




Agenda

- 
- FCC Requirements
 - ANC Data
 - Closed Captioning
 - Closed Caption Troubleshooting



Agenda



FCC Requirements



ANC Data



Closed Captioning



Closed Caption Troubleshooting



FCC Requirments

- (12) *Video programming provider.* Any video programming distributor and any other entity that provides video programming that is intended for **distribution to residential households** including, but not limited to broadcast or nonbroadcast television network and the owners of such programming.
- (b) *Requirements for closed captioning of video programming—(1) Requirements for new English language programming.* Video programming distributors must provide closed captioning for nonexempt video programming that is being distributed and exhibited on each channel during each calendar quarter in accordance with the following requirements:
 - (iv) As of January 1, 2006, and thereafter, 100% of the programming distributor's new nonexempt video programming must be provided with captions.

FCC Requirements

- (c) *Obligation to pass through captions of already captioned programs; obligation to maintain equipment and monitor for captions.* (1) All video programming distributors shall deliver all programming received from the video programming owner or other origination source containing closed captioning to receiving television households with the original closed captioning data intact in **a format that can be recovered and displayed by decoders meeting the standards** of this part unless such programming is recaptioned or the captions are reformatted by the programming distributor.
- (2) Video programming distributors **shall take any steps needed to monitor and maintain their equipment and signal transmissions** associated with the transmission and distribution of closed captioning to ensure that the captioning included with video programming reaches the consumer intact. In any enforcement proceeding involving equipment failure, the Commission **will require video programming distributors to demonstrate that they have monitored their equipment and signal transmissions**, have performed technical equipment checks, and have promptly undertaken repairs as needed to ensure that equipment is operational and in good working order.
- (3) Each video programming distributor shall maintain records of the video programming distributor's monitoring and maintenance activities, which shall include, without limitation, information about the video programming distributor's monitoring and maintenance of equipment and signal transmissions to ensure the pass through and delivery of closed captioning to viewers, and technical equipment checks and other activities to ensure that captioning equipment and other related equipment are maintained in good working order. Each video programming distributor shall maintain such records for a minimum of two years and shall submit such records to the Commission upon request.

FCC Requirements

- (2) The video programmer will make reasonable efforts to employ live display captioning instead of real-time captioning for prerecorded programs if the complete program can be delivered to the caption service provider in sufficient time prior to airing.
- (iii) *Monitoring and Remedial Best Practices*. Video programmers adopting Best Practices will take the following actions aimed at improving prompt identification and remediation of captioning errors when they occur.
 - (A) *Pre-air monitoring of offline captions*. As part of the overall pre-air quality control process for television programs, conduct periodic checks of offline captions on prerecorded programs to determine the presence of captions.
 - (B) *Real-time monitoring of captions*. Monitor television program streams at point of origination (e.g., monitors located at the network master control point or electronic monitoring) to determine presence of captions.
 - (D) *Recording of captioning issues*. Maintain a log of reported captioning issues, including date, time of day, program title, and description of the issue. Beginning one year after the effective date of the captioning quality standards, such log should reflect reported captioning issues from the prior year.
- (B) The intended message of the spoken dialogue is conveyed in the associated captions in a clear and comprehensive manner.
- Electronic Code of Federal Regulations
- <http://www.ecfr.gov/cgi-bin/text-idx?SID=72eb5a624e8dc043293819a5663dff41&node=47:4.0.1.1.6.1.1.1&rgn=div8=47>



Places to monitor

- Original content production – SDI
- Completed files transferred in – MPEG & SDI
- Files ready for transmission – MPEG & SDI
- Programing leaving the broadcaster or MSO
 - ✓ 8VSB, QAM-B, IPTV



Agenda



FCC Requirements



ANC Data



Closed Captioning



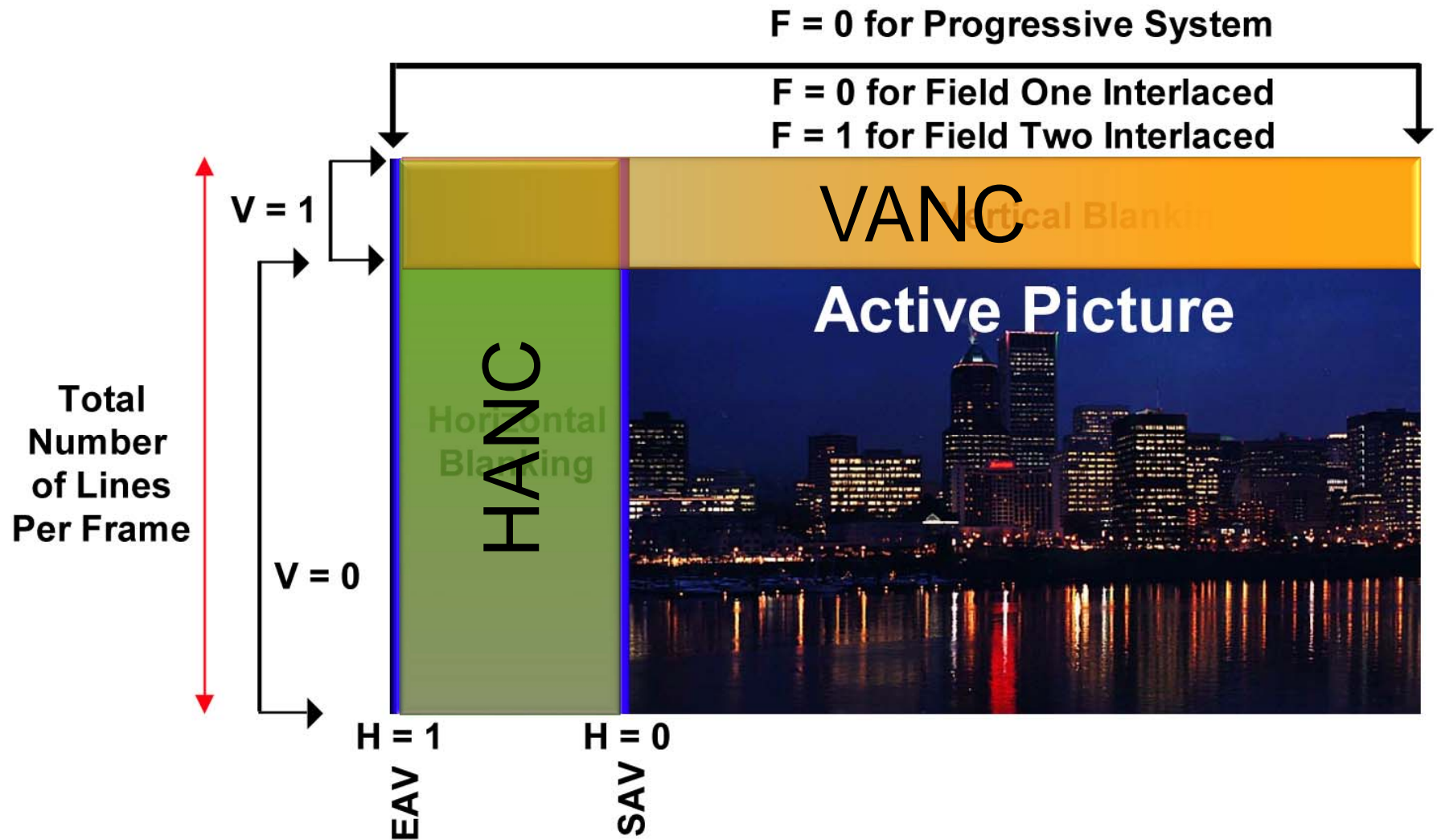
Closed Caption Troubleshooting



SMPTE Standards

- SMPTE 291M - Ancillary Data Packet and Space Formatting
 - Defines format of ANC Data Packet
 - Defines location and spacing of ANC Data
- SMPTE RP291 - Assigned Ancillary Identification Codes
 - Defines DID and SDID for various ANC Data Packets

Ancillary Data Space



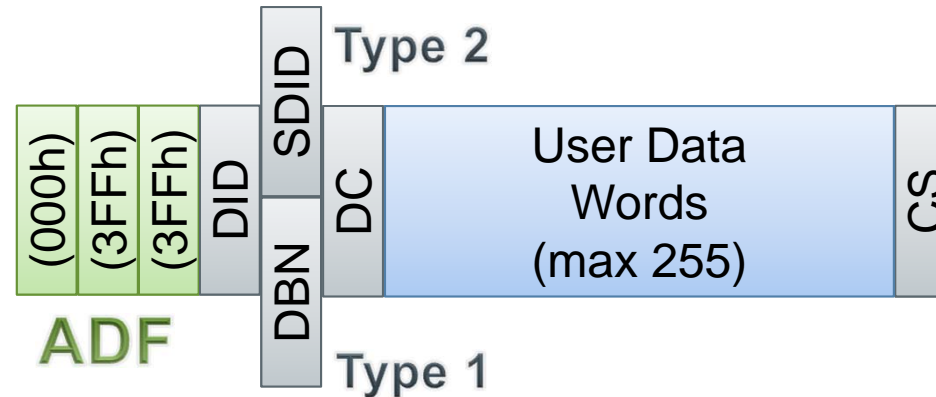
How big are the VANC and HANC spaces?

- Consider HD-SDI formats, all at 1.485 Gb/s bit rate:

Bits/word	10	10	10	10	10
× Words/sample	2	2	2	2	2
× Samples/line	2200	2640	2750	1650	1980
× Lines/frame	1125	1125	1125	750	750
× Frames/sec	30	25	24	60	50
= Bits/sec	1.485×10^9	1.485×10^9	1.485×10^9	1.485×10^9	1.485×10^9

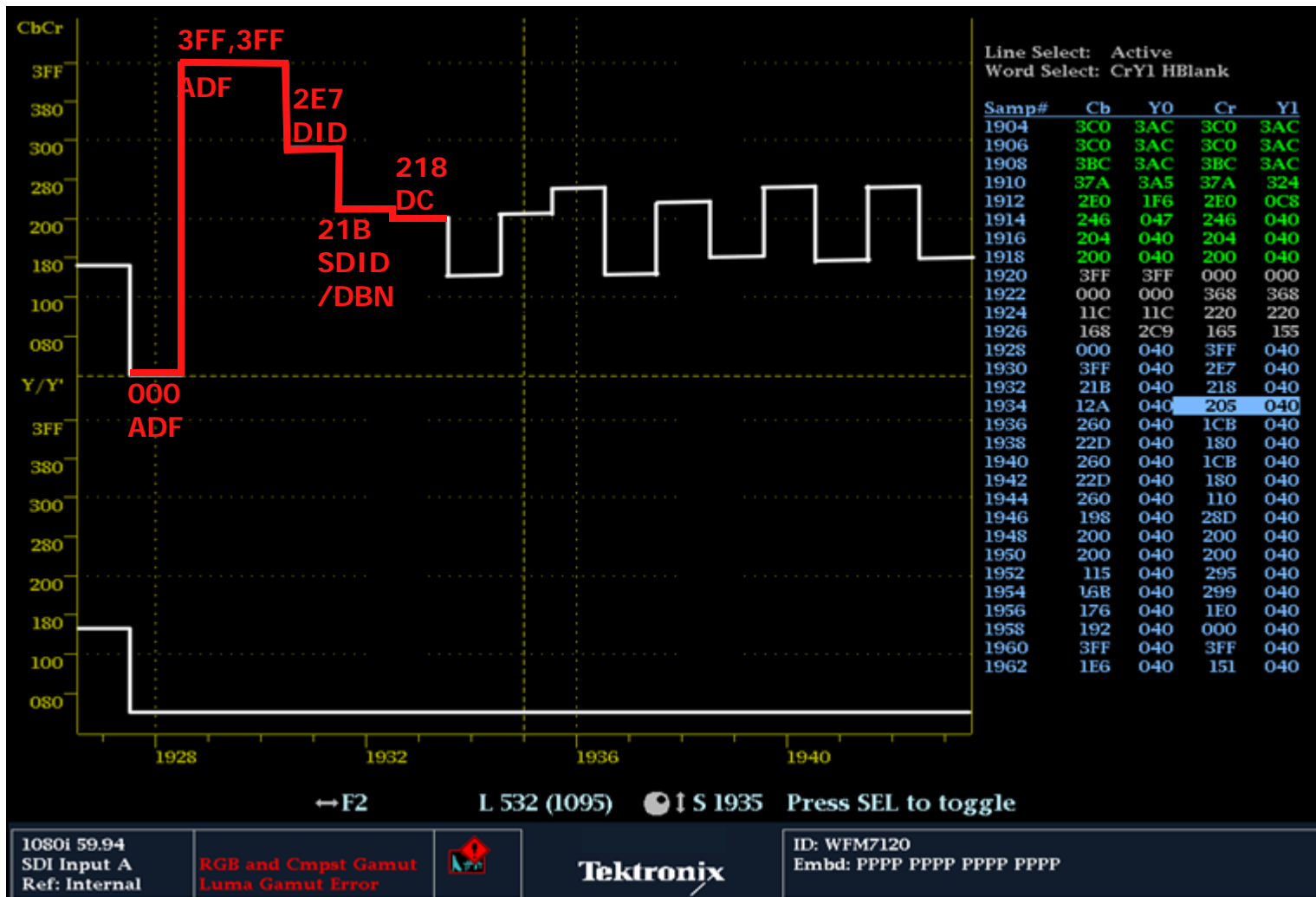
- VANC size is fixed for each format (4% of total lines)
 - 1125-line systems have 1080 lines of active video plus 45 lines of VANC
 - 750-line systems have 720 lines of active video plus 30 lines of VANC
- HANC size depends on frame rate per format
 - 536 words @ 1080i59.94 (~12% of line)
 - 1376 words @ 720p50 (~35% of line)
 - etc.

Ancillary Data Format

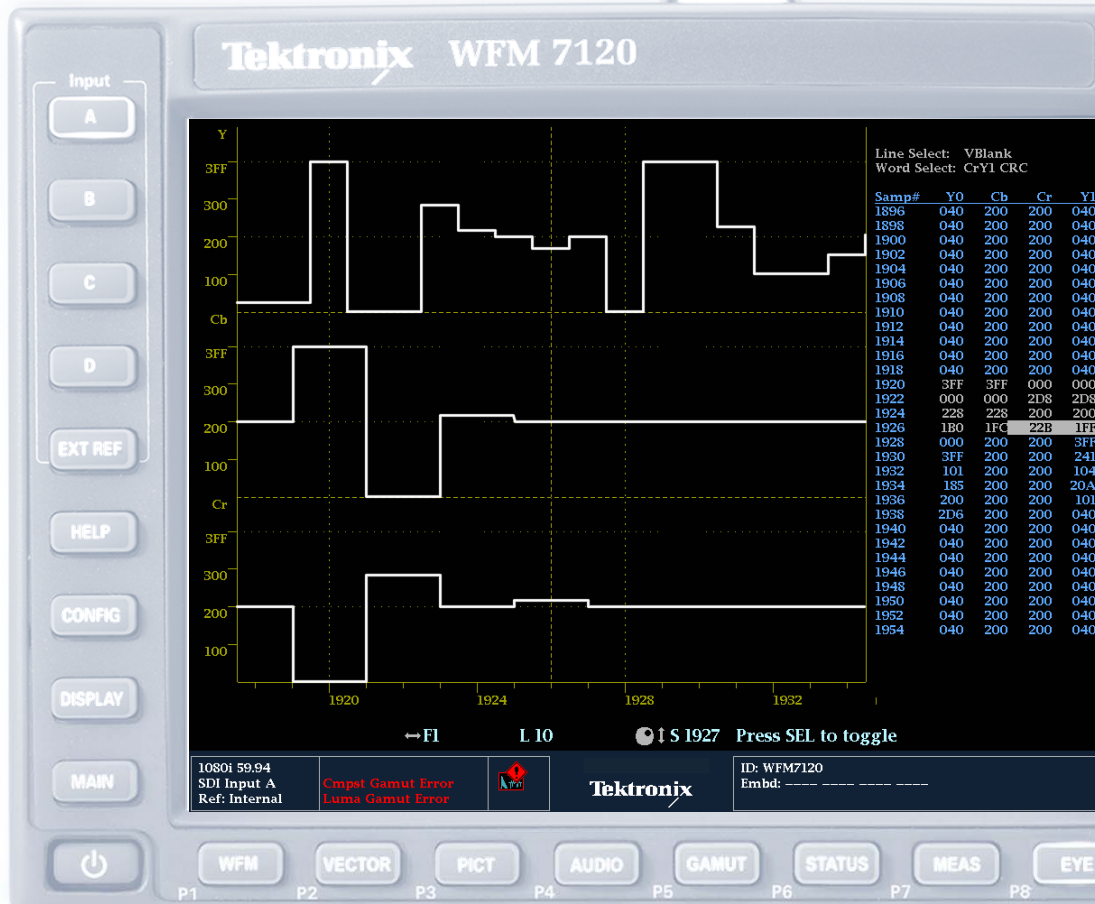


- ADF – Ancillary Data Flag $000_h, 3FF_h, 3FF_h$
- DID – Data Identification Word
- DBN – Data Block Number - for Type 1
- SDID – Secondary Data Identification - for Type 2
- DC – Data Count
- User Data Words up to a maximum of 255 words
- CS – Checksum

Ancillary header flag with examples



Ancillary Data Format - DataList



Line Select: VBlank
Word Select: CrY1 CRC

Samp#	Y0	Cb	Cr	Y1
1896	040	200	200	040
1898	040	200	200	040
1900	040	200	200	040
1902	040	200	200	040
1904	040	200	200	040
1906	040	200	200	040
1908	040	200	200	040
1910	040	200	200	040
1912	040	200	200	040
1914	040	200	200	040
1916	040	200	200	040
1918	040	200	200	040
1920	3FF	3FF	000	000
1922	000	000	2D8	2D8
1924	228	228	200	200
1926	1B0	1FC	22B	1FF
1928	000	200	200	3FF
1930	3FF	200	200	241
1932	101	200	200	104
1934	185	200	200	20A
1936	200	200	200	101
1938	2D6	200	200	040
1940	040	200	200	040
1942	040	200	200	040
1944	040	200	200	040
1946	040	200	200	040
1948	040	200	200	040
1950	040	200	200	040
1952	040	200	200	040
1954	040	200	200	040

SMPTE RP 291 Examples

- Defines a variety of standard DID and SDID used in Standards Today

Standard	Description	DID	DBN / SDID	DC
SMPTE 291M	Undefined Data	00 _h (200 _h)	xxx / 00 _h (200 _h)	
SMPTE 291M	8 Bit Application	04 _h (104 _h)	10 _h (110 _h)	xxx
SMPTE 291M	Packet Marked for Deletion	80 _h (180 _h)	xxx / 00 _h (200 _h)	xxx
SMPTE 291M	Start packet	88 _h (288 _h)	xxx / 00 _h (200 _h)	
SMPTE 291M	End Packet	84 _h (284 _h)	00 _h (200 _h)	00 _h (200 _h)
SMPTE 291M	User Defined	C0 _h (2C0 _h)	xxx	xxx
SMPTE 291M	Metadata Packet	F0 _h (2F0 _h)	xxx	xxx
SMPTE 291M	LTC Timecode	F5 _h (2F5 _h)	00 _h (200 _h)	08 _h (108 _h)
SMPTE 352M	Payload Identification	41 _h (141 _h)	01 _h (101 _h)	04 _h (x04 _h)
RP188 VANC	Timecode (ATC)	60 _h (260 _h)	60 _h (260 _h)	10 _h (110 _h)
RP196 HANC	Timecode (LTC)	64 _h (164 _h)	64 _h (164 _h)	8 _h (108 _h)
RP196 HANC	Timecode (VITC)	64 _h (164 _h)	7F _h (17F _h)	9 _h (209 _h)
RP165	EDH (Error Detection Handling)	F4 _h (1F4 _h)	00 _h (200 _h)	10 _h (110 _h)

Ancillary Data Inspector



- Watch List
 - Easily identifies all ANC Data present within the signal
- Provides Error Checking
- Press MAG
 - Displays ANC data packet information
- Supports All ANC Data types

Ancillary Data Inspector - Capture



- CaptureVu
 - Captures 1 Frame of Data
- Allows review of each ANC Data Packet for all present ANC Data



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FCC Requirements



ANC Data



Closed Captioning



Closed Caption Troubleshooting



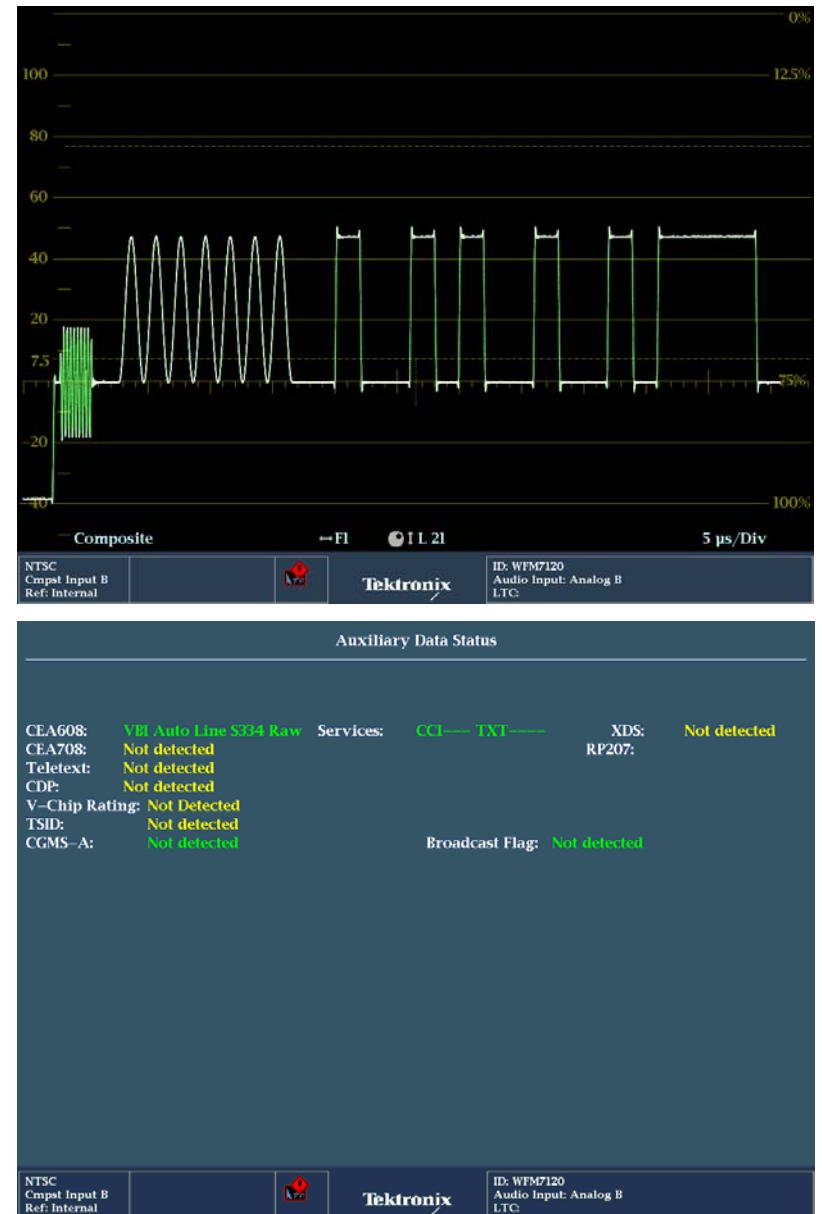
Closed Caption Standards

- Closed Caption is defined by the following standards
 - CEA 608 for standard definition analog NTSC
 - CEA 708 for Digital Television (DTV)
 - SMPTE 334-1
 - Vertical Ancillary Data Mapping of Caption Data and Other Related Data
 - SMPTE 334-2
 - Caption Distribution Packet (CDP) Definition
 - SMPTE EG 43
 - System Implementation of CEA 708 and CEA 608 Closed Captioning

- Standard available from www.ce.org and www.smpte.org

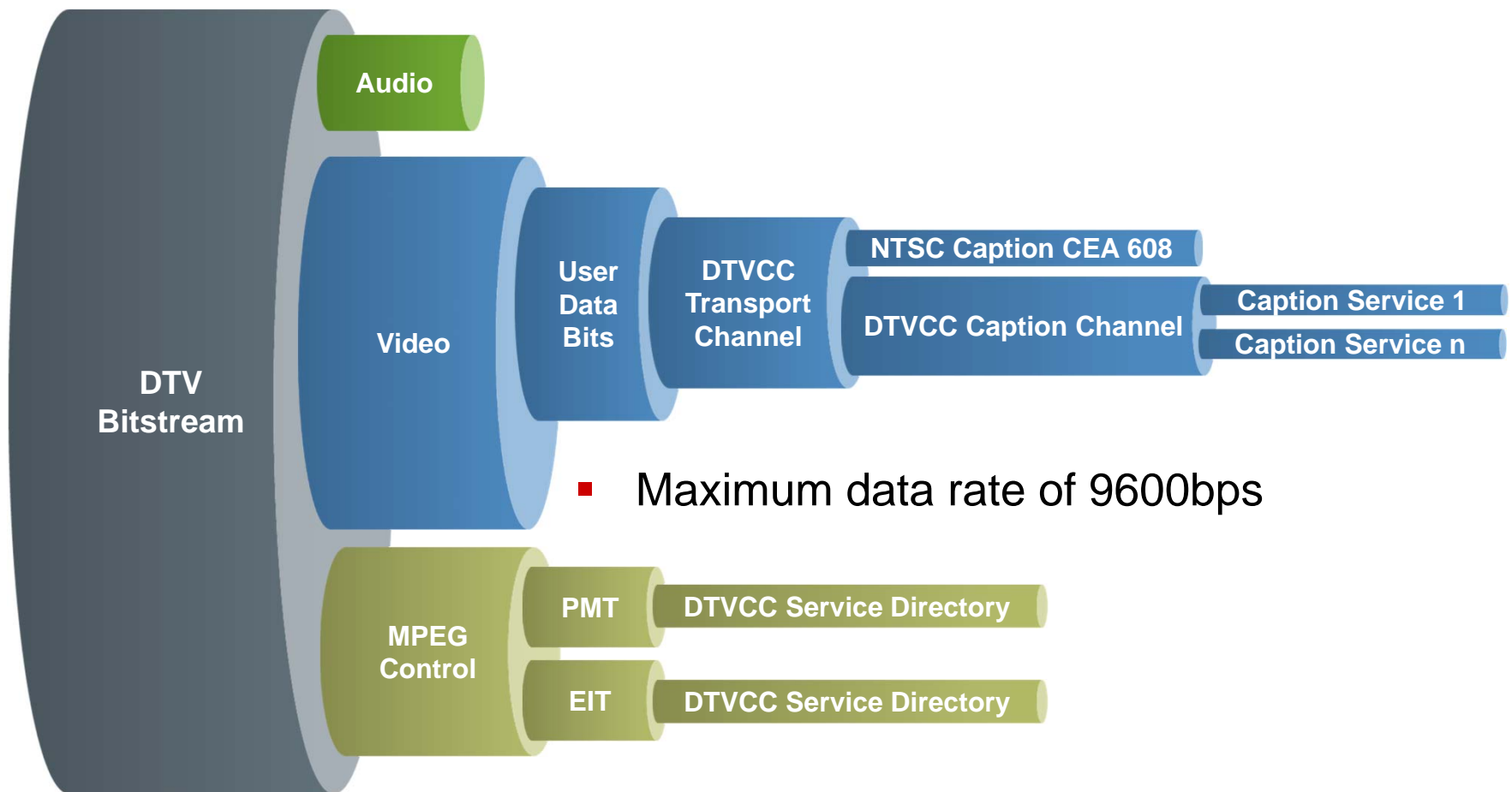
Analog NTSC Closed Caption

- CEA 608 defines analog Closed Captioning
- Data added to Line 21 of Field 1 and Field 2
- Signal contains clock and two data bytes
- Data rate of 120 Bytes per second or 960 bits per second
- CEA 608 can carry services CC1-4 and TXT 1-4
- In SD-SDI analog signal can be digitized as part of the active video or carried as ANC Data Packet.



Digital Television Closed Caption

- CEA 708 defines Digital Television Closed Captions
- Supports backward compatibility with CEA 608



- Maximum data rate of 9600bps

Closed Caption ANC Data

- CEA 608 ANC Data

- DID 161h (0x61h)
- SDID 102h (0x02h)
- Active line portion of VANC at least 2 lines after switching point

- Relatively Simple contains a Line and the 2 bytes of data per field

- CEA 708 ANC Data

- DID 161h (0x61h)
- SDID 101h (0x01h)
- Active line portion of VANC at least 2 lines after switching point
Line 9 of Field 1 or 2.

- Multiple types of data can be present within data stream

Name	DID/SDID	Presence	Status	Location
S272M Ctrl Grp 1	EF/-	Present	OK	Field 2 / Line 12
S272M Aud Grp 1	FF/-	Present	OK	Field 2 / Line 44
S334-1 CEA608	61/02	Present	OK	Field 2 / Line 12

Detail View Mode: Watch List Time Elapsed Since Last Reset: 0 d, 00:08:57

Format: SMPTE 334M / CEA608
 DID: 61 (161) Type: 2 Field: 2 Line: 12 Sample: --
 SDID: 2 (102) DC: 3 (203) Link: -- Stream: Y
 Exp/Act Chksum: 275 / 275 Error: OK

```
000 | 20f 200 200
016 |
032 |
```

Name	DID/SDID	Presence	Status	Location
S299M Ctrl Grp 2	E2/-	Present	OK	Field 2 / Line 8
S299M Ctrl Grp 1	E3/-	Present	OK	Field 2 / Line 8
S299M Aud Grp 2	E6/-	Present	OK	Field 2 / Line 73
S299M Aud Grp 1	E7/-	Present	OK	Field 2 / Line 73
S334-1 CDP(708)	61/01	Present	OK	Field 1 / Line 9
S334-1 CEA608	61/02	Present	--	--

Detail View Mode: Watch List Time Elapsed Since Last Reset: 1 d, 01:07:34

Format: SMPTE 334M CDP (708B)
 DID: 61 (161) Type: 2 Field: 1 Line: 9 Sample: --
 SDID: 1 (101) DC: 73 (149) Link: -- Stream: Y
 Exp/Act Chksum: 2ab / 2ab Error: OK

```
000 | 296 269 149 14f 143 20c 2dd 272 1f4 2fc 180 180 1fd 180 180 2fa
016 | 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200
032 | 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200
048 | 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa
064 | 200 200 2fa 200 200 274 20c 2dd 2ed
080 |
096 |
112 |
```

Closed Caption Data Stream

- SMPTE 334 CDP 708 stream can contain the following data types

- CDP Header
 - (required) 0x9669 (296h, 269h)
- Timecode
 - (optional) 0x71 (271h)
- CDP CC Service Information
 - (optional) 0x73 (173h)
- CDP Footer Section
 - (required) 0x74 (274h)
- CDP CC Data Section
 - (optional) 0x72 (272h)
 - Closed Caption data types
 - CEA 608 field 1 0xFC (2FCh)
 - CEA 608 field 2 0xFD (1FDh)
 - CEA 708 DTVCC Packet Data 0xFE (1FEh) CC 1 Valid
 - CEA 708 DTVCC Packet Start 0xFF (2FFh) CC 1 Valid
 - CEA 708 DTVCC Packet Data 0xFA (2FAh) Invalid 0

The screenshot shows the 'ANC Data Inspector' interface. At the top, there is a table with columns: Name, DID/SDID, Presence, Status, and Location. The table lists several CDP entries, with 'S334-1 CDP(708)' highlighted in blue. Below the table, there is a 'Detail' section showing 'View Mode: Watch List' and 'Time Elapsed Since Last Reset: 1 d, 01:07:34'. The detail section displays the following information: Format: SMPTE 334M CDP (708B), DID: 61 (161), Type: 2, Field: 1, Line: 9, Presence: Present, SDID: 1 (101), DC: 73 (149), Link: --, Stream: Y, Sample: --, Exp/Act Chksum: 2ab / 2ab, Error: OK. Below the detail section is a hex dump showing data values in hexadecimal and decimal format, such as '000 | 296 269 149 14f 143 20c 2dd 272 1f4 2fc 180 180 1fd 180 180 2fa'.

Name	DID/SDID	Presence	Status	Location
S299M Ctrl Grp 2	E2/--	Present	OK	Field 2 / Line 8
S299M Ctrl Grp 1	E3/--	Present	OK	Field 2 / Line 8
S299M Aud Grp 2	E6/--	Present	OK	Field 2 / Line 73
S299M Aud Grp 1	E7/--	Present	OK	Field 2 / Line 73
S334-1 CDP(708)	61/01	Present	OK	Field 1 / Line 9
S334-1 CEA608	61/02	Present	--	--

Detail View Mode: Watch List Time Elapsed Since Last Reset: 1 d, 01:07:34

Format: SMPTE 334M CDP (708B) Presence: Present
 DID: 61 (161) Type: 2 Field: 1 Line: 9 Sample: --
 SDID: 1 (101) DC: 73 (149) Link: -- Stream: Y
 Exp/Act Chksum: 2ab / 2ab Error: OK

```

000 | 296 269 149 14f 143 20c 2dd 272 1f4 2fc 180 180 1fd 180 180 2fa
016 | 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200
032 | 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200
048 | 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa
064 | 200 200 2fa 200 200 274 20c 2dd 2ed
080 |
096 |
112 |
    
```

1080i 59.94 SDI Input A Ref: Internal Tektronix ID: WFM7120 Audio Input: Analog B Anc LTC:



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FCC Requirements



ANC Data



Closed Captioning



Closed Caption Troubleshooting

Closed Caption Problems

- Picture Display not decoding Closed Captions
 - Verify that CC is enabled and the correct service is selected



Closed Caption Problems

- Picture Display not decoding Closed Captions
 - Verify that CC is enabled and the correct service is selected
 - Check Aux Data Status for presence of Closed Captions
 - Verify that there is not more than one caption being inserted
 - Verify the order of the Caption inserter in the food chain
- Does the frame rate of closed caption match video frame rate
 - Mismatches in frame rate can cause encoder problems
- May need to delve into the ANC data packet or MPEG



Auxiliary Data Status			
Anc Data:	Y and C Present		
CEA608:	S334 CDP (ANC)	Services: CCI-3- TXT----	XDS: Present
CEA708:	S334 CDP (ANC)	Services: CCI-----	RP207:
Teletext:	None		
CDP:	Present	Frm Rate: 59.94	Data Count 608: 2 708: 6
V-Chip Rating:	(US TV) TV-G		
TSID:	Absent	CGMS-A: Missing	Broadcast Flag: Missing
SMPTE 2016 AFD:	16:9.8 - Code is 1000 - AR is 16:9		
Desc:	Full Frame 16:9		
Bar 1:	No valid Bar data found		
Bar 2:	No valid Bar data found		

Closed Caption Problems

- Picture Display not decoding Closed Captions
 - Check Aux Data Status for presence of Closed Captions

```
Auxiliary Data Status
-----
Anc Data:      Y and C Present
CEA608: S334 CDP (ANC)  Services: CCI-3- TXT----- XDS: Present
CEA708: S334 CDP (ANC)  Services: CCI-----      RP207:
T-Test: None
CDP: Present  Frm Rate: 59.94  Data Count 608: 2  708: 6
V-Chip Rating: (US TV) TV-G
TSID: Absent  CGMS-A: Missing      Broadcast Flag: Missing
SMPTE 2016 AFD: 16:9_8 - Code is 1000 - AR is 16:9
Desc: Full Frame 16:9
Bar 1: No valid Bar data found
Bar 2: No valid Bar data found
```

- Aux Data Status

Closed Caption Problems

- Picture Display not decoding Closed Captions
 - Verify that there is not more than one caption being inserted

The screenshot shows the ANC Data Inspector interface. At the top, there is a table with columns: Name, DID/SDID, Presence, Status, and Location. The table lists several entries, with 'S334-1 CDP(708)' selected. A red arrow points to this entry. Below the table, there is a 'Detail' section for the selected entry, showing format (SMPTE 334M CDP (708B)), DID (61 (161)), Type (2), Field (1), Line (9), Sample (--), SDID (1 (101)), DC (73 (149)), Link (--), Stream (Y), Exp/Act Chksum (2ab / 2ab), and Error (OK). Below the detail section is a hex dump of the data. At the bottom of the interface, there is a status bar with information like '1080i 59.94', 'SDI Input A', 'Ref: Internal', 'Tektronix', 'ID: WFM7120', 'Audio Input: Analog B', and 'Anc LTC:'.

Name	DID/SDID	Presence	Status	Location
S299M Ctrl Grp 2	E2/--	Present	OK	Field 2 / Line 8
S299M Ctrl Grp 1	E3/--	Present	OK	Field 2 / Line 8
S299M Aud Grp 2	E6/--	Present	OK	Field 2 / Line 73
S299M Aud Grp 1	E7/--	Present	OK	Field 2 / Line 73
S334-1 CDP(708)	61/01	Present	OK	Field 1 / Line 9
S334-1 CEA608	61/02	Present	--	--

Detail View Mode: Watch List Time Elapsed Since Last Reset: 1 d, 01:07:34

Format: SMPTE 334M CDP (708B) Presence: Present
DID: 61 (161) Type: 2 Field: 1 Line: 9 Sample: --
SDID: 1 (101) DC: 73 (149) Link: -- Stream: Y
Exp/Act Chksum: 2ab / 2ab Error: OK

```
000 | 296 269 149 14f 143 20c 2dd 272 1f4 2fc 180 180 1fd 180 180 2fa
016 | 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200
032 | 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200
048 | 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa 200 200 2fa
064 | 200 200 2fa 200 200 274 20c 2dd 2ed
080 |
096 |
112 |
```

1080i 59.94
SDI Input A
Ref: Internal

Tektronix

ID: WFM7120
Audio Input: Analog B
Anc LTC:

- ANC Data Inspector

Closed Caption Problems

- Does the frame rate of closed caption match video frame rate
 - Mismatches in frame rate can cause encoder problems
 - 720p** must be **59.94** and **2**
 - 1080i** must be **29.97** and **4**

Auxiliary Data Status

```

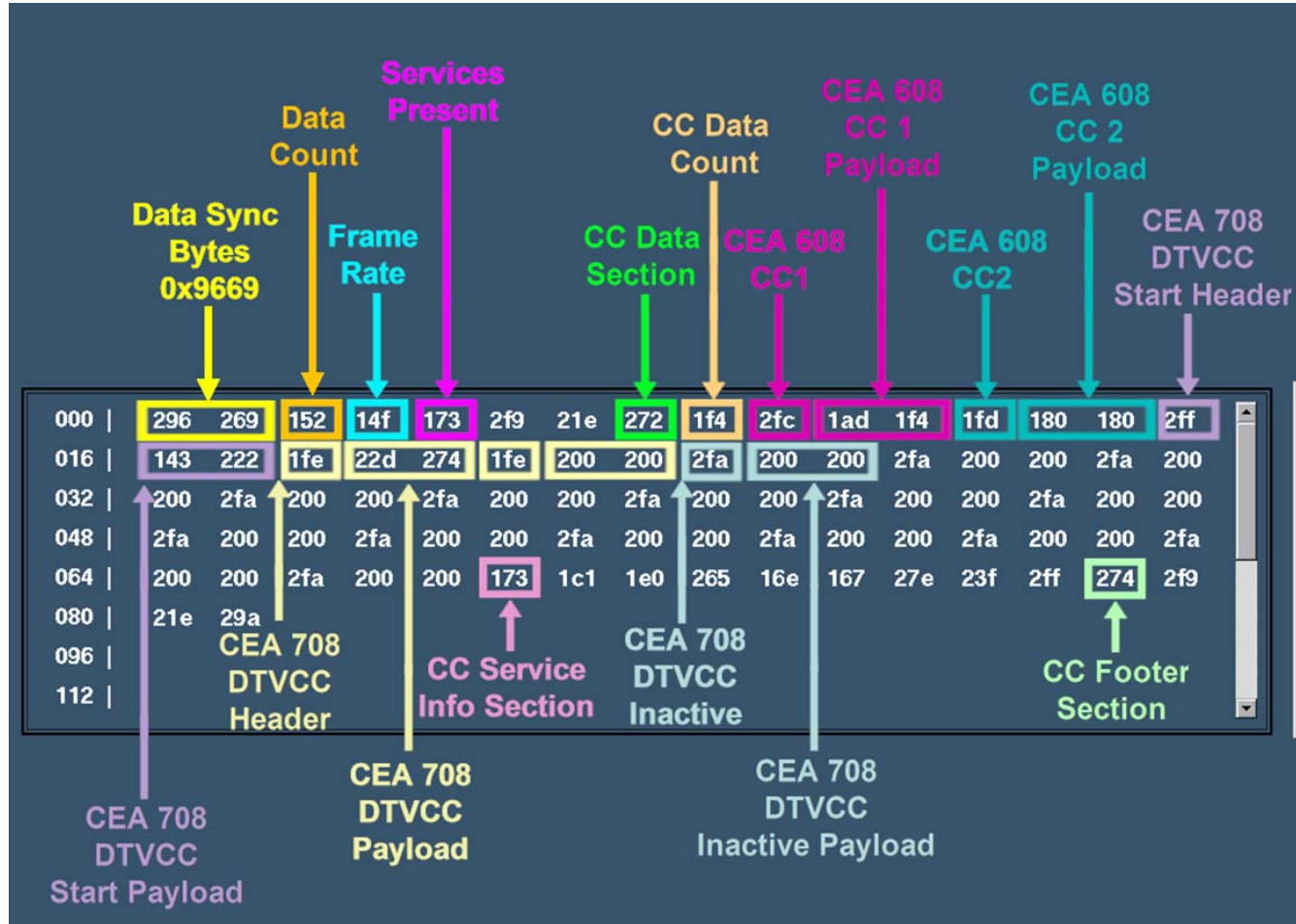
Anc Data:      Y and C Present
CEA608:      S334 CDP (ANC)      Services: CCI—TXT—      XDS: Present
CEA708:      S334 CDP (ANC)      Services: CCI—      RP207:
Teletext:    Not detected
CDP:         Present      Frm Rate: 29.97      Data Count 608: 4      708: 0
V-Chip Rating: (US TV) TV-PG
TSID:        Not detected
CGMS-A:      Not detected      Broadcast Flag: Not detected
TC Flags:    DE:1 CF:0 DBB: 0000 BG Flags: 0 Unspecified/Unspecified BG Data: 00000000
SMPTE 2016 AFD: 16:9_15 - Code is 1111 - AR is 16:9
  Desc:      Full Frame 16:9 (all 4:3 center) in 16:9 frame
  Bar 1:     No valid bar data found
  Bar 2:     No valid bar data found
    
```

Rate	608	708-Max
23.98	4/6	46/44
24	4/6	46/44
25	4	44
<u>29.97</u>	<u>4</u>	36
30	4	36
50	2	22
<u>59.94</u>	<u>2</u>	18
60	2	18

Aux Data Status

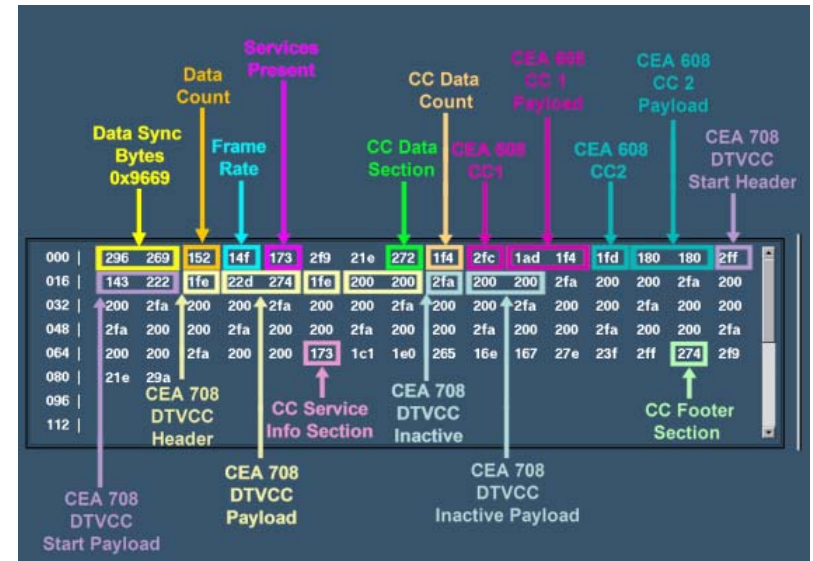
Closed Caption Problems

- May need to delve into the ANC data packet or MPEG



Interpreting Closed Caption Data Stream

- Data Sync 296 269 (0x9669h)
- CC Data Section 272 (0x72h)
- CEA 608 CC1 2FC (0FCh)
- CEA 608 CC2 1FD (0xFDh)
- CEA 708 DTVCC Start Header 2FF (0xFFh)
- CEA 708 DTVCC Header 1FE (0xFEh)
- CEA 708 DTVCC Inactive 2FA (0xFAh)
- Services Information Section 173 (0x73h)
- CC Footer Section 274 (0x74h)
- Timecode 171 (0x71h)



Tools to use for Troubleshooting Closed Caption



- In-Picture closed caption decode
 - Check V-Chip rating
- Aux Data Status
 - Shows presence
 - Shows Number of services
- ANC Data Inspector
 - Shows presence of ANC data packets

ANC Data Inspector and Closed Caption Data



- Select one of the tiles and press MEASURE button
- Push and Hold MEASURE button to access menu
- Navigate to Display Type and select ANC Data Display
- Press Full to display ANC Data Display
- Navigate to Closed Caption data and press MAG

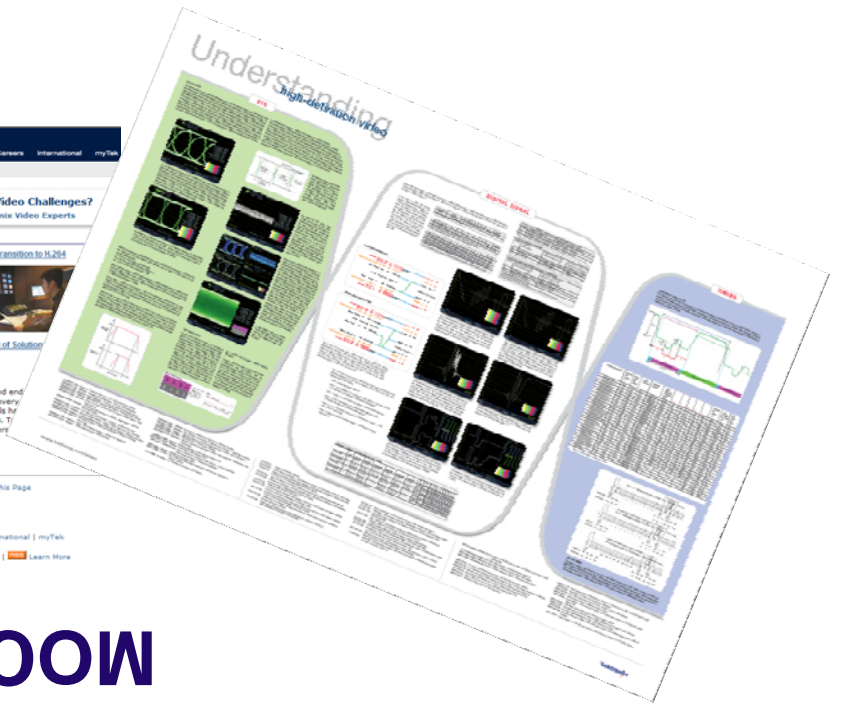


What about MPEG TS Captioning?

- Many manufactures indicate presence
- New tools becoming available
- MTS4EA V7.1 Elementary Stream Analyzer
- For when you need to know what went wrong
- And send it to your CC vendor
- Nothing beats facts



More Information



WWW.TEKTRONIX.COM