

SMPTE STANDARD

10 Gb/s Serial Signal/Data Interface — Part 2: 10.692¹ Gb/s Stream — Basic Stream Data Mapping



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¹Nominal bit rate. The interface is also capable of transmitting streams with the data rate of 10.692/1.001 Gb/s.

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 435-2 was prepared by Technology Committee 32NF.

Intellectual Property

SMPTE draws attention to the fact that it is claimed that compliance with this Standard may involve the use of one or more patents or other intellectual property rights (collectively, "IPR"). The Society takes no position concerning the evidence, validity, or scope of this IPR.

Each holder of claimed IPR has assured the Society that it is willing to License all IPR it owns, and any third party IPR it has the right to sublicense, that is essential to the implementation of this Standard to those (Members and non-Members alike) desiring to implement this Standard under reasonable terms and conditions, demonstrably free of discrimination. Each holder of claimed IPR has filed a statement to such effect with SMPTE. Information may be obtained from the Director, Standards & Engineering at SMPTE Headquarters.

Attention is also drawn to the possibility that elements of this Standard may be subject to IPR other than those identified above. The Society shall not be responsible for identifying any or all such IPR.

Introduction

This 10 Gb/s interface is based upon multiplexing multiple 1.5 Gb/s Basic Streams that comply with the data structure of SMPTE ST 292-1. The ancillary data structure as defined by SMPTE ST 291 is utilized for the mapping of the data into HANC and VANC data areas of a Basic Stream. Audio data mapping is based upon the requirements defined in SMPTE ST 299-1.

1 Scope

This Standard specifies the multiplexing schemes to map up to 8 Basic Streams defined by SMPTE ST 435-1 into the 10 Gb/s Serial Interface. The source image formats supported are referenced in SMPTE ST 435-1. The mapping also supports transmission of the embedded audio, payload ID and other ancillary data defined in SMPTE ST 291 in the source stream.

2 Conformance Notation

Normative text is text that describes elements of the design that are indispensable or text that contains the conformance language keywords: "shall," "should," or "may." Informative text is text that is potentially helpful to the user, but not indispensable, and that 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.

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 ST 292-1:2012, 1.5 Gb/s Signal/Data Serial Interface

SMPTE ST 435-1:2012, 10 Gb/s Serial Signal/Data Interface — Part 1: Basic Stream Derivation

ANSI INCITS 230-1994 (R1999), Information Technology — Fibre Channel — Physical and Signaling Interface (FC-PH)

4 Definition of Terms

4.1 10.692 Gb/s

the term "10.692 Gb/s" is used as a generic term for 10.692 Gb/s and 10.692/1.001 Gb/s in this standard

4.2 Basic Stream

a 10-bit parallel stream which has the same structure as the source data defined in SMPTE ST 292-1

4.3 CRC

Cyclic Redundancy Check codes defined in SMPTE ST 292-1

4.4 EAV

the term EAV used in this standard designates all of timing information at the end of active video area; i.e., EAV bytes plus LN and CRC defined in SMPTE ST 292-1

4.5 Even Basic Stream

CH2, CH4, CH6 and CH8 (Link Bs) of Basic Streams defined in Section 6.3 (Mode C) and Section 6.4 (Mode D)

4.6 HANC Data

data included in a digital line blanking interval between EAV and SAV

4.7 K28.5

special code for the word boundary detection of 8B/10B coding defined in ANSI INCITS 230

4.8 LN

Line Number data defined in SMPTE ST 292-1

4.9 Odd Basic Stream

CH1, CH3, CH5 and CH7 (Link As) of Basic Streams defined in Section 6.3 (Mode C) and Section 6.4 (Mode D)

4.10 SAV

timing information defining the start of active video area defined in SMPTE ST 292-1

4.11 Stuffing Data

the term "Stuffing Data" designates one of the data byte D0.0 of 8B/10B coding defined in ANSI INCITS 230

5 Mapping Overview

The source data of the 10.692 Gb/s data stream shall be multiple Basic Streams as defined in SMPTE ST 435-1.

Figure 1 shows the overall block diagram of the 10.692 Gb/s interface which can carry $4096 \times 2160/24P/4:4:4$, $3840 \times 2160/30P/4:4:4$ or up to four pairs of $2048 \times 1080/24P/4:4:4$ or $1920 \times 1080/60I/4:4:4$ signals.

The outline of the data mapping process shall be as follows:

- The 10-bit Basic Streams shall be packed into arrays of 8 bit words.
- The generated byte array shall be channel coded as 8B/10B encoded data.
- The blocks of encoded data shall be interleaved and serialized into the 10.692 Gb/s serial stream.

HANC Data in some of the Basic Streams are not interleaved into 10.692 Gb/s stream in the case of mapping Mode B, C or D. Details are defined in Section 6.2, Section 6.3, and Section 6.4.

Figure 1 illustrates the signal processing involved at the TX and RX ends of the transport. Default data values (040h for Y' data and 200h for C_B/C_R data) shall be inserted into unused HANC Data area of a Basic Stream if it has not been mapped onto the 10.692 Gb/s stream.

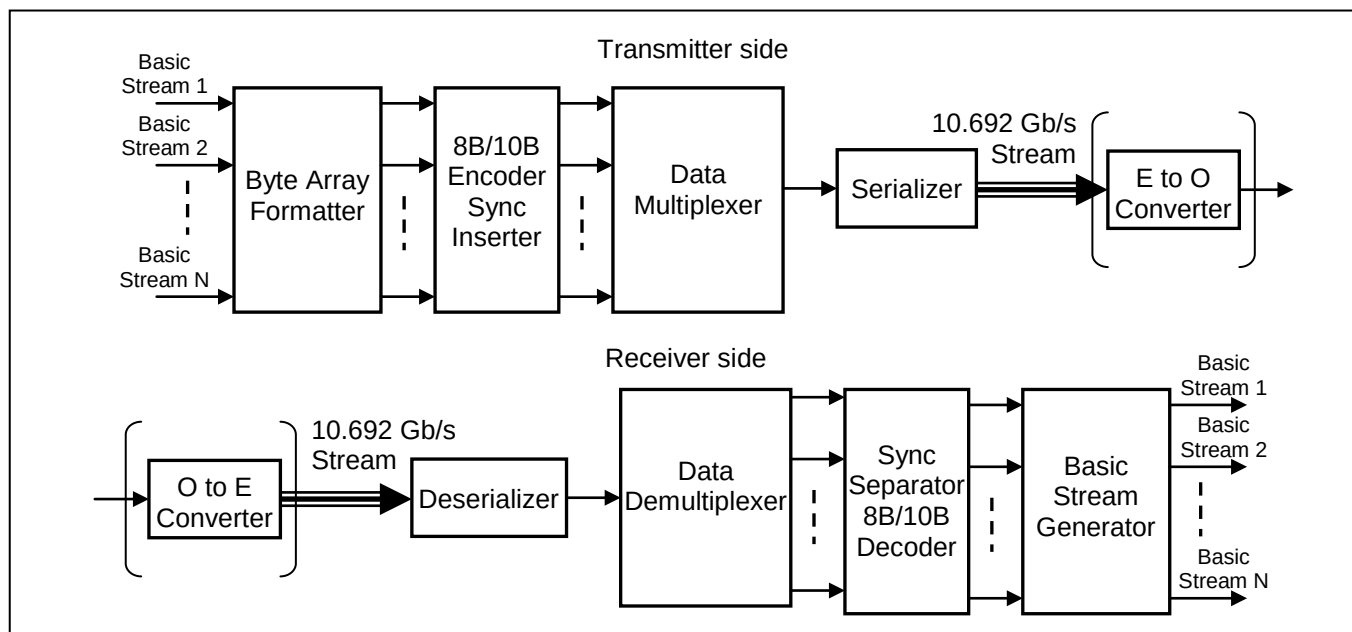


Figure 1 – Overall Block Diagram

6 Basic Stream Data Mapping

This section defines 4 data mapping structures. Mode A and Mode B shall be used for System 1.1 through System 4.3 images. Mode C shall be used for System 8.6 image exclusively. Mode D shall be used for System 8.2 through System 8.7 images, up to four pairs of System 2.2 through System 2.6 images or up to two pairs of System 4.1 through System 4.3 images.

Transmission of up to 5 Basic Streams as defined in SMPTE ST 435-1 is possible in Mode A, up to 6 Basic Streams is possible in Mode B and up to 8 Basic Streams is possible in Mode D. All Basic Streams that are mapped together onto a 10.692 Gb/s stream shall have the same frame rate and the same number of horizontal samples per line.

The placement of the ancillary data including the payload identifier as defined in SMPTE ST 352 shall be immediately following SAV of the line(s) specified in the Basic Stream interface document for Mode B, Mode C and Mode D.

The word clock frequency of each Basic Stream, as defined by SMPTE ST 435-1, shall be 148.5 MHz or 148.5/1.001 MHz. The word clock frequency shall be locked to the serial clock frequency (10.692 GHz or 10.692/1.001 GHz).

6.1 5-Channel Mode (Mode A)

Up to 5 Basic Streams may be embedded into the 10.692 Gb/s stream using mapping Mode A. The mapping shall maintain all the information included in each of the 5 Basic Streams.

The 8B/10B encoded 50-bit data block data from each Basic Stream shall be multiplexed into a single stream by the 50-bit block interleaving. The detail of the 50-bit block packing is defined in Section 6.1.1.

The Channel 1 Basic Stream data shall always be present for encoder and decoder synchronization. Other channels, when not used for image data, shall be filled with Stuffing Data.

Figure 2 defines the basic concept of Mode A mapping.

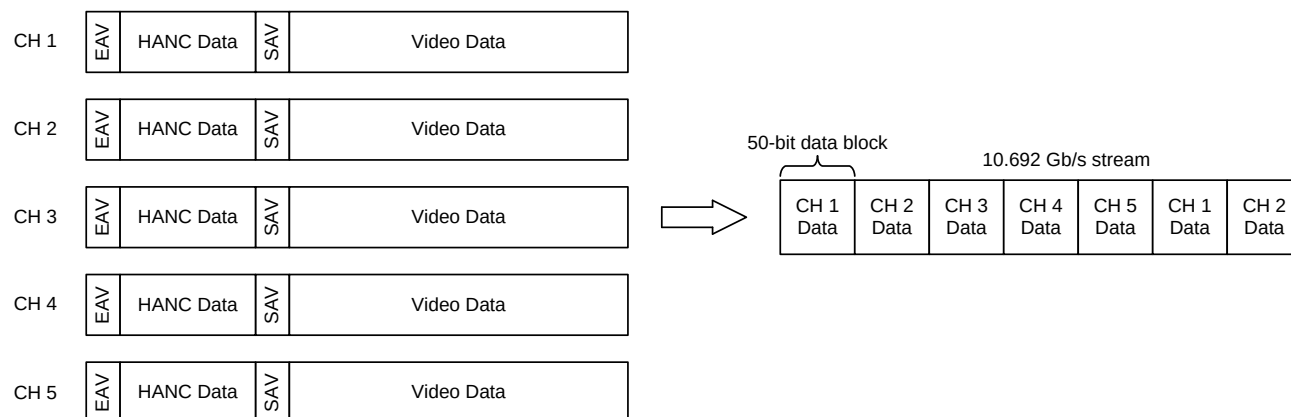


Figure 2 – Basic Stream interleaving for Mode A

6.1.1 Mode A 50-Bit Data Blocking and 8B/10B Encoding

4-word (40-bit) data blocks of the source Basic Stream data starting from the first SAV data shall be used for the blocking process.

Each 40-bit data block shall be packed into five 8-bit words and then shall be 8B/10B coded as defined in Section 11 of ANSI INCITS 230. Consequently a 50-bit encoded data block shall be generated from a 40-bit source data block. Figure 3 defines the blocking process.

Encoding disparity in a 10.692 Gb/s stream shall be alternated at every 10-bit word. Initial value of negative disparity shall be assigned to CH 1 first SAV word of each line.

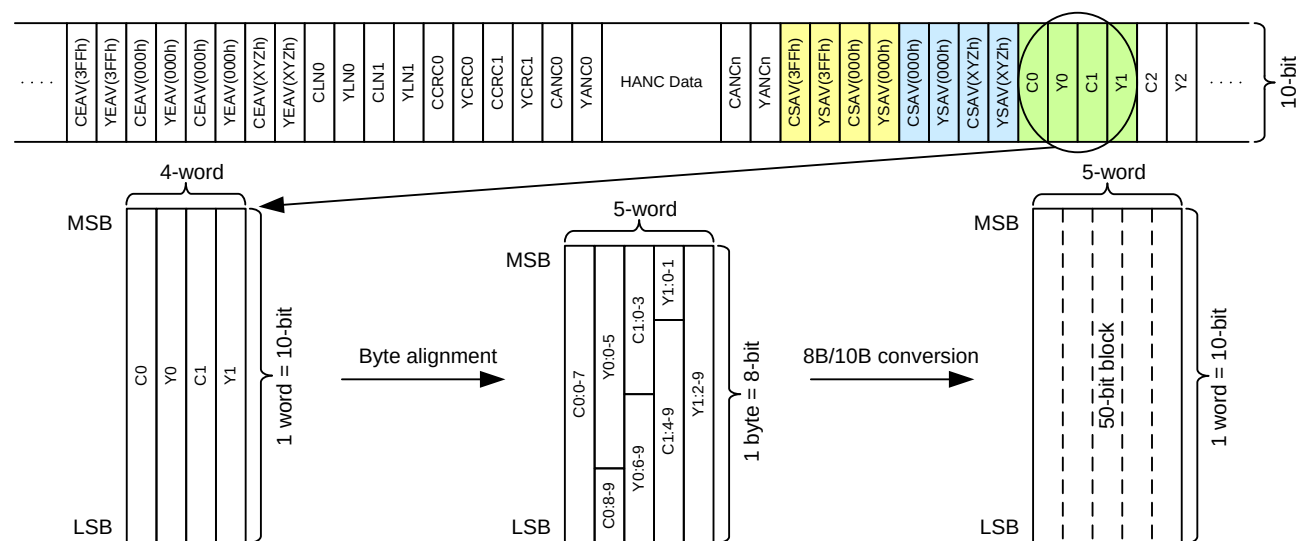


Figure 3 – Data alignment and 8B/10B encode process of 4-word data block

6.1.2 Data Replacement of SAV Part of Channel 1

In the Channel 1 stream, the first 40-bit byte aligned block at the beginning of each SAV shall be replaced by a synchronization block. This process shall be executed before 8B/10B encoding and shall be as defined in Figure 4.

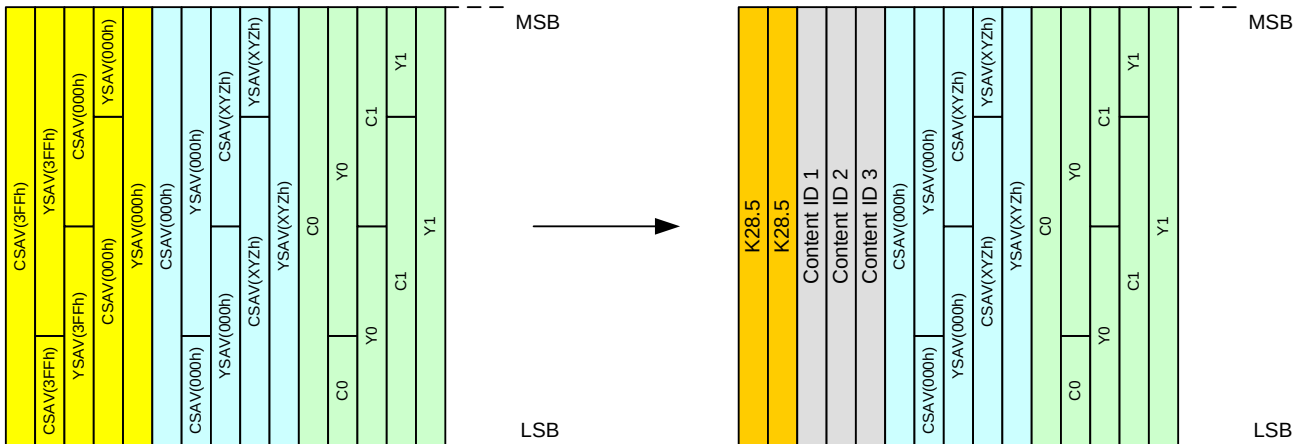


Figure 4 – SAV data replacement for Channel 1 data

The first 2 bytes of the byte aligned SAV data shall be replaced with two K28.5 special characters defined in 8B/10B Code, and successive 3 words of the byte aligned SAV data shall be replaced with the Content ID bytes as defined in Table 1.

Table 1 defines the layout of Content ID words.

Bit 7 of ID 1 shall be set to 0 in the case of the “1920×1080 Basic Stream”, “1280×720 Basic Stream” and shall be set to 1 in the case of the “2048×1080 Basic Stream”.

Bits 5 and 6 of ID 1 shall indicate the Mapping Structure and shall be assigned as defined in Table 3.

Bits 0 through 4 of ID1 shall indicate the System Number of CH 1 basic stream and shall be set as defined in Table 2.

Table 1 – Content ID data arrangement for Mode A

Bit	7 (MSB)	6	5	4	3	2	1	0 (LSB)							
ID 1	Basic Stream	Mapping Structure=00		System ID											
ID 2	Reserved (00h)														
ID 3	Reserved (00h)														

Table 2 – System ID assignment

System ID	System Number
00000	1.1
00001	1.2
00010 ~ 00011	Reserved
00100	2.1
00101	2.2
00110	2.3
00111	2.4
01000	2.5
01010	2.6
01011 ~ 01111	Reserved
10000	4.1
10001	4.2
10010	4.3
10011 ~ 10101	Reserved
10110	8.2
10111	8.3
11000	8.4
11001	8.5
11010	8.6
11011	8.7
11100 ~ 11111	Reserved

Table 3 – Mapping Structure value

00: Mode A	01: Mode B	10: Mode C	11: Mode D
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6.1.3 10.692 Gb/s Stream for Mode A Transmission

The 50-bit encoded data block units from 5 source streams shall be interleaved from CH 1 through CH 5 as shown in Figure 5. The Stuffing Data shall be appended to the end of the HANC code blocks to adjust a line data period of Mode A to be consistent with a line period of a source stream. The data length in a line, and the number of Stuffing Data bytes in Mode A shall be as shown in Table A.1 of Annex A

The interleaved stream shall be serialized to 10.692 Gb/s stream with LSB first order.