



HD-SDI

라운피플(주)



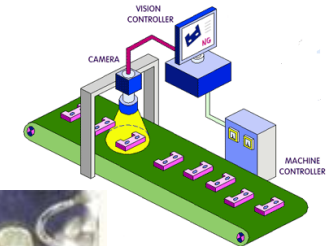
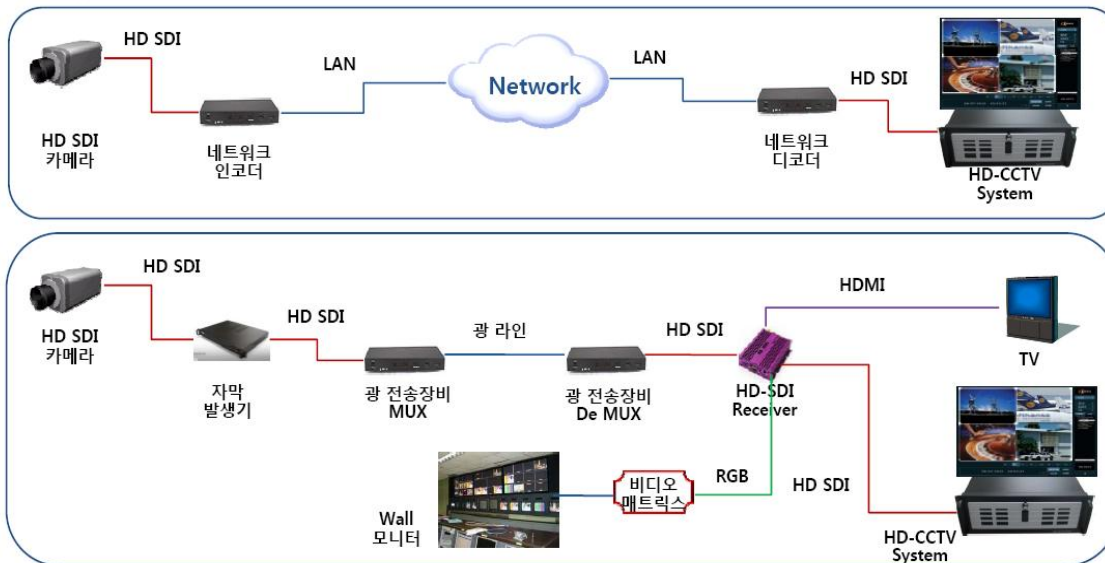
SDI

- 비압축 디지털 비디오 신호를 직렬화(serializing) 하여 75Ω 동축 케이블(신호감쇠 최소)을 통하여, SD급은 350m, HD 급은 150m 까지 전송할 수 있는 기술
- 일정한 거리마다 repeater (equalization and reclocking) 을 통해 데이터 손실 없이 무한 거리까지도 전송 가능
- 비압축 데이터를 사용하기 때문에 화질 열화 없음

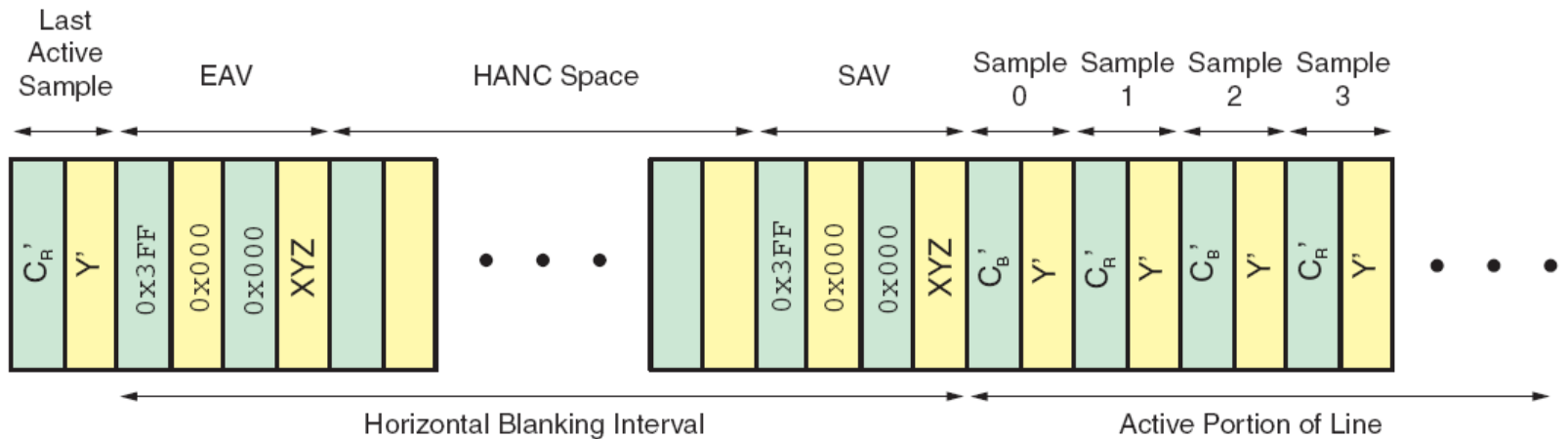
항목	해상도	전송 속도	규격
SD-SDI	480i, 576i	270Mbps	SMPTE 259M
HD-SDI	1080 60i/30p 720 60p	1.485Gbps 1.485/1.001 Gbps	SMPTE 292M
3G-SDI	1080 60p	2.97 Gbps 2.97/1.001 Gbps	SMPTE 424M

응용 분야

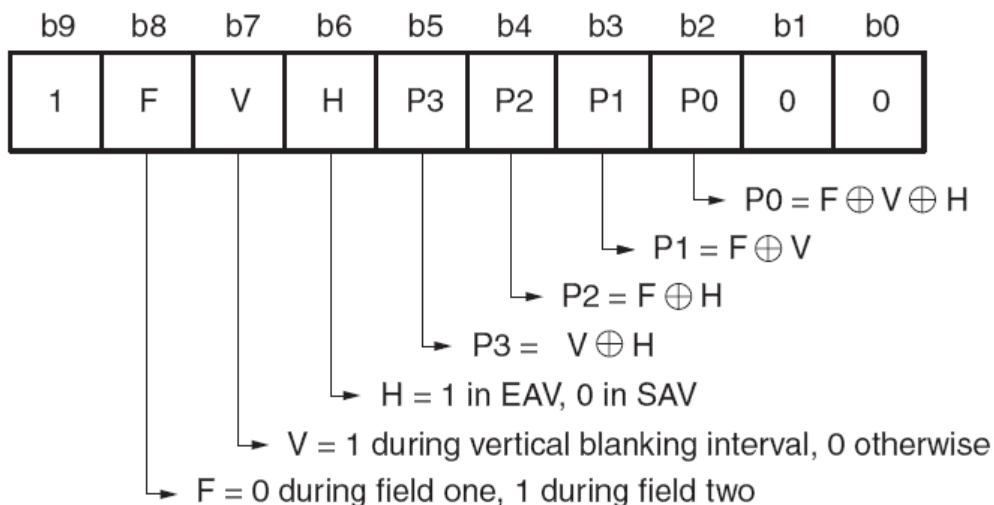
- 기존 Analog Camera 가 적용되어 있는 분야, 실시간 데이터 전송이나 고화질이 요구되는 분야
 - 보안 및 관제(CCTV), 방송 장비, 의료용 모니터, LED 전광판
- Vision Camera
 - 장비용 카메라
- 영상 Capture 가 필요한 분야
 - SDI Capture Card



SD-SDI Data Format



X1014_C2_01_040209

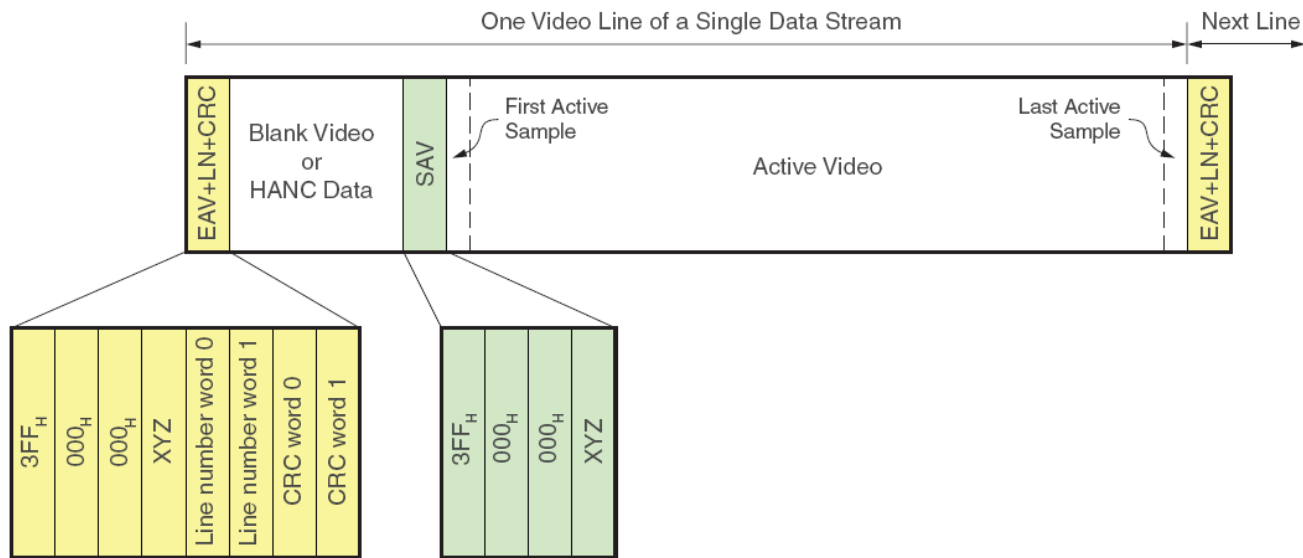


- The space between the EAV and SAV sequences is called the horizontal ancillary (HANC) space.

- Ancillary (ANC) data packets containing non-video data are often found in the HANC space.

- Some types of ancillary data can also be found in the active portion of lines in the vertical blanking interval.

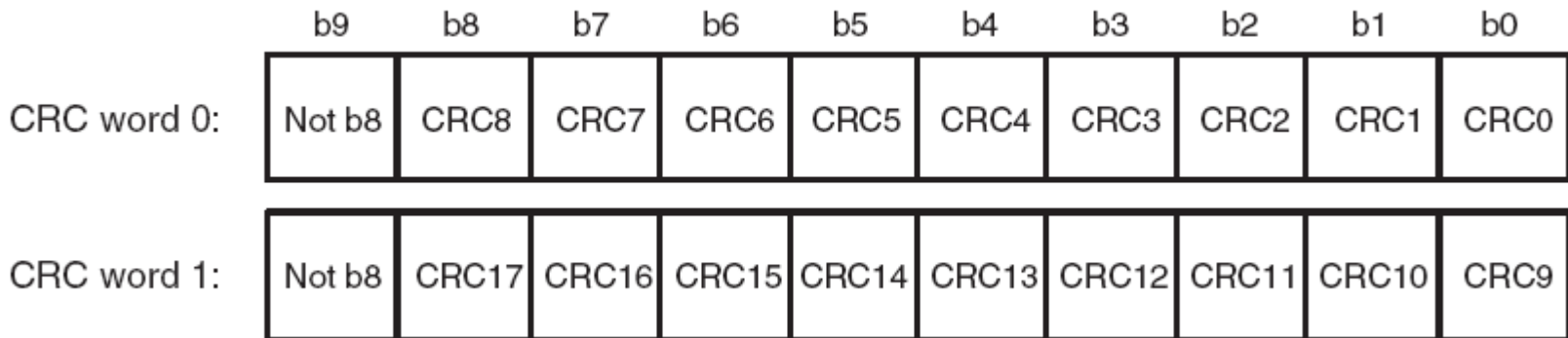
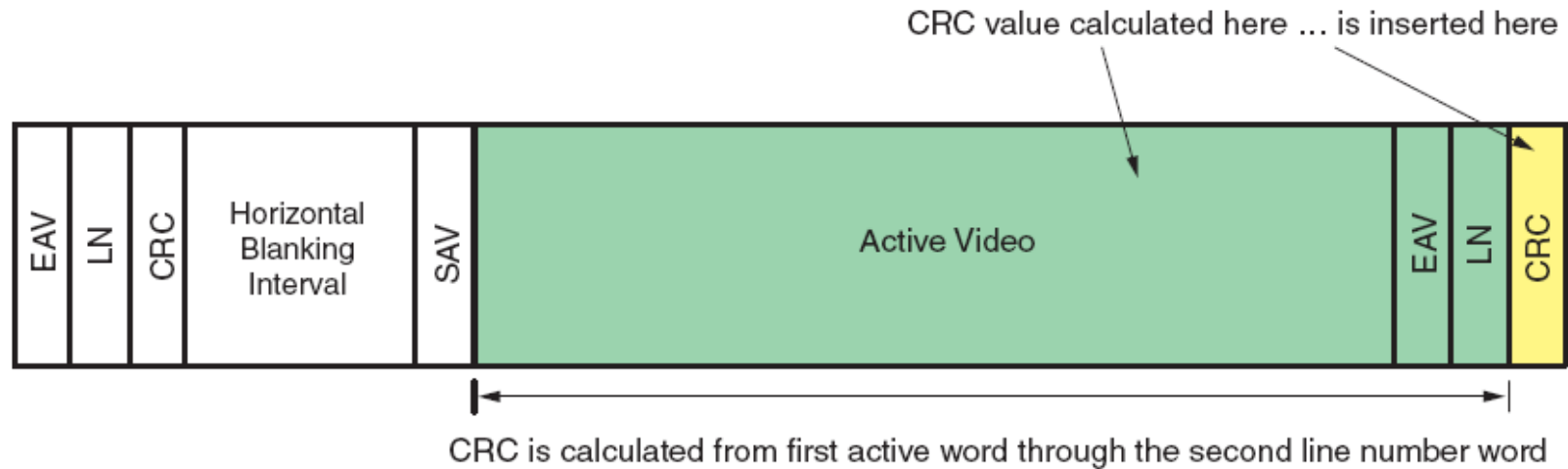
HD-SDI Data Format



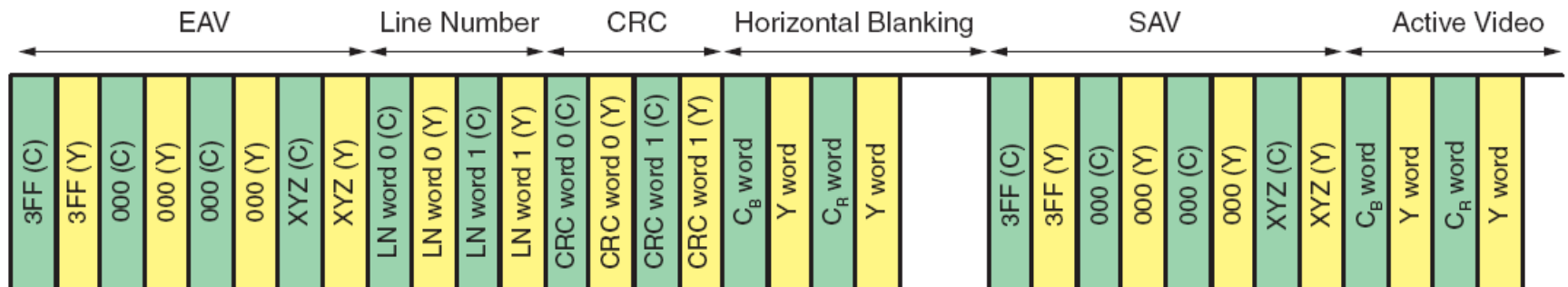
	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Line number word 0:	Not b8	LN6	LN5	LN4	LN3	LN2	LN1	LN0	0	0
Line number word 1:	1	0	0	0	LN10	LN9	LN8	LN7	0	0

- Line numbers are assigned sequentially beginning with 1 and ranging to the maximum line number for the particular video format.

HD-SDI Data Format



HD-SDI Data Stream



X1014_C2_15_041509

- Prior to scrambling the data streams for transmission over the HD-SDI serial interface, the two data streams are interleaved together
- the word from data stream 2 (C) is sent first, followed by the word from data stream 1 (Y).
- HD-SDI is an LSB-first protocol, so the LSB of each word is sent first by the serializer

HD-SDI Video Formats

- Y'CB'CR' color space, 4:2:2 sampling, 10 bits per component (20 bits per video sample).
- The most common of these video formats are defined by these standards:
 - SMPTE 274M formats with 1080 active lines
 - SMPTE 296M formats with 720 active lines
- 4:4:4, 12 bits per component require more bandwidth than provided by HD-SDI.
(dual link HD-SDI and 3G-SDI)

SMPTE 274M Video Formats (1920x1080 Active Samples)

System	Format Name	Sample Rate (MHz)	Frame Rate	Total Samples x Lines
1	1080p60	148.5	60	2200 x 1125
2	1080p59.94	148.5/M	60/M	2200 x 1125
3	1080p50	148.5	50	2640 x 1125
4	1080i60	74.25	30	2200 x 1125
5	1080i59.94	74.25/M	30/M	2200 x 1125
6	1080i50	74.25	25	2640 x 1125
7	1080p30	74.25	30	2200 x 1125
8	1080p29.97	74.25/M	30/M	2200 x 1125
9	1080p25	74.25	25	2640 x 1125
10	1080p24	74.25	24	2750 x 1125
11	1080p23.98	74.25/M	24/M	2750 x 1125

SMPTE 296M Video Formats (1280x720 Active Samples)

System	Format Name	Sample Rate (MHz)	Frame Rate (Hz)	Total Samples x Lines
1	720p60	74.25	60	1650 x 750
2	720p59.94	74.25/M	60/M	1650 x 750
3	720p50	74.25	50	1980 x 750
4	720p30	74.25	30	3300 x 750
5	720p29.97	74.25/M	30/M	3300 x 750
6	720p25	74.25	25	3960 x 750
7	720p24	74.25	24	4125 x 750
8	720p23.98	74.25/M	24/M	4125 x 750

Notes:

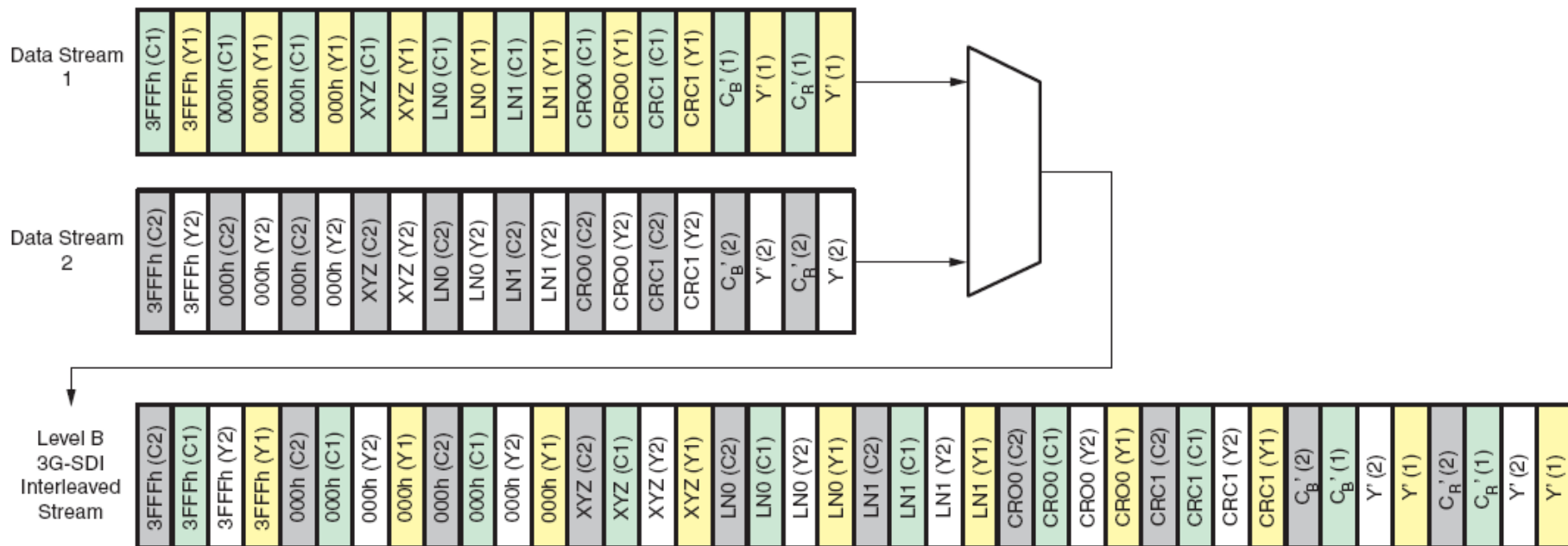
1. The value M indicates the value 1.001.



3G-SDI

- Very similar to HD-SDI.
- Bit rate is twice that of HD-SDI, or approximately 3 Gb/s.
- Two bit rates are supported: 2.97 Gb/s and 2.97/1.001 Gb/s (approximately 2.967 Gb/s).
- Uses exactly the same electrical signal levels, scrambling, connectors, cable as HD-SDI.
- The cable drivers and cable equalizers must be designed to support 3 Gb/s signal rates.
- Defined by SMPTE 424M. Another document, SMPTE 425M, defines how various video formats are mapped to the 3G-SDI
- Defines two levels of operation called level A and level B.
- Level A is identical to that of HD-SDI
- Level B allows very simple conversions between dual link HD-SDI and 3G-SDI
- Level B also has two 10-bit data streams. When a dual link HD-SDI signal is carried by a 3G-SDI level B interface, link A of the dual link HD-SDI pair is carried on data stream 1 of the 3G-SDI interface and link B is carried on data stream 2.

3G-SDI Level B Data Stream





Ancillary Data

- Non-video packetized data(Digital Audio Packet) embedded in the **horizontal blanking interval(HANC)** or in the **active portions of video lines that are in the vertical blanking interval(VANC)**
- SMPTE 291M defines the basic format of ANC packets and describes the rules for how the packets are embedded in the HANC and VANC spaces.
- The actual format of the user data words is defined in each individual standard that defines a particular type of ancillary data packet
- Included 7 ~ 41 line (progressive) / 7~20, 569~583 (interlaced)
- **ADF** : Three-word preamble called the ancillary data flag The first word is 0x000 and the second and third words are 0x3FF. Thus, the ADF is essentially the inverse of the first three words of an EAV or SAV sequence.
- **DID** : Data identification word, uniquely identifies the packet type.
- **SDID** or **DBN** : Secondary DID, further refine the identity of the packet type
Data block number, sequence of related packets.
- **DC** : Data count word, indicating how many user data words are present in the payload portion of the packet.
- **User data word**
- **CS** : Checksum. If there are no user data words, the checksum follows the DC word.

Ancillary Data

Example : User data words for ANC packets containing **digital audio** for HD-SDI interfaces (SMPTE 299M)

Type 1 ANC Packet

ADF		DID	DBN	DC	User Data Words (maximum of 255)	CS	

Type 2 ANC Packet

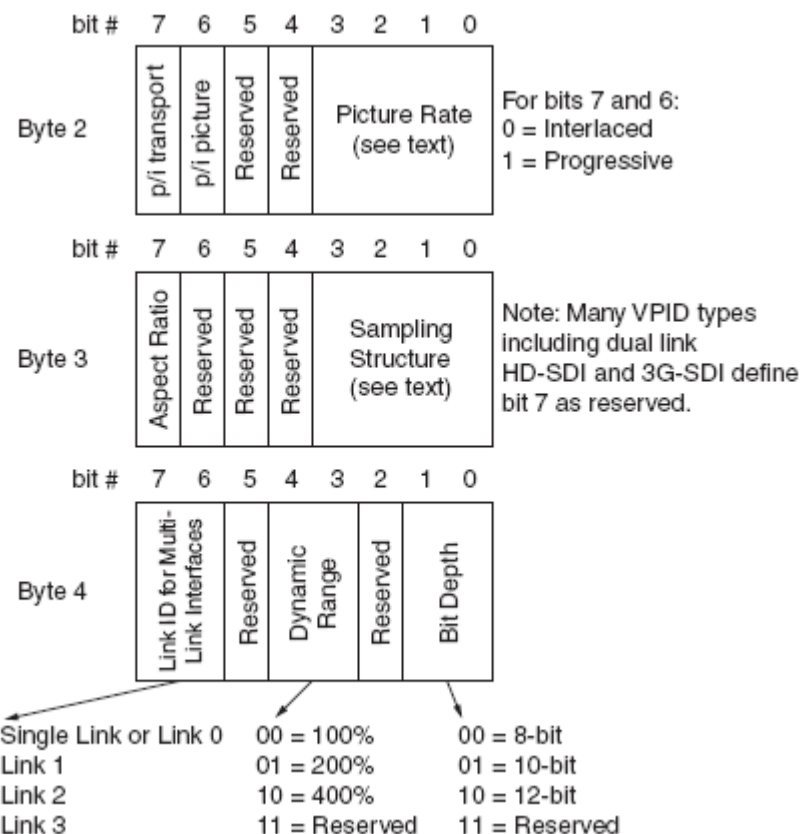
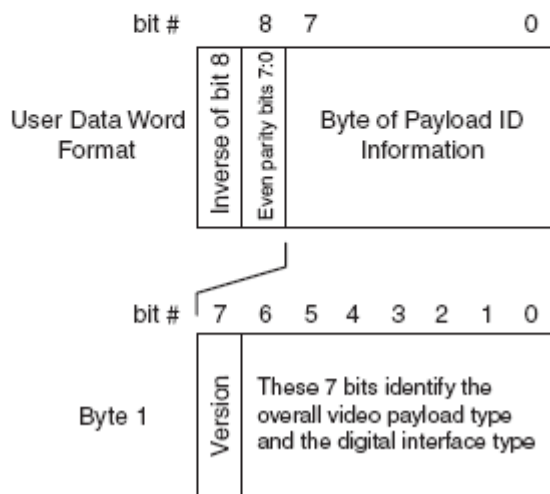
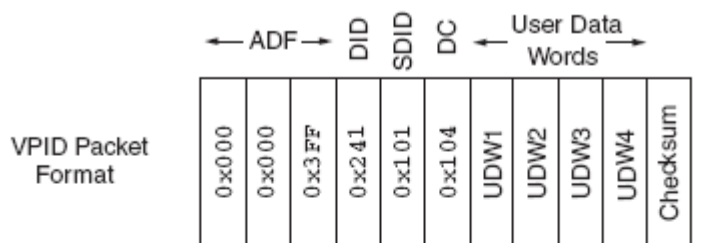
ADF		DID	SDID	DC	User Data Words (maximum of 255)	CS	

Word Contents	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Ancillary Data Flag, Word 1 (0x0)	0	0	0	0	0	0	0	0	0	0
Ancillary Data Flag, Word 2 (0x3FF)	1	1	1	1	1	1	1	1	1	1
Ancillary Data Flag, Word 3 (0x3FF)	1	1	1	1	1	1	1	1	1	1
DID	$\overline{P}$	P	did7	did6	did5	did4	did3	did2	did1	did0
Secondary DID/Data Block Number	$\overline{P}$	P	sdid7 dbn7	sdid6 dbn6	sdid5 dbn5	sdid4 dbn4	sdid3 dbn3	sdid2 dbn2	sdid1 dbn1	sdid0 dbn0
Data Count	$\overline{P}$	P	dc7	dc6	dc5	dc4	dc3	dc2	dc1	dc0
User Data Words (0 to 255 Words)	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
Checksum	$\overline{cs8}$	cs8	cs7	cs6	cs5	cs4	cs3	cs2	cs1	cs0

Note: P is an even parity bit for bits b7 through b0 and is located in b8. Words containing a P bit in b8 also have the inverse of b8 located in b9.

Video Payload ID (VPID)

- Must be included 3G-SDI / Dual Link HD-SDI (HANC space)
- HD-SDI : Only Y data stream / 3G-SDI : both data stream
- Interface type, sampling structure, component bit depth, and picture update rate



VPID : UDW1

Byte 1	Video Payload	Interface
0x81	525i or 625i	SMPTE 259M SD-SDI (270 Mb/s or 360 Mb/s)
0x82	525p or 625p	SMPTE 259M SD-SDI (dual link 270 Mb/s or single link 360 Mb/s)
0x83	525 or 625 line	SMPTE 344M SD-SDI (540 Mb/s)
0x84	SMPTE 296M 720p	SMPTE 292M HD-SDI
0x85	SMPTE 274M 1080i and 1080p	SMPTE 292M HD-SDI
0x86	525 or 625 line	SMPTE 292M HD-SDI using SMPTE 349M mapping
0x87	SMPTE 274M 1080i and 1080p	SMPTE 372M dual link HD-SDI
0x88	SMPTE 296M 720p	SMPTE 425M-A 3G-SDI
0x89	SMPTE 274M 1080i and 1080p	SMPTE 425M-A 3G-SDI
0x8A	SMPTE 372M dual link	SMPTE 425M-B 3G-SDI
0x8B	2 x SMPTE 296M	SMPTE 425M-B 3G-SDI
0x8C	2 x SMPTE 274M	SMPTE 425M-B 3G-SDI
0x8D	2 x 525 or 625 line	SMPTE 425M-B 3G-SDI

VPID : UDW2/3

UDW2

Picture Rate (Hz)	Value	Picture Rate (Hz)	Value
24/1.001	0x2	24	0x3
25	0x5	50	0x9
30/1.001	0x6	30	0x7
60/1.001	0xA	60	0xB

UDW3

Structure	Value	Structure	Value	Structure	Value	Structure	Value
4:2:2 (Y'C _B 'C _R ') (Y'C _B 'C _R)	0x0	4:4:4 (Y'C _B 'C _R ') (Y'C _B 'C _R)	0x1	4:4:4 (R'G'B') (R'G'B')	0x2	4:2:0	0x3
4:2:2:4 (Y'C _B 'C _R 'A)	0x4	4:4:4:4 (Y'C _B 'C _R 'A)	0x5	4:4:4 (R'G'B'A)	0x6	Reserved	0x7
4:2:2:4 (Y'C _B 'C _R 'D)	0x8	4:4:4:4 (Y'C _B 'C _R 'D)	0x9	4:4:4:4 (R'G'B'D')	0xA	Reserved	0xB
Reserved	0xC	Reserved	0xD	4:4:4 (X'Y'Z')	0xE	Reserved	0xF



VPID : UDW4

Bit		
7:6	Link ID for Multi-Link Interface	00 : Single or Link 0 01 : Link 1 10 : Link 2 11 : Link 3
5	Reserved	
4:3	Dynamic Range	00 : 100% (8 bit) 01 : 200% (10bit) 10 : 400% (12bit) 11 : Reserved
2	Reserved	
1:0	Bit Depth	00 : 8 bit 01 : 10 bit 10 : 12 bit 11 : Reserved

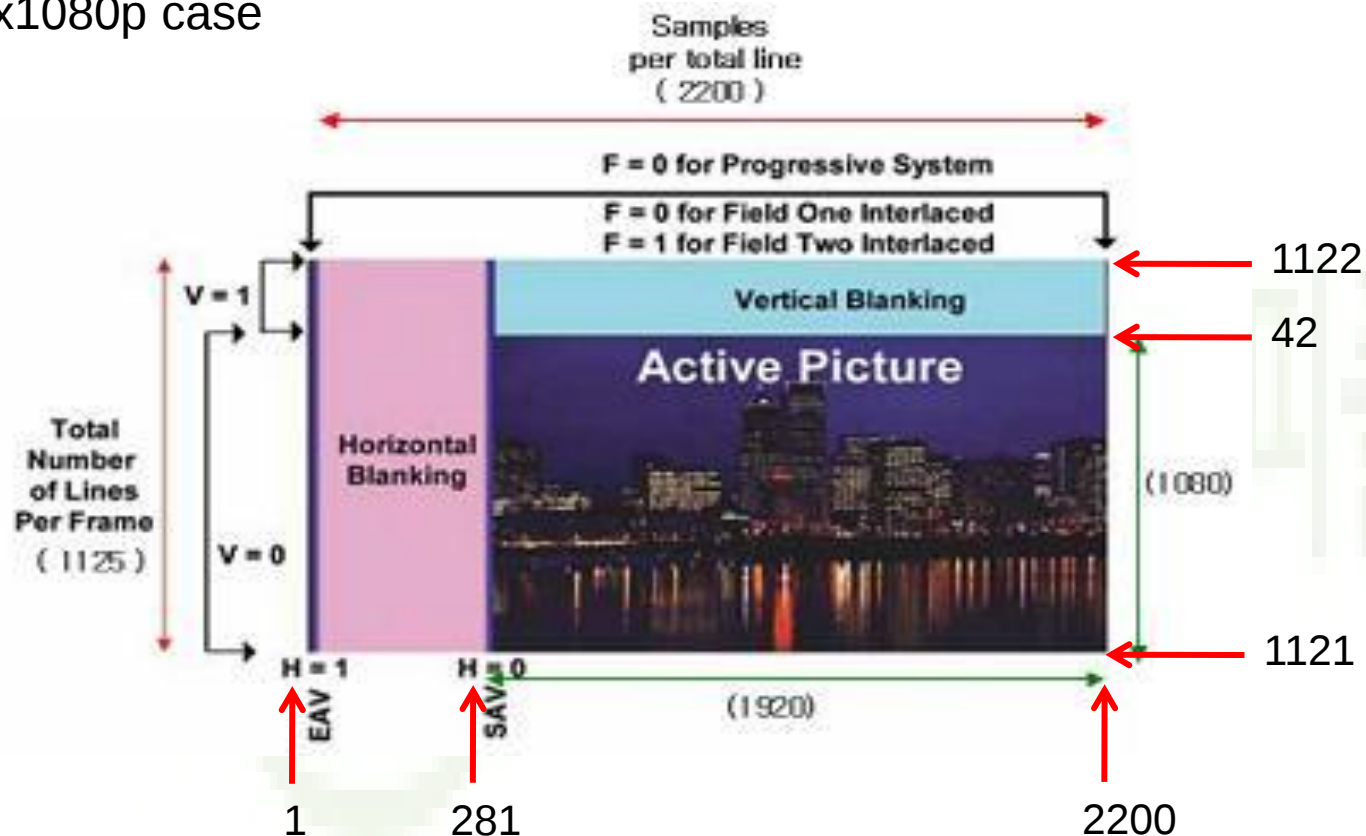


VPID Packet Location

Video Format	Field	Line Number
525i	1	13
	2	276
625i	1	9
	2	322
1080i	1	10
	2	572
525p	-	13
625p	-	9
720p	-	10
1080p	-	10

HD Video Frame Layout Example

1920x1080p case



- Blank 구간(1~41, 1122~1125)에서의 데이터
Y : 040
Cb/Cr : 200
- Active 구간 : 42 ~ 1121



Thank you!

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