Fraunhofer Institut
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Prime

Specification of a Raw Data Format for HD-SDI Single Link

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History

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0.13	H. Sparenberg	04.11.2008	Redesign and changes
0.14	S. Franz	08.11.2008	Added Metadata and Related Work section
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0.23	W. Thieme, H.Sparenberg	28.01.2009	Added Foreword and Scope

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Foreword:

This document provides a standardized way of transmitting camera RAW data using existing infrastructure of SMPTE 292M compliant equipment. The original intend was to transmit unprocessed 12-bit sensor RAW data of a bayer masked sensor to a existing storage unit using the 1.5Gb/s serial digital interface specified in SMPTE 292M in order to do the image processing afterwards. With the image processing outside the camera much more complex algorithms can be used due to the huge amount of processing power in modern computer systems. This approach also avoids the limitations caused by the 4:2:2 chroma subsampling and the limited bit width of the serial digital interface.

1 Scope

This standard defines a RAW data image sampling structure for HDTV formats defined in SMPTE 274M and SMPTE 296M.
This standard defines the digital representation of raw data using a 1.5Gb/s serial digital interface defined in SMPTE 292M.
This standard specifies the usage of SMPTE 352M compliant metadata packeges to transmit raw data related information.

Fehler! Verweisquelle konnte nicht gefunden werden. shows all formats covered in this document.

Table 1: Format overview

System Number	System nomenclature	Framerate (MHz)	Interface sampling frequency (MHz)	Samples per active line	Lines per active frame	Samples per total line	Lines per total frame	Standard
1	1920 x 1080/ 60/ P	60	74.25	1920	1080	2200	1125	274M
2	1920 x 1080/ 59.94/ P	60/ 1.001	74.25/ 1.001	1920	1080	2200	1125	274M
3	1920 x 1080/ 50/ P	50	74.25	1920	1080	2640	1125	274M
4	1920 x 1080/ 48/ P	48	74.25	1920	1080	2750	1125	None
5	1920 x 1080/ 47.96/ P	48/ 1.001	74.25/ 1.001	1920	1080	2750	1125	None
6	1920 x 1080/ 30/ P	30	74.25	1920	1080	2200	1125	274M
7	1920 x 1080/ 29.97/ P	30/ 1.001	74.25/ 1.001	1920	1080	2200	1125	274M
8	1920 x 1080/	25	74.25	1920	1080	2640	1125	274M

	25/ P							
9	1920 x 1080/ 24/ P	24	74.25	1920	1080	2750	1125	274M
10	1920 x 1080/ 23.98/ P	24/ 1.001	74.25/ 1.001	1920	1080	2750	1125	274M
11	1280 x 720/ 120/ P	120	74.25	1280	720	1650	750	None
12	1280 x 720/ 119.88/ P	120/ 1.001	74.25/ 1.001	1280	720	1650	750	None
13	1280 x 720/ 100/ P	100	74.25	1280	720	1980	750	None
14	1280 x 720/ 60/ P	60	74.25	1280	720	1650	750	296M
15	1280 x 720/ 59.94/ P	60/ 1.001	74.25/ 1.001	1280	720	1650	750	296M
16	1280 x 720/ 50/ P	50	74.25	1280	720	1980	750	296M

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or contains the conformance language keywords: "shall", "should", or "may". Informative text is text that is potentially helpful to the user, but not indispensable, and can be removed, changed, or added editorially without affecting interoperability. Informative text does not contain any conformance keywords.

All text in this document is, by default, normative, except: the Introduction, any section explicitly labeled as "Informative" or individual paragraphs that start with "Note:”

The keywords "shall" and "shall not" indicate requirements strictly to be followed in order to conform to the document and from which no deviation is permitted.

The keywords, "should" and "should not" indicate that, among several possibilities, one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required; or that (in the negative form) a certain possibility or course of action is deprecated but not prohibited.

The keywords "may" and "need not" indicate courses of action permissible within the limits of the document.

The keyword “reserved” indicates a provision that is not defined at this time, shall not be used, and may be defined in the future. The keyword “forbidden” indicates “reserved” and in addition indicates that the provision will never be defined in the future.

A conformant implementation according to this document is one that 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.

Unless otherwise specified, the order of precedence of the types of normative information in this document shall be as follows: Normative prose shall be the authoritative definition, tables shall be next, followed by formal languages, then figures, and then any other language forms.

3 Normative References

The following standards contain provisions, which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

SMPTE 274M-2005, Television — 1920 x 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates
SMPTE 292M-2006 — 1.5GB/s Signal/Data Serial Interface
SMPTE 296M-2001, Television — 1280 x 720 Progressive Image Sample Structure — Analog and Digital Representation and Analog Interface
SMPTE 352M-2002, Television (Dynamic) — Video Payload Identification for Digital Interfaces

4 Glossary of Acronyms and Terms

2K	Images size with at least 2000 active pixel per line
4K	Images size with at least 4000 active pixel per line
Bit	Binary digit
D	Data rate
D_{RD}	Data rate of raw data
deg	degree
DI	Digital Intermediate
DNG	Digital Negative – raw format designed by Adobe Systems Inc.
DPX	Digital Picture Exchange
EDL	Edit Decision List
Final Cut Pro	Non-linear editing software application developed by Apple Inc.
fps	frames per second
Gb/s	Gigabyte per second
HD	High Definition
HD-SDI	High Definition Serial Digital Interface
HDTV	High Definition Television
Hz	Hertz – here: framerate
Log	Logarithmic
LTC	Longitudinal Timecode
QuickTime	Multimedia framework developed by Apple Inc.
Rec. 709	ITU-R Recommendation BT.709
SCRATCH	Postproduction suite developed by ASSIMILATE Inc.
SMPTE	Society of Motion Picture and Television Engineers
S/TL	Samples per Total Line
TIFF	Tagged Image File Format
T-Link	ARRIRAW Transport Link - ARRI Raw data format designed to transfer raw data from the ARRIFLEX D-21 camera to a recorder

5 Overview (Informative)

5.1 Related Work

5.1.1 ARRIRAW T-Link

The ARRIRAW T-Link (Transport Link) was designed to transfer raw data from the ARRIFLEX D-21 camera to a recorder. The T-Link standard features a method of packing ARRIRAW 12bit data into the RGBA HD file format. Data is carried over a dual link HD-SDI connection according to SMPTE 372M.

5.1.2 RED Raw Data Flow

The RED Camera generates 4K files using the REDCODE RAW (.R3D) format and additionally generates 1K/2K QuickTime reference movies of the RAW images. The QuickTime reference movies allow immediate offline editing in Final Cut Pro. Afterwards, the EDL created by Final Cut and the native .R3D Files are imported in ASSIMILATE SCRATCH which matches them and is able to render out common DI formats like DPX or TIFF in Log, Linear or REC709 colorspace.

5.1.3 Adobe DNG

Digital Negative (DNG) is a RAW image format designed by Adobe. DNG was developed in an effort to provide an open standard for a unifying camera raw file format. The intention of DNG is to substitute proprietary raw formats of the different camera manufacturers. With the support of all popular image processing software DNG ensures that photographers will be able to access and to work on their raw files in the future.

5.2 Motivation for a raw data workflow

The short overview of the ARRIRAW T-Link and the RED Raw Data Flow indicates that there is no standard for a raw data format for HD-SDI single link. The ARRIRAW T-Link uses dual link HD-SDI connections. The problem with RED Raw Data flow is that it is a proprietary workflow. In summary there is a considerable need for a raw data format which supports transmission over a HD-SDI single link connection. This required raw format should also feature the integration of metadata as well.

By the use of raw image sensor information the data rate can be reduced to 50% compared to an YC_bC_r (4:2:2) formatted image. Due to this fact it is possible to nest data of e.g. 50 frames in a 1080p25 format specification, formerly defined for a frame rate of 25Hz.

Since there are no filter operations on the raw data inside the camera the full dynamic range can be saved for the post production later. This is very interesting for a non destructive post processing workflow where the raw data is than the source material for certain filters and color grading.
Furthermore cameras can be built easier because there is no need to do any calculations on the image data. Filter algorithms can be replaced more easily because they could be realized in software rather than hardware.

Workflow overview

Creating a standard for storing raw sensor data into a HD-SDI stream claims a look at a workflow from the camera to the post production. **Figure 1** shows a proposed raw data workflow. As source for the raw data there are two cameras with an image sensor size of each 1920x1080 pixels or each 1280x720 pixels. The figure shows two cameras for a stereoscopic system. Each camera will be connected to a field recorder by HD-SDI single link.

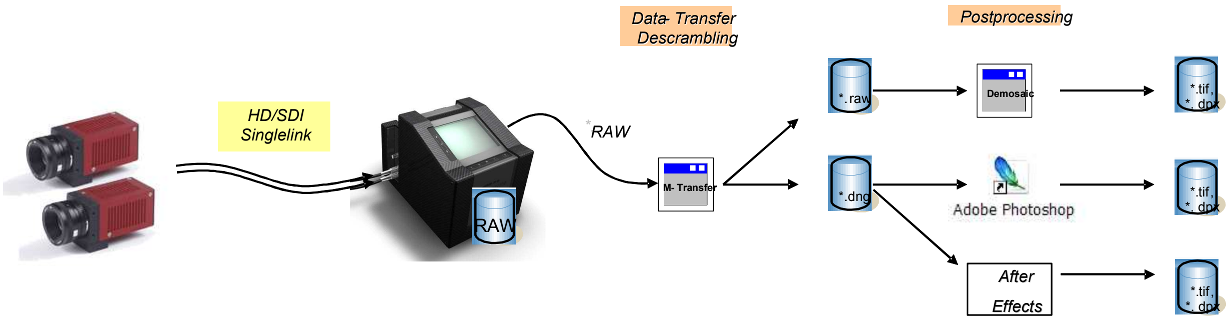

Figure 1: Raw Data Workflow Example

The storage device shall be able to record the incoming data without interpretation of the embedded information. In case the storage device has a built in display it shall be able to create a preview using the raw data. The preview can be used for preview functionality, view finder on set and perhaps focus setting.
After recording data the information will be transferred to standard PC using special software. This software is able to produce different destination formats out of the raw data. It is also possible to stay with the raw data for further post processing and not to convert them to another format.

At this point the raw data workflow splits into different parts depending on the desired format. Since Adobe's raw data format Digital Negative (DNG) is supported in certain applications we recommend to convert the data into this format. The subsequent software tools shall be able to read the DNG format and to process the tasks using the raw data.

All software tools in the workflow are able to get the full dynamic range from the camera sensor which will be very useful for certain tasks in the post production process.

6 Datarate

6.1 High Frame Rate formats

The transfer rate of HD-SDI Single Link does not specify a frame rate greater than 30Hz for 1080p formats. However, the maximum input frame rate defined in this section is 60Hz. Without any horizontal or vertical blanking the data rate for such images in the YC_bC_r formatting would be:

$$D = 1920 \cdot 1080 \cdot 10bit \cdot 60Hz \cdot 2 = 2.48832 \frac{Gbit}{s} \qquad (6\text{-}1)$$

Since HD-SDI Single Link is defined to have a maximum data rate of 1.485Gbit/s there is no way to write YC_bC_r formatted images with that parameters into this framing. Fortunately raw data needs a smaller bandwidth or in other words: It is possible to put larger images into an already defined and accepted specification. To put 10bit raw data at 60Hz into a HD-SDI Single Link framing it is possible to use the 1080p30 specification.

Transferring only RAW data needs only half of the bandwidth so data rate without any horizontal or vertical blanking for such images would be:

$$D = 1920 \cdot 1080 \cdot 10bit \cdot 60Hz = 1.24416 \frac{Gbit}{s} \qquad (6\text{-}2)$$

According to the SMPTE HD-SDI Single Link standard Samples per total line (S/TL) have a value of 2200 and total lines per frame are 1125. This results in:

$$\begin{aligned} D_{RD} &= x \cdot y \cdot 10\,bit \cdot f \\ D_{RD} &= 2200 \cdot 1125 \cdot 10\,bit \cdot 60\,Hz \\ D_{RD} &= 1.485 \frac{Gbit}{s} \end{aligned} \qquad (6\text{-}3)$$

Equation (6-4) and (6-5) show the same result for 720p120 format specification:

$$D = 1280 \cdot 720 \cdot 10bit \cdot 120Hz = 1.10592 \frac{Gbit}{s} \qquad (6\text{-}4)$$

According to the SMPTE HD-SDI Single Link standard Samples per total line (S/TL) have a value of 1650 and total lines per frame are 750. This results in:

$$
\begin{aligned}
D_{RD} &= x \cdot y \cdot 10\,bit \cdot f \\
D_{RD} &= 1650 \cdot 750 \cdot 10\,bit \cdot 120\,Hz \\
D_{RD} &= 1.485\,\frac{Gbit}{s}
\end{aligned}
\qquad (6\text{-}5)
$$

Table 2 shows an overview of all high frame rate formats supported in this document.

Table 2: Overview high frame rate formats

	System nomenclature	samples per active line	Active lines per frame	Frame Rate, Hz
1	1280 x 720/100	1280	720	100
2	1280 x 720/120	1280	720	120
3	1920 x 1080/48	1920	1080	48
4	1920 x 1080/50	1920	1080	50
5	1920 x 1080/59.94	1920	1080	59.94
6	1920 x 1080/60	1920	1080	60

6.2 High Dynamic Range Formats

This section defines the handling of camera sensor data with 12, 14 or 16bits. The transfer rate of HD-SDI Single Link does not allow data values greater than 10bit. But with the increasing prevalence of cameras sensors with 12 and higher bit values there will be a demand for an interface transferring the entire dynamic range. Thus, the maximum bit value defined in this section is 16bit. Without any horizontal or vertical blanking the data rate for a 1080p30 image in the YC_bC_r formatting would be:

$$D = 1920 \cdot 1080 \cdot 16bit \cdot 30Hz \cdot 2 = 1.990656\frac{Gbit}{s} \qquad (6\text{-}6)$$

Since HD-SDI Single Link is defined to have a maximum data rate of 1.485Gbit/s there is no way to write YC_bC_r formatted images into this framing. Fortunately raw data needs a smaller bandwidth or in other words: It is possible to put larger images into an already defined and accepted specification. To put 16bit raw data at 30Hz into a HD-SDI Single Link framing it is possible to use the 1080p30 at 10bit specification. To achieve this, the 16bit value of each pixel will be split to the Y- and the C_bC_r-Channel. The data rate of a 1080p30 at 16bit input format is:

$$D = 1920 \cdot 1080 \cdot 16bit \cdot 30Hz = 0.995328\frac{Gbit}{s} \qquad (6\text{-}7)$$

According to the SMPTE HD-SDI Single Link standard Samples per total line(S/TL) have a value of 2200 and total lines per frame are 1125. This results in:

$$\begin{aligned} D_{RD} &= x \cdot y \cdot 20\,bit \cdot f \\ D_{RD} &= 2200 \cdot 1125 \cdot 20\,bit \cdot 30\,Hz \\ D_{RD} &= 1.485\,\frac{Gbit}{s} \end{aligned} \qquad (6\text{-}8)$$

Equation (6-9) and (6-10) show the same result for 720p60 format specification:

$$D = 1280 \cdot 720 \cdot 16 bit \cdot 60 Hz = 0.884736 \frac{Gbit}{s} \qquad (6\text{-}9)$$

According to the SMPTE HD-SDI Single Link standard Samples per total line (S/TL) have a value of 1650 and total lines per frame are 750. This results in:

$$\begin{aligned} D_{RD} &= x \cdot y \cdot 20\,bit \cdot f \\ D_{RD} &= 1650 \cdot 750 \cdot 20\,bit \cdot 60\,Hz \\ D_{RD} &= 1.485\,\frac{Gbit}{s} \end{aligned} \qquad (6\text{-}10)$$

Table 3 shows an overview of all high dynamic range formats supported in this document.

Table 3: Overview high dynamic range formats

	System nomenclature	samples per active line	Active lines per frame	Frame Rate, Hz
1	1280 x 720/50	1280	720	50
2	1280 x 720/59.94	1280	720	59.94
3	1280 x 720/60	1280	720	60
4	1920 x 1080/23.98	1920	1080	23.98
5	1920 x 1080/24	1920	1080	24
6	1920 x 1080/25	1920	1080	25
7	1920 x 1080/29.97	1920	1080	29.97
8	1920 x 1080/30	1920	1080	30

6.3 Save Range

According to SMPTE 292M-2006 the following values inside the HD-SDI image data are not allowed. Values in the save range shall be clipped before they will be written into the HD-SDI frame.

Table 4: Save Range

From	To
000_h	003_h
$3FC_h$	$3FF_h$

Equation (6-11) shows how the video signal (V) shall to be clipped dependent upon the raw sensor data S_{RD}

$$V = \begin{cases} 004_h & , \quad 000_h \le S_{RD} \le 003_h \\ S_{RD} & , \quad 003_h < S_{RD} < 3FC_h \\ 3FB_h & , \quad 3FC_h < S_{RD} \end{cases} \qquad (6\text{-}11)$$

7 Frame Mapping

This chapter explains how the raw data shall be nested into a HD-SDI packet format.

7.1 High Frame Rate Mapping

According to Figure 2 all green (G) pixel values shall be stored in the Y-Channel of a HD-SDI frame. The red (R) and blue (B) pixel data shall be stored in the C_bC_r-Channel of the HD-SDI frame. Sensor Data shall be read out and put into the HD-SDI channels in their native order, from upper left to lower right, line by line. This means storing the upper left red pixel value (0/0) in the C_bC_r-Channel first and then storing the neighbouring green pixel (1/0) in the Y-Channel and so on. With this procedure the camera doesn't need an image buffer because the data can directly be written to the output stream.

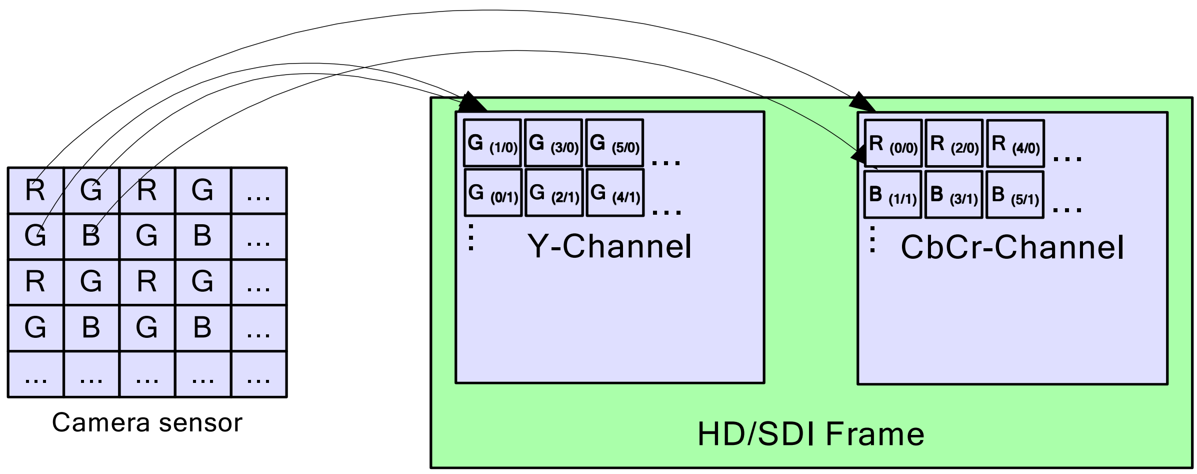

Figure 2: Nesting raw data into the Y-Channel and C_bC_r-Channel

The advantage of storing all green pixel data in the Y-Channel is that this channel contains the vast majority of luminance information of the sensor. Therefore, it is possible to extract an undistorted grayscale picture out of the Y-Channel of the HD-SDI stream.

7.2 High Dynamic Range Mapping

Figure 6 shows the idea of nesting 16bit values into a HD-SDI packet format. The Y- and the C_bC_r-Channel each offer almost 10bit space per pixel, in total 20bits for hosting one 16bit pixel value. The 9 most significant bits shall be stored in the Y-Channel of a HD-SDI frame. The 7 least significant bits shall be stored in the C_bC_r-Channel of the HD-SDI frame. Considering 12 or 14bit raw data the 3, respectively 5 least significant bits shall be stored correspondingly in the C_bC_r-Channel.

Extracting the excluded area (0-64) of the Y- and C_bC_r-Channel the raw data can be reconstructed completely.

8 Value Mapping

This section assumes that the camera sensor delivers more than 10bit raw data values. In case of high frame rates it is necessary to reduce the data values to a maximum of 10bit because the transfer rate of HD-SDI Single Link does not allow a bit depth greater than 10bit per sample. For this reason every bit depth greater than 10bit shall be mapped into a 10bit raster. This should be done by using a user definable transfer function on the raw data. The parameters of the transfer function shall be carried within the metadata.

This specification defines three different types of transfer function:

1. Linear transfer function

This is the standard transfer function and it will be used as default value.

2. Rec. 709
   The mapping can also be done using the Rec. 709 transfer function. Figure 3 shows the Rec. 709 transfer function which is used in SDTV and HDTV.

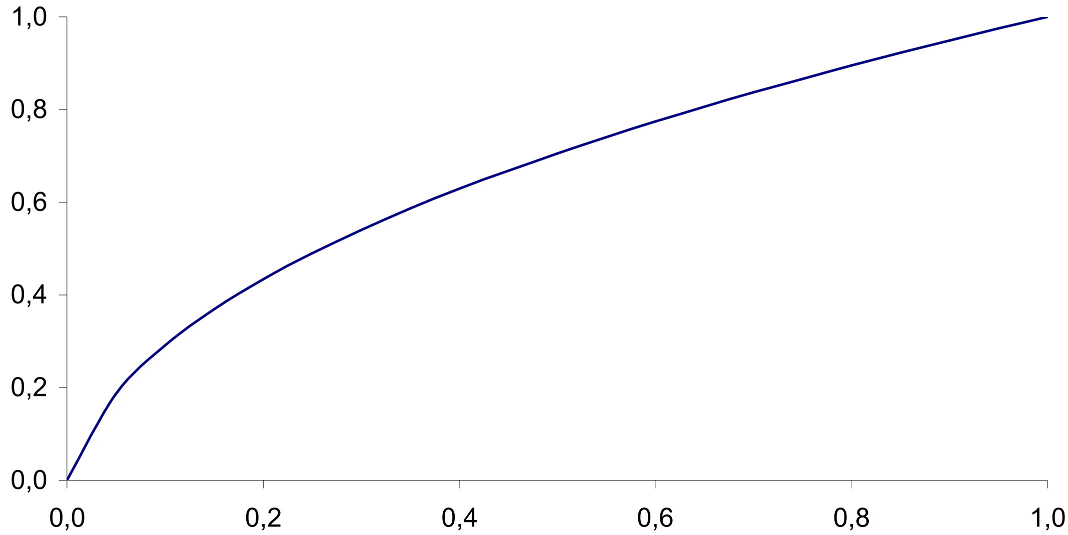

Figure 3: Rec. 709 transfer function

Equation (8-1) shows the definition of the Rec. 709 transfer function where the linear light is denoted *L*.

$$V'_{709} = \begin{cases} 4.5L & , \quad 0 \le L < 0.018 \\ 1.099L^{0.45} - 0.099 & , \quad 0.018 \le L \le 1 \end{cases} \qquad (8\text{-}1)$$

Equation 8-2 shows how 12bit data can be mapped to 10bit using the Rec. 709 transfer function.

$$O_{10} = 2^{10} \cdot V'_{709}\left(\frac{A_{12}}{2^{12}}\right) \qquad (8\text{-}2)$$

Figure 4 shows the Rec. 709 transfer function used to map 12bit raw data in a 10bit raw data raster.

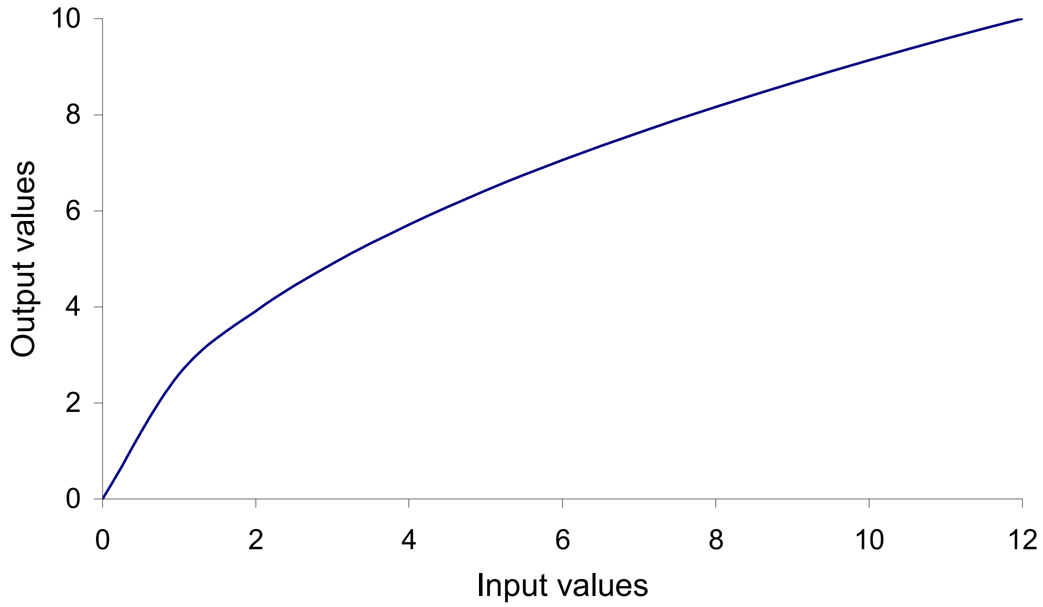

Figure 4: Rec. 709 transfer used for 12bit to 10bit mapping

3. Cubic Splines
   The transfer function shall be a natural cubic spline interpolation. Cubic splines are smooth curves with n segments through n+1 given points. Every segment of the curve between two points (nodes) can be described by a cubic parable.

$$y_i = a_i x^3 + b_i x^2 + c_i x + d_i \qquad (8\text{-}3)$$

The coefficients a_i, b_i, c_i and d_i can be calculated by the use of the given nodes and the boundary conditions. As already described this specification suggests natural cubic splines. "Natural" refers to the boundary conditions and means the second derivative of the first point and of the last point is zero. As a result, the overall bending of the spline is minimal. The definable points shall be carried within the metadata. According to them the transfer function can easily be reconstructed.

Figure 5 shows a natural cubic spline with 8 given points for mapping 12bit to 10bit values. The first Point P_1 has the coordinates (0|0.5), the last Point P_8 has the coordinates (12|10).

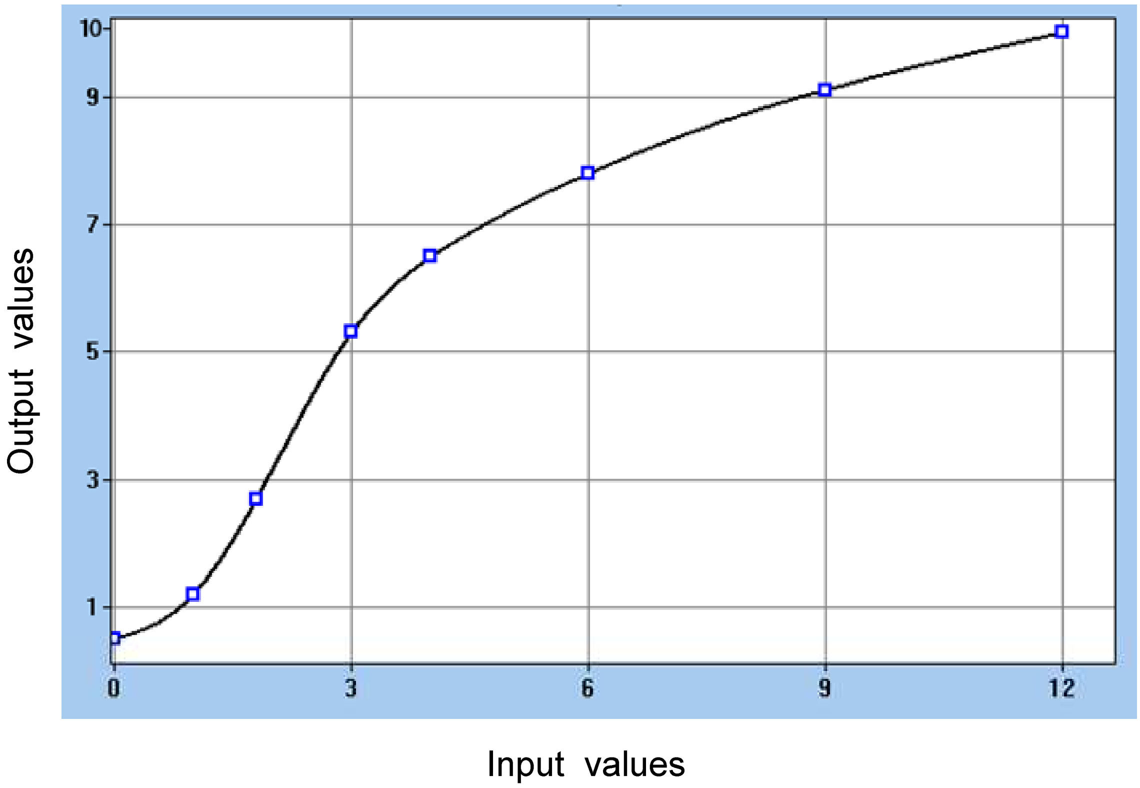

Figure 5: Natural cubic spline transfer function

Because for post processing the raw data it is essential to know every operation that has been executed on the data, this document proposes a two level mechanism to determine the transfer function in the metadata section.

First level defines one of the three different types of a transfer function. If no setting is available default value is a linear transfer function.

Linear transfer function and Rec. 709 only have one Second Level metadata:

Table 5: Source bit depth metadata

Name	Description
src_bitdepth	Stores the source bit depth before transfer function.

If no setting is available default value for the source bit depth is 12.

For a cubic spline transfer function it is necessary to provide the nodes as metadata. To be able to define complex splines space for eight points will be reserved.

Tabelle 6: Cubic spline metadata

Name	Datatype	Description
xvalue_1	Float32	x-value of the first user definable point.
xvalue_2	Float32	x-value of the second user definable point.
…	…	…
xvalue_8	Float32	x-value of the last user definable point.
yvalue_1	Float32	y-value of the first user definable point.
yvalue_2	Float32	y-value of the second user definable point.
…	…	…
yvalue_8	Float32	y-value of the last user definable point.

9 Metadata

9.1 Parameter

This section describes which metadata the proposed raw data format should support. Aside from the Longitudinal Timecode, Table 7 shows four different types of metadata. The first two groups of data refer to the type and settings of the sensor and the camera. Additionally they cover the setting of the lens and the relation between the two cameras of a stereoscopic setting. The third group indicates which reprocessing operations have already been applied to the raw data and/or which value suggestion for certain operations can be delivered by the camera. This means that previous processing steps can either alter the raw data or suggest a value for the processing step. Table 9 shows detailed structure of preprocessing metadata type.

The last group refers to the transfer function for logarithmic high frame rate formats. The use of the provided metadata items is dependent on the format, setup, type of camera and the optical system. Unfortunately HD-SDI standard supports limited space for metadata description. To achieve some tiny metadata chunks names should be declared as abbreviations. Table 8 shows proposed abbreviation for metadata description.

Table 7: Metadata for raw data format

Data	Comment
Longitudinal Timecode (LTC)	indicates the timecode of the actual frame
camera id	
camera type	indicates the camera model
serial number	indicates the camera serial number
version	indicates the camera version
sensor type	indicates the sensor type
sensor filter pattern	indicates the type of color filter pattern
first pixel color	indicates the color mask of the upper left pixel of the sensor
camera status	
speed	speed: value in 1/1000 fps;
shutter angle	angle: value in 1/100 deg;
sensitivity (ASA)	indicates the sensitivity of the sensor, if variable
white balance recommendation	proposal of a default whitepoint value for postproduction issues (Note: in the raw image the whitepoint is not fixed)
f-stop	indicates the f-stop of the lens
focal length	indicates the focal length of the attached lens
camera position	indicates whether the camera is left eye or right eye
distance between cameras	indicates the distance between the optical axis of the two cameras

(baseline)	
included angle	indicates the angle between the optical axis of the two cameras
preprocessing	
black level offset global	indicates if the black level offset is globally adjusted
black level offset R,G,B	indicates if the black level offset for a single RGB-Channel is adjusted
fixed pattern noise	indicates whether the fixed pattern noise is compensated
defect pixel correction	indicates whether the defect pixels are corrected
white balance	indicates whether the white balance is adjusted
transfer function	
source bit depth type x-value point 1…8 y-value point 1…8	Indicates the source bit depth from camera sensor data Linear (0), Rec. 709 (1), Cubic splines (2) with these 8 points the natural cubic spline transfer function can be reconstructed with these 8 points the natural cubic spline transfer function can be reconstructed

Table 8: Abbreviations for metadata

Operation	Abbreviation
Longitudinal Timecode (LTC)	LTC
camera id	
camera type	CTP
serial number	CSN
version	CVN
sensor type	CST
sensor filter pattern	CSFP
first pixel color	CFPC
camera status	
speed	CSP
shutter angle	CSA
sensitivity (ASA)	ASA
white balance recommendation	WBR
f-stop	FST
focal length	FOC

camera position	
distance between cameras (baseline)	DBC
included angle	IAN
Preprocessing black level offset global	 BLOG
black level offset R,G,B	BLOC
fixed pattern noise	FPN
defect pixel correction	DPC
white balance	WB
transfer function	
source bit depth type x-value point $_{1-8}$	SBD TFT TFX_0 – TFC_7
y-value point $_{1-8}$	TFY_0 – TFC_7

Table 9: Detailed structure of preprocessing metadata type

Data	Comment
name	The name of the preprocessing operation, e.g. BLOG, BLOC.
value	Calculated value from camera or interconnected hard-/software.
applied	0 – not applied on raw data 1 – value applied on the current metada

According to SMPTE 296M-2001, ancillary data may optionally be included in the blanking intervals of a digital interface according to this standard. All metadata shall be packed into a xml scheme. This scheme shall be stored in the blanking intervals. The following text shows an xml formatted instance of raw metadata.

```
<?xml version="1.0" encoding="UTF-8"?>
<rdf_metadata xmlns="http://www.acme.anco/SOME-THINK-20090111#"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.acme.anco//SOME-THINK-20090111# Metdata.xsd">
		<LTC>0100101010010111100101001010100101111001010010101001011110010100101010010111100 1</LTC>
		<camera>
				<identification>
						<CTP>Insert camera type here</CTP>
						<CSN>12345674890</CSN>
						<CVN>1.1</CVN>
						<CST>brilliant</CST>
				</identification>
				<status>
						<CSP>24000</CSP>
						<CSA>460</CSA>
						<WBR>48.57</WBR>
				</status>
		</camera>
	<preprocessing name="WB" value="5600K" applied="0"/>
		<preprocessing name="DPC" value="0" applied="1"/>
		<preprocessing name="FPN" value="1234" applied="0"/>
		<transfer_function SBD="12" TFT="2">
				<TFCX_0>1</TFCX_0>
				<TFCX_1>2</TFCX_1>
				<TFCY_0>3.30</TFCY_0>
				<TFCY_1>4</TFCY_1>
		</transfer_function>
</rdf_metadata>
```


9.2 Payload Identifier

This section describes how the proposed raw data format shall guarantee interoperability with other raw data format specifications. According to SMPTE 352M-2002 a Payload Identifier can be embedded in HD-SDI streams. This identifier should assure, that other well known raw data formats can also be embedded in the raw data specification described in this document. If no Payload Identifier is available the data shall be interpreted like stated in this document. If a Payload Identifier is available a hard-/software can decide what to do. It could either interpret the raw data specified by the identifier or just bypass.

Annex A Related Work

Y	0 – 63 (excluded area)	64 – 575 (9bit raw data)	576 – 939 (unused)	940 – 1023 (excluded area)

Cb/Cr	0 – 63 (excluded area)	64 – 191 (7bit raw data)	192 – 959 (unused)	960 – 1023 (excluded area)

The 16bit raw data of one pixel are shared among the Y-Channel and C_bC_r-Channel. The Y-Channel contains 9bit and the C_bC_r-Channel contains 7bit.

9bit raw data	7bit raw data

MSB LSB

Figure 6: High Dynamic Date Mapping