Agenda

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

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

- (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
- Programming 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

- **HANC**
- **VANC**

**F** = 0 for Progressive System

**F** = 0 for Field One Interlaced

**F** = 1 for Field Two Interlaced

- **Active Picture**

**Total Number of Lines Per Frame**

1. **V = 1**
2. **V = 0**

1. **H = 1**
2. **H = 0**

- **EAV**
- **SAV**
How big are the VANC and HANC spaces?

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

<table>
<thead>
<tr>
<th>Bits/word</th>
<th>10</th>
<th>10</th>
<th>10</th>
<th>10</th>
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<tr>
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<td>× Samples/line</td>
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<td>2640</td>
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<td>× Frames/sec</td>
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<td>= Bits/sec</td>
<td>1.485×10⁹</td>
<td>1.485×10⁹</td>
<td>1.485×10⁹</td>
<td>1.485×10⁹</td>
<td>1.485×10⁹</td>
</tr>
</tbody>
</table>

- 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 000h,3FFh,3FFh
- DID – Data Identification Word
- DBN – Data Block Number - for Type I
- 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

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<thead>
<tr>
<th>Samp#</th>
<th>Y0</th>
<th>Cb</th>
<th>Cr</th>
<th>Y1</th>
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<td>040</td>
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```
### SMPTE RP 291 Examples

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

<table>
<thead>
<tr>
<th>Standard</th>
<th>Description</th>
<th>DID</th>
<th>DBN / SDID</th>
<th>DC</th>
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</thead>
<tbody>
<tr>
<td>SMPTE 291M</td>
<td>Undefined Data</td>
<td>00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>xxx / 00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td></td>
</tr>
<tr>
<td>SMPTE 291M</td>
<td>8 Bit Application</td>
<td>04&lt;sub&gt;h&lt;/sub&gt; (104&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>10&lt;sub&gt;h&lt;/sub&gt; (110&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>xxx</td>
</tr>
<tr>
<td>SMPTE 291M</td>
<td>Packet Marked for Deletion</td>
<td>80&lt;sub&gt;h&lt;/sub&gt; (180&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>xxx / 00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>xxx</td>
</tr>
<tr>
<td>SMPTE 291M</td>
<td>Start packet</td>
<td>88&lt;sub&gt;h&lt;/sub&gt; (288&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>xxx / 00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td></td>
</tr>
<tr>
<td>SMPTE 291M</td>
<td>End Packet</td>
<td>84&lt;sub&gt;h&lt;/sub&gt; (284&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
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<td>SMPTE 291M</td>
<td>User Defined</td>
<td>C0&lt;sub&gt;h&lt;/sub&gt; (2C0&lt;sub&gt;h&lt;/sub&gt;)</td>
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<td>SMPTE 291M</td>
<td>Metadata Packet</td>
<td>F0&lt;sub&gt;h&lt;/sub&gt; (2F0&lt;sub&gt;h&lt;/sub&gt;)</td>
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<td>SMPTE 291M</td>
<td>LTC Timecode</td>
<td>F5&lt;sub&gt;h&lt;/sub&gt; (2F5&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>08&lt;sub&gt;h&lt;/sub&gt; (108&lt;sub&gt;h&lt;/sub&gt;)</td>
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<tr>
<td>SMPTE 352M</td>
<td>Payload Identification</td>
<td>41&lt;sub&gt;h&lt;/sub&gt; (141&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>01&lt;sub&gt;h&lt;/sub&gt; (101&lt;sub&gt;h&lt;/sub&gt;)</td>
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<td>RP188 VANC</td>
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<td>10&lt;sub&gt;h&lt;/sub&gt; (110&lt;sub&gt;h&lt;/sub&gt;)</td>
</tr>
<tr>
<td>RP196 HANC</td>
<td>Timecode (LTC)</td>
<td>64&lt;sub&gt;h&lt;/sub&gt; (164&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>64&lt;sub&gt;h&lt;/sub&gt; (164&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>8&lt;sub&gt;h&lt;/sub&gt; (108&lt;sub&gt;h&lt;/sub&gt;)</td>
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<tr>
<td>RP196 HANC</td>
<td>Timecode (VITC)</td>
<td>64&lt;sub&gt;h&lt;/sub&gt; (164&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>7F&lt;sub&gt;h&lt;/sub&gt; (17F&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>9&lt;sub&gt;h&lt;/sub&gt; (209&lt;sub&gt;h&lt;/sub&gt;)</td>
</tr>
<tr>
<td>RP165</td>
<td>EDH (Error Detection Handling)</td>
<td>F4&lt;sub&gt;h&lt;/sub&gt; (1F4&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>00&lt;sub&gt;h&lt;/sub&gt; (200&lt;sub&gt;h&lt;/sub&gt;)</td>
<td>10&lt;sub&gt;h&lt;/sub&gt; (110&lt;sub&gt;h&lt;/sub&gt;)</td>
</tr>
</tbody>
</table>
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 - CaptureVu

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

1. FCC Requirements
2. ANC Data
3. Closed Captioning
4. 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](http://www.ce.org) and [www.smpte.org](http://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 ID 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**
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
Agenda

- 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

![Image of closed caption settings on a video screen]
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

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<tr>
<th>Auxiliary Data Status</th>
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<tr>
<td>Decc:</td>
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<tr>
<td>Bar 1:</td>
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<td>Bar 2:</td>
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Closed Caption Problems

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

**Aux Data Status**

<table>
<thead>
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<th>Y and C Present</th>
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<tr>
<td>CEA608: S334 CDP (ANC)</td>
<td>Services: CCI-3 - TXT ---- XDS: Present</td>
</tr>
<tr>
<td>CEA708: S334 CDP (ANC)</td>
<td>Services: CCI----- RP207:</td>
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</tbody>
</table>

- 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 3 – 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
  - Verify that there is not more than one caption being inserted

**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
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