratio
Flip - X	ImageOrient	Flip Horizontal	Image Orientation
Flip - Y	ImageOrient	Flip Vertical	Image Orientation
LUT UID	LookLutMode	Camera 3D LUT	
Tint	WbTintCc	Tint	Tint Correction
White balance	wbKelvin	Kelvin	White Balance
Saturation	LookSaturation	CDL Saturation	
SOP	LookCdISlope	CDL Slope	
Tilt	Camera Tilt		
Roll (Dutch)			
Camera Roll	Camera Roll		
Circle Take	Circle Take		
Unstructured Camera Attributes			

Term	ARRI	RED	Sony Venice
Structured Camera Data			

A.2 Lens

Term	ARRI	RED	Sony Venice
Aperture	Lens Iris	Aperture	
Focus	Lens Focus Distance	Lens Focus Distance	
Focal length	Lens Focal Length	Focal Length	
Lens make			
Lens model	LensType	Lens Name	
Lens Squeeze	Lens Squeeze		
Lens serial number	Lens Serial Number	Lens Serial Number	
Unstructured Lens Attributes			Lens Attributes
Structured Lens Data			

A.3 Recorder

Term	ARRI	RED	Sony Venice
Recorder firmware version			
Recorder make			
Recorder model			
Recorder serial number			
Storage Media UID	Storage Media Serial Number	Media Serial Number	
Unstructured Recorder Attributes			
Structured Recorder Data			

A.4 Creative work

Term	ARRI	RED	Sony Venice
Title	Production		

A.5 Slate-related

Term	ARRI	RED	Sony Venice
Slate UID			

Term	ARRI	RED	Sony Venice
Scene Number		Scene	
Shoot Date		Date	
Camera Unit			
Camera Roll?			
Slate UID			
Scene Descriptor			
Setup			
Take		Take	

A.6 Participant

Term	ARRI	RED	Sony Venice
<i>Director</i>	Director	Director	Director
<i>Cinematographer</i>	Cinematographer	Cinematographer	Director Of Photography
<i>Camera Operator</i>	Camera Operator		Camera Operator

Appendix B Mapping to VES and SMPTE ST 2065-4

A number of other specifications and standards have terms and practices for camera metadata. This appendix provides mappings for two of them: the VES Camera Report Interchange Format Specification⁶ and SMPTE ST 2065-4:2013 ACES Image Container File Layout.⁷

This mapping is informative, and its accuracy cannot be guaranteed. Empty entries do not mean the absence of a mapping.

B.1 Camera

Term	VES Camera Report (v1.1)	SMPTE ST 2065-4:2013
Recording FPS	Tk FPS	captureRate
Playback FPS		
Timecode		timeCode
Timecode start	Tk Timecode	
Timecode end		
Shutter angle	Tk Shutter Angle	[expTime]
ISO		isoSpeed??
Exposure index		
Reel Name		reelName
Camera make	Camera Body	cameraMake
Camera model		cameraModel
Camera UID		cameraIdentifier
Camera serial number		cameraSerialNumber
Camera firmware version		cameraFirmwareVersion
Camera label	Camera Letter	cameraLabel
Frame width		
Frame height		
Pixel aspect ratio		pixelAspectRatio
Flip - X		
Flip - Y		
LUT UID		
Tint		
White balance	White Balance	
Saturation		
SOP		
Tilt	Tk Camera Tilt	
Roll (Dutch)	Tk Camera Dutch	

⁶ <https://camerareports.org/>

⁷ <https://ieeexplore.ieee.org/document/7290441>

Term	VES Camera Report (v1.1)	SMPTE ST 2065-4:2013
Camera Roll	Tk Roll	
Circle Take		
Unstructured Camera Attributes		
Structured Camera Data		

B.2 Lens

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Aperture	Tk Stop	aperture
Focus	Tk Lens Focus	focus
Focal length	Tk Focal Length	focalLength
Lens make		lensMake
Lens model		lensModel
Lens Squeeze		
Lens serial number	Tk Lens Serial Num	lensSerialNumber
Unstructured Lens Attributes		lensAttributes
Structured Lens Data		

B.3 Recorder

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Recorder firmware version		recorderFirmwareVersion
Recorder make		recorderMake
Recorder model		recorderModel
Recorder serial number		recorderSerialNumber
Storage Media UID		
Unstructured Recorder Attributes		
Structured Recorder Data		

B.4 Creative work

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Title	Job	

B.5 Slate-related

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Slate UID	Slate	

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Scene Number		
Shoot Date	Shoot Timestamp	
Camera Unit	Unit	
Camera Roll?		
Slate UID		
Scene Descriptor		
Setup		
Take	Tk Take	

B.6 Location

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Production Location	Set Location	

B.7 Participant

Term	VES Camera Report (v1.1)	SMPTE ST 2650-4:2013
Director		
Cinematographer		
Camera Operator		