Misc. 61883, 1394 and AVB info for tutorial, discussion, brainstorming, etc. for AVBTP working group.

Editor's working slides version 0.04
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IEEE 1394 and IEC 61883-1 formats and info

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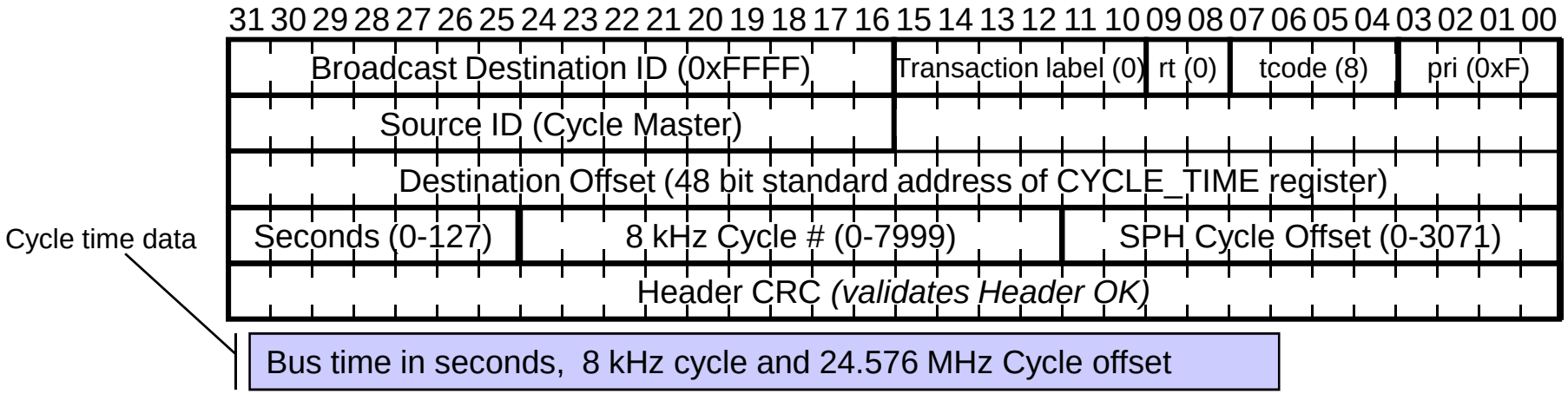
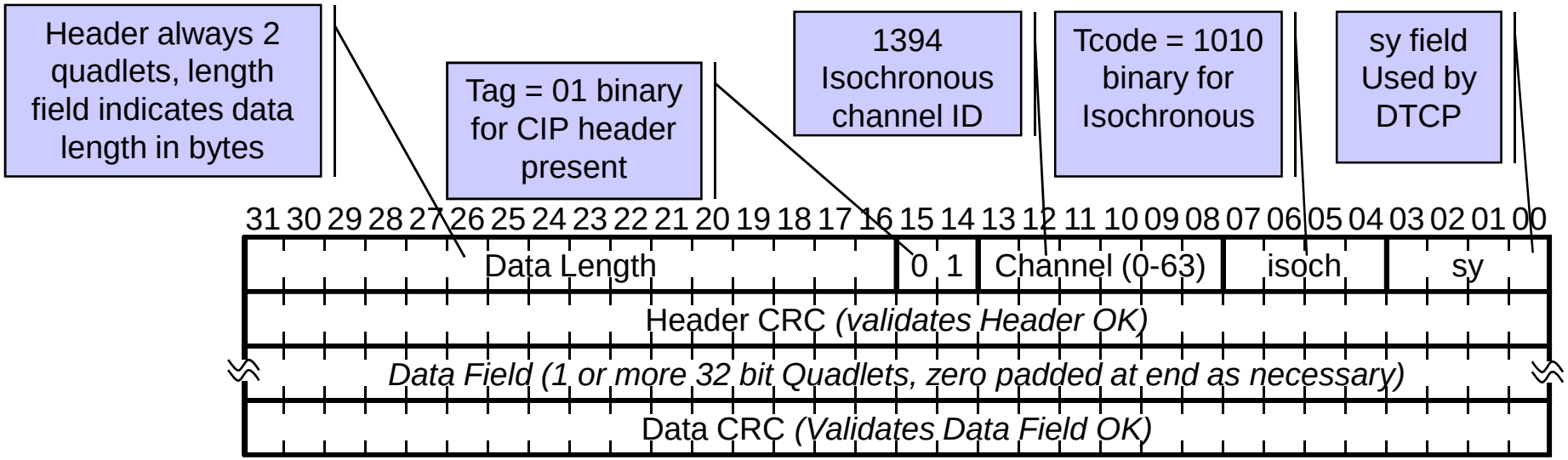
IEEE 1394 Cycle start



- Cycle start packet is sent out by 1394 Cycle Master device every 8 kHz delayed by a maximum of one Asynchronous packet.
- All Isochronous Packets immediately follow the cycle start packet for a given 8 kHz cycle.

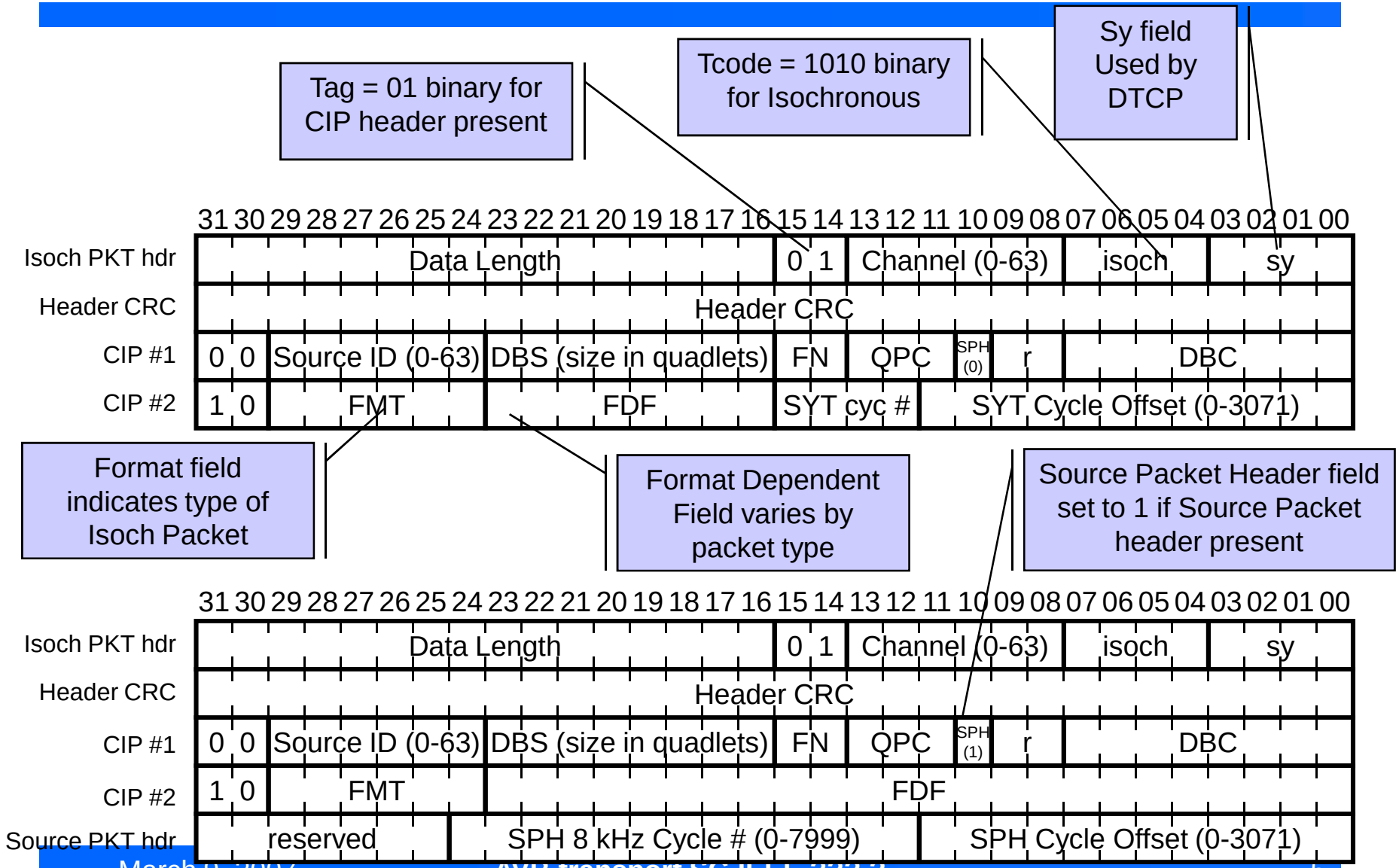
IEEE 1394 Isochronous Packet



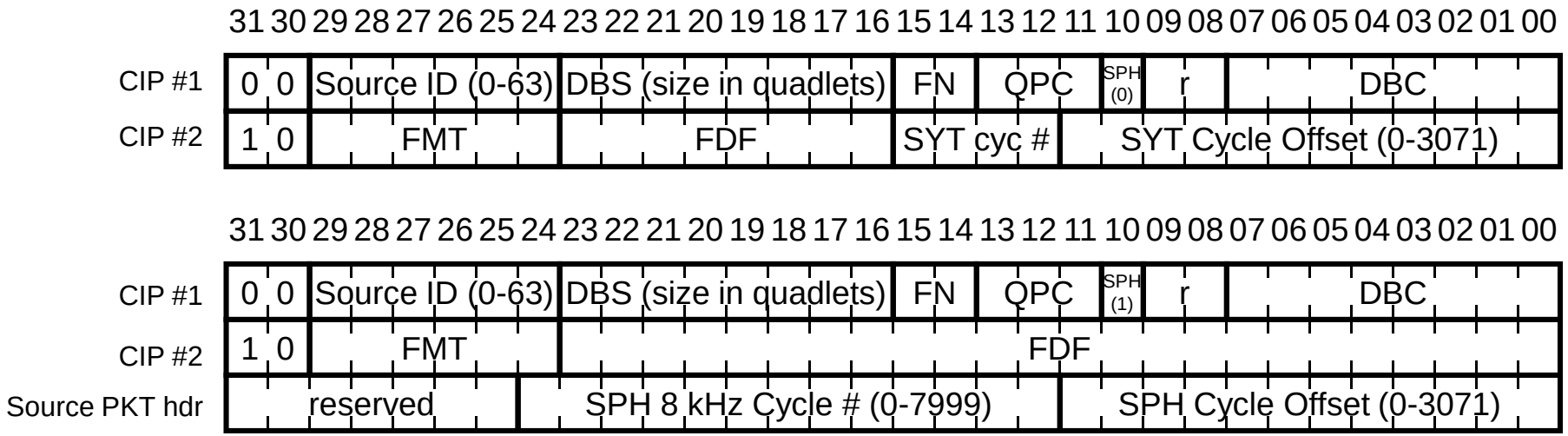
DTCP "sy" field values:

Field	Value	Comments
Encryption Mode Indicator EMI (bits 3,2)	00b	Copy Freely, No Authentication Required, Data not encrypted
	01b	No More copies, Full or Restricted Authentication Required, Encrypted Data
	10b	Copy One Generation, Full or Restricted Authentication Required, Encrypted Data
	11b	Copy Never, Full Authentication Required, Encrypted Data
Odd/Even (bit 1)	0b	Use Even key to Decrypt Data
	1b	Use Odd key to Decrypt Data
Reserved (bit 0)	---	*Reserved, set to 0 on transmit, ignore on receive*

1394 CIP Isochronous Headers



CIP Headers



- CIP#1 Quadlet always has the same format, remaining quadlets vary based on if SPH bit is 0 or 1
  - Source ID: Senders ID: 0-63
  - Data Block Size (DBS): size in Quadlets of individual Data blocks within the packet (max 256)
  - Fraction Number (FN): number of data blocks into which a source packet is divided: 1, 2, 4 or 8 (00 – 11 binary)
  - Quadlet Padding Count (QPC): Indicates number of padding bytes in last quadlet of packet (if any, 0 through 7)
  - Reserved (r): Reserved
    - Editor's note: Perhaps we can use this field to define a new time base of 802.1AS nanosecond time.
  - Data Block Count (DBC): Sequence number modulo 256 of 1st Data block in this packet

61883 variants and key fields

Protocol	Title	DBS (Quadlets)	FN Fractions/ source packet	QPC	SPH	DBC Increment	FMT	FDF	Source packet size bytes
61883-2	SD-DVCR	120	0	0	0	0, 1, 2, 4	0x00	sect. 5.2	480
61883-4	MPEG2-TS	6	8	0	1	0, 1, 2, 4, 8, 16, 24, etc.	0x40	sect. 5.3	192
61883-6	Audio and Music Data	Varies by formats, channels, number of sample periods, etc.	0	0	0	Varies	0x10	clause 10	DBS * 4
61883-7	ITU-R BO.1294 System B	9	4	0	1	0, 1, 2, 4, 8, 12, etc.	0x41	…	140
61883-8	BT.601	Varies by video format	0	0	0	varies by number of data blocks	0x01	Figure 6	DBS * 4

IEC 61883-6 formats and info

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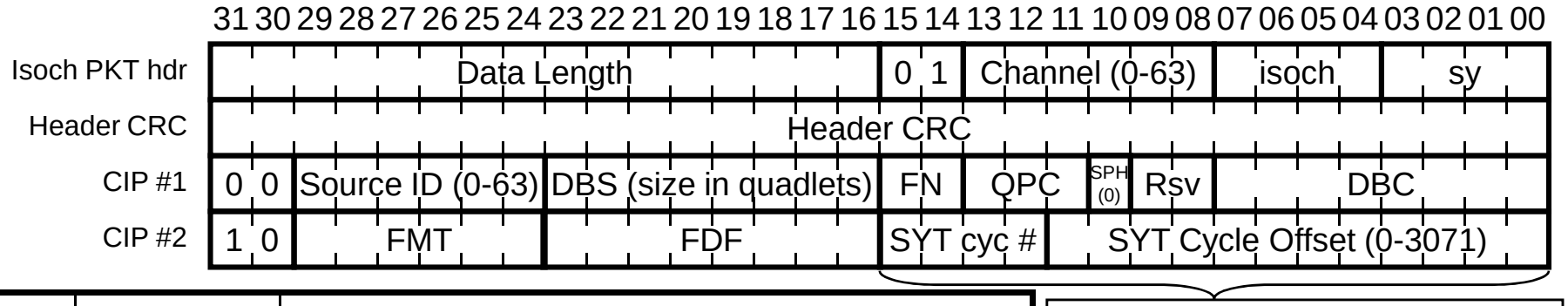
61883-6 Isochronous Header

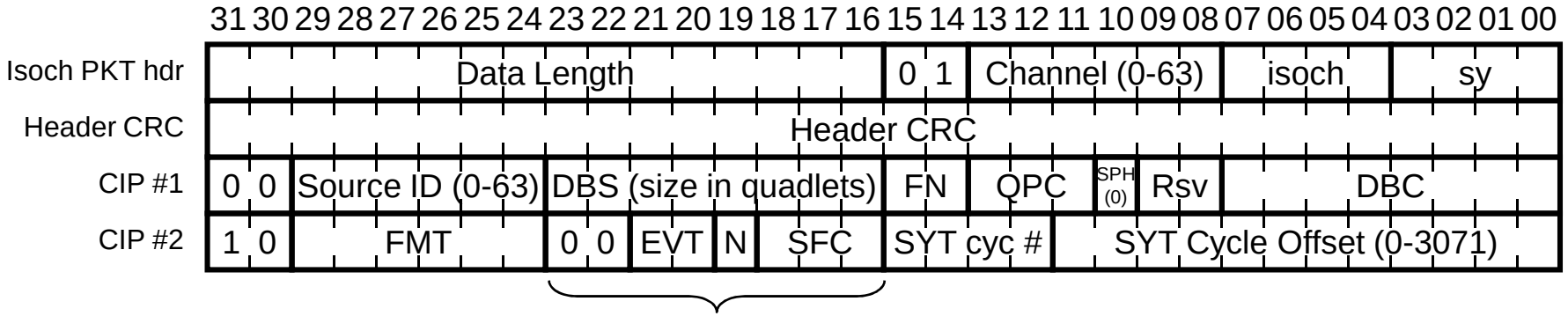


Field	Value	Comments
FMT	0x10 (010000b)	*Format*: Audio/Music format
FN	00	*Fragment Number*: Always match of 1 to 1 between CIP packet and Source Packet (i.e. never fragmented)
QPC	000	*Quadlet Padding Count* : No dummy padding quadlets needed (or supported)
SPH	0	*Source Packet Header*: None
DBC	0-255	*Data Block Counter:* Indicates modulo 256 sample count number of 1st data quadlet of the packet. Used for detecting lost data, amount thereof.
SYT	xxx-xxxxxxxxxxx	*Synchronization Time*: Time when the data block specified by DBC_NUMBER Modulo SYT_INTERVAL is presented at the receiver
FDF	0-255	*Format Dependent Field*: See FDF data

SYT Data:

- **Delivery time of the first audio or Data bit to the application (codec, decoder, transmitter, etc.)**
- **Set by source of audio data**
- **Processed by sink of audio data**
- **Presentation Time Range**
  - **2 milliseconds**
    - **4 bit 8kHz Cycle**
    - **12 bit 24.576 MHz Cycle offset**
- **Set to All ones (0xFFFF) for entire 16 bit field as “No info” value**

61883-6 Isochronous Audio Data Header

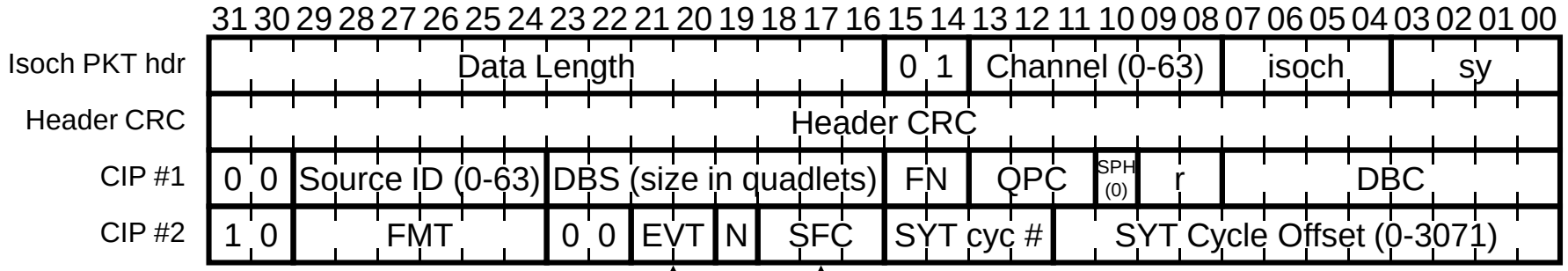


When FDF = 0x00-0x3F, FDF field broken up into:

- **EVT**
- **N**
- **SFC**

- **Editor's note, SFC also used in One bit audio which is 0x50-**

61883-6 Isochronous Header (N=0)

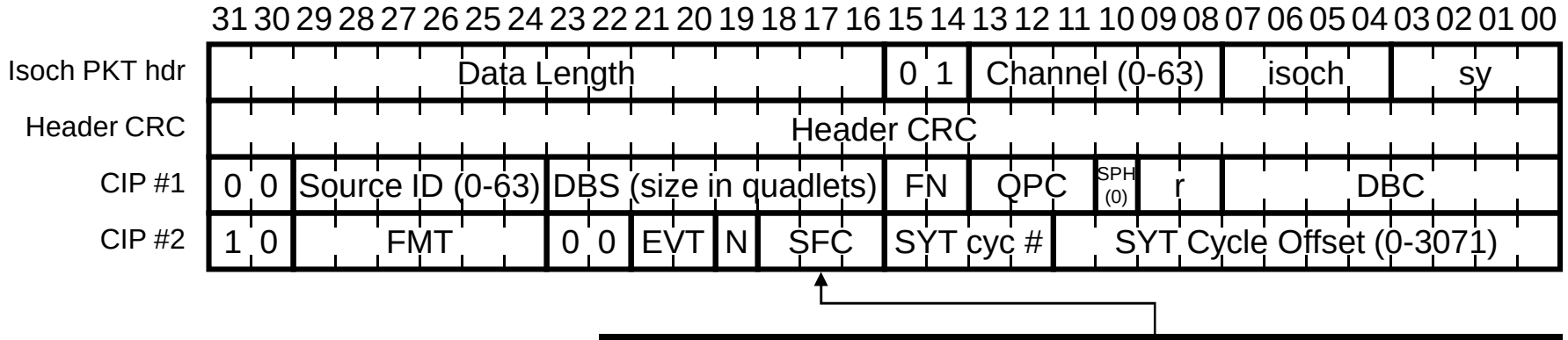


EVT (Event type) code definition	
Value (binary)	Description
00	AM824 data
01	24 bit * 4 Audio Pack
10	32 bit Floating Point data
11	Reserved for 32 bit or 64 bit data

Default SFC (Nominal Sampling Frequency Code) definition N = 0		
Value (binary)	Nominal Sampling frequency	SYT INTERVAL
000	32kHz	8
001	44.1kHz	8
010	48kHz *(or not indicated??)*	8
011	88.2 kHz	16
100	96 kHz *(or not indicated??)*	16
101	176.4 kHz	32
110	192 kHz	32
111	Reserved	---

Editor's Note:
2002 version indicated "not indicated" which appears removed in 2005 version. Appears 2005 version added concepts of "sampling frequency, "original sampling frequency", "nominal sampling frequency" "up and down sampling ratios" etc. Needs further investigation on which/what options we'll have to support and how.

61883-6 Isochronous Header (N=1)

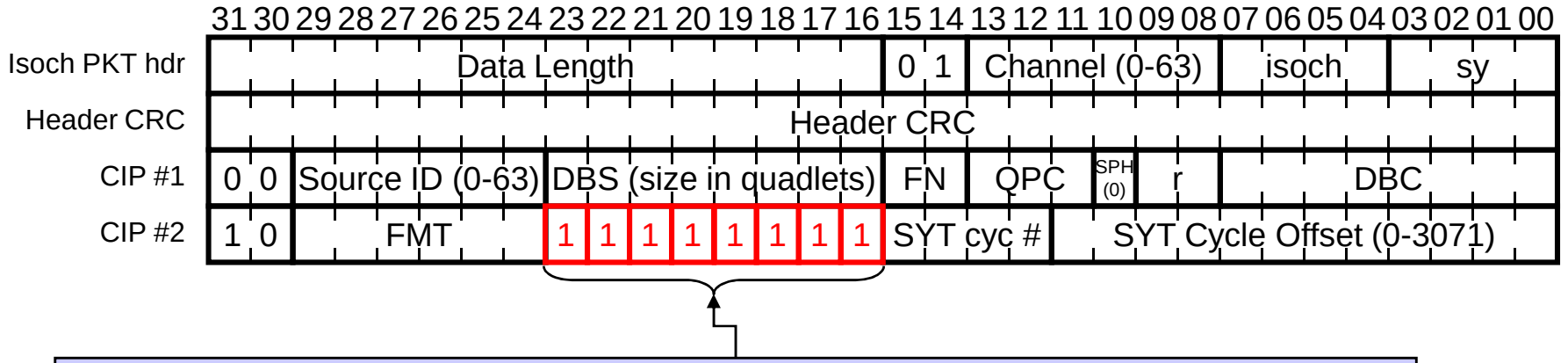


Editor's Note, need to know if we need to support this mode in Ethernet AVBTP and if so, how we will support setting, handling, etc. of "N", how it would affect physical and virtual interfaces, etc.

Default SFC (Nominal Sampling Frequency Code) definition
N = 1

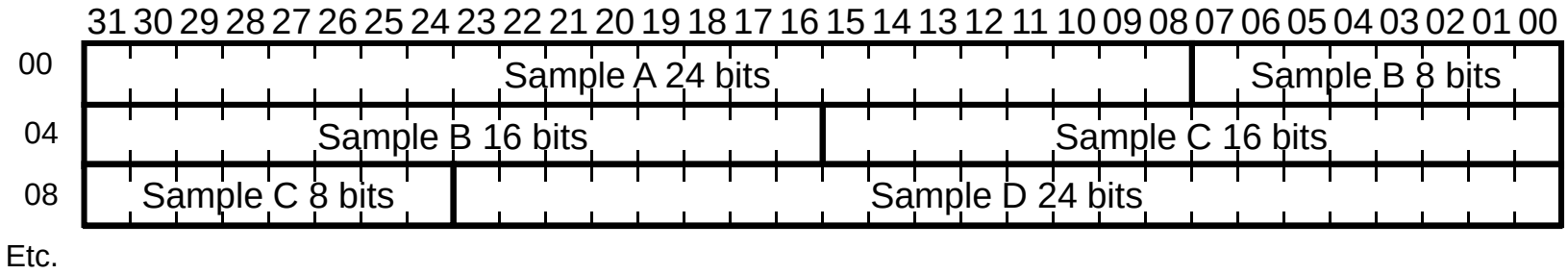
Value (binary)	Nominal Sampling frequency	SYT INTERVAL	Sampling Frequency
000	32 kHz	8 * *n*	32 kHz * *n*
001	44.1 kHz	8 * *n*	44.1 kHz * *n*
010	48 kHz	8 * *n*	48 kHz * *n*
011	88.2 kHz	16 * *n*	88.2 kHz * *n*
100	96 kHz	16 * *n*	96 kHz * *n*
101	176.4 kHz	32 * *n*	176.4 kHz * *n*
110	192 kHz	32 * *n*	192 kHz * *n*
111	Reserved	---	---

61883-6 “NO-DATA” packet



FDF field all ones indicates a “NO-DATA” packet.
Used by transmitter only for blocking transmission method
Mandatory for receiver to ignore all data in a CIP packet when received

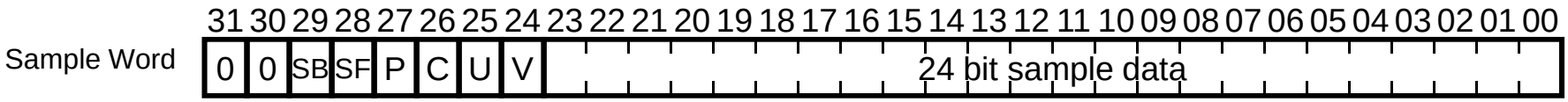
24 bit audio Pack



DBS field for 24 bit x 4 Audio Pack	
Value (Decimal)	Description
3 – 255	Cluster Dimension = DBS / 3

- Indicated by EVT field = 01 binary
- 4 24 bit samples packed together into 3 quadlets

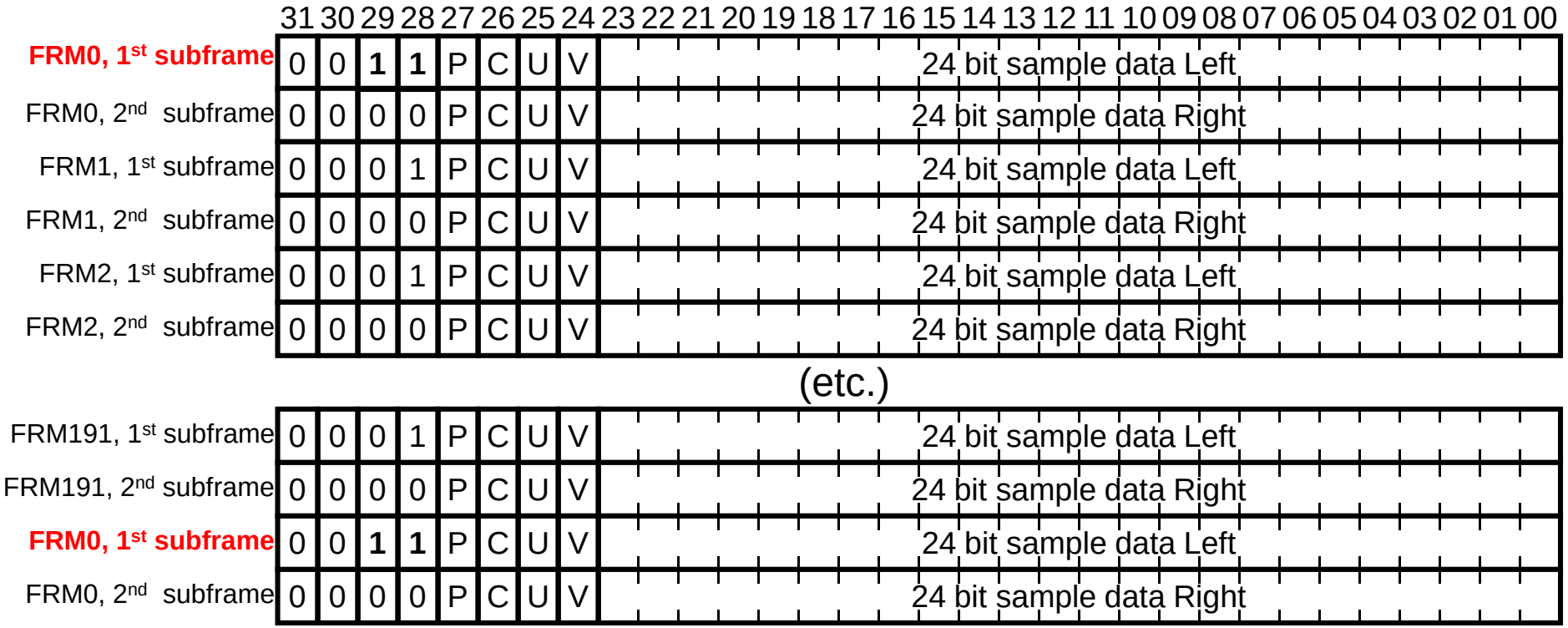
IEC 60958 format (S/PDIF & AES3)



SB	SF	Description	Equivalent IEC 60958 preamble codes
0	0	Second sub-frame of IEC 60958 frames 0 to 191	W,Y
0	1	First sub-frame of IEC 60958 frames 1 to 191	M,X
1	0	Reserved	N/A
1	1	First sub-frame of IEC 60958 frame 0	B,Z

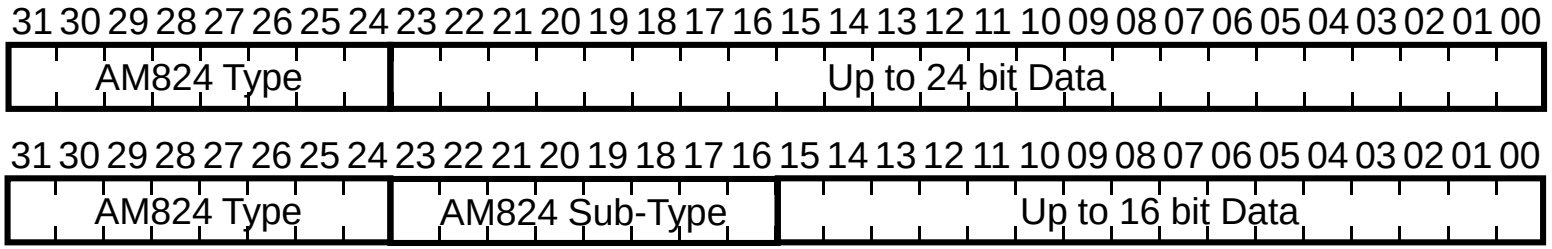
- Uses AM824 Data format (indicated in EVT code of 00 binary in CIP header)
- 60958 frame data in first 8 bits
- 24 bit sample data is in remaining 24 bits
- Definitions
  - SB: Start of Block
  - SF: Start of Frame
  - P: Parity
  - C: Control word bit (bits combined to make 24 control words in 192 word frame)
  - U: User Bit
  - V: Validity Bit

IEC 60958 stream example (stereo)



SB	SF	Description	Equivalent IEC 60958 preamble codes
0	0	Second sub-frame of IEC 60958 frames 0 to 191	W,Y
0	1	First sub-frame of IEC 60958 frames 1 to 191	M,X
1	0	Reserved	N/A
1	1	First sub-frame of IEC 60958 frame 0	B,Z

AM824 Format

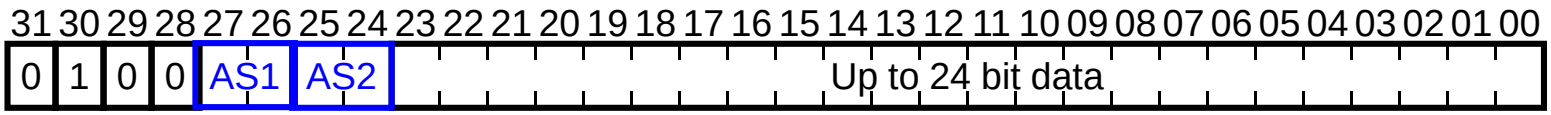


Type Value (Hex)	Description
0x00-0x3F	IEC 60958 format
0x40-0x4F	Multi-bit Linear audio
0x50-0x57	One Bit Audio (plain)
0x58-0x5F	One Bit audio (encoded)
0-60-0x67	High Precision Multi-Bit Linear Audio
0x68-0x7F	Reserved
0x80-0x83	MIDI conformant
0x84-0x87	Reserved
0x88-0x8B	SMPTE time code conformant
0x8C-0x8F	Sample Count
0x90-0xBF	Reserved
0xC0-0xCF	Ancillary data (common)
0xD0-0xEF	Ancillary data (application specific)
0xF0-0xFF	Reserved

Editor's Notes:

•Need to investigate which of the data formats we support for egress to physical and virtual interfaces.

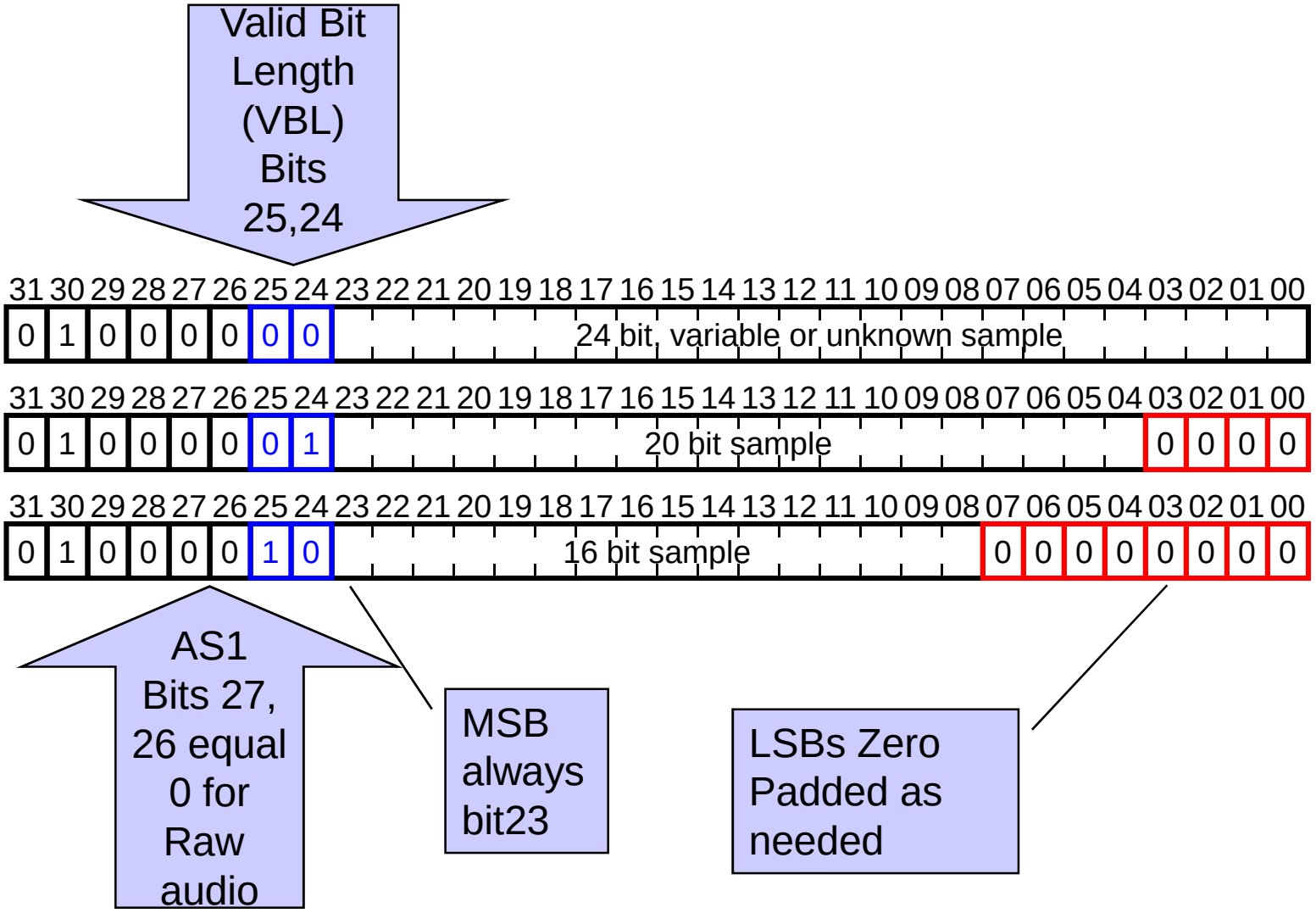
Multi-Bit Linear Audio (MBLA) format



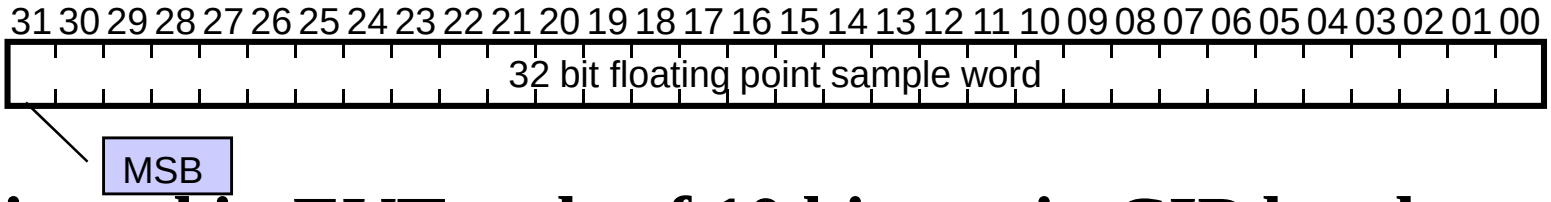
AS1 (Binary)	Description
00b	**Raw Audio format**. The sample word can be fed direct to a D/A converter. Ancillary data may accompany elsewhere in the packet. The definition of ASI2 is identical to VBL (valid bit length) defined in IEC 61883-6:2002.
01-11b	**Application-specific information**. The sample word may be fed direct to a D/A converter but, in some processing, required according to the application identified by application-specific ancillary data which shall appear in the same data block.

AS2 (Valid Bit Length) (Binary)	Description
00b	24 bit, unknown or variable
01b	20 bit
10b	16 bit
11b	reserved

AM824 Raw audio data format examples

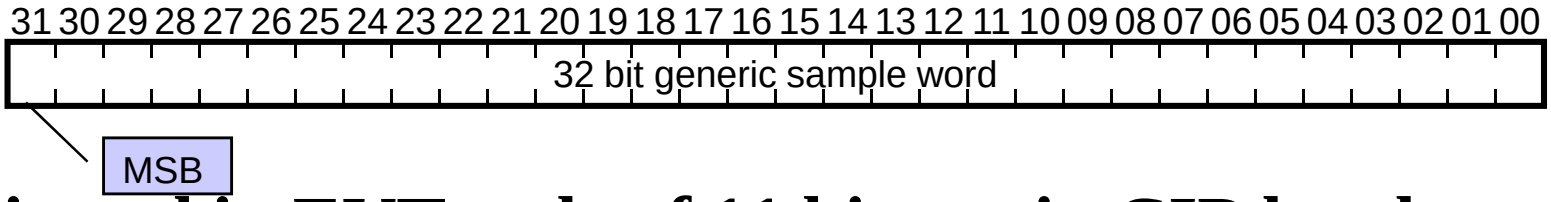


32 bit floating point data format



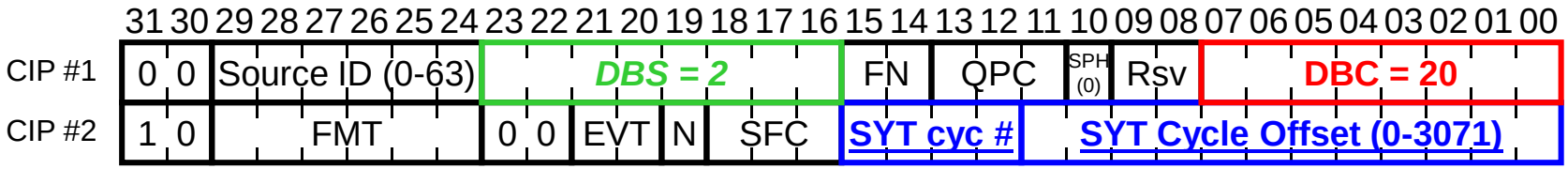
- **Indicated in EVT code of 10 binary in CIP header**
- **32 bit format takes up the entire quadlet with one sample per quadlet.**

32 bit generic data format



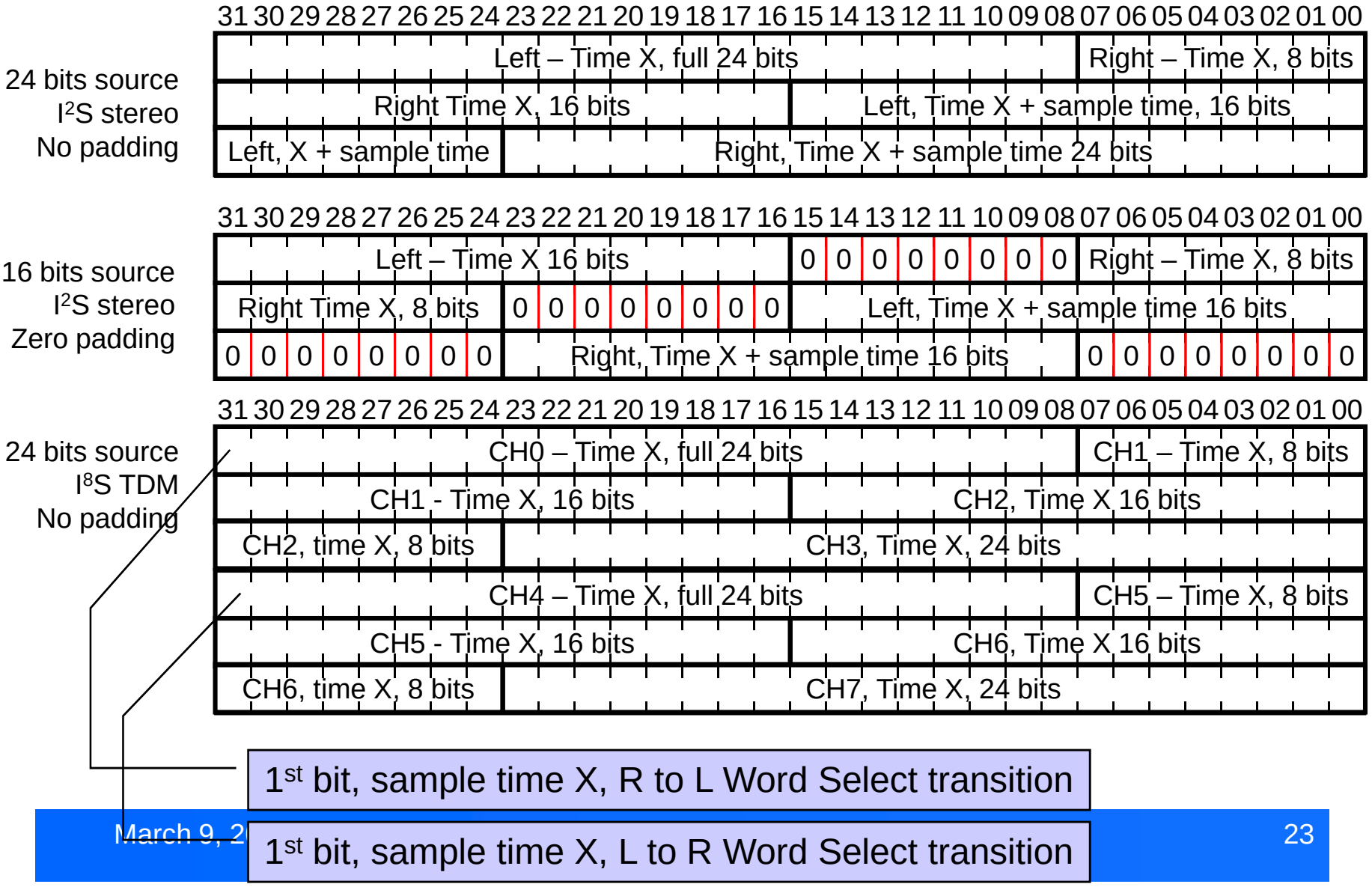
- **Indicated in EVT code of 11 binary in CIP header**
- **32 bit format takes up the entire quadlet with one sample per quadlet.**

Example “Empty” Packet

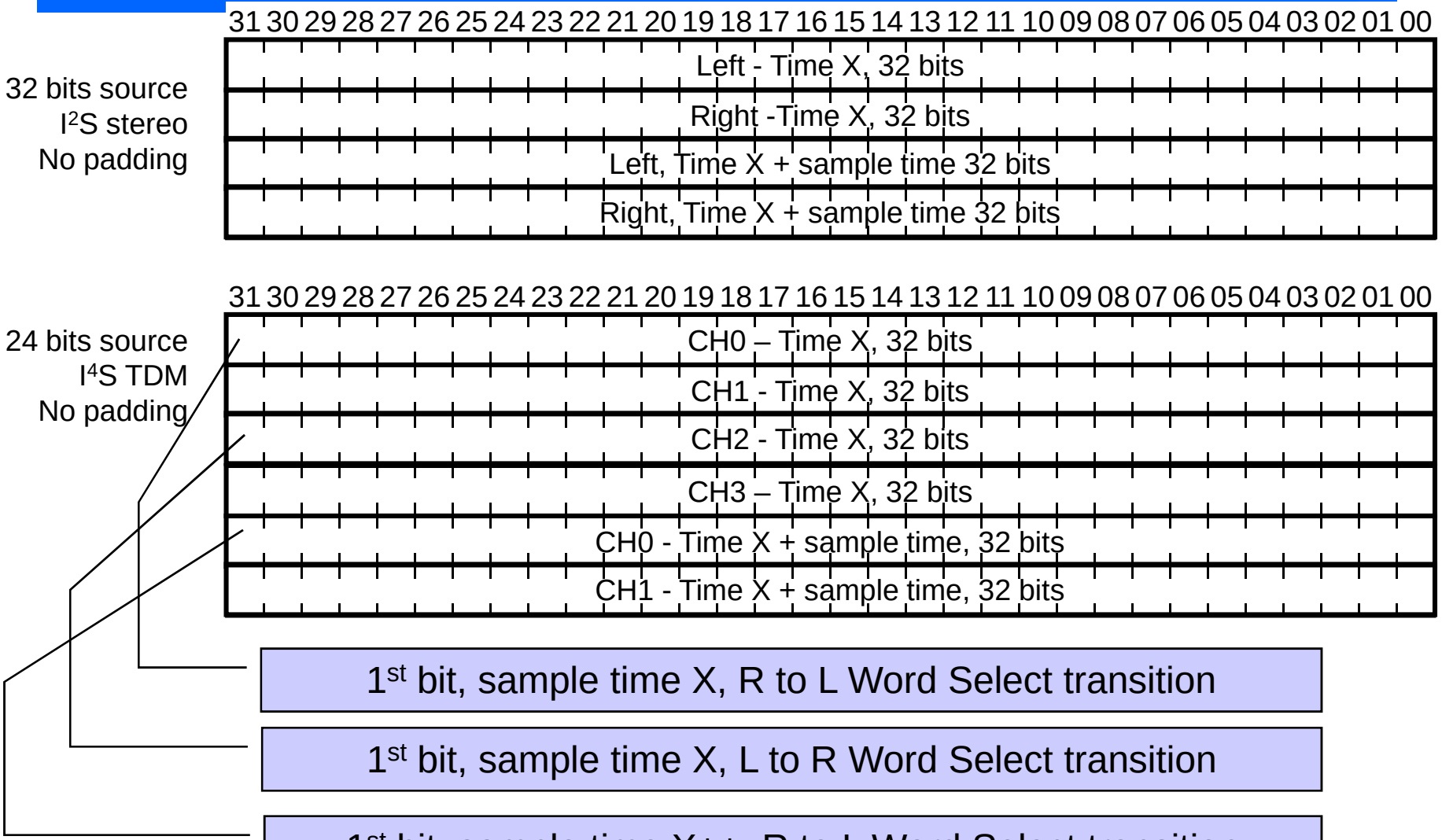


- Example from Non-Blocking Data Flow diagram.
  - ***DBS*** = size of data blocks in quadlets == ***2*** in this example
  - **DBC** indicates 1st data block (sample group) == **20** in this example
  - **SYT** set to “no info” as there are no Data Blocks to have a timestamp corresponded to in this packet.
    - Value set to “all ones” 1111-111111111111
- *Editor’s note: Need to look into more about empty packet versus “NO-DATA” packet, how they are sent, how DBC is manipulated, etc.*

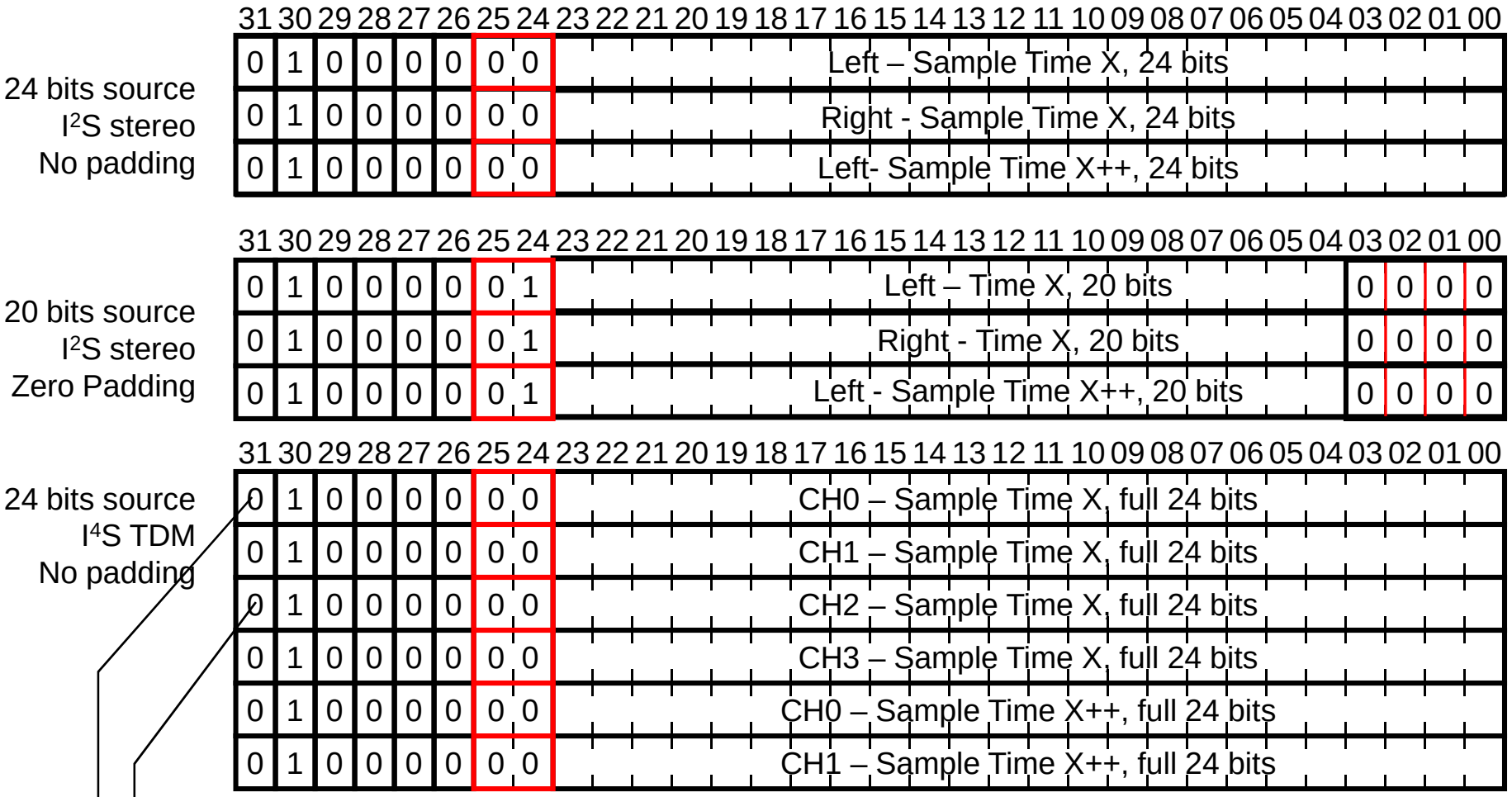
Examples, packed format, 24 bit



Examples, 32 bit format



Examples, unpacked format, 24 bit



Examples, I²S fill values

24 bits
or not 20 bits
or not 16 bits
or unknown
Length source
I²S stereo

31	30	29	28	27	26	25	24	23 22 21 20 19 18 17 16 15 14 13 12 11 10 09 08 07 06 05 04 03 02 01 00
0	1	0	0	0	0	0	0	Left – Sample Time X, 24 bits
0	1	0	0	0	0	0	0	Right - Sample Time X, 24 bits
0	1	0	0	0	0	0	0	Left- Sample Time X++, 24 bits

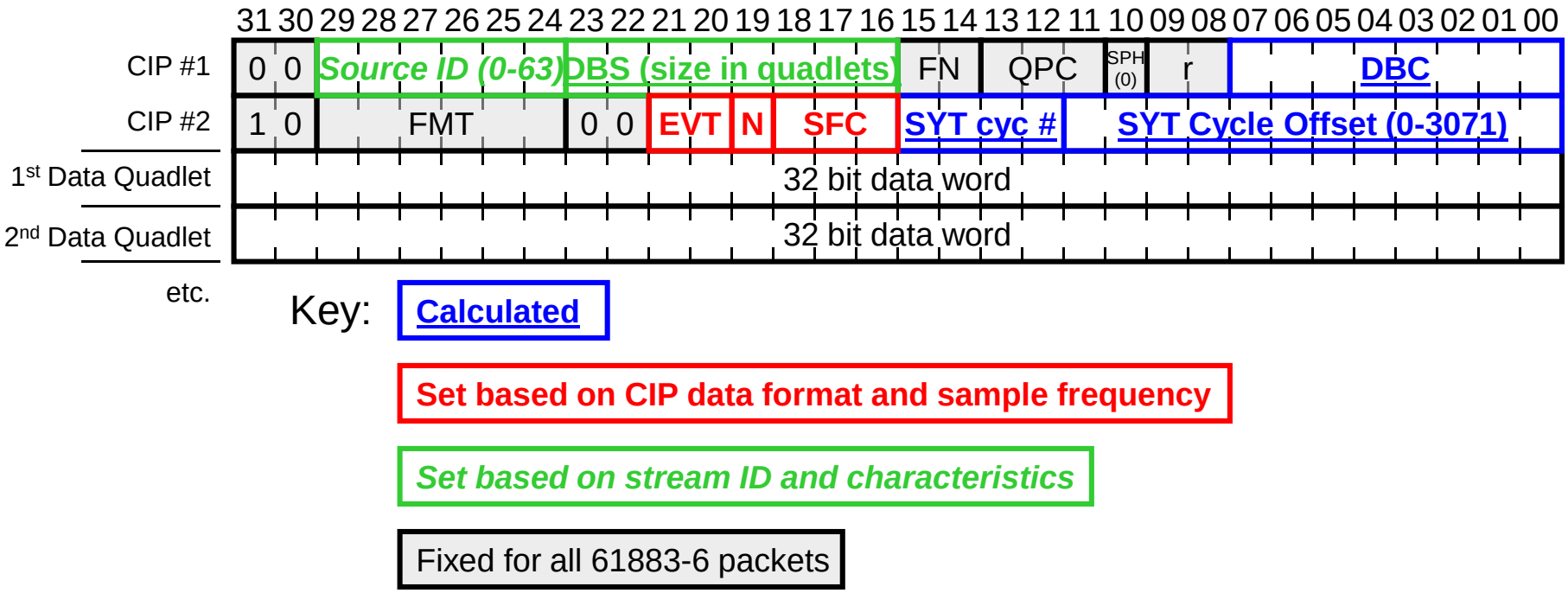
20 bits source
I²S stereo
Zero Padding

31	30	29	28	27	26	25	24	23 22 21 20 19 18 17 16 15 14 13 12 11 10 09 08 07 06 05 04	03	02	01	00
0	1	0	0	0	0	0	1	Left – Time X, 20 bits	0	0	0	0
0	1	0	0	0	0	0	1	Right - Time X, 20 bits	0	0	0	0
0	1	0	0	0	0	0	1	Left - Sample Time X++, 20 bits	0	0	0	0

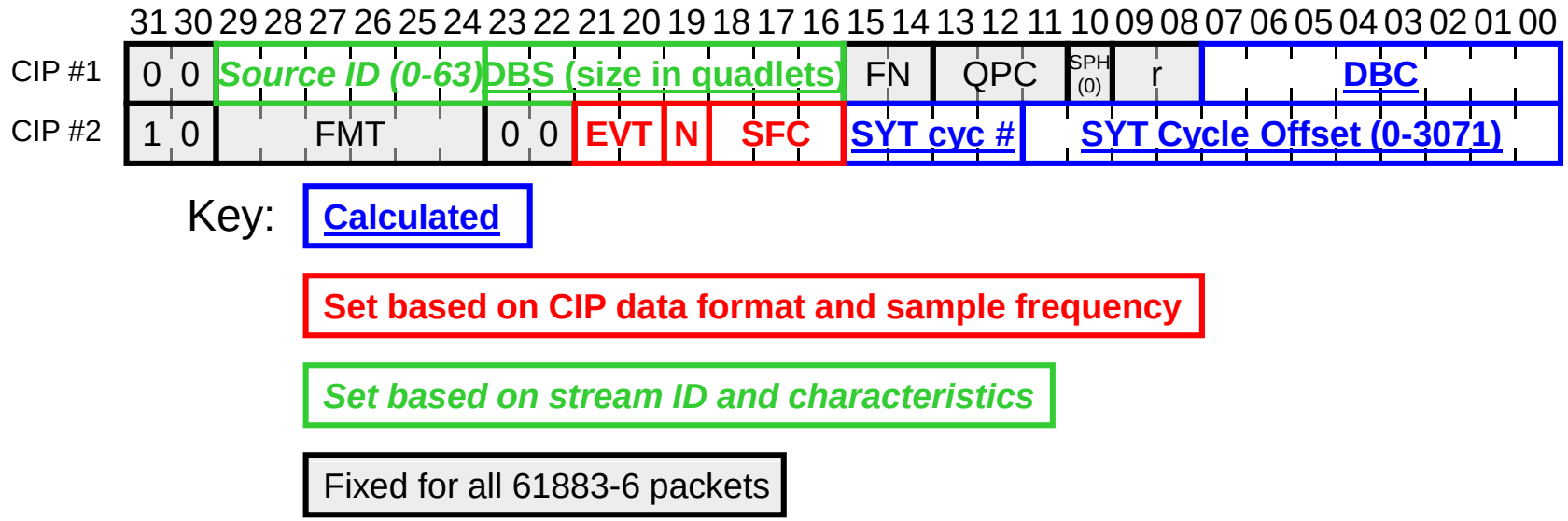
16 bits source
I²S stereo
Zero Padding

31	30	29	28	27	26	25	24	23 22 21 20 19 18 17 16 15 14 13 12 11 10 09	08	07	06	05	04	03	02	01	00
0	1	0	0	0	0	1	0	Left – Time X, 16 bits	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	Right - Time X, 16 bits	0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	Left - Sample Time X++, 16 bits	0	0	0	0	0	0	0	0	0

Creation of a 61883-6 packet



Creation of an Empty CIP packet



- An Empty CIP packet is:
  - Data Block Size: Same as other packets in the stream
  - Data Block Count (DBC): Sequence number, HW keeps local counter and increments per 61883-6 specification and stores into header.
  - SYT field: All ones for Cycle and Cycle offset field.
  - Length: 8 bytes, CIP header only, no payload.
- *Editor's note: Need more detail and study here, there is also an invalid data AM824 type.*

End to End Network Flow

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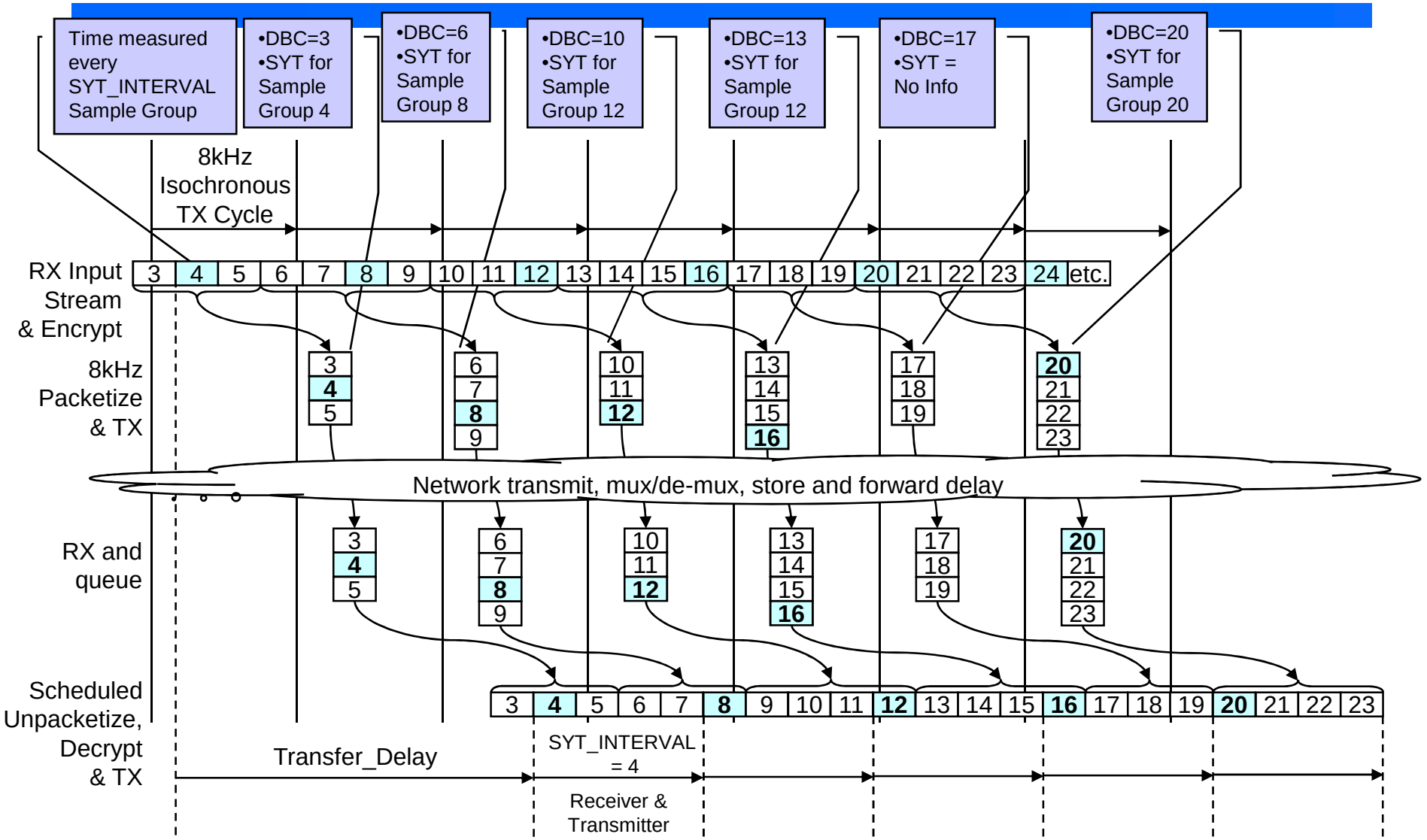
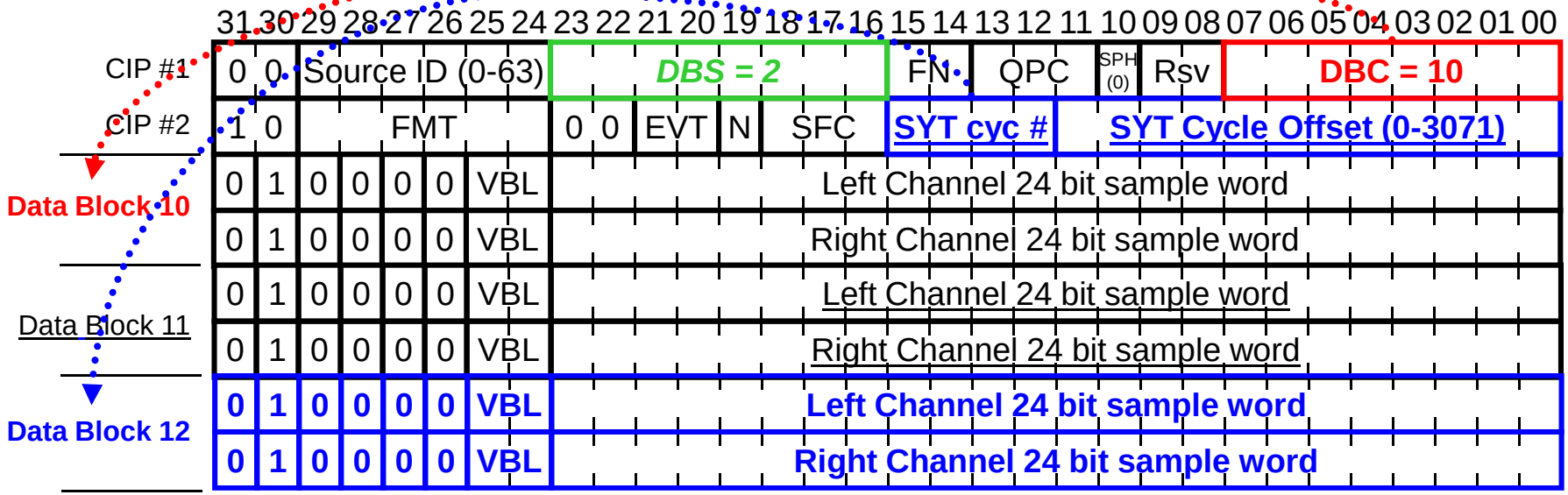
Examples 61883-6 type flows of receiving a source stream, transmitting it via packets through the network to where it is reconstituted and sent out at the destination.

Non-Blocking Transmission

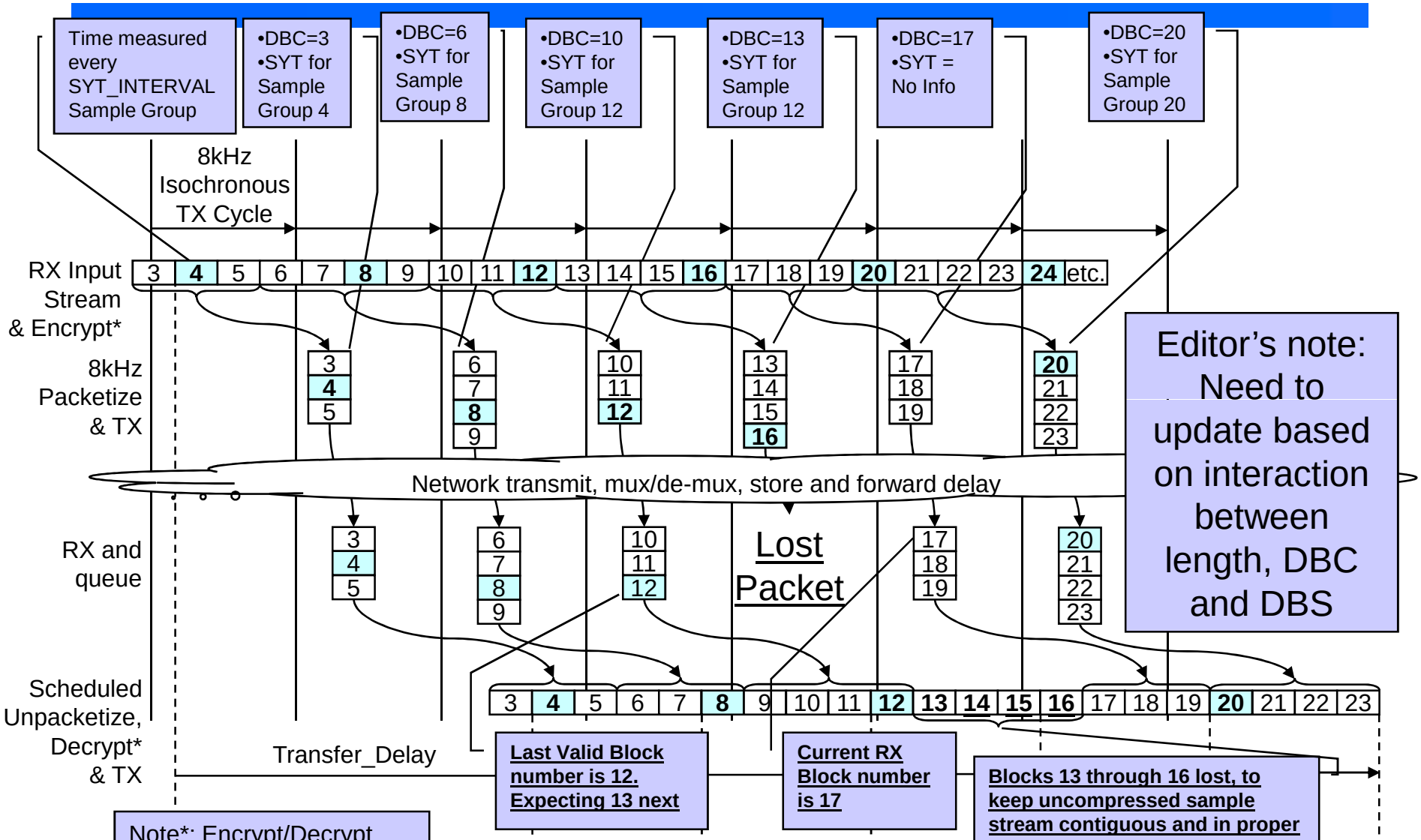


Example Data Packet

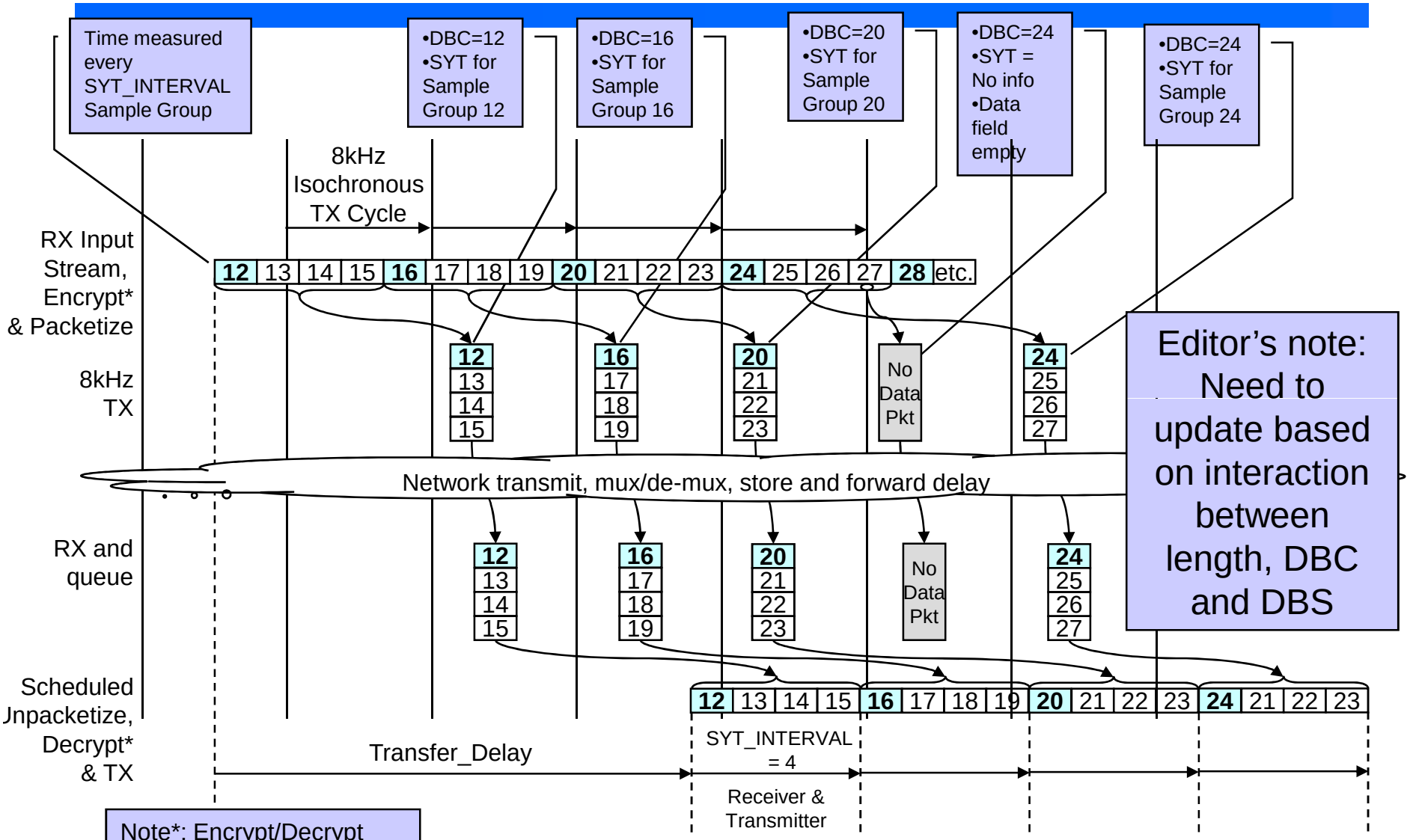


- Example from Non-Blocking Data Flow diagram.
  - Data Length (from 1394 header, not shown above) == 64 bytes (8 quadlets, includes size of CIP header)
  - **DBS** = Data Block Size of data quadlets == **2** in this example
  - **DBC** indicates 1st data block (sample group) sequence number == **10** in this example
  - **SYT** field used to timestamp the presentation time of the Data Block where Data Block number modulo SYT_INTERVAL == 0, so in this example:
    - SYT_INTERVAL = 4
    - Data Block 12 modulo 4 == 0
    - SYT field used for Data Block 12

Non-Blocking Transmission, Packet loss



Blocking Transmission



61883-4 formats and info

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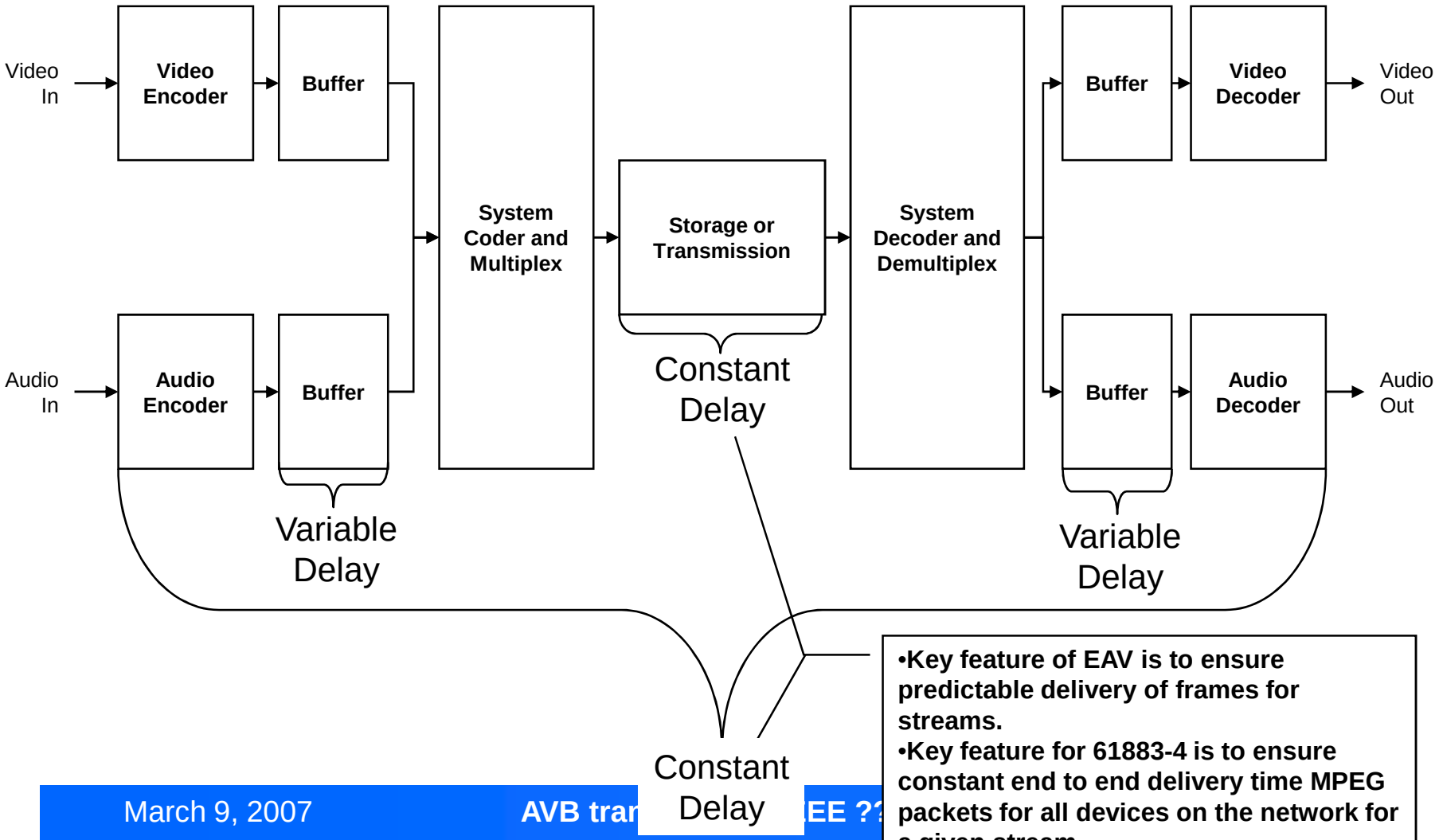
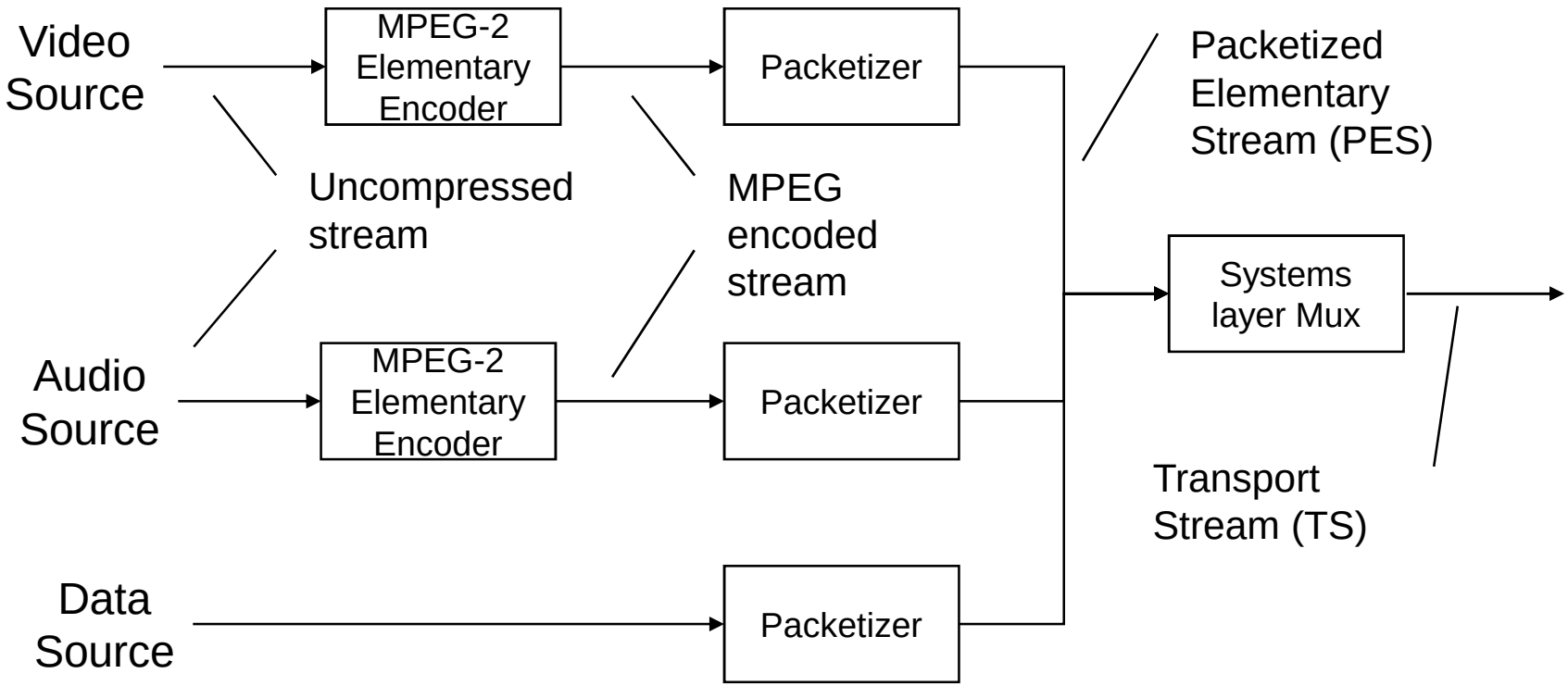
Draft for discussion in general adapting 61883-4 to AVBTP

MPEG-2 system timing model

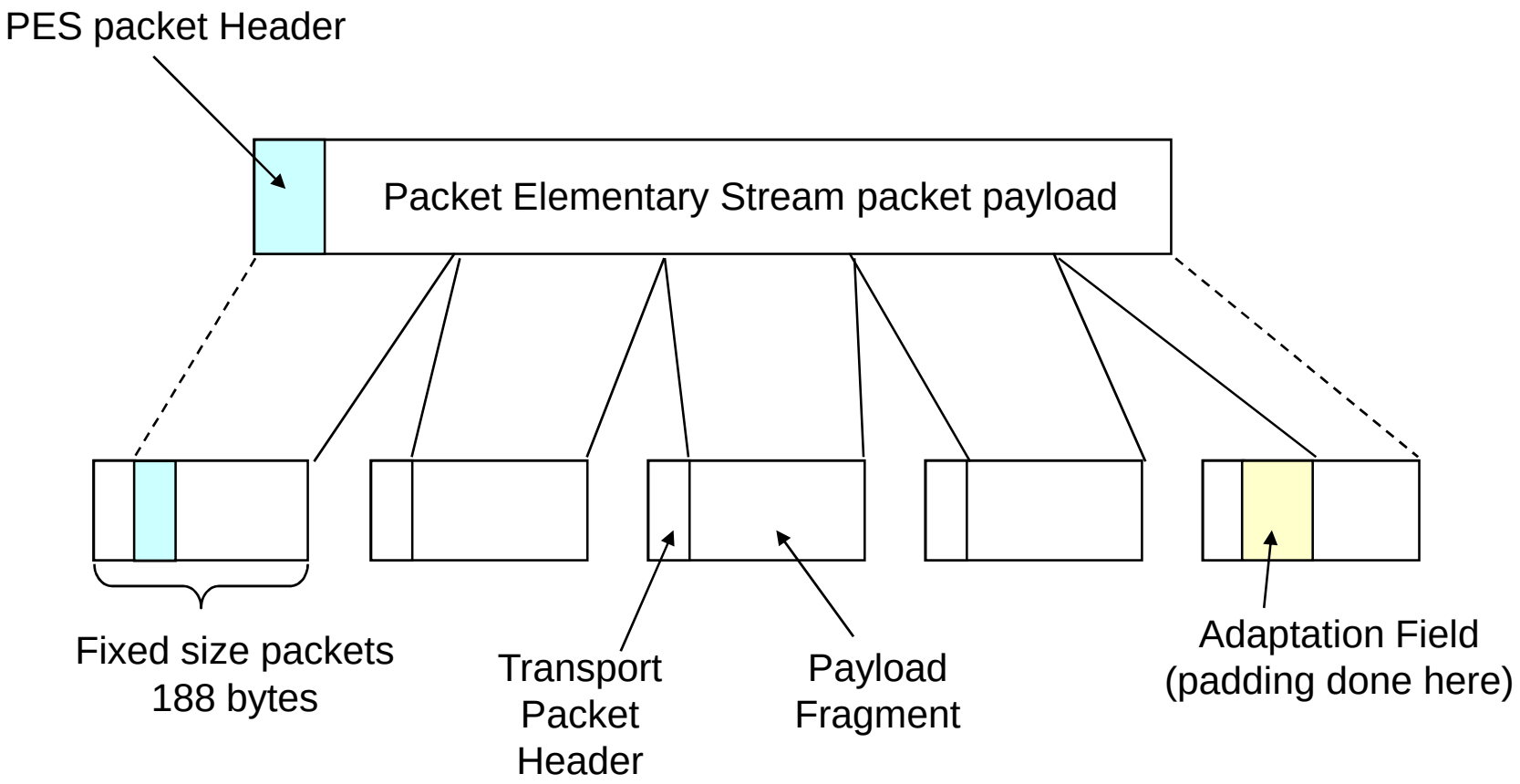


- **Key feature of EAV is to ensure predictable delivery of frames for streams.**
- **Key feature for 61883-4 is to ensure constant end to end delivery time MPEG packets for all devices on the network for a given stream.**

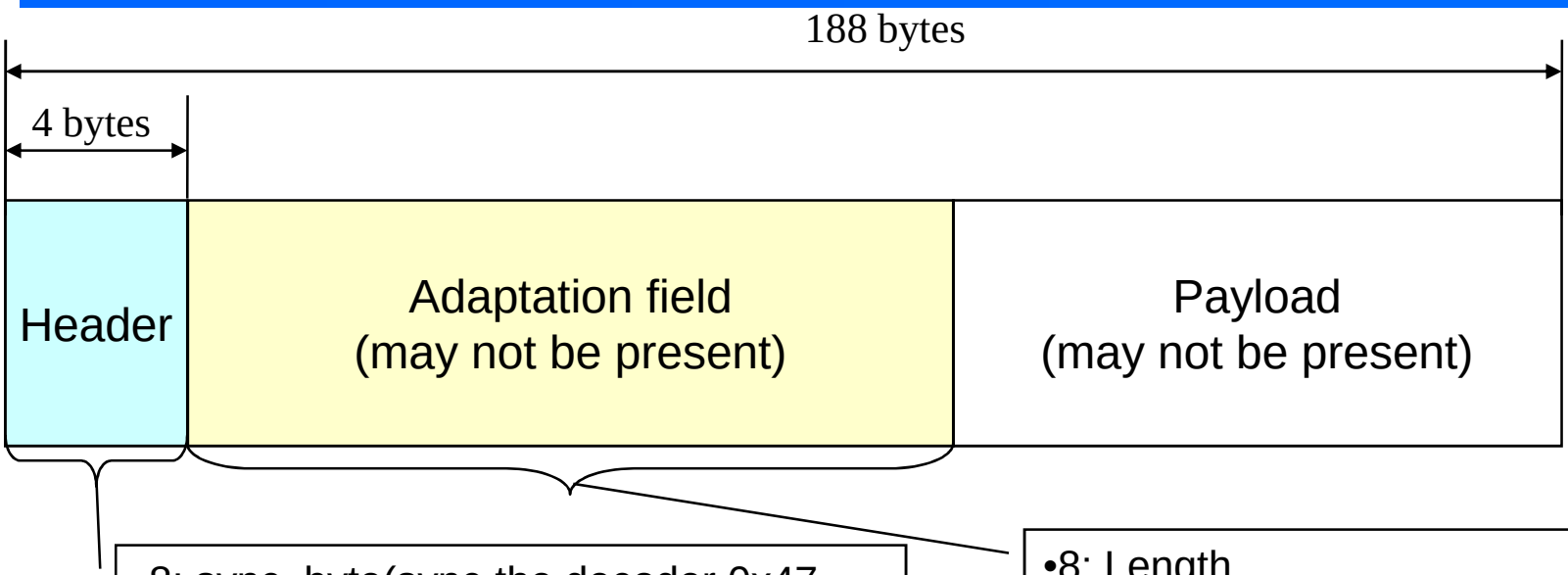
MPEG-2 Source stream to TS flow



Transport Stream Fragmentation



Transport Packet Structure



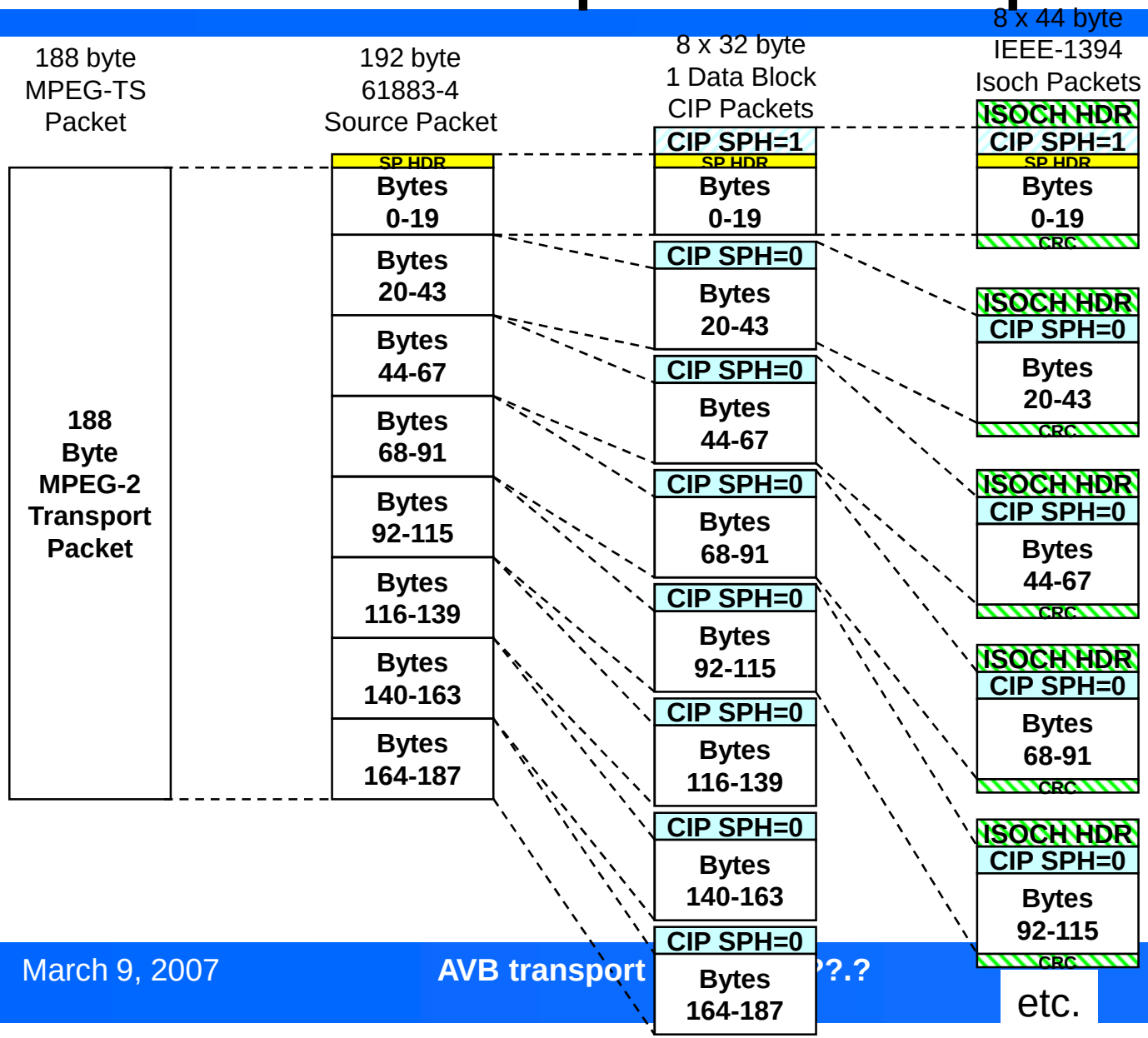
- 8: sync_byte(sync the decoder 0x47 hex start of TP)
- 1: transport_error_indicator
- 1: payload_unit_start_indicator (PSI or PES packet)
- 1: transport priority (useful in scalable MPEG2)
- 13: PID(ID for each stream)
- 2: transport_scrambling control
- 2: adaptation_field _control
- 4: continuity_counter(counts packets of PES)

- 8: Length
- 1: discontinuity_indicator
- 1: random_access_indicator
- 1: ES_priority_indicator
- 5: various flags (PCR_flag...)
- Optional fields
- Stuffing bytes

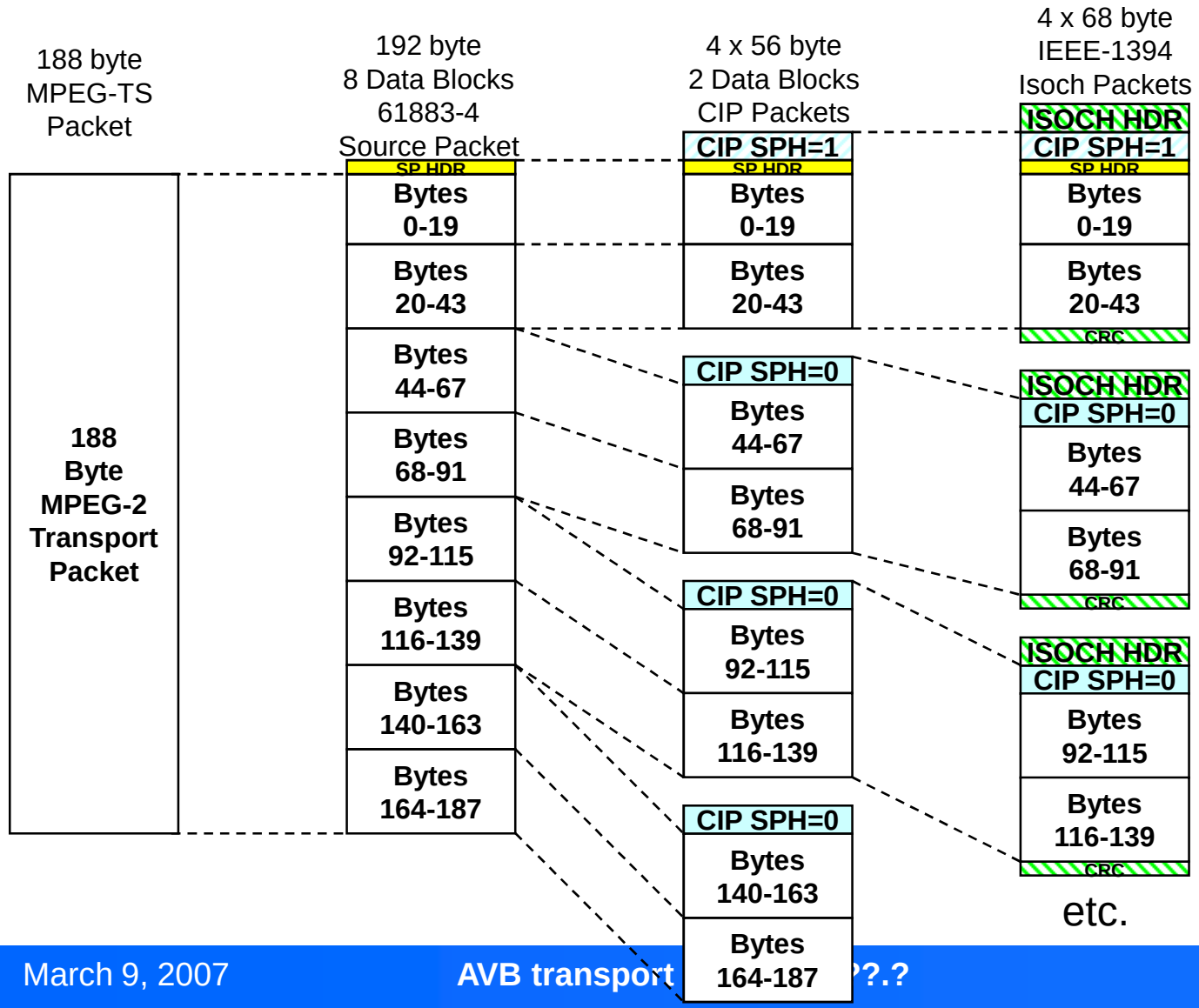
Base 61883-4 mechanism

- MPEG-2 Transport stream delivers 188 byte packets to the 61883-4 transmit function.
- 61883-4 adds a four byte Transport Stream Header to create a 192 byte “Source Packet”
  - The source packet header optionally contains the desired presentation time (MPEG packet local arrival time plus additional time added to specify presentation time on the remote device).
  - Time is in Cycle number (0-7999 8 kHz ticks) plus Cycle offset (0-3071 24.576 MHz ticks)
    - Giving a max resolution of 1 second
- 61883-4 then divides up the 192 byte source packet into 8 fixed size Data Blocks (6 quadlets each) and if necessary fragments the packet into multiple CIP packets.
- Depending on rate of transport stream, zero, one or more CIP packets are sent out at 8 kHz intervals. Valid values of Data blocks per Isochronous packet are:
  - 0 (empty packet), 1, 2, 4, 8, N times 8 (where N is an integer number of source packets)
- Data Block count increments for every 6 quadlet Data block as defined above

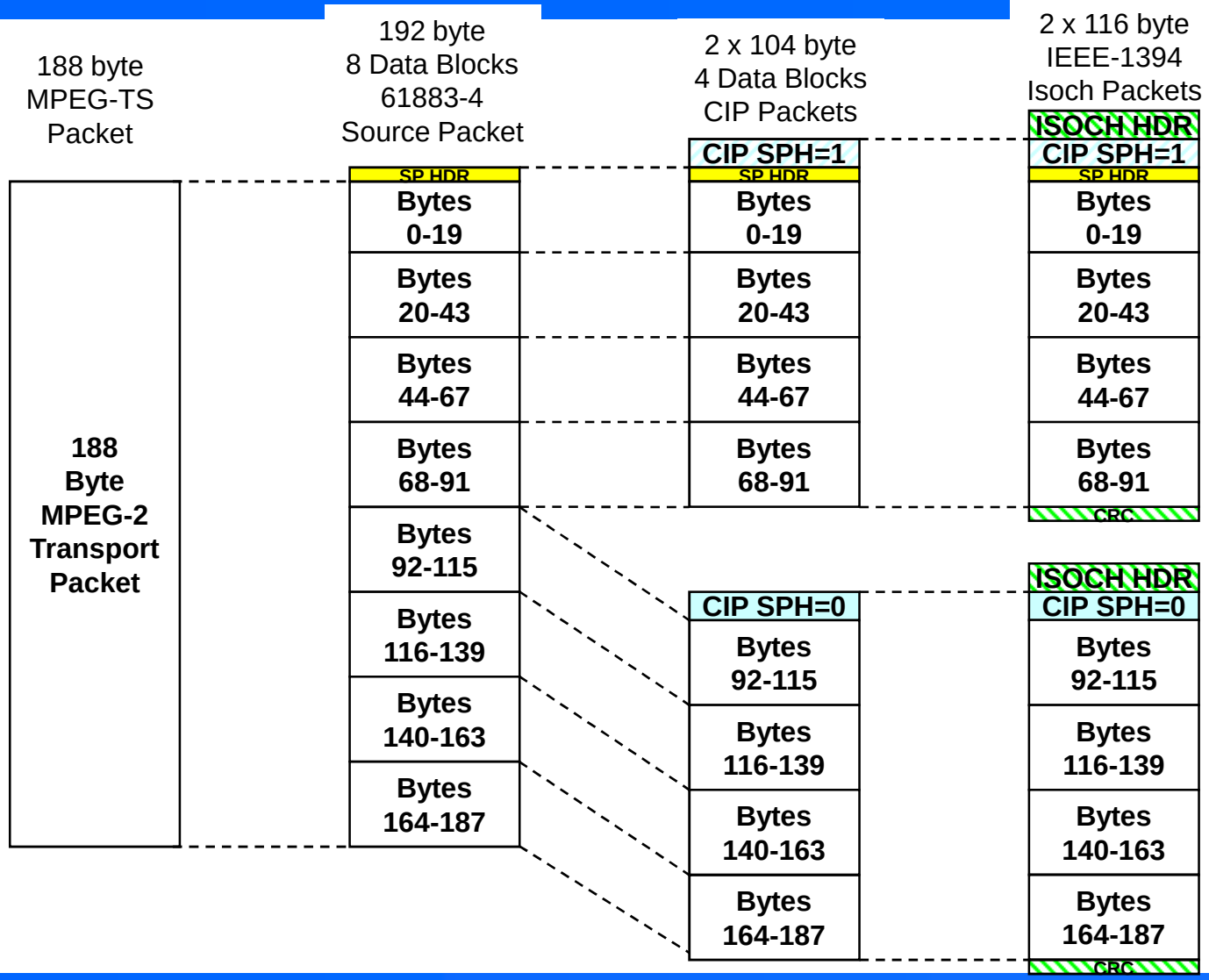
1 data block per Isoch packet



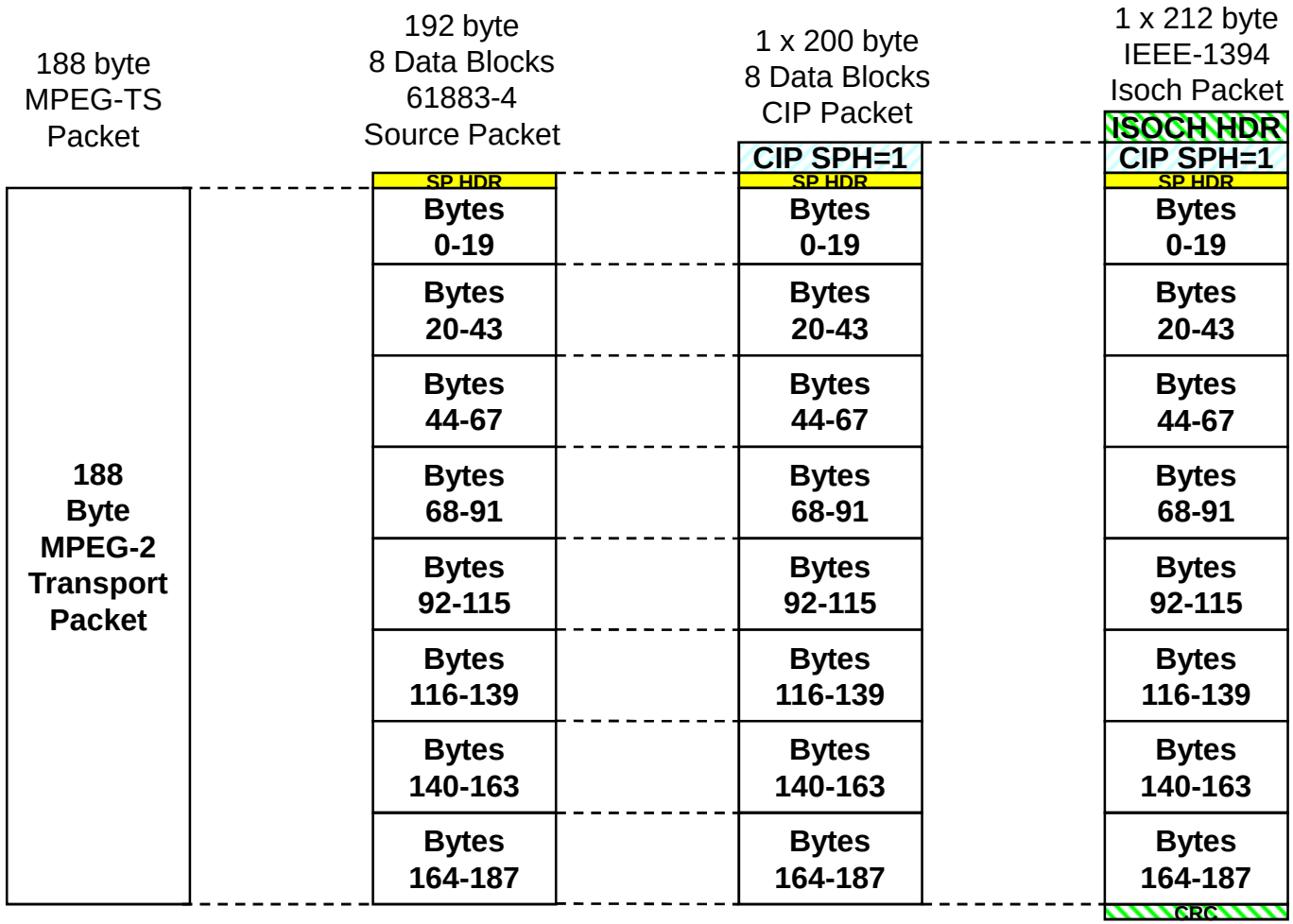
2 Data blocks per Isoch packet



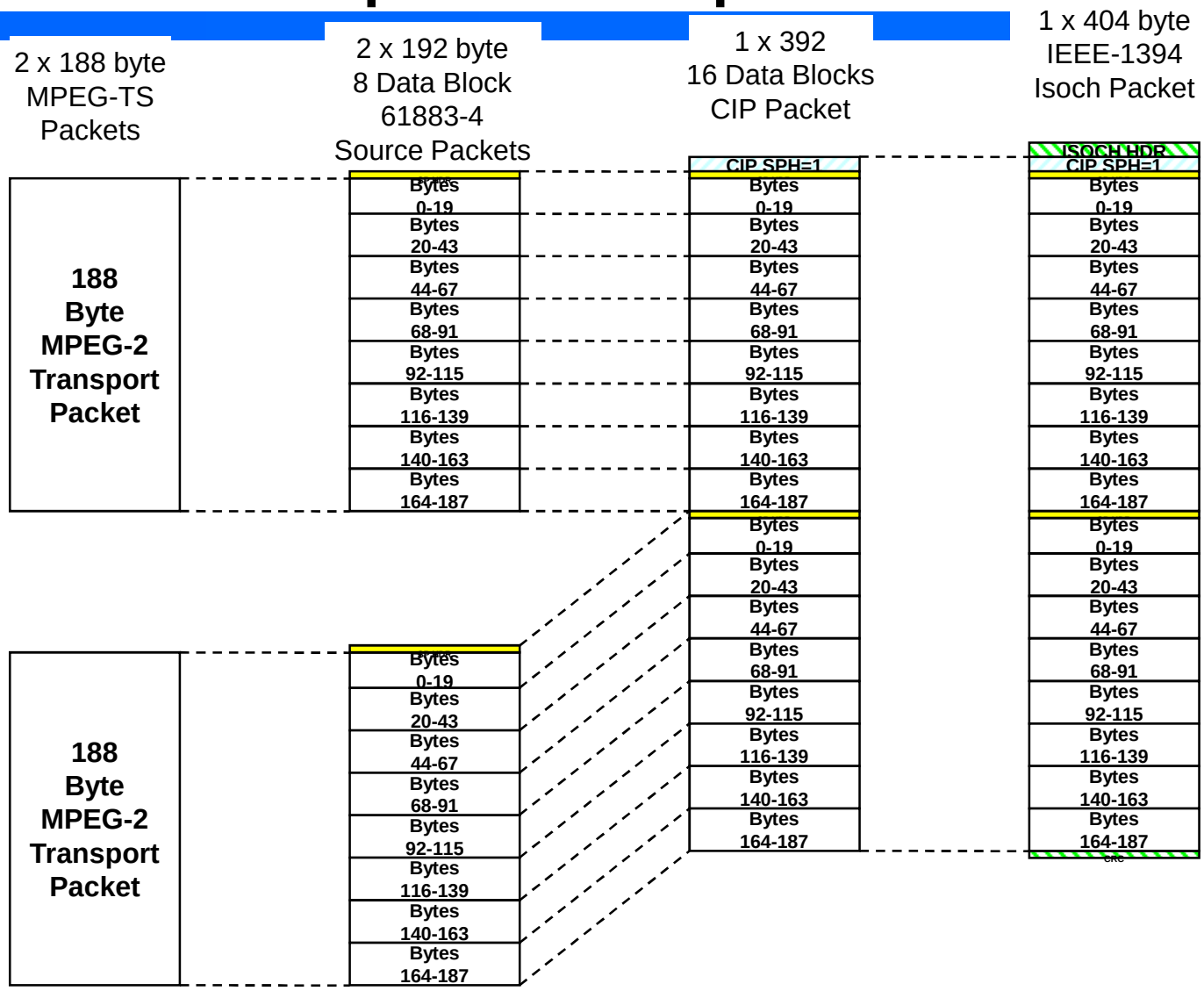
4 Data Blocks per Isoch packet



8 Data Blocks per Isoch packet



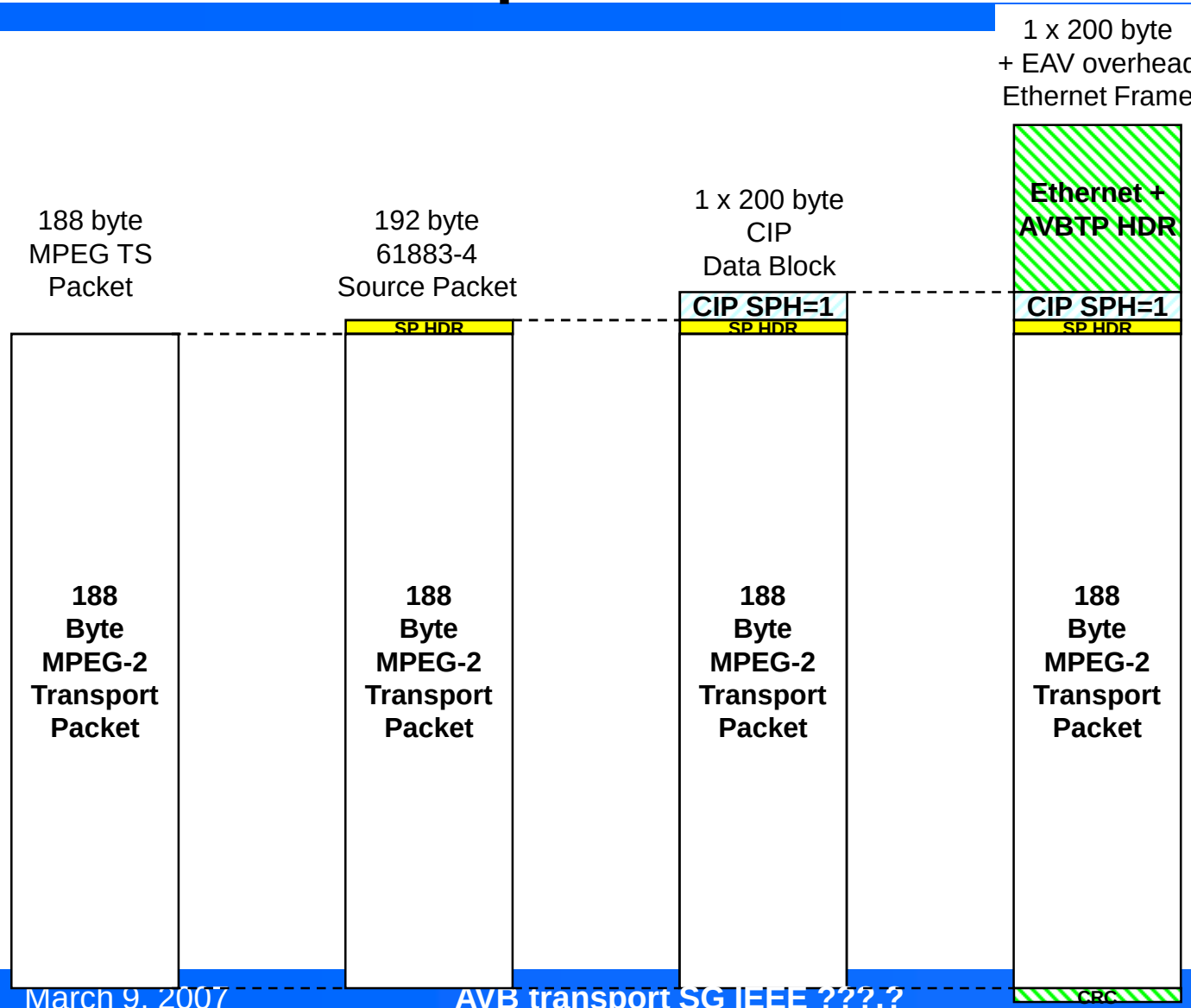
2 MPEG packets per Isoch packet



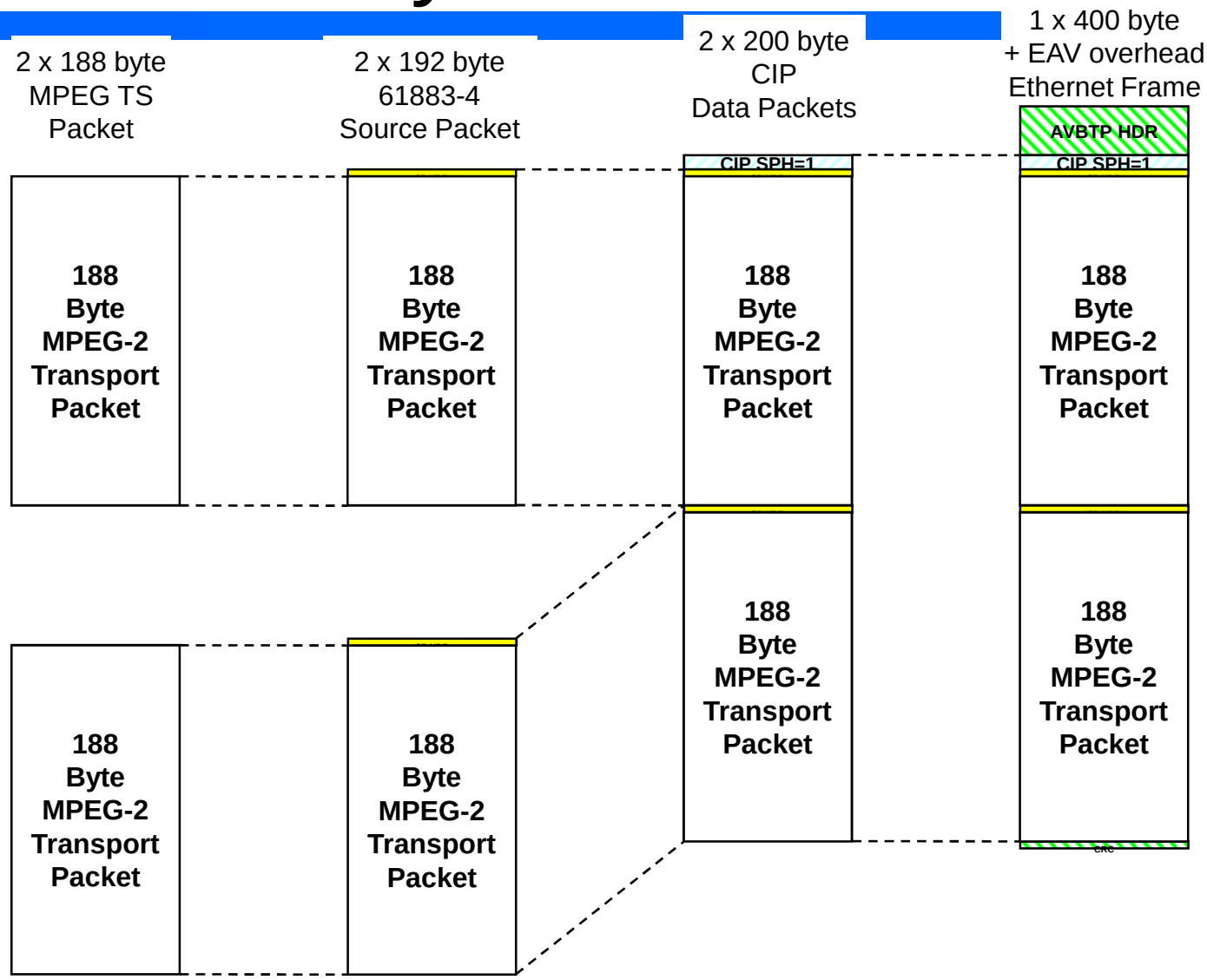
Issues with current 61883-4

- MPEG packets at lower stream rates require more processing due to having to spread out the bandwidth across multiple
- In today's world probably better to optimize on NTSC and above streams for EAV and if necessary penalize slower streams from a relative point of view.
- Alternate proposal for 1394 and EAV to simplify 61883-4 to remove MPEG packet fragmentation.
  - Still allows 1394 devices to evolve and for EAV to not pick up the current overhead/burden of MPEG packet fragmentation.
  - Lower bandwidth streams can use class 4 EAV service and empty packets as necessary.
  - Higher bandwidth streams can use class 5 service
  - Both can use one or more MPEG packets per Ethernet frame and if nothing to send, send an empty packet instead.
- Diagrams on following slides

EAV 1 CIP per MPEG example



2 MPEG by 1 EAV frame example



Study of 61883-6 and 61883-4 processing requirements

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Ingress Frame Handling

- Frames to be parsed/detected for layer 2 processing by AVBTP end stations are:
  - Ethernet AV stream
  - 802.1AS Timing Control protocol
  - 802.1Qat Stream Reservation Protocol

61883-6 Ingress processing

- Functions:
  - Validate CIP header format. Discard if unknown or unsupported.
    - Editor's Note 1394 says in certain cases, you have to send an error indication, I do not believe we should do this in AVBTP.
  - Track data block count in relation to SYT_Interval.
  - Detect lost frames/packets based on unexpected value in DBC field
  - Extract Timestamp information from SYT field when valid, map to local time and use to process egress stream for case of real physical device.
  - Discard/Ignore any unknown/unsupported payload formats
  - Strip unused fields/data (e.g. AM824 8 bit header)
  - For Encrypted data, feed into Decryption function.
    - Also based on device type, do we have to discard data if copy protected.

61883-4 Ingress processing

- Functions:
  - Recognize/parse 61883-4 Source Packet Header (SPH) for timestamp information.
    - Editor's note: 61883-4 also has reassembly function for low speed streams, I'd like to see if we could drop support for that function in AVBTP.
  - Detect lost frames/packets based on unexpected value in DBC field
  - Extract Timestamp information from SYT field when valid, map to local time and map to proper sample within the packet.
  - For Encrypted data, feed into Decryption function.
    - Also based on device type, do we have to discard data if copy protected.

Ingress Decryption processing

- If DTCP supported and configured for a given stream:
  - Take samples and optionally decrypt them prior to sending to egress physical or virtual device.
  - Mandatory support of AES-128
  - TBD if M6 cipher also required.

Egress Encryption processing

- If DTCP supported and configured for a given stream:
  - Take data from ingress physical device and optionally encrypt them prior to being packetized.
  - Mandatory support of AES-128
  - TBD if M6 cipher also required.

61883-6 Encapsulation

- Functions:
  - Collect individual samples into packet/buffer/descriptor
  - Optionally append correct AM824 type header
  - Get timestamp information for the data block from the physical or virtual device to create presentation time based on the inbound sample data in relation to SYT_Interval.
  - Build 61883-6 header, insert timestamp in proper format.
  - Build Ethernet and AVBTP header based on stream ID and characteristics.
  - Forward to Ethernet queuing function based on class 5 or class 4 service.

61883-4 Encapsulation

- Functions:
  - Create initial 61883-4 CIP and Source Packet header based on timestamp of arrival of first byte from TSI interface of the 188 byte MPEG packet.
  - Collect individual bytes into packet/buffer/descriptor
    - Editor's Note: For AVBTP, I'd like to have it so we don't have to fragment Source packets into as 2, 4 or 8 fragments as is currently required by 61883-4 over 1394 for lower rate MPEG-2 streams (and have us use empty packets as necessary to keep the bridges happy).
  - Build Ethernet and AVBTP header based on stream ID and characteristics.
  - Forward to Ethernet queuing function based on class 5 or class 4 service.

Basics of I²S and variations on it
Draft 0.02 2006-12-28

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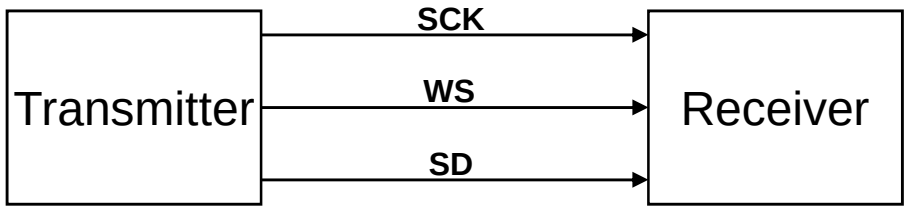
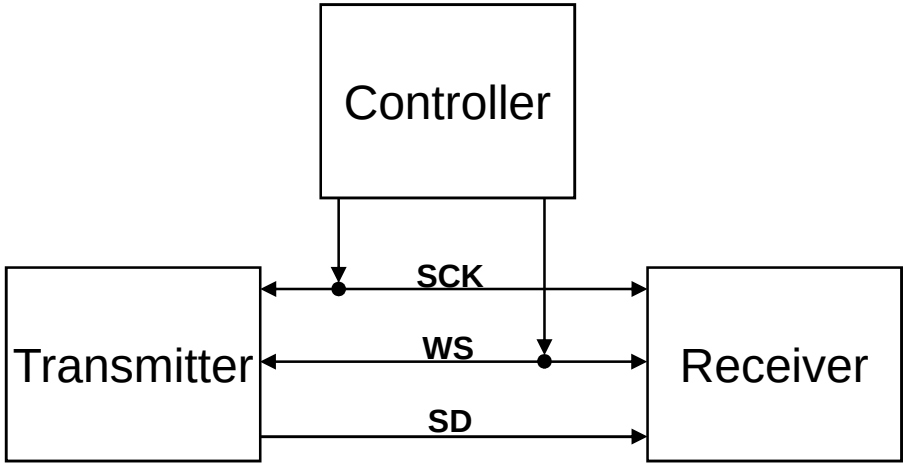
I²S connection options



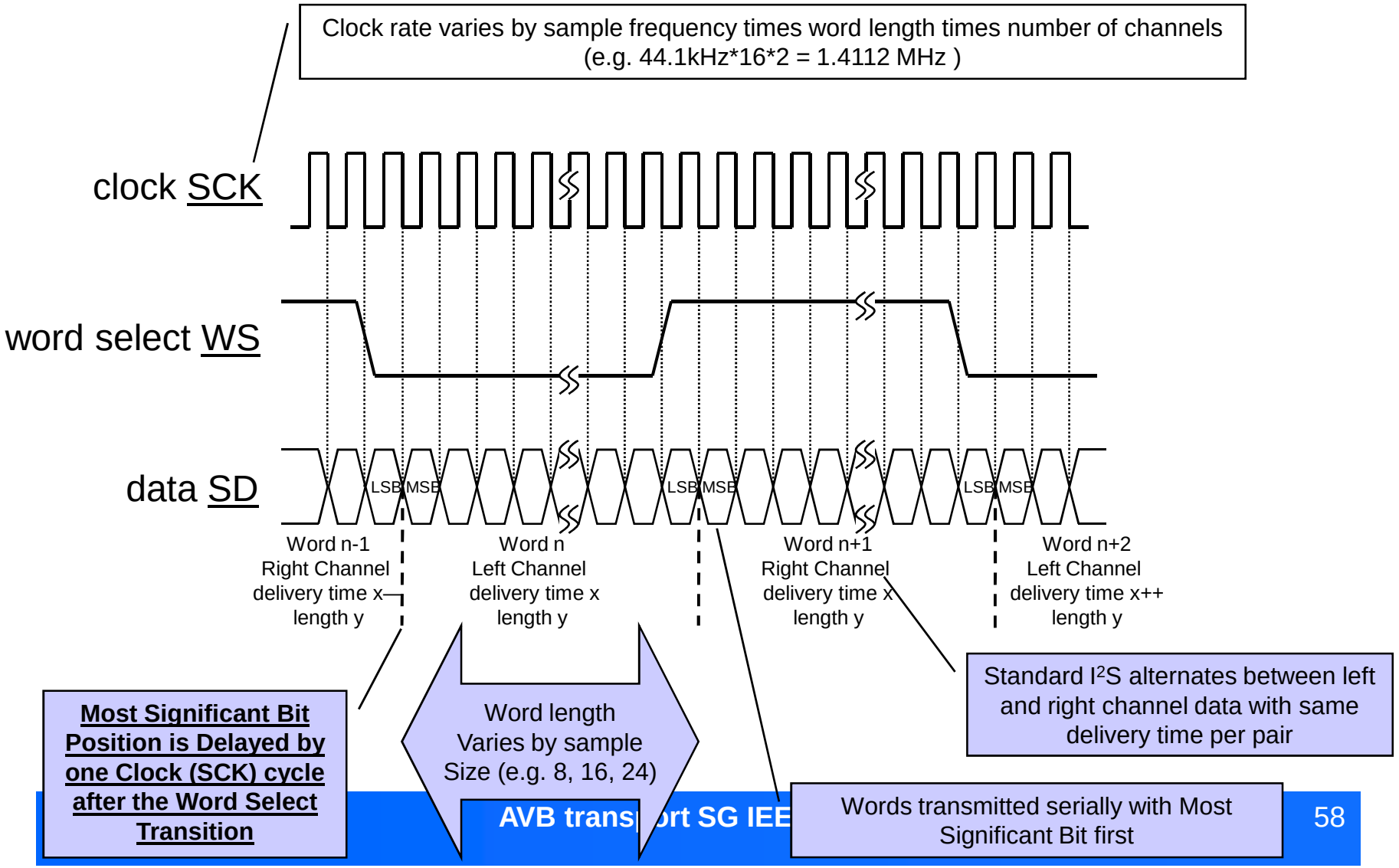
TRANSMITTER = MASTER

RECEIVER = MASTER

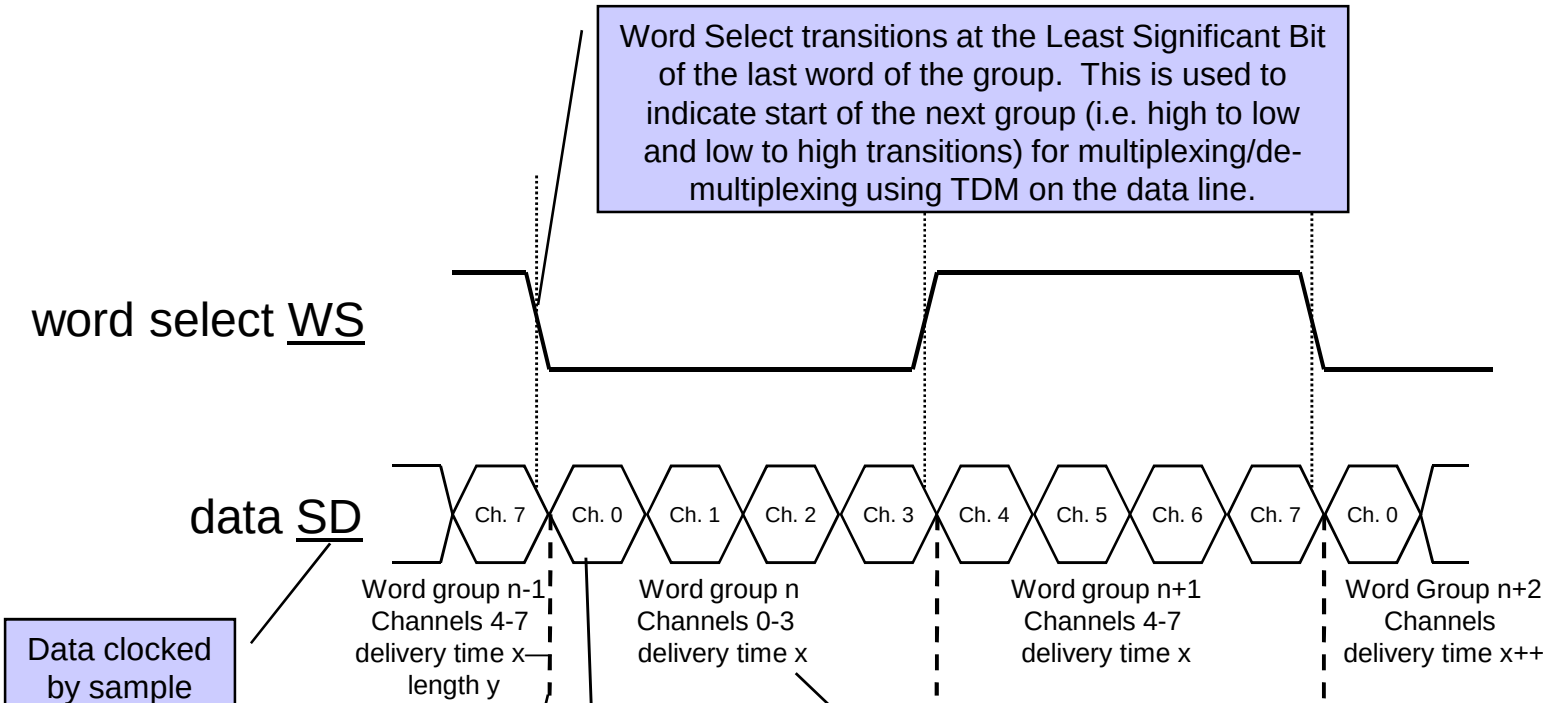


CONTROLLER = MASTER

I²S Timing diagram



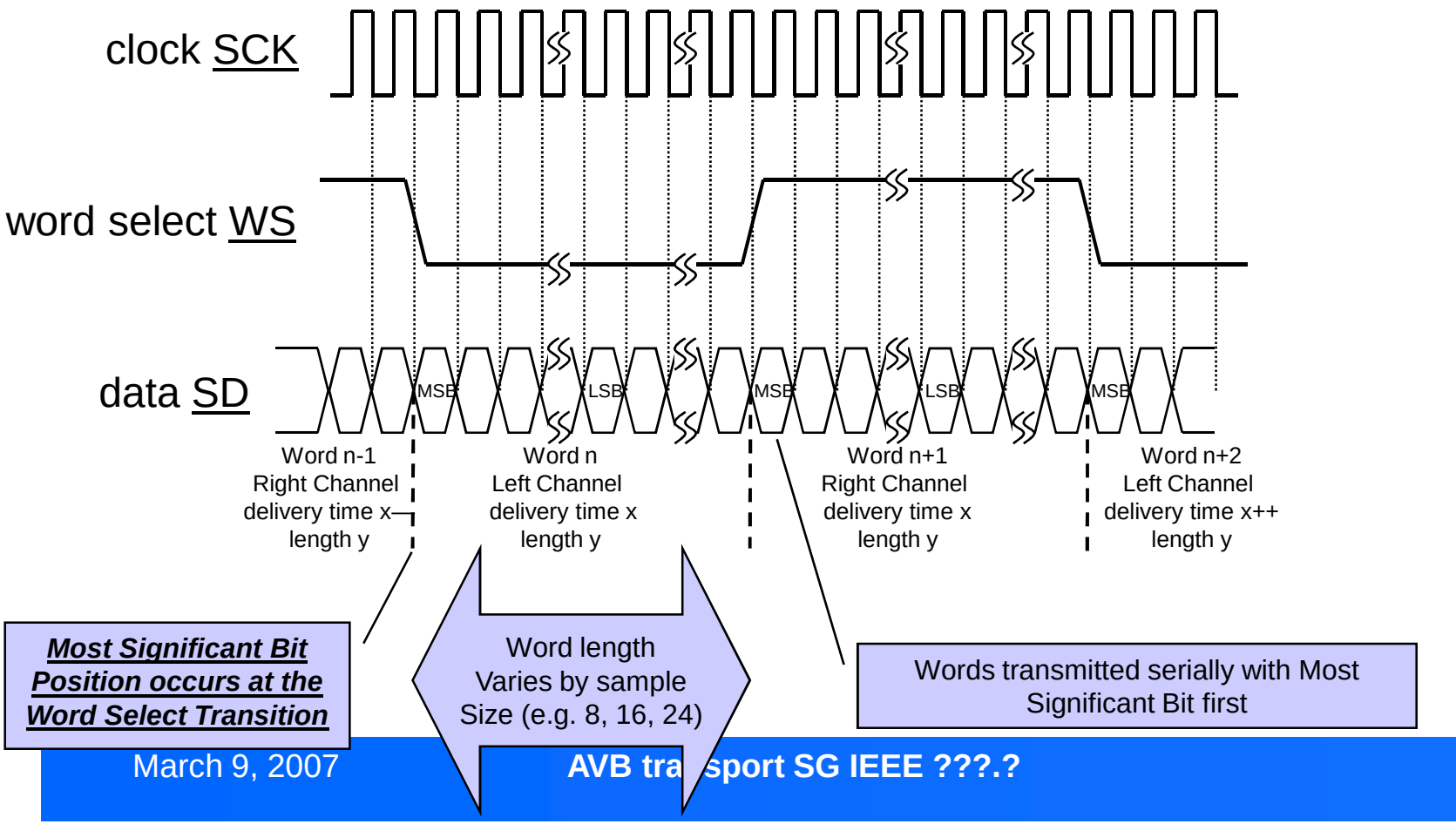
I^{8}S variation using TDM



I^{32}S works the same, it just has 32 channels transmitted in 2 groups with 16 words each.

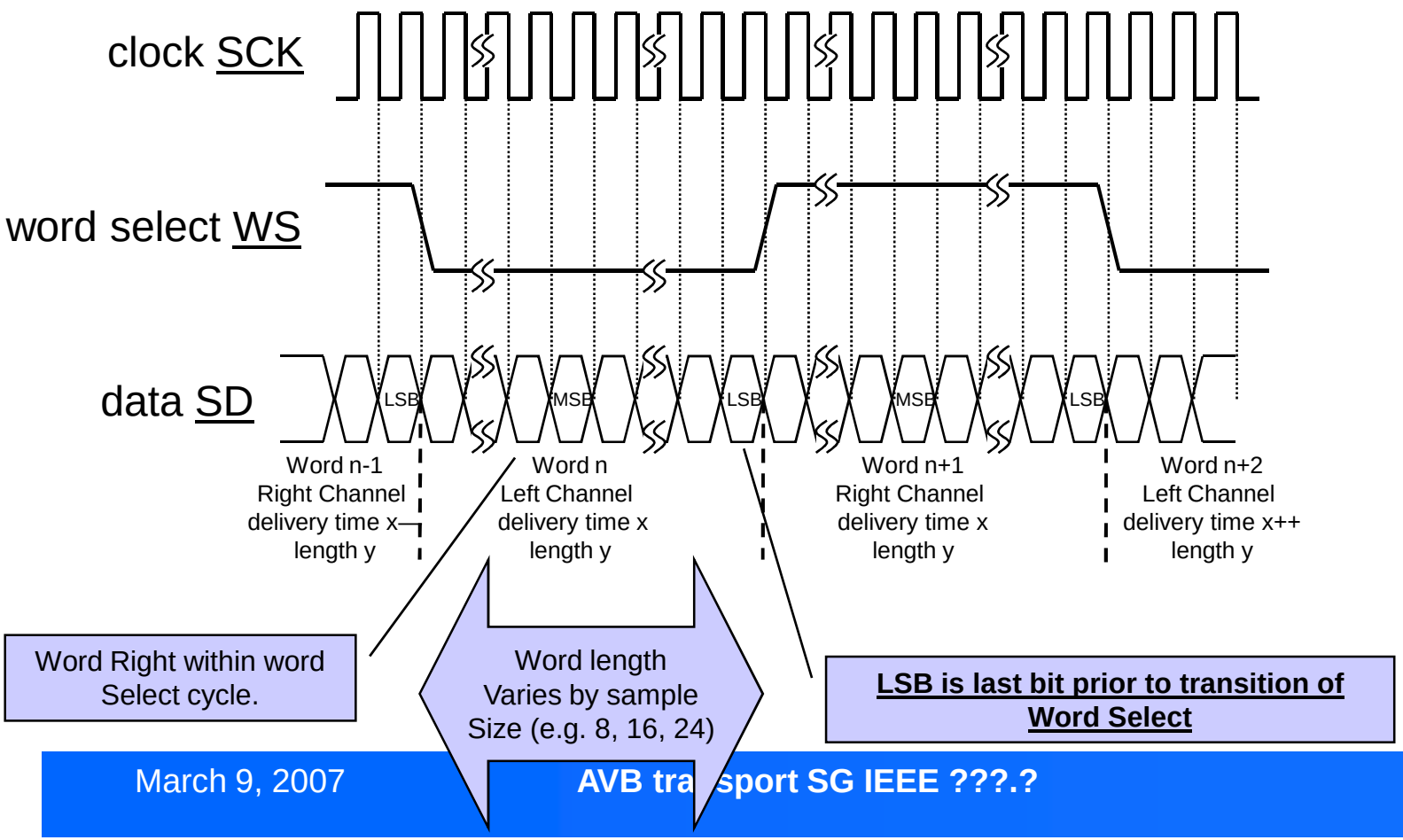
Left Justified Serial Timing diagram

Alternate to I²S as supported by some CODECs (TI, ADC).
Uses Same physical interface as I²S (clock, data, word select)



Right Justified Serial Timing diagram

Alternate to I²S as supported by some CODECs (TI, ADC)



BT.601 over IEEE 1394 (to become 61883-8) Working slides

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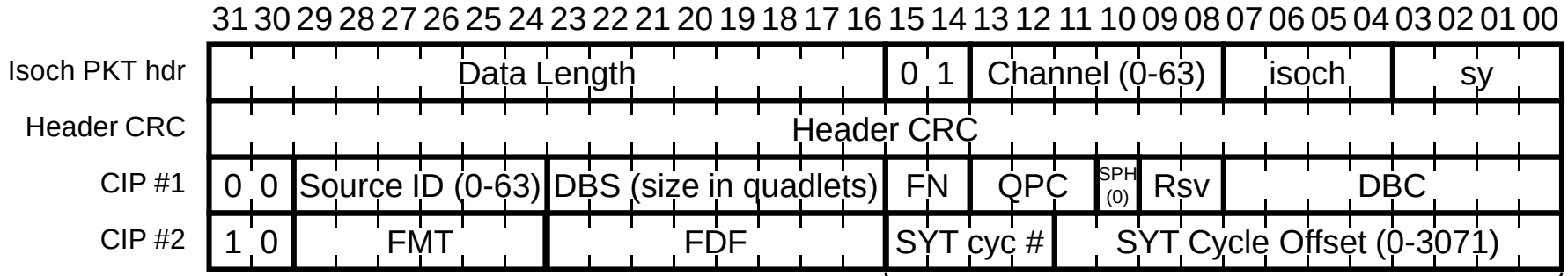
BT.601 Isochronous Header

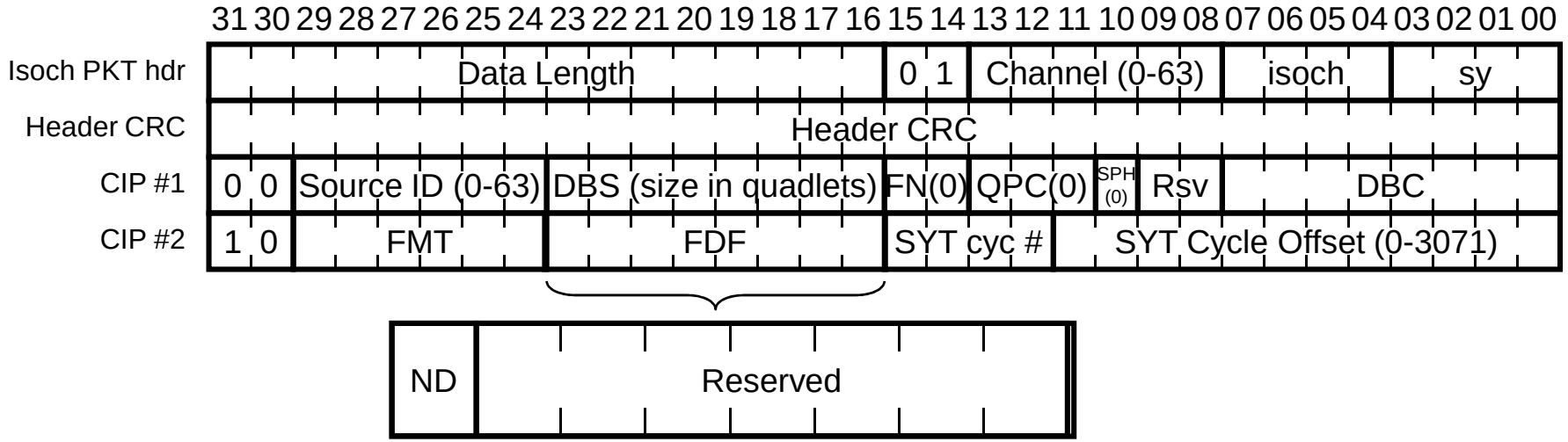


Field	Value	Comments
FMT	0x01 (000001b)	*Format*: BT.601 format
FN	00	*Fragment Number*: Always match of 1 to 1 between CIP packet and Source Packet (i.e. never fragmented)
QPC	000	*Quadlet Padding Count* : No dummy padding quadlets needed (or supported)
SPH	0	*Source Packet Header*: None
DBC	0-255	*Data Block Counter:* Indicates modulo 256 sample count number of 1st data quadlet of the packet. Used for detecting lost data, amount thereof.
SYT	xxx-xxxxxxxxxxx	*Synchronization Time*: Time when the data block specified by DBC_NUMBER Modulo SYT_INTERVAL is presented at the receiver
FDF	0-255	*Format Dependent Field*: See FDF data

SYT Data:

- **Delivery time of the first audio or Data bit to the application (codec, decoder, transmitter, etc.)**
- **Set by source of video data**
- **Processed by sink of video data**
- **Presentation Time Range**
  - **2 milliseconds**
    - **4 bit 8kHz Cycle**
    - **12 bit 24.576 MHz Cycle offset**
- **Set to All ones (0xFFFF) for entire 16 bit field as “No info” value**

BT.601 FDF field

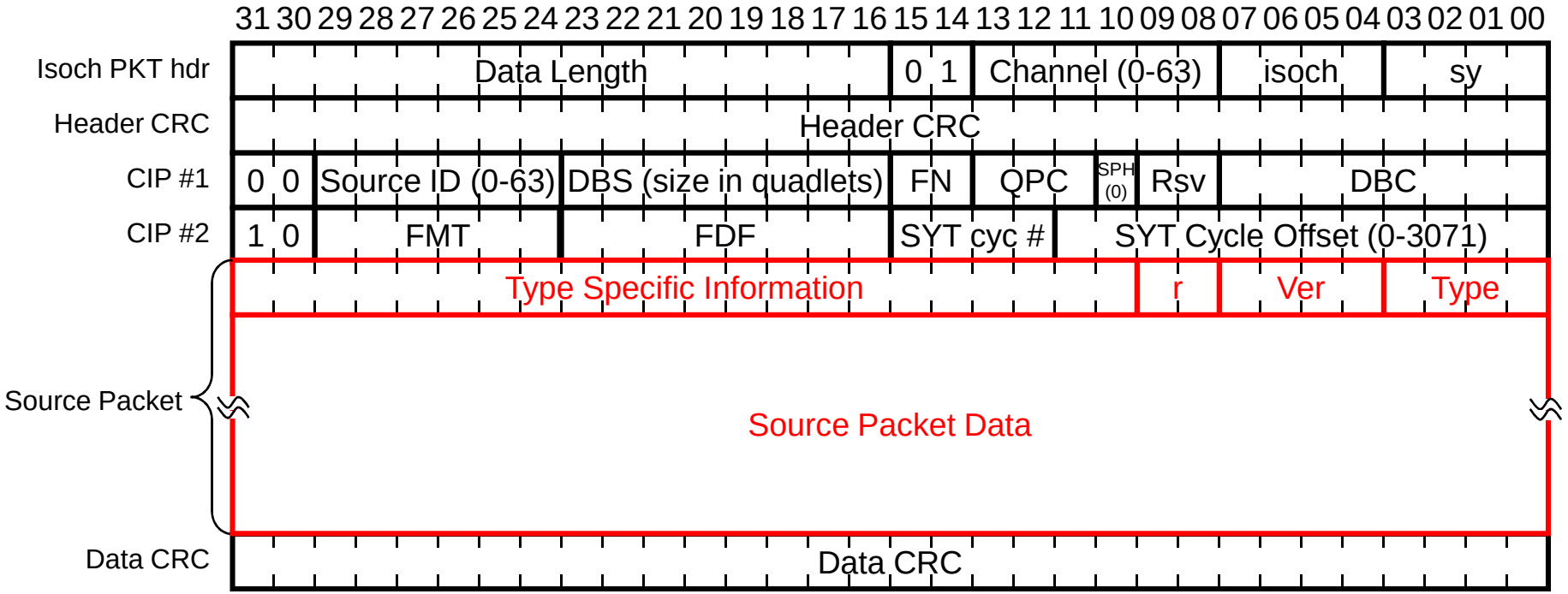


- No Data (ND) Field
  - If set to 1:
    - Subsequent payload data is not valid and shall be ignored.
    - Only used in blocking mode transmission.
    - DBC equals count value of next valid data block
  - If set to 0:
    - Subsequent payload data is valid.
    - For non-blocking mode transmission all
- Other bits in FDF reserved for future use
  - Sending devices set to 0
  - Receiving devices ignore

Color Space

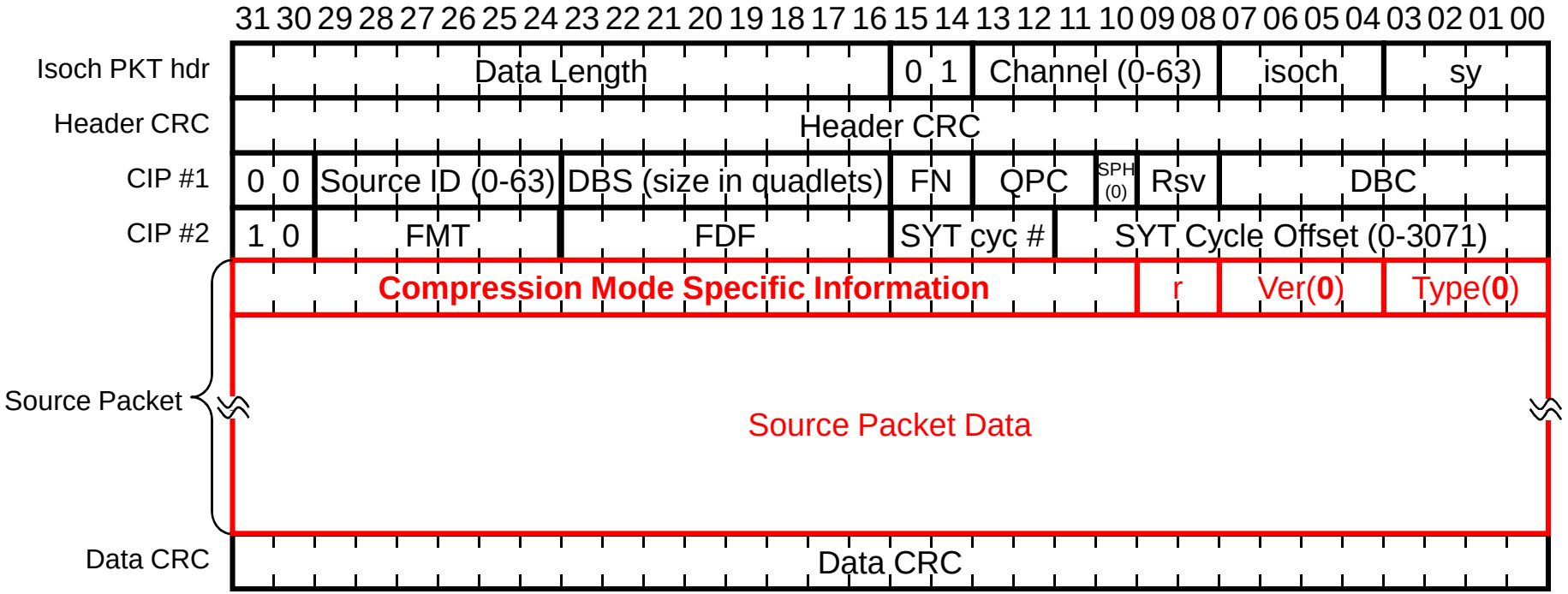
Value	Description
0	YUV 4:2:2 (16 bits / pixel, 8 bits / sample)
1	YUV 4:4:4 (24 bits / pixel, 8 bits / sample)
2	RGB (24 bits / pixel, 8 bits / sample)
3	RGB (18 bits / pixel, 6 bits / sample)
255	Other color space
Other	Reserved for future specification

General format of a source packet



- The **Type** field indicates the source packet type
  - **0**: Video Data
  - **1**: Stream information and metadata
  - **2**: Reserved for future specification for transport of audio data (currently recommends use of 61883-6)
  - **3-255**: Reserved
- The **Ver** field indicates the version of the specified source packet type
- The **Type** specific Information varies by source packet
- The **r** field is reserved for future use.

Video Source packet



- The **Type** field set to 0.
- The **Ver** field set to 0
- The **Type** Specific Information varies by compression mode
- The **r** field is reserved for future use.

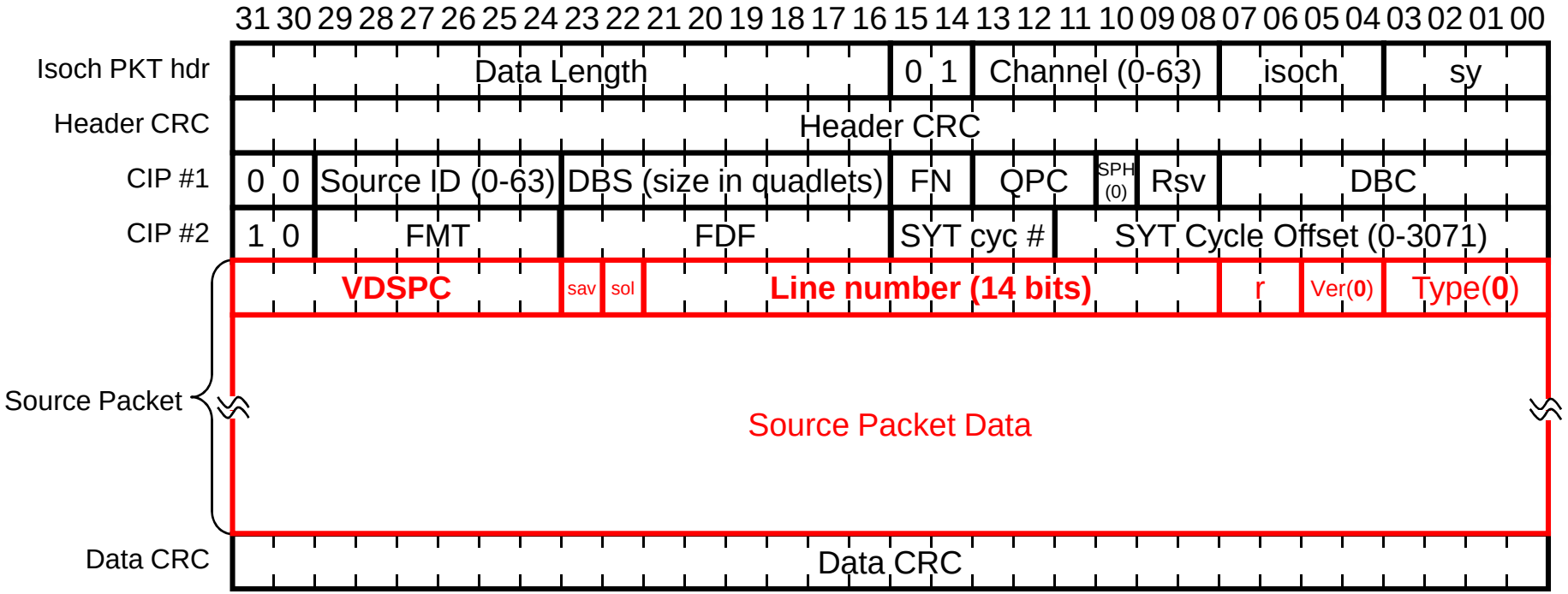
Compression Mode

Value	Description	Documentation reference
0	Uncompressed Video Data	N/A
1	Compressed video using Light Codec	Oxford Semiconductor Light Codec Specification Version 1.0
2	Compressed video using SmartCODEC	Fujitsu SmartCODEC Specification Version 1.0
255	Compressed video using other video codec	*N/A*
Other	Reserved for future specification	*N/A*

SMARTCodec characteristics

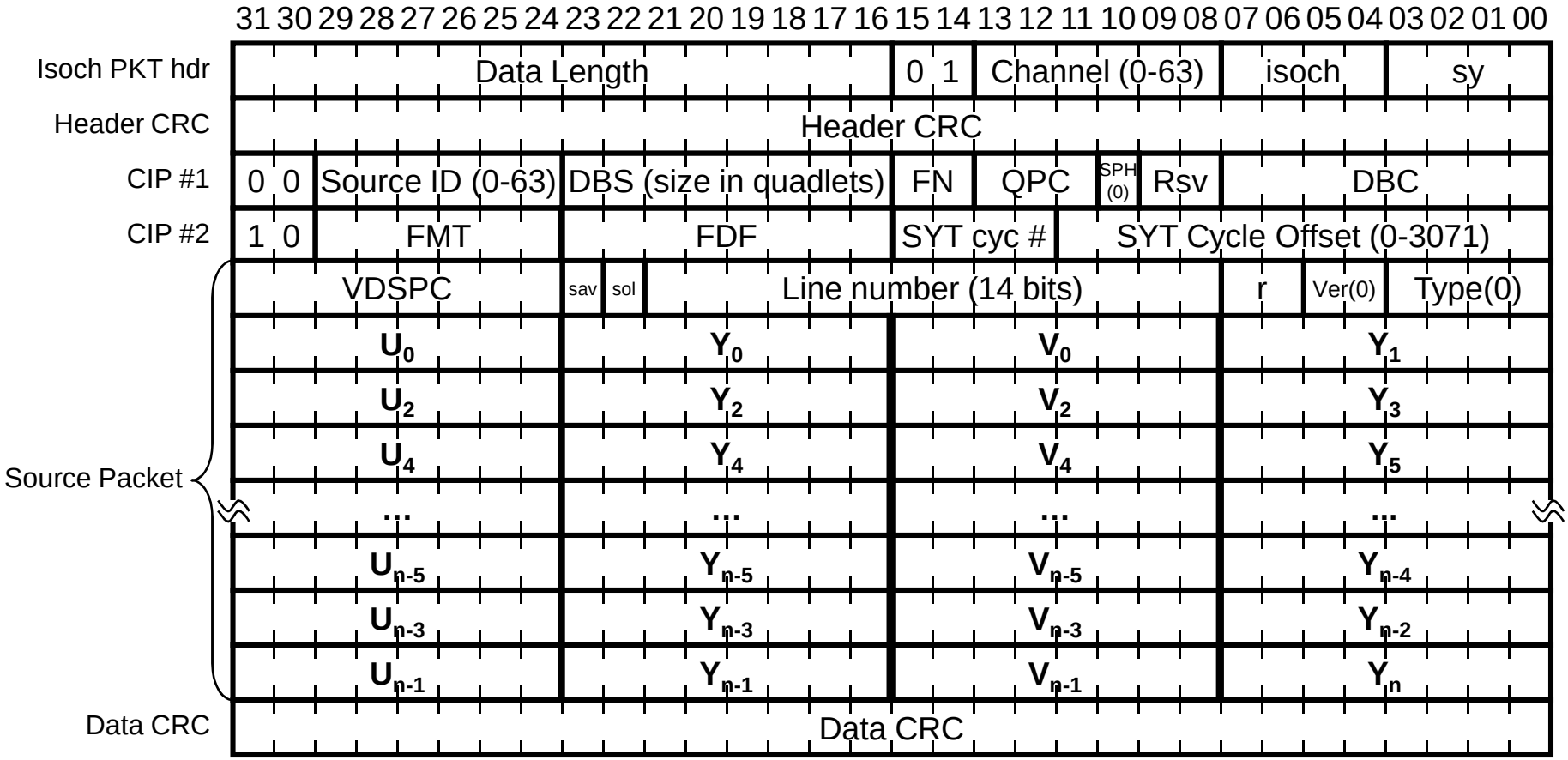
- Public info from Fujitsu press release:
  - Target images:
    - Natural images, letter and line drawings, YUV 720 x 480 pixels; RGB 800 x 480 pixels, etc.
  - Processing speed:
    - Maximum: 60 frames/second; equivalent to RGB 800 x 480 pixels
  - Delay time:
    - Compression-decompression time is 2 -3 milliseconds
  - Compression ratio:
    - Fixed rate of 1/3; (YUV 720 x 480 pixels; transmission rate 55 Mbps for 30 frames/second)

Uncompressed Video Source packet



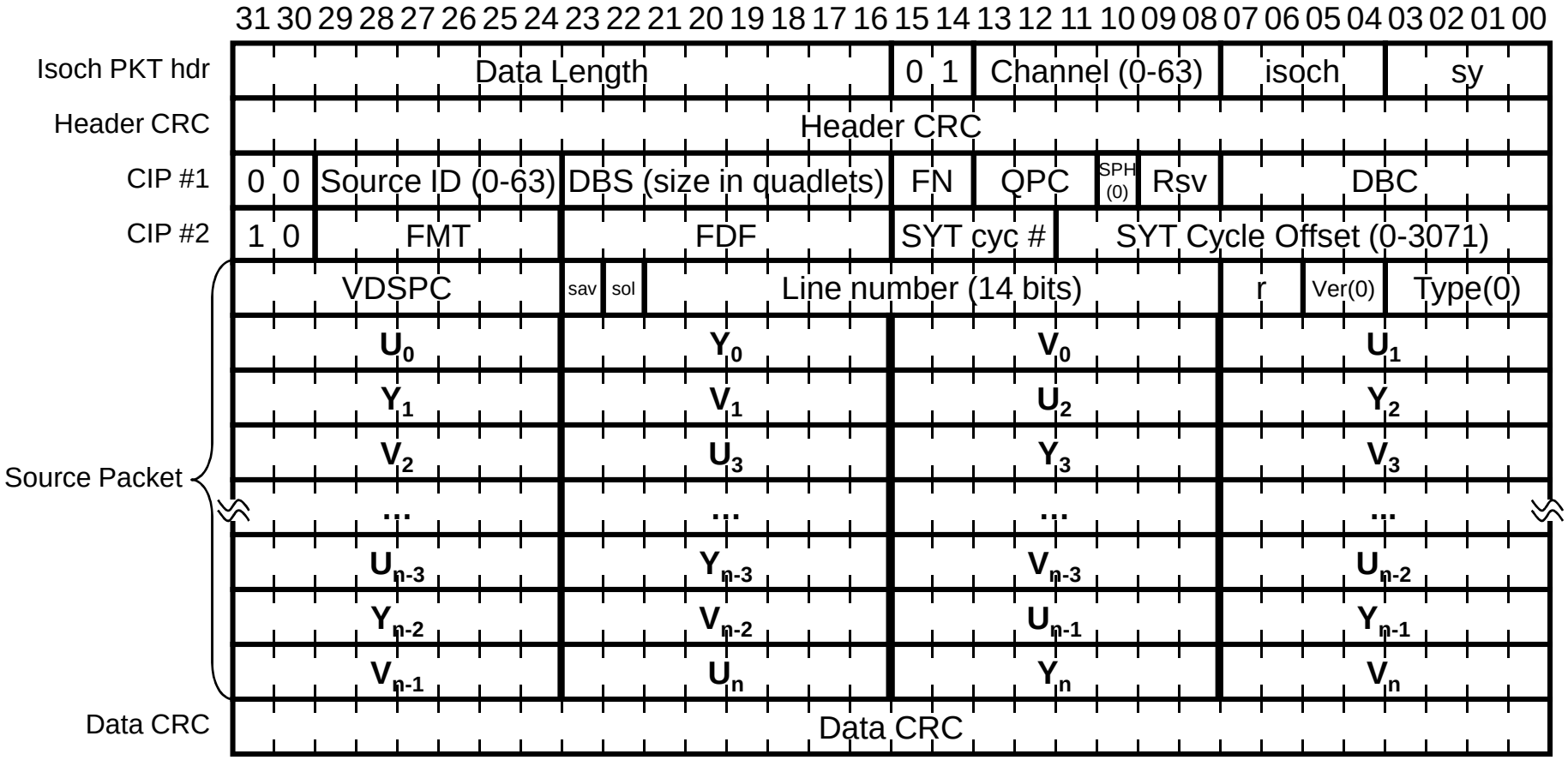
- **Identified by Type field == 0, size varies by video type**
- **Video Data source Packet Count (VDSPC):** Running modulo 256 count of Source Packets.
- **Start Of Line (sol):** Packet contains first pixel of a video line
- **Start of Active Video (sav):** Packet contains first pixel of the first active video line of each frame (progressive) or each field (interlace)

Color Space 0 Video Source packet



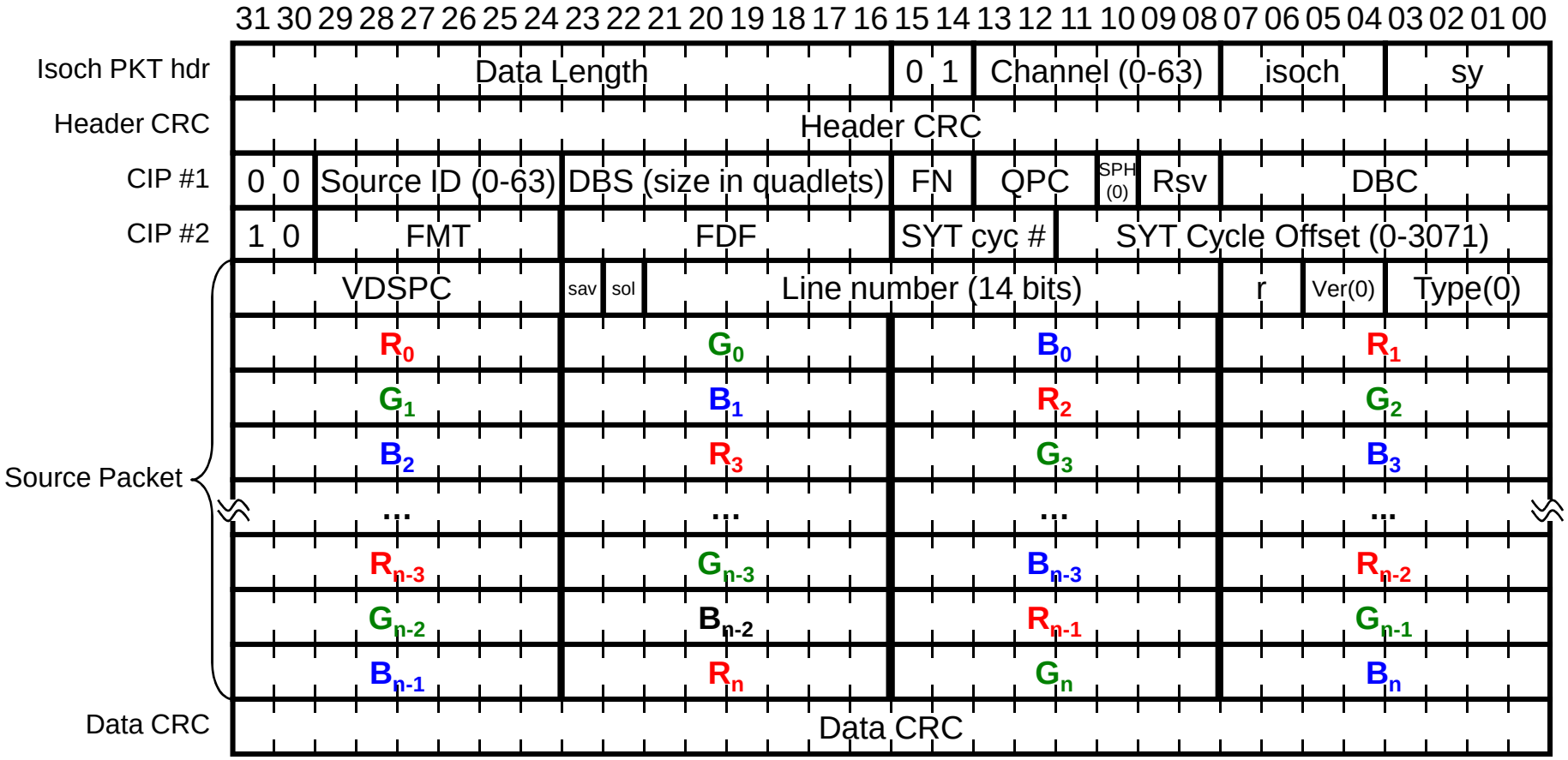
- **Color Space 0 –YUV 4:2:2, 8 bits/sample**
  - 1 Y sample per pixel
  - Each U and V sample is used for 2 pixels.

Color Space 1 Video Source packet



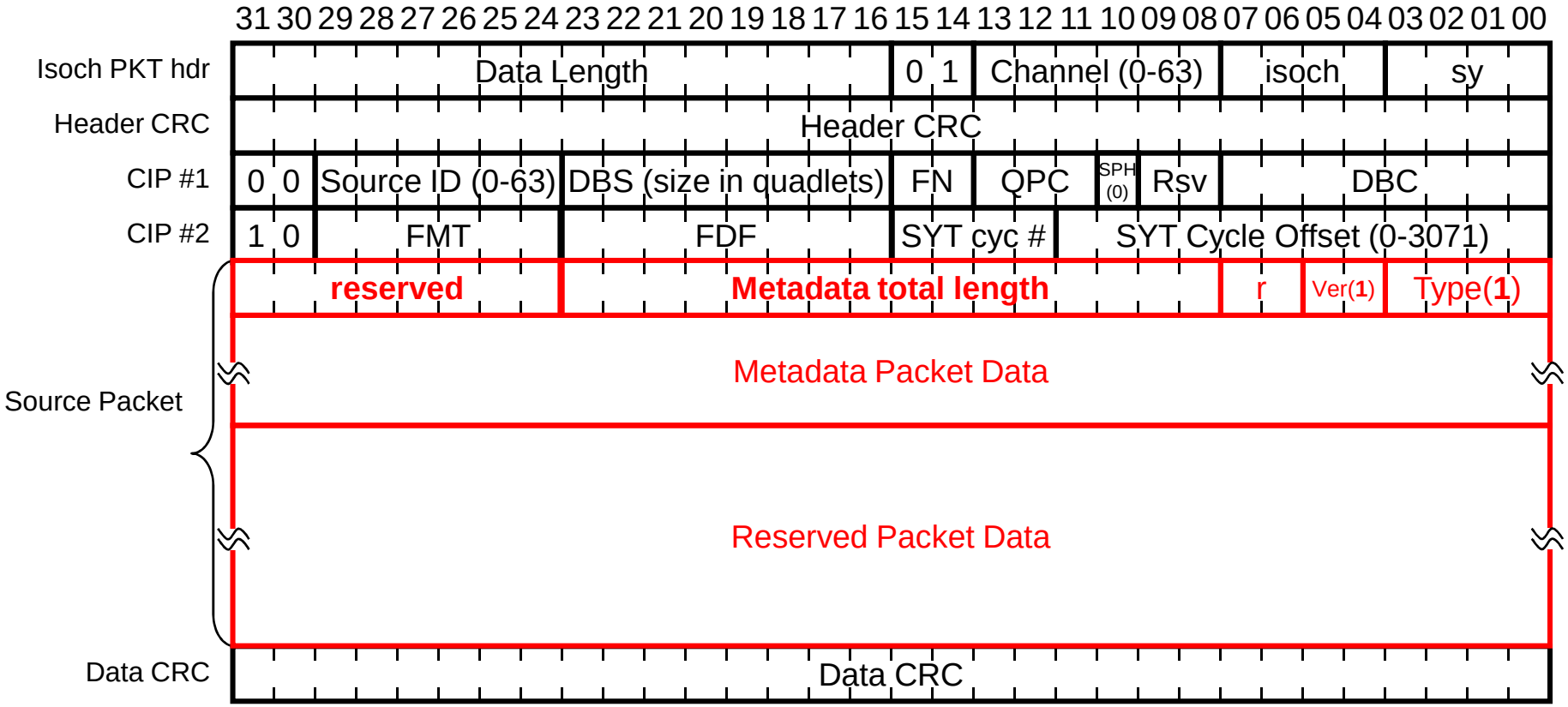
- **Color Space 1 –YUV 4:4:4, 8 bits/sample**
  - 1 U, Y, V sample per pixel

Color Space 2 Video Source packet



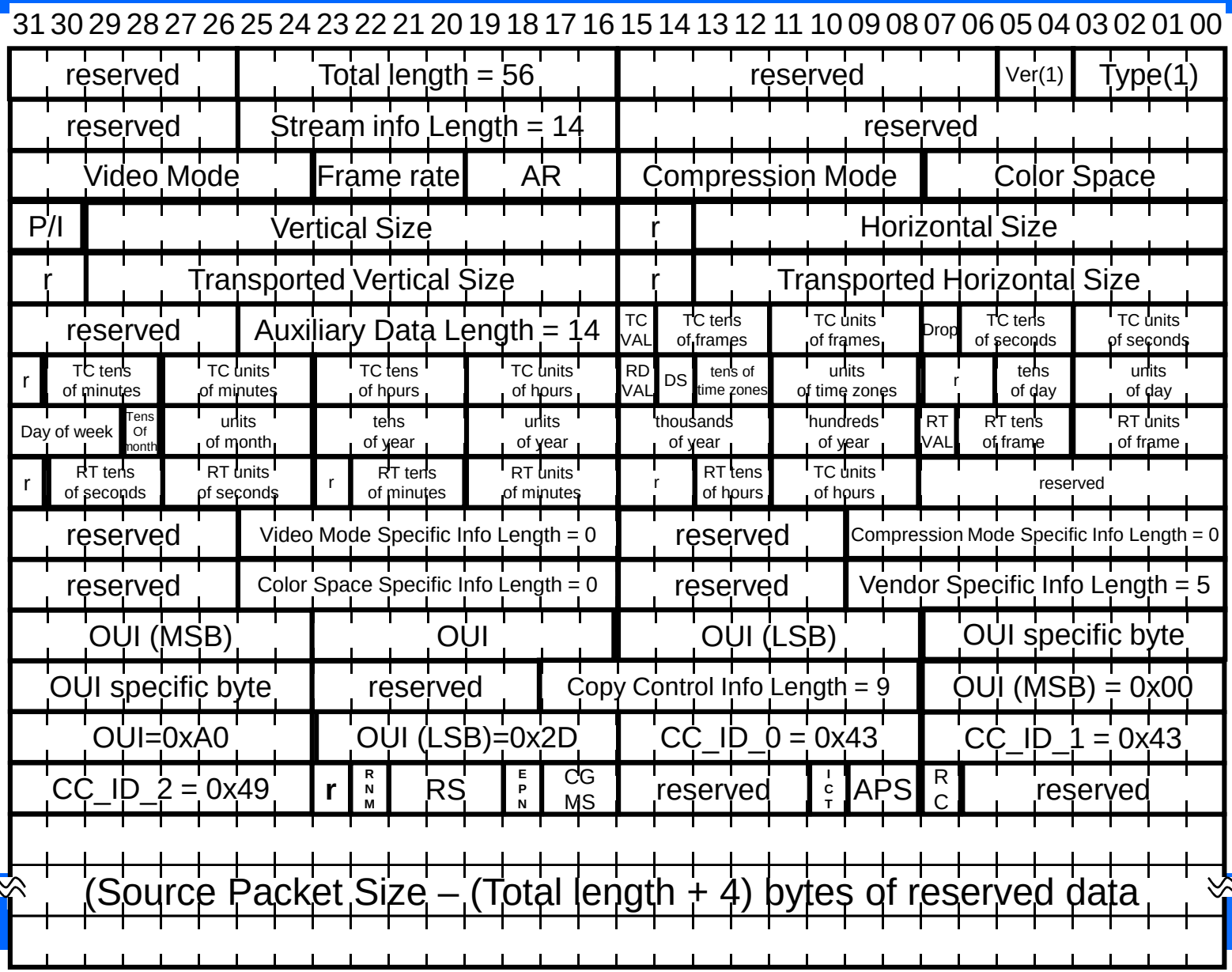
- **Color Space 2 –RGB, 8 bits/sample**
  - 1 R, G, B sample per pixel

Metadata Source packet



- **Identified by Type field == 1, size varies by video type**
- **Metadata total length:** Total length in bytes of Metadata
- **Reserved packet data:** Reserved/Unused data to create source packet of same size as normal video data source packet.

Example Metadata source packet



802.15.3 Protocol Adaptation Layer (PAL) Working slides

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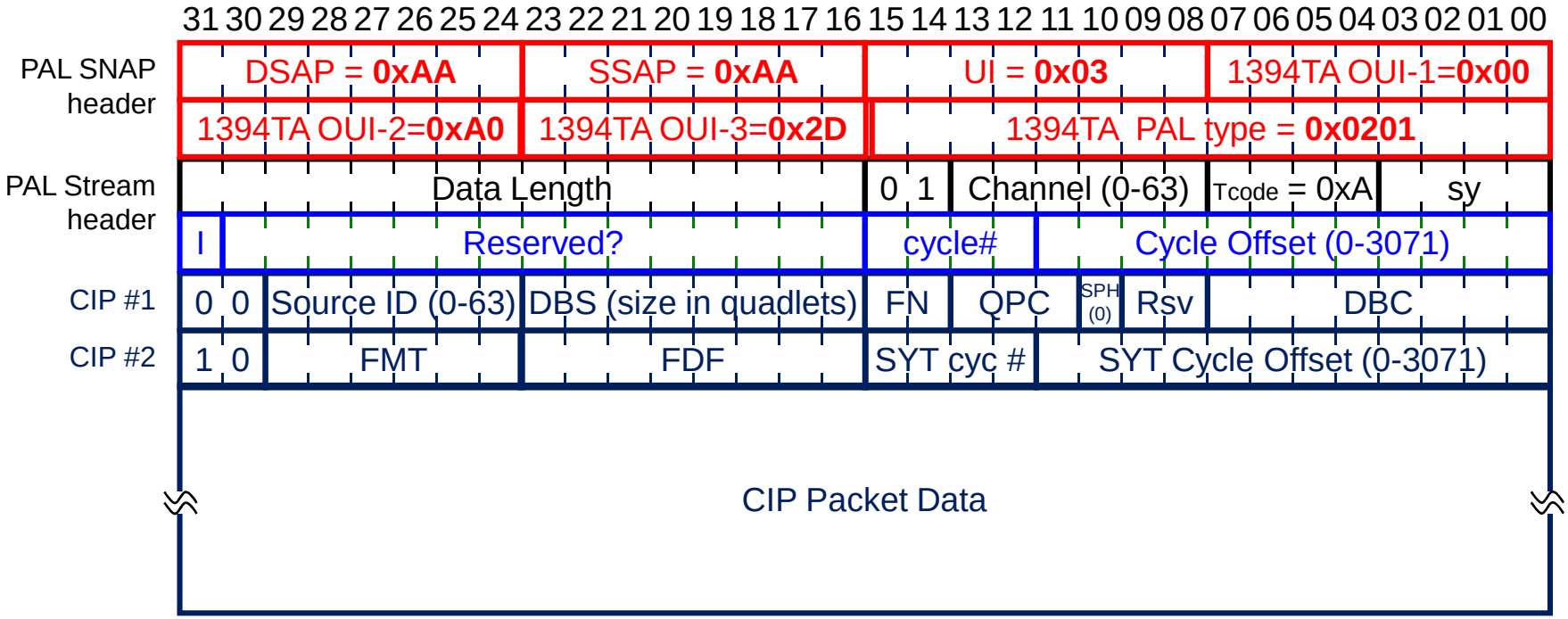
PAL stream packet format



- Format summary
  - SNAP compliant header, OUI 0x00-A0-2D, type 0x0201
  - PAL stream header1st quadlet same as 1394 header for CIP packets
  - PAL stream header 2nd quadlet used in 1394 for Header CRC reused for
    - I bit: Indicates Isochronous or Asynchronous Stream
    - Cycle time: Equivalent data of Cycle Start 1394 packet
  - CIP Header and remaining CIP data are identical.

Backup
Misc. Info

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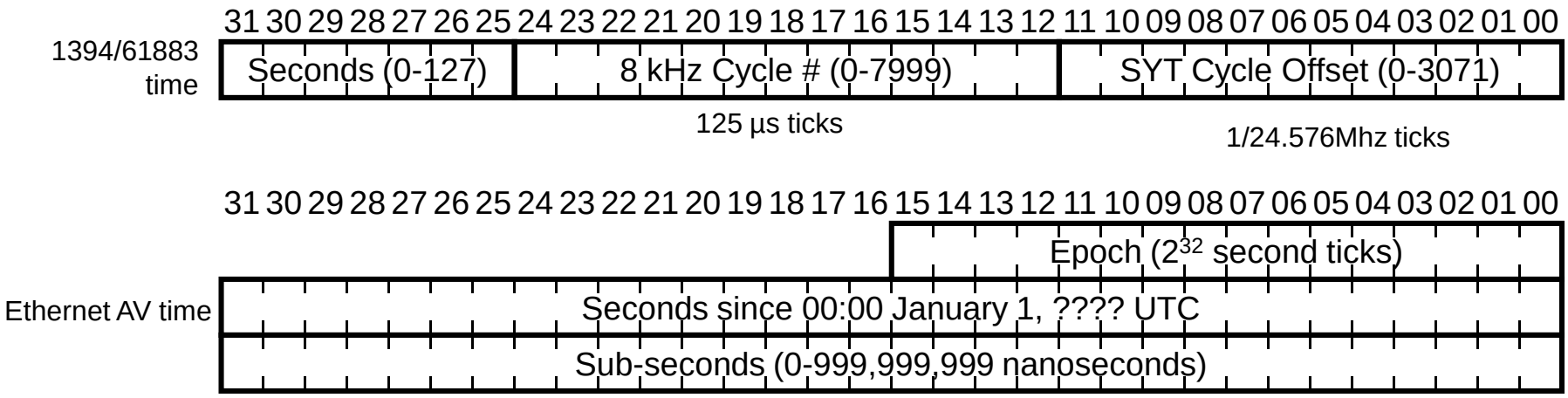
Time formats



61883-6 Data bytes per packet, Unpacked

		Bits/Sample:	32	32	32	32	32
Hz	samples/ channel/ 8kHz	Channels:	2	4	8	16	32
8,000	1	Data Bytes per Packet:	8	16	32	64	128
16,000	2		16	32	64	128	256
32,000	4		32	64	128	256	512
48,000	6		48	96	192	384	768
96,000	12		96	192	384	768	**1536**
192,000	24		192	384	768	**1536**	**3072**
11,025	1.378125	Average Data Bytes per Packet:	11.025	22.05	44.1	88.2	176.4
22,050	2.75625		22.05	44.1	88.2	176.4	352.8
44,100	5.5125		44.1	88.2	176.4	352.8	705.6
88,200	11.025		88.2	176.4	352.8	705.6	*1411.2*
174,600	21.825		174.6	349.2	698.4	*1396.8*	**2793.6**

- Max 100 megabit 1394 payload is 256 quadlets (1024 bytes)
- Max AVB Ethernet Frame payload is 1500
- Invalid sizes not supportable for 100 megahertz 1394 in yellow
- Invalid sizes not supportable for a single normal max size Ethernet Frame in Red.

61883-6 Data bytes per packet, Packed

		Bits/Sample:	24	24	24	24	24
Hz	samples/ channel/ 8kHz	Channels:	2	4	8	16	32
8,000	1	Data Bytes per Packet:	6	12	24	48	96
16,000	2		12	24	48	96	192
32,000	4		24	48	96	192	384
48,000	6		36	72	144	288	576
96,000	12		72	144	288	576	*1152*
192,000	24		144	288	576	*1152*	**2304**
11,025	1.378125	Average Data Bytes per Packet:	8.26875	16.5375	33.075	66.15	132.3
22,050	2.75625		16.5375	33.075	66.15	132.3	264.6
44,100	5.5125		33.075	66.15	132.3	264.6	529.2
88,200	11.025		66.15	132.3	264.6	529.2	*1058.4*
174,600	21.825		130.95	261.9	523.8	*1047.6*	**2095.2**

- Max 100 megabit 1394 payload is 256 quadlets (1024 bytes)
- Max AVB Ethernet Frame payload is 1500
- Invalid sizes not supportable for 100 megahertz 1394 in yellow
- Invalid sizes not supportable for a single normal max size Ethernet Frame in Red.

Cut and paste (802.1P/Q packet)