SMPTE STANDARD

Dual 3 Gb/s Serial Digital Interface for Stereoscopic Image Transport

Table of Contents

Approved
June 5, 2012

Foreword

SMPTE (the Society of Motion Picture and Television Engineers) is an internationally-recognized standards developing organization. Headquartered and incorporated in the United States of America, SMPTE has members in over 80 countries on six continents. SMPTE's Engineering Documents, including Standards, Recommended Practices, and Engineering Guidelines, are prepared by SMPTE's Technology Committees. Participation in these Committees is open to all with a bona fide interest in their work. SMPTE cooperates closely with other standards-developing organizations, including ISO, IEC and ITU.

SMPTE Engineering Documents are drafted in accordance with the rules given in Part XIII of its Operations Manual.

SMPTE ST 425-4 was prepared by Technology Committee 32NF.

Intellectual Property

At the time of publication no notice had been received by SMPTE claiming patent rights essential to the implementation of this Standard. However, attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. SMPTE shall not be held responsible for identifying any or all such patent rights.

Introduction

This section is entirely informative and does not form an integral part of this Standard.

There is a need in the industry to have an interface for transporting stereoscopic images complying with 4:2:2 and 4:4:4, 10-bit and 12-bit image formats which can each be transported by a single SMPTE ST 424 serial interface. This standard also defines the payload identifier that will identify the Left/Right (L/R) eye images, audio and other associated ancillary data.

1 Scope

This standard defines a means of transporting stereoscopic images (Left eye and Right eye images) using an interface consisting of two streams based on the SMPTE ST 425-1 data structures. The Left eye images are carried on one stream of the interface and the Right eye images are carried on the other stream.

The stereoscopic image formats to be transported using this standard are the 4:2:2 and 4:4:4 image formats enumerated in Table 1, where each image format is defined by SMPTE ST 274, SMPTE ST 296, SMPTE ST 2048-2, SMPTE ST 428-9 or SMPTE ST 428-19, has a payload capacity of nominally 3 Gb/s and can be transported by a single SMPTE ST 424 serial interface.

Audio and other associated ancillary data may also be transported. This standard also defines a payload identifier.

Mapping structures for the video essence and ancillary data shall be as defined in SMPTE ST 425-1 Level A or Level B-DL.

It is not necessary for implementations to include support for all formats defined in Table 1, nor is it a requirement to support both mapping modes to conform to this standard. Implementers should indicate supported formats and supported mapping modes in commercial publications.

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.

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

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 12-2:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 12M-2-2008). Documents with the same root number (e.g. 12-2) and publication year (e.g. 2008) are functionally identical.

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

SMPTE ST 12-2:2008, Television — Transmission of Time Code in the Ancillary Data Space

SMPTE ST 299-1:2009, 24-Bit Digital Audio Format for SMPTE ST 292 Bit-Serial Interface

SMPTE ST 299-2:2010, Extension of the 24-Bit Digital Audio Format to 32 Channels for 3 Gb/s Bit-Serial Interfaces

SMPTE ST 352:2011, Payload Identification Codes for Serial Digital Interfaces

SMPTE ST 425-1:2011, Source Image Format and Ancillary Data Mapping for the 3 Gb/s Serial Interface

4 Definitions

4.1 Stereoscopic Image Pair

Two uncompressed images representing a left eye (Le) image and a right eye (Re) image which are coincident in time having identical sampling structure, raster resolution, pixel depth and colorimetry.

5 Source Image Format

The source image formats shall be those 4:2:2 and 4:4:4, 10-bit or 12-bit image formats referenced by SMPTE ST 425-1, which can be transported by a single SMPTE ST 424 serial interface as shown in Table 1. The Left eye image and the Right eye image shall have the identical image pixel format structure and they shall be a stereoscopic image pair.

For the carriage of stereo production image formats, the source image horizontal and vertical data structure for each Left Eye (Le) and Right Eye (Re), shall be as defined for those formats referenced by SMPTE ST 425-1.

Table 1, repeated from SMPTE ST 425-1 for convenience, shows the source formats so referenced.

Table 1 – Source Image Formats SMPTE ST 425-1 (Informative)

Reference SMPTE Standard	Image Format	Signal Format Sampling Structure/Pixel Depth	Frame / Field Rates (Frames per second / Fields per second)	Mapping mode	
ST 274	1920 × 1080	4:2:2 ($Y'C'_BC'_R$)/10-bit	60, 60/1.001 and 50 Frames Progressive	Level A	Level B-DL
ST 2048-2	2048 x 1080**(5)**	4:2:2 ($Y'C'_BC'_R$)/10-bit	60, 60/1.001, 50, 48 and 48/1.001 Frames Progressive	Level A	Level B-DL
ST 296	1280 x 720	4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A)/10-bit**(6)**	60, 60/1.001 and 50 Frames Progressive	Level A	-
		4:4:4 ($Y'C'_BC'_R$), 4:4:4:4 ($Y'C'_BC'_R$+A)/10-bit**(6)**	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	-
ST 274	1920 x 1080	4:4:4 (R'G'B'), 4:4:4:4 (R'G'B' +A)/10-bit**(6)**	60, 60/1.001 and 50 Fields Interlaced	Level A	Level B-DL
			30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
		4:4:4 ($Y'C'_BC'_R$), 4:4:4:4 ($Y'C'_BC'_R$+A)/10-bit**(6)**	30, 30/1.001, 25, 24 and 24/1.001 PsF**(1)**	Level A	Level B-DL

ST 2048-2	2048 x 1080(5)	4:4:4 (R'G'B')(7), 4:4:4:4 (R'G'B' +A)/10-bit(6)	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
		4:4:4 ($Y'C'_BC'_R$), 4:4:4:4 ($Y'C'_BC'_R$+A)/10-bit(6)	30, 30/1.001, 25, 24 and 24/1.001 PsF(2)	Level A	Level B-DL
ST 274	1920 x 1080	4:4:4 (R'G'B')/12-bit	60, 60/1.001 and 50 Fields Interlaced	Level A	Level B-DL
		4:4:4 ($Y'C'_BC'_R$)/12-bit	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
ST 2048-2	2048 x 1080(5)	4:4:4 (R'G'B')/12-bit(7)	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
		4:4:4 ($Y'C'_BC'_R$)/12-bit	30, 30/1.001, 25, 24 and 24/1.001 Frames PsF(2)	Level A	Level B-DL
ST 428-9	2048 x 1080(5)	4:4:4 ($X'Y'Z'$)/12-bit	24 Frames Progressive	Level A	Level B-DL
			24 Frames PsF(3)	Level A	Level B-DL
ST 428-19	2048 x 1080(5)	4:4:4 ($X'Y'Z'$)/12-bit	25 and 30Frames Progressive	Level A	Level B-DL
			25 and 30Frames PsF(4)	Level A	Level B-DL
ST 274	1920 x 1080	4:2:2 ($Y'C'_BC'_R$)/12-bit	60, 60/1.001 and 50 Fields Interlaced	Level A	Level B-DL
			30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
			30, 30/1.001, 25, 24 and 24/1.001 Frames PsF(1)	Level A	Level B-DL
ST 2048-2	2048 x 1080(5)	4:2:2 ($Y'C'_BC'_R$)/12-bit	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive	Level A	Level B-DL
		4:2:2:4 ($Y'C'_BC'_R$+A)/12-bit(6)	30, 30/1.001, 25, 24 and 24/1.001 Frames PsF(2)	Level A	Level B-DL

Notes:
(1) PsF structure as defined in SMPTE ST 274
(2) PsF structure as defined in SMPTE ST 2048-2
(3) PsF structure as defined in SMPTE ST 429-9
(4) PsF structure as defined in SMPTE ST 428-19
(5) This is the maximum pixel array, the active image may not fill the maximum array.
(6) Definition of the Alpha channel mapping is application dependant. Refer to SMPTE ST 425-1 for further details.
(7) In this image format R'G'B' indicates either R'G'B' or $R'_{FS}G'_{FS}B'_{FS}$.

6 20-Bit Virtual Interface Data Structure

Each Le and Re image of the stereoscopic image pair shall be constructed as an individual 20-bit virtual interface consisting of two times 10-bit data structures, Data Stream 1 and Data Stream 2, as defined in SMPTE ST 425-1.

The 20-bit virtual interface for each Le and Re image shall be constructed in accordance with either the Level A mapping mode, or the Level B-DL mapping mode defined in SMPTE ST 425-1.

In addition to the different mapping modes, SMPTE ST 425-1 also defines different mapping structures for each image format. Refer to SMPTE ST 425-1 for details of the mapping structures and mapping modes for each format in Table 1.

Each virtual interface shall contain timing reference code words (SAV/EAV), line numbers and line based CRC's as defined in SMPTE ST 425-1 and/or the source image format document.

Each virtual interface shall be frame, line and word aligned, having an interface frequency of 148.5 MHz or 148.5/1.001 MHz.

An example of the 20-bit virtual interface for both Le and Re is shown in Figure 1. By way of example, Figure 1 illustrates mapping structure 1 of the Level A direct mapping mode for $Y'C'_BC'_R$ 4:2:2 / 10-Bit signals at 60, 60/1.001, 50, 48 and 48/1.001 Progressive Frames/Sec.

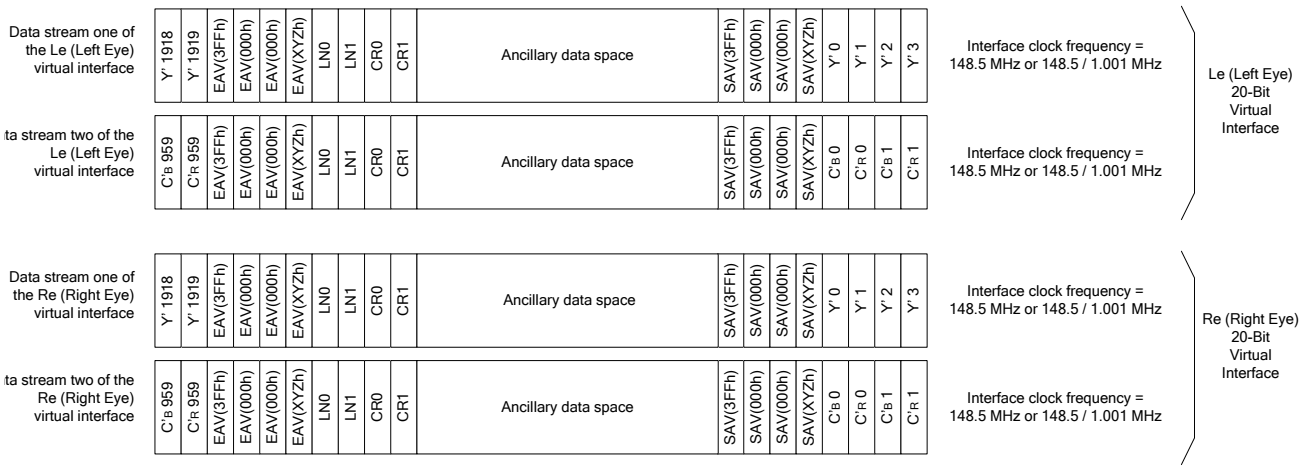

Figure 1 – Example Mapping Structure 1 from SMPTE ST 425-1 — 4:2:2 ($Y'C'_BC'_R$)/10-Bit Signals at 60, 60/1.001, 50, 48 and 48/1.001 Progressive Frames/Sec

6.1 Level A – Direct Mapping Mode

6.1.1 Image Mapping Structures

R', G', B',/ Y', C'_B, C'_R,/ *X*', *Y*', *Z*' and A components shall be mapped into the virtual interface of each Le and Re image according to the Level A mapping structures defined in SMPTE ST 425-1.

6.1.2 Level A – Direct Mapping Mode – Audio Data

When present, audio data shall be mapped into the ancillary data space of the Le and Re virtual interface, according to the Level A audio mapping rules defined in SMPTE ST 425-1.

The audio data shall be mapped onto the Le virtual interface first and any remaining data shall then be mapped onto the Re virtual interface. In some applications audio data of the Le interface may be duplicated in the Re interface.

Audio channel usage shall be further signaled using the payload identifier as defined in Section 7 of this document.

6.1.2.1 Number of Audio Channels

Up to 32 audio channels sampled at 32 kHz, 44.1 kHz or 48 kHz may be mapped into each Le and Re virtual interface for a maximum of up to 64 channels.

At 96-kHz sampling, up to 16 audio channels may be mapped into each Le and Re virtual interface for a maximum of up to 32 channels.

The maximum number of audio channels that can be mapped into the available ancillary data space of the Le and Re virtual interface varies in accordance with the video format and the video frame rate as shown in SMPTE ST 425-1, repeated here in Table 2 for convenience.

Table 2 – Number of audio channels supported for each image format frame rate and audio sampling rate (Informative)

Image Format	Frame/Field Rates	Maximum number of audio channels at 32-kHz, 44.1-kHz or 48-kHz sampling	Maximum number of audio channels at 96-kHz sampling
1920 × 1080	60, 60/1.001 and 50 Frames Progressive	Up to 32 channels	Up to 16 channels
	60, 60/1.001 and 50 Fields Interlaced		
	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive		
SMPTE 2048-2 2048 x 1080	60, 60/1.001, 30 and 30/1.001, Frames Progressive, 30 and 30/1.001 PsF	Up to 16 channels	Up to 8 channels
	50, 48, 48/1.001, 25, 24 and 24/1.001 Frames Progressive, 25, 24 and 24/1.001 PsF	Up to 32 channels	Up to 16 channels
SMPTE 428-9 2048 x 1080	24 Frames Progressive and 24 Frames PsF	Up to 32 channels	Up to 16 channels
SMPTE 428-19 2048 x 1080	30 Frames Progressive and 30 Frames PsF	Up to 16 channels	Up to 8 channels
	25 Frames Progressive and 25 Frames PsF	Up to 32 channels	Up to 16 channels
1280 x 720	60, 60/1.001 and 50 Frames Progressive	Up to 32 channels	Up to 16 channels
	30, 30/1.001, 25, 24 and 24/1.001 Frames Progressive		

6.1.2.1.1 Carriage of up to 64 channels of audio at up to 48-kHz sampling

For Le and Re interfaces that each provide sufficient ancillary data space for the carriage of up to 32 channels of audio as referenced in Table 2, the audio data and control packets and extended audio data and control packets for the first 32 channels (channels 1 to 32), shall be mapped into the Le virtual interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4) and SMPTE ST 299-2 (audio groups 5 to 8), respectively.

The audio data and control packets and extended audio data and control packets for the second 32 channels (channels 33 to 64), shall be mapped into the Re virtual interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4), and SMPTE ST 299-2 (audio groups 5 to 8), respectively.

Note: When the number of audio channels at up to 48 KHz sampling rate is less than or equal to 16, audio data and audio control packets mapped into the Le virtual interface use the DID's for audio groups 1 to 4, as defined in SMPTE ST 299-1.

In the case where the Re interface is carrying a duplicate of the Le interface audio, the audio data and control packets shall be an exact replica of the audio carried in the Le interface – specifically the Re interface audio shall use the same audio groups and channel numbering as applied to the Le interface audio.

The payload identifier associated with each Le and Re interface shall indicate whether the audio data contained in the Re interface is a copy of the Le interface audio, or whether additional audio channels are being carried in the Re interface.

Using a combination of information from the payload identifier, the audio channel group number and the location of the audio in either the Le or Re interface, implementers can uniquely identify up to 64 audio channels at 32-kHz, 44.1-kHz or 48-kHz sampling as illustrated in Table 3.

Table 3 – Level A mapping of up to 64 Audio Channels at 32-kHz, 44.1-kHz or 48-kHz sampling

Audio Group Number	Reference Embedded audio standard	Audio Channel number in accordance with payload ID byte 4 definition		
		Left eye interface	Right eye interface carries additional audio channels	Right eye interface carries a copy of Left eye audio
1	ST 299-1	Ch 1 through Ch 4	Ch 33 through Ch 36	Ch 1 through Ch 4
2	ST 299-1	Ch 5 through Ch 8	Ch 37 through Ch 40	Ch 5 through Ch 8
3	ST 299-1	Ch 9 through Ch 12	Ch 41 through Ch 44	Ch 9 through Ch 12
4	ST 299-1	Ch 13 through Ch 16	45 through 48	Ch 13 through Ch 16
5	ST 299-2	Ch 17 through Ch 20	Ch 49 through Ch 52	Ch 17 through Ch 20
6	ST 299-2	Ch 21 through Ch 24	Ch 53 through Ch 56	Ch 21 through Ch 24
7	ST 299-2	Ch 25 through Ch 28	Ch 57 through Ch 60	Ch 25 through Ch 28
8	ST 299-2	Ch 29 through Ch 32	Ch 61 through Ch 64	Ch 29 through Ch 32

Note: Embedded audio channel mapping to AES audio channel mapping is defined in SMPTE ST299-1.

6.1.2.1.2 Carriage of up to 32 channels of audio at 96-kHz sampling

For Le and Re interfaces that each provide sufficient ancillary data space for the carriage of up to 16 channels of audio at 96-kHz sampling as referenced in Table 2, the audio data and control packets and extended audio data and control packets for the first 16 channels (channels 1 to 16) shall be mapped into the Le virtual interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4) and SMPTE ST 299-2 (audio groups 5 to 8), respectively.

The audio data and control packets for the second 16 channels (channels 17 to 32), shall be mapped into the Re virtual interface, in conformance with SMPTE ST 299-1 (audio groups 1 through 4) and SMPTE ST 299-2 (audio groups 5 through 8), respectively.

In the case where the Re interface is carrying a duplicate of the Le interface audio, the audio data and control packets shall be an exact replica of the audio carried in the Le interface – specifically the Re interface audio shall use the same audio groups and channel numbering as applied to the Le interface audio.

The payload identifier associated with each Le and Re interface shall indicate whether the audio data contained in the Re interface is a copy of the Le interface audio, or whether additional audio channels are being carried in the Re interface at up to 48-kHz sampling.

Using a combination of information from the payload identifier, the audio channel group number and the location of the audio in either the Le or Re interface, implementers can uniquely identify up to 32 audio channels at 96-kHz sampling as illustrated in Table 4.

Table 4 – Level A mapping of up to 32 Audio Channels at 96-kHz sampling

Audio Group Number	Reference Embedded audio standard	Audio Channel number in accordance with payload ID byte 4 definition		
		Left eye interface	Right eye interface carries additional audio channels	Right eye interface carries a copy of Left eye audio channels
1	ST 299-1	Ch 1 and Ch 2	Ch 17 and Ch 18	Ch 1 and Ch 2
2	ST 299-1	Ch 3 and Ch 4	Ch 19 and Ch 20	Ch 3 and Ch 4
3	ST 299-1	Ch 5 and Ch 6	Ch 21and Ch 22	Ch 5 and Ch 6
4	ST 299-1	Ch 7 and Ch 8	Ch 23 and Ch 24	Ch 7 and Ch 8
5	ST 299-2	Ch 9 and Ch 10	Ch 25 and Ch 26	Ch 9 and Ch 10
6	ST 299-2	Ch 11 and Ch 12	Ch 27 and Ch 28	Ch 11 and Ch 12
7	ST 299-2	Ch 13 and Ch 14	Ch 29 and Ch 30	Ch 13 and Ch 14
8	ST 299-2	Ch 15 and Ch 16	Ch 31 and Ch 32	Ch 15 and Ch 16

Note 1: For 96-kHz sampling, Single Channel Double Sampling Frequency Mode is employed as defined in AES3. For 96-kHz sampling, two successive samples of two AES audio channels (AES1 channel 1 1st and 2nd sample and AES2 channel 1 1st and 2nd sample) are carried in a single audio group. Refer to SMPTE ST 299-1 for further details.

Note 2: Embedded audio channel mapping to AES audio channel mapping is defined in SMPTE ST 299-1.

6.1.3 Level A – Direct Mapping Mode – Time code Data

When present the time code shall be mapped into the ancillary data space of the Le virtual interface according to the Level A ancillary data mapping rules defined in SMPTE ST 425-1, and shall be in conformance with SMPTE ST 12-2.

The time code may also be mapped onto both the Le and Re virtual interfaces in which case the corresponding Time Address values shall be identical.

6.1.4 Other Ancillary Data

Other ancillary data if present, shall be mapped into VANC or HANC of either the Le or the Re virtual interface, according to the Level A ancillary data mapping rules defined in SMPTE ST 425-1.

Ancillary data specifically intended for the Le or Re interface shall be inserted into the appropriate interface only.

6.2 Level B-DL – SMPTE ST 372 Dual-Link Mapping Mode

6.2.1 Image Mapping Structures

R', G', B',/ Y', C'_B, C'_R,/ *X'*, *Y'*, *Z'* and A components shall be mapped into each Link A and Link B of the Left Eye (Le) ST 372 Dual-Link interface and the Right Eye (Re) SMPTE ST 372 Dual-Link interface, according to the Level B-DL mapping rules defined in SMPTE ST 425-1.

6.2.2 Level B-DL – SMPTE ST 372 Dual-Link Mapping – Audio Data

When present, audio data shall be mapped into Link A and Link B of the Dual-Link SMPTE ST 372 interface for each Le and Re image prior to final mapping into the Virtual Interface of this standard, in accordance with the SMPTE ST 425-1 Level B-DL mapping rules.

The formatting and location of the audio data and control packets shall be in conformance with SMPTE ST 299-1.

The audio data shall be mapped onto the Le virtual interface first and any remaining data shall then be mapped onto the Re virtual interface. In some applications audio data of the Le interface may be duplicated in the Re interface.

Audio channel usage shall be further signaled using the payload identifier. See Section 7 of this document for further details.

6.2.2.1 Number of Audio Channels

Up to 32 audio channels sampled at 32 kHz, 44.1 kHz or 48 kHz may be mapped into each Le and Re virtual interface for a maximum of up to 64 channels.

At 96-kHz sampling, up to 16 audio channels may be mapped into each Le and Re virtual interface for a maximum of up to 32 channels.

The maximum number of audio channels that can be mapped into the available ancillary data space varies in accordance with the video format and the video frame rate as shown in SMPTE ST 425-1, repeated in Table 2.

6.2.2.1.1 Carriage of up to 64 channels of audio at up to 48-kHz sampling

For Le and Re interfaces that each provide sufficient ancillary data space for the carriage of up to 32 channels of audio at up to 48-kHz sampling for the formats referenced in Table 2, the audio data and control packets and extended audio data and control packets for the first 16 channels shall be mapped into Link A of the Le interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The next 16 channels (channel 17 to 32), shall be mapped into Link B of the Le interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The next 16 channels (channels 33 to 48), shall be mapped into Link A of the Re interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

The final 16 channels (channels 49 to 64), shall be mapped into Link B of the Re interface, in conformance with SMPTE ST 299-1 (audio groups 1 to 4).

In the case where the Re interface is carrying a duplicate of the Le Link A and Link B interface audio, the audio data and control packets in the Re Link A and Link B interface, shall be an exact replica of the audio carried in the Le Link A and Link B interface respectively.

The payload identifier associated with each Le and Re interface shall indicate whether the audio data contained in the Re interface is a copy of the Le interface audio, or whether additional audio channels are being carried in the Re interface.

Using a combination of information from the payload identifier, the Link A or Link B identifier, the audio channel group number and the location of the audio in either the Le or Re interface, implementers can uniquely identify up to 64 audio channels at 32-kHz, 44.1-kHz or 48-kHz sampling as illustrated in Table 5.

Table 5 – Level B-DL mapping of up to 64 Audio Channels at 32-kHz, 44.1-kHz or 48-kHz sampling

Virtual Interface mapping	Audio Group Number	Reference Embedded audio standard	Audio Channel number in accordance with payload ID byte 4 definition		
			Left eye interface	Right eye interface carries additional audio channels	Right eye interface carries a copy of Left eye audio channels
Link A	1	ST 299-1	Ch 1 through Ch 4	Ch 33 through Ch 36	Ch 1 through Ch 4
	2	ST 299-1	Ch 5 through Ch 8	Ch 37 through Ch 40	Ch 5 through Ch 8
	3	ST 299-1	Ch 9 through Ch 12	Ch 41 through Ch 44	Ch 9 through Ch 12
	4	ST 299-1	Ch 13 through Ch 16	Ch 45 through Ch 48	Ch 13 through Ch 16
Link B	1	ST 299-1	Ch 17 through Ch 20	Ch 49 through Ch 52	Ch 17 through Ch 20
	2	ST 299-1	Ch 21 through Ch 24	Ch 53 through Ch 56	Ch 21 through Ch 24
	3	ST 299-1	Ch 25 through Ch 28	Ch 57 through Ch 60	Ch 25 through Ch 28
	4	ST 299-1	Ch 29 through Ch 32	Ch 61 through Ch 64	Ch 29 through Ch 32

Note 1: Groups 5 through 8 as defined in SMPTE ST 299-2 are not used in the Level B-DL mapping mode.

Note 2: Embedded audio channel mapping to AES audio channel mapping is defined in SMPTE ST 299-1.

6.2.2.1.2 Carriage of up to 32 channels of audio at 96-kHz sampling

For Le and Re interfaces that each provide sufficient ancillary data space for the carriage of up to 16 channels of audio at 96-kHz sampling for the formats referenced in Table 2, the audio data and control packets and extended audio data and control packets for the first 8 channels (channels 1 to 8) shall be mapped into Link A of the Le interface, in conformance with SMPTE ST 299-1 groups 1 through 4.

The audio data and control packets for the next 8 channels (channels 9 to 16), shall be mapped into Link B of the Le interface, in conformance with SMPTE ST 299-1 groups 1 through 4.

The audio data and control packets for the next 8 channels (channels 17 to 24), shall be mapped into Link A of the Re interface, in conformance with SMPTE ST 299-1 groups 1 through 4.

The final 8 channels (channels 25 to 32), shall be mapped into Link B of the Re interface, in conformance with SMPTE ST 299-1 groups 1 through 4.

In the case where the Re interface is carrying a duplicate of the Le interface audio, the audio data and control packets shall be an exact replica of the audio carried in the Le interface – specifically the Re interface audio shall use the same audio groups and channel numbering as applied to the Le interface audio.

The payload identifier associated with each Le and Re interface shall indicate whether the audio data contained in the Re interface is a copy of the Le interface audio, or whether additional audio channels are being carried in the Re interface at up to 48 kHz sampling.

Using a combination of information from the payload identifier, the audio channel group number and the location of the audio in either the Le or Re interface, implementers can uniquely identify up to 32 audio channels at 96-KHz sampling as illustrated in Table 6.

Table 6 – Level B-DL mapping of up to 32 Audio Channels at 96-kHz sampling

Virtual Interface mapping	Audio Group Number	Reference Embedded audio standard	Audio Channel number in accordance with payload ID byte 4 definition		
			Left eye interface	Right eye interface carries additional audio channels	Right eye interface carries a copy of Left eye audio channels
Link A	1	ST 299-1	Ch 1 and Ch 2	Ch 17 and Ch 18	Ch 1 and Ch 2
	2	ST 299-1	Ch 3 and Ch 4	Ch 19 and Ch 20	Ch 3 and Ch 4
	3	ST 299-1	Ch 5 and Ch 6	Ch 21and Ch 22	Ch 5 and Ch 6
	4	ST 299-1	Ch 7 and Ch 8	Ch 23 and Ch 24	Ch 7 and Ch 8
Link B	1	ST 299-1	Ch 9 and Ch 10	Ch 25 and Ch 26	Ch 9 and Ch 10
	2	ST 299-1	Ch 11 and Ch 12	Ch 27 and Ch 28	Ch 11 and Ch 12
	3	ST 299-1	Ch 13 and Ch 14	Ch 29 and Ch 30	Ch 13 and Ch 14
	4	ST 299-1	Ch 15 and Ch 16	Ch 31 and Ch 32	Ch 15 and Ch 16

Note 1: For 96-kHz sampling, Single Channel Double Sampling Frequency Mode is employed as defined in AES3. For 96-kHz sampling, two successive samples of two AES audio channels (AES1 channel 1 1st and 2nd sample and AES2 channel 1 1st and 2nd sample) are carried in a single audio group. Refer to SMPTE ST 299-1 for further details.

Note 2: Embedded audio channel mapping to AES audio channel mapping is defined in SMPTE ST 299-1.

6.2.3 Level B-DL – SMPTE ST 372 Dual-Link Mapping Mode – Time code Data

When present the time code shall be mapped into the ancillary data space of the Le virtual interface according to the Level B-DL ancillary data mapping rules defined in SMPTE ST 425-1, and shall be in conformance with SMPTE ST 12-2.

The time code may also be mapped onto both the Le and Re virtual interfaces in which case the corresponding Time Address values shall be identical.

6.2.4 Other Ancillary Data

Other ancillary data if present shall be mapped into VANC or HANC of each Link A and Link B of the Dual-Link interface for each Le and Re image, prior to final mapping into the Virtual Interface of this standard in accordance with the SMPTE ST 425-1 Level B-DL mapping rules.

Ancillary data specifically intended for the Le or Re interface shall be inserted into the appropriate interface only.

7 Payload Identifier

The payload identifier data structure shall be in conformance with SMPTE ST 352 and shall be mapped onto each Le and Re interface in accordance with the Level A and Level B-DL mapping rules defined in SMPTE ST 425-1.

The payload identifier shall be 4 bytes where each byte has a separate significance. The first byte of the payload identifier shall have the highest significance and subsequent bytes shall define lower order video and ancillary payload information.

The recommended location for the payload identifier is defined in SMPTE ST 425-1.

7.1 Byte 1 – Digital Interface and Payload Identification

Byte 1 of the payload identifier identifies the video payload and the digital interface and shall be as defined in Table 7.

Table 7 – Byte 1 Video Payload and Digital Interface Identification

Mapping Nomenclature	Byte 1: Video Payload and Digital Interface Level A	Byte 1: Video Payload and Digital Interface Level B-DL
Stereoscopic 720-line video payloads on a dual 3 Gb/s serial digital interface	91h	not applicable
Stereoscopic 1080-line video payloads on a dual 3 Gb/s serial digital interface	92h	93h

7.2 Byte 2 – Picture Rate

Byte 2 of the payload identifier shall be in conformance with the picture rates defined in Table 2 of SMPTE ST 352.

7.3 Byte 3 – Sampling Structure, Aspect Ratio and Horizontal Size

Byte 3 of the payload identifier shall be used to identify the aspect ratio, horizontal pixel array size, and sampling structure of the video payload.

For Level A mapping, the payload ID byte 3 values shall be in conformance with the Level A payload ID rules defined for byte 3 in SMPTE ST 425-1.

For Level B-DL mapping, the payload ID byte 3 values shall be in conformance with the Level B-DL payload ID rules defined for byte 3 in SMPTE ST 425-1.

Note: SMPTE ST 425-1 normatively references SMPTE ST 372 for the precise definition of byte 3 values in the Level B-DL mapping mode.

7.4 Byte 4 – Extended Aspects

Byte 4 identifies extended aspects of the payload identifier and shall be as defined in Table 8.

Note: Byte 4 values are different for the Level A mapping mode and the Level B-DL mapping mode.

Table 8 – Payload Identifier Byte 4 definition

<table>
<tr><th>Bits</th><th>Byte 4
Level A mapping mode</th><th>Byte 4
Level B-DL mapping mode</th></tr>
<tr><td>Bit 7</td><td>Reserved (0h)</td><td>Reserved (0h)</td></tr>
<tr><td>Bit 6</td><td>Interface assignment
Left eye Interface(0h) or Right eye interface (1h)</td><td>Link assignment
Link A (0)
Link B (1)</td></tr>
<tr><td>Bit 5</td><td>Reserved (0)</td><td>Interface assignment
Left Eye (0)
Right Eye (1)</td></tr>
<tr><td>Bit 4</td><td>Reserved (0)</td><td>Reserved (0)</td></tr>
<tr><td>Bit 3</td><td rowspan="2">Audio - Right eye interface,
audio not present or status unknown (0h)
Right eye interface carries a copy of Left eye audio (1h)
Right eye interface carries additional channels (2h)
Reserved (3h)</td><td>Audio - Right eye interface,
audio not present or status unknown (0h)
Right eye interface carries a copy of Left eye audio (1h)
Right eye interface carries additional channels (2h)
Reserved (3h)</td></tr>
<tr><td>Bit 2</td></tr>
<tr><td>Bit 1</td><td rowspan="2">Bit depth
Reserved (0h), 10-bit (1h),
12-bit (2h), Reserved (3h)</td><td>Bit depth
Reserved (0h), 10-bit (1h),
12-bit (2h), Reserved (3h)</td></tr>
<tr><td>Bit 0</td></tr>
</table>

8 Left/Right Eye Image Interface Timing

The timing difference between the serial digital clocks and EAV / SAV of the Left Eye Interface and the Right Eye interface shall not exceed 400 ns at the source. This difference should be taken into consideration when designing systems and destination equipment input stages.

9 Levels of Operation (Informative)

To define the level of support for this standard, manufacturers are encouraged to indicate in publications which mapping format is supported. For example:

Stereo Level A – Direct image format mapping

Stereo Level B-DL – SMPTE ST 372 Dual Link mapping

Manufacturers are also encouraged to indicate in publications supported audio and video formats.

Annex A Bibliography (Informative)

Note: All references in this document to other SMPTE documents use the current numbering style (e.g. SMPTE ST 12-1:2008) although, during a transitional phase, the document as published (printed or PDF) may bear an older designation (such as SMPTE 12M-1-2008). Documents with the same root number (e.g. 12-1) and publication year (e.g. 2008) are functionally identical.

SMPTE ST 12-1:2008, Television — Time and Control Code

SMPTE ST 274:2008, Television — 1920 × 1080 Image Sample Structure, Digital Representation and Digital Timing Reference Sequences for Multiple Picture Rates

SMPTE ST 291:2011, Ancillary Data Packet and Space Formatting

SMPTE ST 296:2012, 1280 × 720 Progressive Image Sample Structure — Analog and Digital Representation and Analog Interface

SMPTE ST 372:2011, Dual Link 1.5 Gb/s Digital Interface for 1920 × 1080 and 2048 × 1080 Picture Formats

SMPTE ST 424:2006, Television — 3 Gb/s Signal/Data Serial Interface

SMPTE ST 428-1:2006, D-Cinema Distribution Master (DCDM) — Image Characteristics

SMPTE ST 428-9:2008, D-Cinema Distribution Master — Image Pixel Structure Level 3 — Serial Digital Interface Signal Formatting

SMPTE ST 428-11:2009, Additional Frame Rates for D-Cinema

SMPTE ST 428-19:2010, D-Cinema Distribution Master — Additional Frame Rates Level AFR2 and Level AFR4 — Serial Digital Interface Signal Formatting

SMPTE ST 429-2:2011, D-Cinema Packaging — DCP Operational Constraints

SMPTE ST 429-13:2009, D-Cinema Packaging — DCP Operational Constraints for Additional Frame Rates

SMPTE ST 2048-1:2011, 2048 × 1080 and 4096 × 2160 Digital Cinematography Production Image Formats FS/709

SMPTE ST 2048-2:2011, 2048 × 1080 Digital Cinematography Production Image FS/709 Formatting for Serial Digital Interface

Annex B SMPTE ST 425-4 Document Road Map (Informative)

This road map shows the relationships between SMPTE ST 425-4 and its reference documents.