EBU – TECH 3349

EBU Acquisition Technical Metadata Set

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Version 1.1

Geneva
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Conformance Notation

This document contains both normative text and informative text.

All text is normative except for that in the Introduction, any section explicitly labelled as 'Informative' or individual paragraphs which start with 'Note:'.

Normative text describes indispensable or mandatory elements. It contains the conformance keywords 'shall', 'should' or 'may', defined as follows:

'Shall' and 'shall not':	Indicate requirements to be followed strictly and from which no deviation is permitted in order to conform to the document.
'Should' and 'should not':	Indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others. OR indicate that a certain course of action is preferred but not necessarily required. OR indicate that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.
'May' and 'need not':	Indicate a course of action permissible within the limits of the document.

Default identifies mandatory (in phrases containing "shall") or recommended (in phrases containing "should") presets that can, optionally, be overwritten by user action or supplemented with other options in advanced applications. Mandatory defaults must be supported. The support of recommended defaults is preferred, but not necessarily required.

Informative text is potentially helpful to the user, but it is not indispensable and it does not affect the normative text. Informative text does not contain any conformance keywords.

A conformant implementation is one which includes all mandatory provisions ('shall') and, if implemented, all recommended provisions ('should') as described. A conformant implementation need not implement optional provisions ('may') and need not implement them as described.

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Editor's note: *EBU publications are written in Standard British English. Exceptionally, in this document, the American English spelling 'color' has been used throughout so as to match the usage in SMPTE RDD18.*

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Acquisition Technical Metadata Set

EBU Committee	*First Issued*	*Revised*	*Re-issued*
ECM	May 2011	September 2012	

Keywords: Metadata, Television, Production, Acquisition, File-based.

1. Introduction

This is version 1.1 of the "Acquisition Metadata Set" specification.

This specification has been developed by the EBU's Expert Community on Metadata (ECM), under the umbrella of the EBU HIPS Strategic Programme (SP-HIPS). The goal of this Strategic Programme has been to define solutions to improve interoperability in HDTV production (audio and video encoding, wrappers, metadata and SDI interfacing). HIPS-META is the SP-HIPS subgroup on metadata.

The "Acquisition Technical Metadata Set" is a set of metadata collected at capture through interfaces from live cameras or camcorders. It is intended to improve interoperability for the purposes of exchange of material. This set has been commonly agreed by EBU Members (users) and manufacturers for use in a tapeless file-based or live production environment.

The "Acquisition Technical Metadata Set" is clustered in *camera device* (shooting parameters), *lens device* (settings and identification) and *microphone device* (identification) video and audio metadata sets. This document only provides definitions of the different relevant metadata attributes.

For cameras and camcorders, it is expected that the file format used for the export of the essence will be MXF. The metadata structure should support the exchange of native available MXF (export) AND XML (Import and export) formats. Additional EBU specifications provide implementation guidelines for different configurations (e.g. using KLV and XML encodings for exchange inside MXF files, or using separate XML files). Descriptive Metadata sets are also specified in a separate EBU specification.

More information on the role of this specification with regard to other related EBU metadata specifications is provided in the 'metadata' section of the EBU TECHNICAL website (http://tech.ebu.ch/metadata).

2. Why is this specification important?

In order to facilitate exchange between different TV production platforms, it is essential that the relevant parameters characterising capture of content are open (standardised) or at least they must be available to third parties on fair and equitable terms.

A new generation of live cameras and file-based camcorders must provide the functionalities necessary to permit an economical integration into IT based production platforms. Particular importance is placed on the support of non-linear operations.

This document was written at a time of migration to tapeless production. More metadata is now natively generated by cameras and camcorders; far beyond the tape timecodes and labels of old. In file-based (e.g. service oriented) production architectures, it is expected that this metadata will play a key role at each production stage. For this reason, the metadata attributes defined in this document have been structured to be compatible with other metadata sets and common practice in a generic operational production environment.

Original capture structural/technical metadata is important to keep memory of the original shooting conditions in particular in a digital world where content is re-processed several times during its lifetime. This information, when available, may also actively contribute to a more effective restoration process.

This information is vital and interoperability is required for the lossless exchange of this data.

This documents aims at preventing different competing implementations of metadata formats in cameras, camcorders and storage media used in acquisition.

The EBU encourages broadcasters to use this document as a reference for the evaluation of live cameras and file-based camcorders. Similarly the EBU encourages manufacturers to develop new generations of equipment in compliance with this specification.

3. Definitions

Attribute	An attribute is the name given to each atomic element of metadata information
Type	A type is used to specialise a description e.g. of a production device.
Type "Camera"	"Camera" is one type of production device covered by this specification.
Type "Camcorder"	"Camcorder" is one type of production device covered by this specification.
"Camera"	"Camera" is used in this specification to identify capture devices without storage capacity such as "live cameras".
"Camcorder"	"Camcorder" is used in this specification to identify capture devices with storage capacity
Clip	Individual clips represent the material that is part of the preparation of an item, scene or programme, i.e. for its planning, description and production. Clips can have references to business objects of any other types, clips, scenes, items and programmes.

4. Acquisition Metadata Set

This specification defines technical metadata for file-based acquisition.

The technical metadata (shooting/recording device parameters, lens, microphone, device as well as audio and video parameters) developed in this document are compatible with the association and processing of metadata at the clip (one frame or more) level. Technical Metadata should be automatically generated by live cameras and camcorders.

The focus of this specification is 'capture' at an interface through which metadata is pushed / uploaded (user defined metadata with static production contextual information) to, or downloaded (technical and dynamic descriptive metadata) from a live camera or a camcorder and stored. This is illustrated in Figure 1.

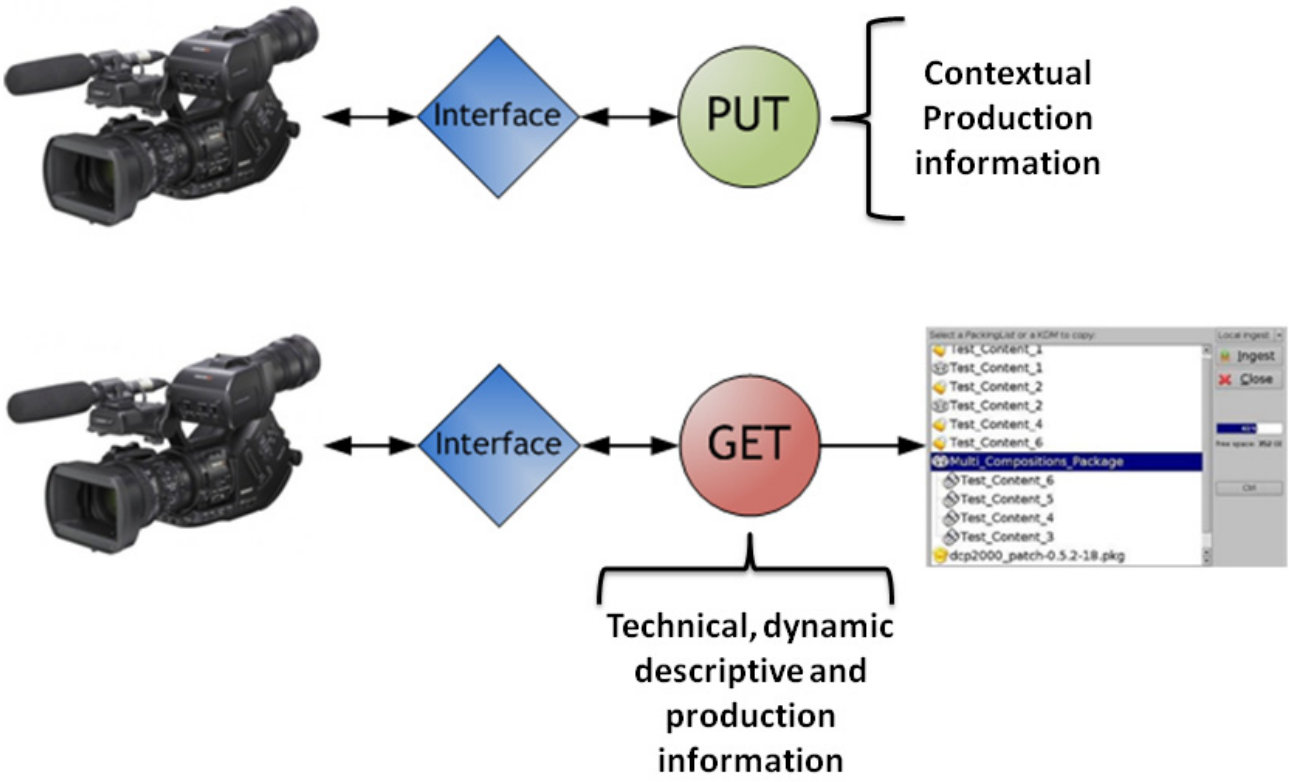

Figure 1: Metadata flows for capture

The mechanisms (storage media, protocols, metadata formats/containers, default behaviour) used to load, extract, exchange and store metadata are defined in a separate specification.

4.1 Technical metadata

The technical metadata specified in this document is composed of:

- Lens metadata based on SMPTE RDD 18;
- Camera metadata based on SMPTE RDD 18;
- Device metadata based on EBU Tech 3301;
- Audio metadata based on EBU Tech 3301;
- Video metadata based on EBU Tech 3301;
- Microphone metadata based on "2020 3D Media Special Sound & Vision" Deliverable 3.5 - Metadata Representation for 3D Cinema Production

Figure 2 shows a graphical description of the technical metadata sets and their relationships.

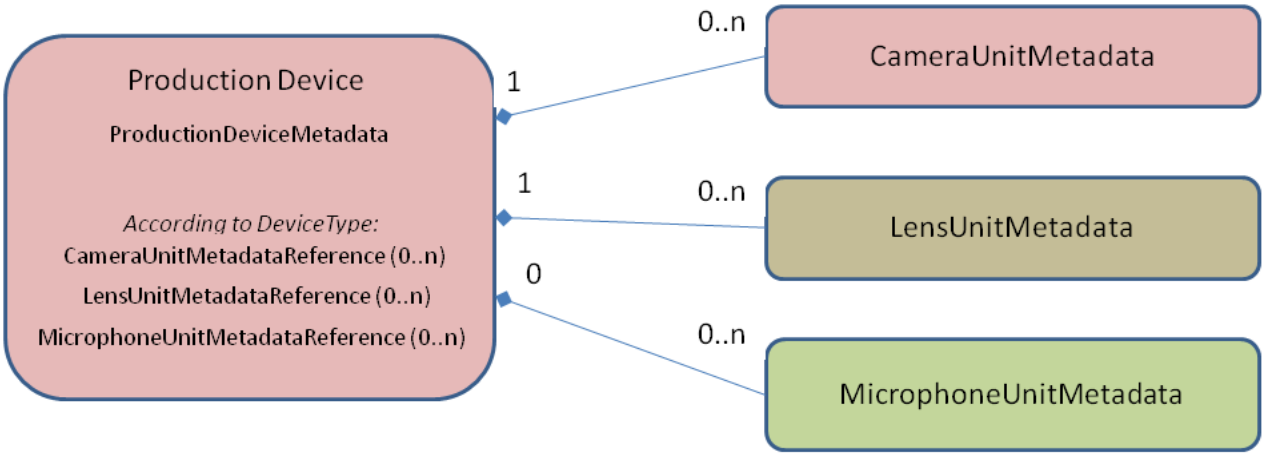

Figure 2: Technical metadata sets and their relationships

As defined in this specification, the description of devices involved in capture can be made in two different ways, the choice of which is left to the user:

- **Option 1**: Capture is made by several production devices i.e. a camera unit, a lens and optionally, a microphone. An instance of “ProductionDevice” (see Annex D) provides identification information for the device and contains one of the metadata sets (“CameraUnitMetadata”, “LensUnitMetadata” or "MicrophoneUnitMetadata") with the technical metadata corresponding to the type of production device.

  In this case, the optional identification attributes in the lens and microphone metadata sets should not be used as they are provided using the "ProductionDevice" identification attributes. The “ProductionDevice” metadata set should be instantiated as many times as necessary to describe all the production devices used for the capture.

- **Option 2**: Capture is made by one device composed of several components (lens and one or more microphones).

  In this case, the "ProductionDevice" identifies the device to which the components are attached, typically of type camera, and described via their respective “LensUnitMetadata” or "MicrophoneUnitMetadata" sets containing the identification attributes of each component.

The technical video parameters are composed in a “VideoEssenceDescriptor” metadata set.

The technical audio parameters are composed in an “AudioEssenceDescriptor” metadata set.

It has to be noticed that several of the metadata attributes included in this specification are variable in time by nature with a granularity higher than clip level.

It is recommended therefore that all future implementations of this specification allow users to access the information related to the variation in time of these metadata attributes.

4.2 Lens Metadata Attributes and Definitions

The lens attributes are listed in **Annex A**.

Definitions

Iris F-number

This attribute represents the iris position of the lens as a value calculated from the "F-**number**" according to the following equation:

$$\text{Value} = 10000_{\text{h}} \times \left(1 - \frac{\log_2(F)}{8}\right)$$

The value is represented by a 16-bit unsigned integer.

The F-number is a measure of the amount of light transmitted through the lens. It is the focal length divided by the "effective" aperture diameter and is given by

$F = \frac{f}{D}$; where f is the focal length of a lens, and D is the effective lens diameter.

Note 1 The equation above implies that opening iris by one stop (+1EV, e.g. 8 to 5.6) results in increasing 1000h (i.e. 4096) in value, such that, F000h represents F1.4, E000h represents F2, A000h represents F8 and 0000h~6000h actually represents "Closed".

Note 2 The iris position represents the continuous setting of the iris ring on the lens without taking the granularity known as "F-stop" into consideration. This is commonly known as the "F-number".

Note 3 This representation allows only F-numbers greater (and not equal) than F/1.0

Iris T-number

This attribute represents the iris position of the lens as a value calculated from the "T-**number**" according to the following equation:

$$\text{Value} = 10000_{\text{h}} \times \left(1 - \frac{\log_2(T)}{8}\right)$$

The value is represented by a 16-bit unsigned integer.

The T-number (T) is a measure of the amount of light transmitted through the lens in practice and is given by

$\text{T} = \frac{F}{\sqrt{t}}$; where t is the transmittance of the lens.

Iris Ring Position

This attribute represents the rotational position of the lens iris ring.

The value is set by a lens controller and forms the "Iris Ring Position" metadata item.

The value has no units and is expressed as a 16-bit unsigned integer. 0000h represents a fully open iris, FFFFh a closed (or narrowest possible) iris. Intermediate values are proportional to the angle of rotation between the minimum and maximum angles, scaled between 0000h and FFFFh.

Focus Position

This attribute represents the value of the focus position of the lens, in metres, using the common distance format (see ref). The value is a 16-bit floating point number.

There are two variants of the Focus attribute: Focus (Image plane) and Focus (Front lens vertex).

The Focus (Image plane) attribute indicates the distance between the image plane (which is on the optical axis) and the object placed centrally in front of the lens when the centre of the image is in focus.

The Focus (Front lens vertex) attribute indicates the distance between the front of the lens and the object placed centrally in front of the lens when the centre of the image is in focus.

Note 1 The focus position value can be, for example, derived from the setting of the focus ring on the lens.

Note 2 If both of the Focus (Image plane) and the Focus (Front lens vertex) attributes are recorded, priority is given to the Focus (Image plane) attribute.

Focus Ring Position

This attribute represents the rotational position of the lens focus ring.

The value is set by a lens controller and forms the "Focus Ring Position" metadata item.

The value has no units and is expressed as a 16-bit unsigned integer. 0000h represents the minimum focus distance, FFFFh represents focusing at infinity. Intermediate values are proportional to the angle of rotation between the minimum and maximum angles, scaled between 0000h and FFFFh.

Macro Setting

This attribute is a Boolean data type whose value is non-zero (TRUE) if the macro setting is ON, or zero (FALSE) if the macro setting is OFF.

This attribute indicates the capability of the lens macro function for close-up work with a limited focal range and can be generated by a macro on/off switch or by the zoom ring position. When the switch is ON, the value is true even if the focusing distance is long-range or infinity.

Lens Zoom

This attribute represents the focal length (zoom position) of the lens in metres, using the common distance format. The value is a 16-bit floating point number.

There are two variants of the Lens Zoom attributes: Lens Zoom (Actual focal length) and Lens Zoom (35mm equivalent), as shown in Figure 3.

The Lens Zoom (Actual focal length) implies the "effective focal length" considering the focal point on the image plane side. The value may be calculated by the angle of the zoom ring on the lens.

The Lens Zoom (35mm equivalent) is normalized to the 35mm film equivalent value. The actual focal length multiplied by the crop factor is the 35mm equivalent value, where the crop factor is calculated as follows:

$$\text{crop factor} = \frac{\text{(effective diagonal of 35mm film image area)}}{\text{(effective diagonal of the image sensor)}}$$

The diagonal of 35mm film image area is 43.267 mm ($d_{35} = \sqrt{24^2 + 36^2}$)

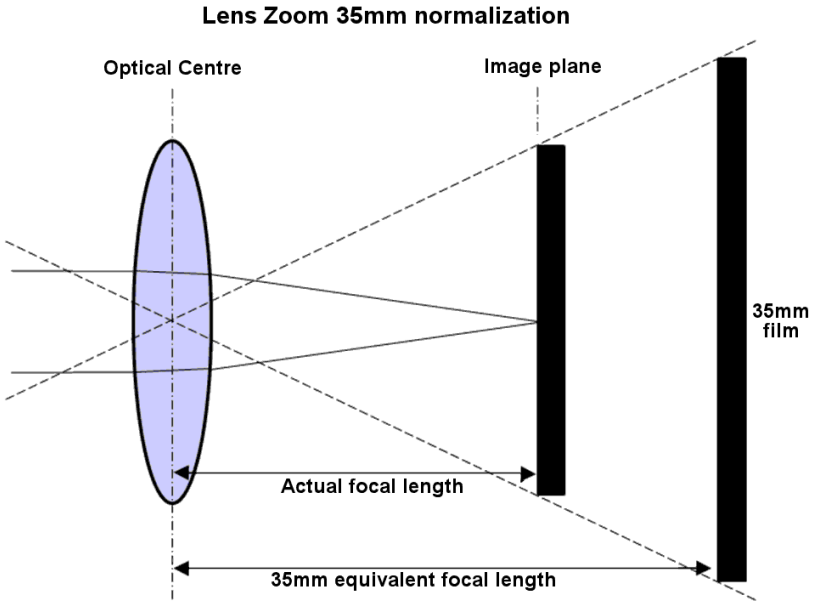

Figure 3: Lens Zoom

The magnification ratio of any conversion lens or of any optical extender is ignored.

Note 1 This 35mm equivalent value is usually used to calculate the angle of view.

Note 2 If both of the 35mm equivalent and the actual value attributes are recorded, priority is given to the Lens Zoom (35mm equivalent) attribute.

Zoom Ring Position

This item represents the rotational position of the lens zoom ring.

This value is set by a lens controller and forms the "Zoom Ring Position" metadata item.

This value has no units and is expressed as a 16-bit unsigned integer. 0000h represents the wide end of the zoom, FFFFh represents the tele end. Intermediate values are proportional to the angle of rotation between the minimum and maximum angles, scaled between 0000h and FFFFh.

Optical Extender Magnification

This attribute represents the magnification ratio of the optical extender as a percentage value where 100% is a magnification ratio of 1.

The value is an unsigned 16-bit integer and the MSB is set to 0.

The attribute is expressed as a nominal value, which represents the magnification ratio at the central point of the image.

This function may be served by a lens built-in Extender, an optional Extender Lens unit, a Close-Up Lens unit or a Wide/Tele Conversion Lens unit. The data may be automatically or manually set. When two or more lenses are attached, the data should be the product of their magnification ratio. If all these functions are inactive or unavailable, the value is set to 100 (64h).

Common Distance Format

The common distance format is used to describe a spatial length (in metres) by a 16-bit floating point value.

$$\text{Distance (value)} = m \times 10^{e} \text{ [metres]},$$

where:

"e" is the exponent in 2's complement form and is the upper 4 bits of the 16 bit value.
"e" represents -8 to 7 with sign.

"m" is the unsigned mantissa, and is the lower 12 bits of the 16 bit value.
"m" represents 0 to 4095 unsigned.

Using the above method of representation, multiple expressions could indicate a particular distance. The expression with the maximum value of mantissa should be used

Note *This format is compatible with the industry practice known as the "Lens Serial" format which is supported by several major camera manufacturers.*

4.3 Camera Metadata Attributes and Definitions

The camera attributes are listed in **Annex B**.

Definitions

Auto Exposure Mode

This attribute identifies the automatic exposure (AE) function by an SMPTE Label value. The default SMPTE Label values are defined in Table 1.

When the exposure is controlled by a camera-specific method (so-called "program AE"), other SMPTE Label values may be used, including class 14 label values.

The evaluation area of the captured image, the response and transition to a change of brightness, and the controlling algorithm are not included in the scope of this function.

When the automatic control is inactive, the SMPTE Label value is set to the manual exposure mode.

Table 1: AE Mode Label Values

Name	Universal Label	Description
Manual Exposure mode	06.0E.2B.34.04.01.01.0B. 05.10.01.01.01.01.00.00	Fully manual exposure control
Full Auto Exposure mode	06.0E.2B.34.04.01.01.0B. 05.10.01.01.01.02.00.00	All available camera facilities used for exposure control
Gain Priority Auto Exposure mode	06.0E.2B.34.04.01.01.0B. 05.10.01.01.01.03.00.00	Gain control set to manual exposure control.
Iris Priority Auto Exposure mode	06.0E.2B.34.04.01.01.0B. 05.10.01.01.01.04.00.00	Iris control set to manual exposure control. This is widely known as 'aperture priority'.
Shutter Priority Auto Exposure mode	06.0E.2B.34.04.01.01.0B. 05.10.01.01.01.05.00.00	Shutter speed set to manual exposure control. This is widely known as 'shutter priority'
Camera specific control mode	06.0E.2B.34.04.01.01.vv. 0E.xx.xx.xx.xx.xx.xx.xx	SMPTE class 14 Labels for manufacturers' private use

Note 1 Although several components (i.e. iris, shutter or gain of the amplifier) affect the exposure, the camera operator can manually fix each component in AE operation. For this reason, the AE mode label value identifies which component is manual.

Note 2 Label values are registered in SMPTE RP 224. The values of the second 8-byte group for each entry in table 3 are structured as follows:

Byte 9: 05 (Process)
Byte 10: 01 (Setting)
Byte 11: 01 (Device Settings)
Byte 12: 01 (Camera Settings)
Byte 13: 01 (Exposure Settings)
Byte 14: 01~05 (per Table 1 above)

Exposure Index of Photo Metre

This attribute represents the applied index of the light metre in terms of an ISO number.

The value is an unsigned 16-bit integer.

Note: This item is referred to by a push/pull process in post production. If the value is different from the ISO Sensitivity of the camera, pull or push processing will be needed during post production.

Auto Focus Sensing Area Setting

This attribute is an unsigned integer 8-bit code value to indicate the automatic focusing (AF) sensing area.

Available code values are assigned as defined in Table 2.

If the camera uses external methods of measuring distance (e.g. by the reflection of an ultrasonic or infra-red ray), the "Special Sensor" mode code is used.

The AF Mode value is used to evaluate the area of the image for distance measurement.

The response and transition to a moving object, including any wobbling rate and depth, assistance from other measurement methods or any controlling algorithm is not included in the scope of this definition.

When any automatic control is inactive, the value is set to the code for the Manual Focus mode.

Table 2: AF Mode Code List

Name	Code (hex)	Description
Manual Focus mode	00	Focus manually set
Centre Sensitive Auto Focus mode	01	Focus at the centre of the frame
Full Screen Sensing Auto Focus mode	02	Focus set for the whole screen
Multi Spot Sensing Auto Focus mode	03	Focus set using multiple spot sensing
Single Spot Sensing Auto Focus mode	04	Focus set at a spot located adaptively or by the user
Reserved	05 - FE	Reserved
Undefined	FF	Undefined

Color Correction Filter Wheel Setting

This attribute represents the characteristics of the built-in optical color compensation (CC) filter. The value is an 8-bit unsigned integer.

Available code values are as listed in Table 3.

Table 3: CC Filter Code List

Name	Code	Description
Cross effect filter	00	transparent filter with meshed groove for cross effect
CC filter 3200K	01	transparent filter for 3200K lighting
CC filter 4300K	02	light yellow filter for 4300K lighting
CC filter 6300K	03	pale orange filter for 6300K lighting
CC filter 5600K	04	pale orange filter for 5600K lighting
Reserved	06 - FE	Reserved
Undefined	FF	Undefined

Note 1 This attribute should be omitted from the metadata set if the camera is not equipped with a built-in CC filter wheel.

Note 2 This attribute does not represent any pseudo-CC-filter code which is not an optical effect (i.e. an electrical color compensation function). In such cases, the White Balance attribute can be used.

Neutral Density Filter Wheel Setting

This attribute describes the attenuation ratio of the built-in optical neutral density (ND) filter (i.e. flat grey filter). It represents the reciprocal number of the attenuation ratio (i.e. the denominator of the attenuation ratio of the filter where the numerator is 1). The value is an unsigned 16-bit integer as follows.

$$\text{Attenuation ratio} = \frac{1}{\text{Value}}$$

Note 1 For example, the ND Filter Value of 32 is identified as "ND32" whose attenuation ratio is 1/32. In general, the value is expressed as a power of two. The data can be set automatically by any built-in ND filter.

Note 2 This attribute is not intended for any "ND filter" which uses gradation or color tone for artistic effect.

Image Sensor Dimension

The Image Sensor Dimension is specified by the Image Sensor Dimension Effective Width and Image Sensor Dimension Effective Height values.

These values represent the width and height of the rectangular area of the image sensor in micrometres and are expressed as unsigned 16-bit integers.

Note: The rectangular area of the image sensor corresponds to the rectangular area of the video output image and can vary according to the selected aspect ratio. For example, when an image sensor has the effective area of 10 mm x 5.6 mm (16:9) and the output image is edge cropped to 4:3, the Image Sensor Dimension values are 7467 for width and 5600 for height.

Capture Frame Rate

This attribute represents the rate at which video images are captured, expressed in frames per second.

The Frame Rate value is a 64-bit RATIONAL number (ratio of two 32 bit signed integers, the first is the numerator and the second is the denominator).

The denominator value is a constant value throughout capture.

The numerator value should be less than 32768 and the value may vary during capture.

Note This attribute can be used to describe over/under-cranking to create slow/quick motion.

Image Sensor Readout mode

This attribute is an unsigned integer 8-bit code which identifies the method of reading the sensor signals from the image sensor pixels.

Available code values are assigned as defined in Table 4 (also see Figure 4).

Table 4: Image Sensor Readout Mode

Name	Code	Description
Interlaced field	00	Interlaced scan (average of two lines)
Interlaced frame	01	Interlaced scan (line alternation)
Progressive frame	02	Progressive scan
Reserved	04-FE	Reserved
Undefined	FF	Undefined method

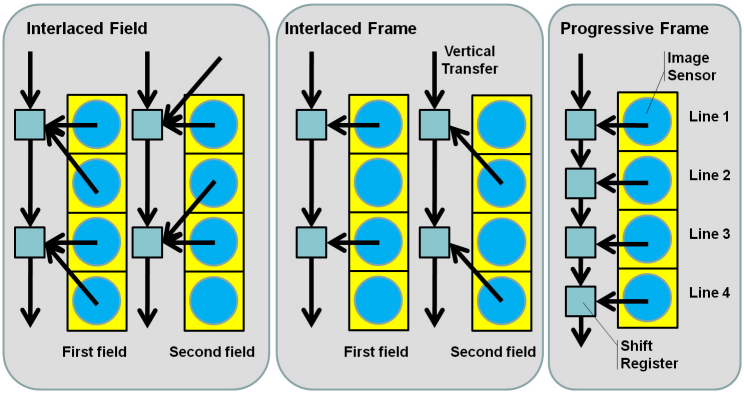

Figure 4: Image sensor readout mode (e.g. CCD)

Shutter Speed (Angle)

This attribute represents the exposure period, expressed as an angle [minutes, 1/60 degree].

This value is represented by a 32-bit unsigned integer where the value is the angle in minutes and is set to 21600 (360 x 60 = 5460_h) where 21600 minutes represent a frame period.

Note 1 This function can also be used for slow shutter mode operation. For example, when the image sensor charges for 2 frame periods, the angle will be 43200 minutes, resulting in a value of 0000A8C0h.

Note 2 When the shutter effect is not used, this is the equivalent to 360 degrees resulting in a value of 21600 minutes.

Note 3 If both of the Shutter Speed (Angle) and the Shutter Speed (Time) attributes are recorded, priority is given to the Shutter Speed (Angle).

Shutter Speed (Time)

The Shutter Speed (Time) attribute represents the exposure period in seconds.

This value is a 64-bit RATIONAL number (ratio of two 32 bit signed integers, the first is the numerator and the second is the denominator) that defines the Shutter Speed (Time) expressed in seconds.

Note 1 For example, 1/1000 would define a shutter speed of 1 ms.

Note 2 This function can also be used for slow shutter mode operation. For example, when the image sensor charges for 2 frame periods in a 24-frame system, i.e. 2/24 seconds, the result is a value of 0000000200000018_h

Camera Master Gain Adjustment

This attribute represents the adjustment level of the master gain control, expressed in increments of 0.01 dB (decibel). The gain value implies a gain for each RGB signal.

This value is expressed as a 16-bit integer. When this function is inactive, the value is set to 0.

Note For example, when a head-amplifier boosts the camera signal by +12dB, the value is set to 1200 ($4B0_h$).

ISO Sensitivity

This attribute represents the sensitivity of the camera unit to light in terms of an ISO number.

The value is an unsigned 16-bit integer.

The value (i.e. the ISO number) is calibrated in accordance with the exposure index defined in ISO 12232:2006 and is measured under the test conditions described in ISO 12232 except for "photosite integration time" which depends on the video rate. The range of possible values is continuous, unlike the discrete values (e.g., 100, 125, 160, 200 etc) defined for still cameras in ISO 12232.

Note: This item does not specify the performance of the image sensor device, but is a parameter to determine the exposure during acquisition. Therefore, although the ISO number is initially adjusted to an appropriate setting as made available by the camera manufacturer, the actual value will in practice fluctuate depending on the Master Gain or other settings.

Electrical Extender Magnification

This attribute represents the ratio of the Electrical Extender Magnification, expressed as a percentage value where 100% is a magnification ratio of 1.

The percentage value is an unsigned 16-bit integer and the MSB is set to 0.

Since this attribute is for simple picture magnification, it does not separately specify the position of the close up. The centre of the resized picture should be considered the same as the captured picture. This attribute is not intended for any special effects such as partial screen zooming, i.e. distorting picture or superimposing sub screen, but for full screen zooming.

When this function is inactive, the value is set to 100 (64_h).

Auto White Balance Mode

This attribute represents the mode of the automatically adjusted white balance as an 8-bit code value.

Available code values are as enumerated in Table 5.

Table 5: White Balance (WB) Setup Code List

Name	Code	Description
Preset White Balance Setup	00	The WB is set to a fixed value.
Automatic White Balance Setup	01	The WB value is continuously adjusted automatically.
Hold White Balance Setup	02	The current WB value is held. This mode is usually triggered manually during the automatic WB mode.
One Push White Balance Setup	03	Rapid adjustment to an automatically determined WB value. This mode is usually triggered manually during the preset WB mode or the automatic WB mode.
Reserved	04 - FE	Reserved values.
Undefined	FF	Undefined

Note 1 This function is not used to define a target color tone. The evaluation area of the image, the response and transition against the change of light and the controlling algorithm are considered out of scope for this definition.

Note 2 When the automatic white balance mode control is inactive, the value is set to the

'Preset White Balance' code.

White Balance (Temperature)

This attribute represents the white balance, expressed as the color temperature [Kelvin].

The value is an unsigned 16-bit integer and the MSB is set to 0.

Note 1 This value does not imply the actual color temperature of the light source.

Note 2 The White Balance color temperature has a spectral power distribution curve that is a close approximation to that of black body radiation calculated by Planck's law.

Camera Master Black Level

This attribute represents the master black level setting of the camera.

The value is a signed 16-bit integer

The value is the difference between the camera output black level and the input black level in units of 0.1 percent where 100 percent means white.

When this function is inactive, the value is set to 0.

Note A positive value means that the black level is shifted upwards to brighten the picture. The contrast of picture will be affected by this control in order to maintain a stable white level.

Knee Function

Video cameras typically ameliorate the harsh clipping with a knee which allows cameras to compress their dynamic range. The knee function is expressed as two parameters to approximate its compression characteristics, i.e. Knee Point and Knee Slope. When this function is inactive, the Knee Slope value is set to 1/1.

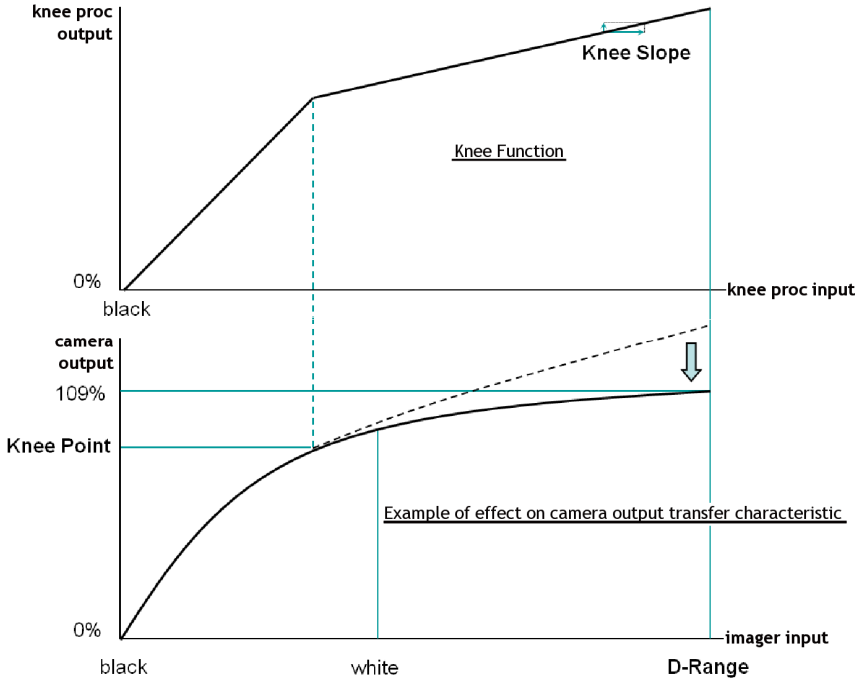

Figure 5: Knee and Dynamic Range

Camera Knee Point

This attribute represents the knee point of the camera knee characteristic (see Figure 5) expressed as the luminance level at which dynamic range compression starts to flatten the contrast curve.

The Knee Point value increment is in units of 0.1 percent and the value is represented as a UInt16 (unsigned 16-bit integer).

Camera Knee Slope

This attribute, indicated in the upper part of Figure 5, represents the degree of compression applied to the signal from the camera image sensor. In the figure it is the slope of the line to the right of the Knee Point.

$$\text{Knee Slope} = \frac{\Delta \text{ output}}{\Delta \text{ input}}$$

The value is a 64-bit RATIONAL number (ratio of two 32-bit signed integers, the first is the numerator and the second is the denominator).

The slope of the line between black level and the Knee Point is 1 (e.g. no transformation).

Camera Luminance Dynamic Range

This attribute represents the peak signal level that the camera image sensor would deliver in the absence of any signal compression that may be applied through the knee characteristics described above. The value is expressed in units of 0.1% and is represented as a UInt16 (unsigned 16-bit integer) to allow a large headroom for peak signal levels at the camera sensor (see Figure 5).

Capture Gamma Equation

This attribute represents the camera capture gamma value as a 16-byte SMPTE Label.

The Label values are given in Table 6.

When a camera-specific gamma curve is required, an org/private label (i.e. Class 14) may be used.

Note *The signal processor compensates for the distortion of the image sensor. Since this attribute indicates the basic gamma curve, the value is not affected by the other non-linear level conversion functions (i.e. knee control, black gamma, solarisation reduction etc.).*

Table 6: Gamma Type Label list

Name	Universal Label	Description
ITU-R BT.709 Transfer Characteristic	06.0E.2B.34.04.01.01.01 - 04.01.01.01.01.02.00.00	
SMPTE ST 240 Transfer Characteristic	06.0E.2B.34.04.01.01.01 - 04.01.01.01.01.03.00.00	
Preset-specific gamma curve	06.0E.2B.34.04.01.01.vv - 0E.xx.xx.xx.xx.xx.xx.xx	Class 14 Labels for manufacturers' private use

Gamma for CDL

This attribute represents the gamma characteristics at the input of the CDL, i.e. called ICT (Input Conversion Transform).The value is described in an 8-bit code. Available code values are as enumerated in Table 7.

Table 7: ASC CDL code list

Name	Code	Description
Content Video	00	gamma not defined below, specified as Capture Gamma
Scene Linear	01	proportional to the light level
S-Log	02	The formula representing the S-Log curve is as follows $y = (0.432699 \times \log_{10}(t + 0.037584) + 0.616596) + 0.03$ Where t ranges from 0 to 10.0, representing 0% to 1000% input light level to the camera. Multiply y by 100 to obtain the percentage value.
Cine-Log	03	generic logarithm gamma in cinema system
Reserved	04 - FE	Reserved
Undefined	FF	Undefined

ASC CDL V1.2

This attribute represents ASC CDL V1.2.

The V1.2 includes 10 items: Slope R, Slope G, Slope B, Offset R, Offset G, Offset B, Power R, Power G, Power B and Saturation. Each item is described in “ASC Color Decision List (ASC CDL) Transfer Functions and Interchange Syntax” instituted by American Society of Cinematographers.

The attribute type is an array of Half Float that is defined in IEEE 754 as the half precision binary floating-point format.

Table 8: Structure of ASC CDL V1.2

Name	Type	Length	Description
Number of elements	UInt32	4	10
Length of each element.	UInt32	4	2
Slope R	Half Float	2	ASC Slope Red Value
Slope G	Half Float	2	ASC Slope Green Value
Slope B	Half Float	2	ASC Slope Blue Value
Offset R	Half Float	2	ASC Offset Red Value
Offset G	Half Float	2	ASC Offset Green Value
Offset B	Half Float	2	ASC Offset Blue Value
Power R	Half Float	2	ASC Power Red Value
Power G	Half Float	2	ASC Power Green Value
Power B	Half Float	2	ASC Power Blue Value
Saturation	Half Float	2	ASC Saturation Value

Camera Setting File URI

This attribute is used to identify the URI (Uniform Resource Identifier) of a file that defines the camera setting values as human-readable UTF8 text. The URI complies with RFC 3986.

Note UTF8 may be used within a URI to represent characters outside the range of the US-ASCII coded character set. RFC 3987 defines this method as a complement to the URI.

Color Matrix

This attribute represent the matrix applied between the R, G and B channels.

Compensation of a color filter of an image sensor according to the color matrix should be applied prior to gamma encoding.

The Color Matrix attribute is a 9 elements ordered vector of a 64-bit RATIONAL number (ratio of two 32-bit signed integers, the first is the numerator and the second is the denominator) containing the values in Table 9.

Table 9: Color Matrix Label List

Color Matrix Label	Description	Value
Number of elements	9	UInt32
Length of each element.	8	UInt32
R>R	Amount of Red channel into Red Channel	RATIONAL
G>R	Amount of Green channel into Red Channel	RATIONAL
B>R	Amount of Blue channel into Red Channel	RATIONAL
R>G	Amount of Red channel into Green Channel	RATIONAL
G>G	Amount of Green channel into Green Channel	RATIONAL
B>G	Amount of Blue channel into Green Channel	RATIONAL
R>B	Amount of Red channel into Blue Channel	RATIONAL
G>B	Amount of Green channel into Blue Channel	RATIONAL
B>B	Amount of Blue channel into Blue Channel	RATIONAL

4.4 Microphone Metadata

The microphone attributes are listed in **Annex C**.

4.5 Device Metadata

The device attributes are listed in **Annex D**.

4.6 Audio Metadata

The audio attributes are listed in **Annex E**.

4.7 Video Metadata

The video attributes are listed in **Annex F**.

5. Maintenance

The specification is maintained by the EBU and suggestions for corrections or additions can be made by e-mailing to (metadata@ebu.ch). Contributions will be subject to peer review by the metadata experts participating in ECM, the EBU Expert Community on Metadata, (http://tech.ebu.ch/groups/ecm).

6. Bibliography

EBU R 114	"User requirements for non tape-based camcorders", P/AGTR / 2005
EBU Tech 3301	"Metadata for non-tape-based camcorders for broadcast production", 2005
	Basic analysis of the processes in acquisition, P/CP / 2007
SMPTE RDD18, 2010	Acquisition Metadata Sets for Video Camera Parameters
SMPTE RP224	Registry of SMPTE Universal Labels
ITU-R BT.709-5 (04/02)	Parameter values for the HDTV standards for production and international programme exchange
SMPTE ST 240	(Legacy) SMPTE C Transfer Characteristic
"2020 3D Media Special Sound & Vision" Project, Deliverable 3.5	Metadata Representation for 3D Cinema Production

Annex A: LENS UNIT METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
LensUnitMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
IrisFNumber	Opt	Iris position value calculated from the “F-number” that is a measure of the amount of light transmitted through the lens			UInt16 (RP215)
IrisTNumber	Opt	Iris position value calculated from the “T-number” that is a measure of the amount of light transmitted through the lens			UInt16 (RP215)
IrisRingPosition	Opt	represents the rotational position of the lens iris ring			UInt16 (RP215)
FocusPositionFromImagePlane	Opt	Distance between the image plane and the object in focus.	Metres		Float16 (RP 215)
FocusPositionFromFrontLensVertex	Opt	Distance between the front of the lens and the object in focus.	Metres		Float16 (RP 215)
FocusRingPosition	Opt	represents the rotational position of the lens focus ring			UInt16 (RP215)
MacroSetting	Opt	Specifies by a flag, whether the macro setting is activated.	n.a.	True: on, False: off	Boolean
LensZoom35mmStillCameraEquivalent	Opt	Focal length	Metres		Float16 (RP 215)
LensZoomActualFocalLength	Opt	Focal length	Metres		Float16 (RP 215)
ZoomRingPosition	Opt	represents the rotational position of the lens zoom ring			UInt16 (RP215)
OpticalExtenderMagnification	Opt	Magnification factor setup of an optical extender or conversion lens where present			UInt16
LensAttributes	Opt	Informative description of additional attributes about the lens in use (as a text string). The string length is less than 64 bytes.			UTF8 String
LensType	Opt	Specifies the type of the lens used during capturing,		e.g. tele, zoom.	UTF8 String
LensSerialNumber	Opt	Describes the serial number of the lens, given by the manufacturer.			UTF8 String
LensManufacturer	Opt	Describes the name of the manufacturer of the lens.			UTF8 String
LensModelName	Opt	Describes the model name given by the manufacturer.			UTF8 String
LensComments	Opt	Describes comments about the used lens.			UTF8 String

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Annex B: CAMERA METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
CameraUnitMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
AutoExposureMode	Opt	Auto Exposure setup Mode. Describes the mode the camera uses for automatic exposure .		SMPTE RP 224	Label (UL)
AutoFocusSensingAreaSetting	Opt	Auto Focus Sensing Area. Describes the selected areas used for the auto focus.		Registered code RDD 18	UInt8
ColorCorrectionFilterWheelSetting	Opt	Color Compensation Filter Wheel. Specifies the setting of the filter wheel used for color correction.		Registered code RDD 18	UInt8
NeutralDensityFilterWheelSetting	Opt	Neutral Density Filter Wheel setting describes the reciprocal of the attenuation ratio of the built-in optical density (ND) filter.		1 means 'clear'	UInt16
FilterWheelSetting	Opt	Specifies the type of filter applied or selected.		Color filter; Neutral filter; Star filter;	UTF8 String
ImageSensorDimensionEffectiveWidth	Opt	Image sensor effective width	µm		UInt16
ImageSensorDimensionEffectiveHeight	Opt	Image sensor effective height	µm		UInt16
CaptureFrameRate	Opt	Capture Frame Rate in fps (e.g. 50:1, 60000:1001). The rate at which the video is captured in frames per second	The number of frames per second		Rational: RP210 4bytes+4bytes -> frame + '1'
ImageSensorReadoutMode	Opt	Image sensor Readout mode		Registered codes RDD 18	UInt8
ShutterSpeed_Angle	Opt	Shutter speed as an Angle defining the shutter speed (angle) in minutes relative to a completely open shutter angle of 360 degrees.	Angle minutes		UInt32
ShutterSpeed_Time	Opt	Shutter speed as a Time defining the shutter speed (time) - preferred to angle	seconds		RATIONAL
CameraMasterGainAdjustment	Opt	Master Gain Control setting	0.01dB		Int16
ExposureIndexOfPhotoMetre	Opt	represents the applied index of the light metre in terms of an ISO number			UInt16
ISOSensitivity	Opt	represents the sensitivity of the camera unit to light in terms of an ISO number		ISO 12232	UInt16
ElectricalExtenderMagnification	Opt	Expresses the magnification setup of the picture size in percent where 100% (64h) represents the original picture size	Percents		UInt16

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
CameraUnitMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
AutoWhiteBalanceMode	Opt	Auto White Balance Mode		Registered code RDD 18	UInt8
WhiteBalance	Opt	White Balance value defined by the temperature	degree kelvin		UInt16
CameraMasterBlackLevel	Opt	Level of the master black level of the camera expressed as a percentage in relation to the white value	0.10%		UInt16
CameraKneePoint	Opt	Level of the knee point in the camera transfer characteristic expressed as a percentage. Specifies the level in the white signal above which a nonlinear signal processing is active.	0.10%		UInt16
CameraKneeSlope	Opt	Slope of the transfer characteristic above the knee point as a percentage of the slope below the knee point			RATIONAL
CameraLuminanceDynamicRange	Opt	Luminance Dynamic Range expressed as a percentage in reference to the nominal white level	0.10%		UInt16
CaptureGammaEquation	Opt	Specifies the gamma of the camera transfer function. It describes the non-linear relationship between the linear scene light level and the amplitude compressed video signal levels at signal origination.		SMPTE RP 224.	Label (UL)
GammaForCDL		Represents the gamma characteristics at the input of the ASC Color Decision List			UInt8
ASC_CDL_V12		Represents the gamma characteristics at the input of the ASC Color Decision List V1.2			header + Vector of 10 half float
CameraSettingFileURI	Opt	URI value of the file containing the camera setup parameters. The string length is less than 64 bytes.			UTF8 String
CameraAttributes	Opt	Informative description of additional attributes about the camera in use (as a text string). The string length is less than 64 bytes.			UTF8 String
SensorType	Opt	Describes the type of sensor used in camera, e.g. CCD or CMOS.		CCD; CMOS	UTF8 String
CameraSubsampling	Opt	Describes the sub-sampling of the luminance and chrominance signal used for operating the camera. In certain circumstances, this can be different from the one used for recording.			UTF8 String
ColorMatrix	Opt	Specifies the setting of the color balance of the camera with the ordered vector matrix (R>R, G>R, B>R, R>G, G>G, B>G, R>B, G>B, B>B)			header +Vector of 9 RATIONAL

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
CameraUnitMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
ColorSpace	Opt	Specifies the color space used by the camera.			Label (UL)
SensorPixelHeight	Opt	Describes the number of active vertical pixel (lines) of the camera sensor.			UInt16
SensorPixelWidth	Opt	Describes the number of active horizontal pixel of the camera sensor.			UInt16
VideoClipping	Opt	Specifies the level above that the video signal will be hard clipped, expressed in percent in relation to the nominal white level.	0.10%		UInt16
VideoLimiter	Opt	Specifies the level above that the video signal will be limited nonlinear, expressed in percent in relation to the nominal white level.	0.10%		UInt16
CameraSampleHeight	Opt	Describes the number of vertical active samples (lines) used for operating the camera. In certain circumstances, this can be different from the one used for recording.			UInt16
CameraSampleWidth	Opt	Describes the number of horizontal active samples used for operating the camera. In certain circumstances, this can be different from the one used for recording.			UInt16
OffsetBlackLevelSetting	Opt	Specifies the black level offset setting in percent in relation to nominal value of the white level.	0.10%		UInt16
BlackstretchLevel	Opt	Specifies the level in the black signal below which a nonlinear signal processing is active. The level is specified in percent in relation to the nominal white level.	0.10%		UInt16
BlackstretchRange	Opt	Specifies the slope of the transfer characteristic below the black stretch level in percent in relation to the slope above.	0.10%		UInt16
MaskSetting	Opt	Specifies a label, which selects a set of a defined six vector matrix already stored in the camera.			UTF8 String
Shutter	Opt	A flag indicating the shutter state		True = active	Boolean
CameraFrameLayout	Opt	Describes the method of scanning frames (e.g. interlaced, progressive), used for operating the camera. In certain circumstances, this can be different from the one used for recording.		interlaced / progressive	UTF8 String or Label (UL)

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Annex C: MICROPHONE METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
MicrophoneUnitMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
OutputType	Opt	Output type for audio format (implicit in the model, but useful to specify explicitly), values are *A format*, *B format*, or custom (with an additional identifier for the format)			UTF8 String
Microphone position	Opt	Microphone position in 3D space (with respect to a local absolute reference point)	degrees, [0°;360°)); degrees, (-90°,90°)); degrees, (-180°,180°))		Float (degrees, [0°;360°)); Float (degrees, (-90°,90°)) Float (degrees, (-180°,180°))
Microphone orientation	Opt	Microphone orientation in 3D space (given as pan/tilt/roll angles and convention for specifying the angles)	metres		Float Float Float
MicrophoneType	Opt	Specifies the type of the microphone used during capturing,			UTF8 String
MicrophoneSerialNumber	Opt	Describes the serial number of the microphone, given by the manufacturer.			UTF8 String
MicrophoneManufacturer	Opt	Describes the name of the manufacturer of the microphone.			UTF8 String
MicrophoneModelName	Opt	Describes the model name given by the manufacturer.			UTF8 String
MicrophoneComments	Opt	Describes comments about the used microphone.			UTF8 String

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Annex D: DEVICE METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
ProductionDeviceMetadata					
InstanceUID	Opt	Unique ID of the instance of this data set.			
DeviceType	Opt	Describes the type of a production device, e.g. camcorder, camera, monitor.	n.a.	n.a.	UTF8 String or Label (UL)
DeviceDescription	Opt	Informative description of the device in use (as a text string). The string length is less than 64 bytes.	n.a.	n.a.	UTF8 String
DeviceManufacturer	Opt	Describes the name of the manufacturer of the device.	n.a.	n.a.	UTF8 String
DeviceModelName	Opt	Describes the name of the device, given by the manufacturer, e.g. Sony PDW-F800 XDCAM HD422 Camcorder.	n.a.	n.a.	UTF8 String
DeviceSerialNumber	Opt	Describes the serial number of a production device assigned by the manufacturer.	n.a.	n.a.	UTF8 String
DeviceSoftwareVersion	Opt	Describes the number of the software version used in the production device	n.a.	n.a.	UTF8 String
DeviceComment	Opt	Describes comments about the device.	n.a.	n.a.	UTF8 String
CameraUnitMetadataReference	Opt	The CameraUnitMetadataReference attribute describe the relevant parameters of the used camera unit	n.a.	n.a.	CameraUnitMetadata (strong reference)
LensUnitMetadatReference	Opt	The LensUnitMetadataReference attribute describe the relevant parameters of the used lens unit	n.a.	n.a.	LensUnitMetadata (strong reference)

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Annex E: AUDIO METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
AudioEssenceDescriptor					
InstanceUID	Opt	Unique ID of the instance of this data set.			
ElectroSpatialFormulation	Opt	e.g. Stereo Left			UTF8 String or Label (UL)
SampleRate	Opt	Specifies the sampling rate of the audio signals	sample/s		UInt64
AudioSampleResolution	Opt	Specifies the active number of bits per audio sample.			UInt16
AudioEncoding	Opt	Specifies the compression algorithm used to encode the audio signal.			UTF8 String or Label (UL)
AudioCodingBitrate	Opt	The maximum bit rate of the applied audio coding scheme	bit/s		UInt64
AudioGainSetting	Opt	Specifies the setting of the gain of the audio signal, expressed in units of 0.1dB.	0.1dB		UInt16
AudioHeadroom	Opt	Specifies the setting of the headroom of the audio signal expressed in units of 0.1dB.	0.1dB		UInt16
AudioLimiter	Opt	Specifies the level above that the audio signal will be limited nonlinear, expressed in units of 0.1% in relation to the nominal audio level.	0.10%		UInt16

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Annex F: VIDEO METADATA SET

Attribute Name	Req?	Meaning	Unit	Reserved Values	Datatype
VideoEssenceDescriptor					
InstanceUID	Opt	Unique ID of the instance of this data set.			
FrameLayout	Opt	Describes the method of scanning frames, used for operating the camera. In certain circumstances, this can be different from that used for recording.		interlaced / progressive	UTF8 String or Label (UL)
FrameRate	Opt	Specifies the frame frequency of the video signal.	frame/s		RATIONAL
AspectRatio	Opt	Specifies the proportion of the picture width to picture height of the picture format used during shooting.			RATIONAL
VideoSamplingRaster	Opt	Describes the sampling raster (e.g. 1280 x 720) of a video signal.			UTF8 String or Label (UL)
VideoEncoding	Opt	Specifies the compression algorithm used to encode the video signal.			UTF8 String or Label (UL)
VideoCodingBitrate	Opt	The maximum rate at which the compressed bit stream is delivered, e.g. from the storage medium to the input of a decoder	bit/s		UInt64
VideoClipping		Specifies the level above which the video signal will be hard clipped, expressed in units of 0.1% in relation to the nominal white level.	0.10%		UInt16
VideoLimiter		Specifies the level above which the video signal will be limited (nonlinear), expressed in units of 0.1% in relation to the nominal white level.	0.10%		UInt16