

DELIVERING CAPTIONS IN DTV

An NCAM DTV Access Brief

October 2002

NOTICE: The following information is offered by NCAM solely as a general overview of the current status of closed captioning support in digital television. Features and capabilities of related systems and equipment vary widely. Please consult your vendors to confirm specific product details for your installation.

There are two major issues engineers and managers need to be aware of concerning delivery of caption data in DTV broadcasts:

- 1.) You Need To Provide Both EIA-608 (NTSC) and EIA-708B (DTVCC) Caption Data.
- 2.) You Need To Provide A "Caption Service Descriptor" in PSIP (PMT/EIT).

The Short Story - What You Need To Do

As of July 1, 2002, DTV programming must meet FCC rules for closed captioning and must include DTVCC caption data. To ensure continued support for existing NTSC consumer devices, DTV programming must also include NTSC caption data to be counted toward current captioned programming obligations.

DTV receivers on the market prior to July 1, 2002 very likely do not have a 708 (DTVCC) caption decoder, since there were no FCC rules in effect at that time. These devices may be decoding 608 (Line 21) caption data, if it is present in your signal.

Current FCC rules require all DTV receivers manufactured as of July 1, 2002 to include a 708 caption decoder. These allow the viewer to control the caption display by selecting key 708 features such as different fonts, character sizes and colors.

The new DTV caption decoders are expecting to see 708 (DTVCC) captions data in all of your DTV broadcasts, both SD and HD. It's likely they will ignore any 608 data in a DTV signal.

If you do not provide DTVCC caption data in your DTV broadcasts, you will not be providing captions to these devices.

Since 1998, technical solutions have existed to support DTV captioning at the local station by preserving caption services from existing captioned NTSC sources (your analog air, or tape library), and "data-bridging" from locked NTSC and HD sources.

Caption data server products from EEG, Evertz, Norpak, Ultech and others take existing Line 21 caption data and "translate" or "upconvert" them on the fly to provide both the 608 and 708 data you need. Clearly there are timing and latency issues here, and these caption encoders typically provide offset capability.

You should make sure that your current MPEG encoders (BOTH SD and HD) can accept 608/708 data and have the proper interface compatible with currently available caption servers.

If your MPEG encoder provides Line 21 data extraction as an on-board feature, you need to be sure it encodes the caption data in an ATSC compliant manner, and that it provides translation to 708 as well. Recent conversations with key manufacturers indicate this feature may now be coming to market, for both SD and HD product, likely as a software upgrade.

New DTV receivers are also expecting to see more PSIP data, including the "caption_service descriptors", in your signal.

Without a proper descriptor that identifies all available 708 caption services, the receiver's user interface may display "This feature currently not available" and ignore the captions even if there is 708 data present.

You should make sure your PSIP generation equipment can provide the caption_service

descriptors according to ATSC A/65A. We recommend you place these in the PMT as well as the EIT, to accommodate the different requirements for the terrestrial and cable virtual channel tables (TVCT/CVCT).

The Background Details

The proper method of providing captions for ANY ATSC signal (SD or HD) is described in CEA/EIA-708-B and governed by 47 CFR 15.122.

In a compliant ATSC DTV transport, the DTV Closed Caption Transport Channel is a dedicated 9600bps (9.6k) in the user_data of a video elementary stream (per EIA-708-B and ATSC A/53B). This means that each program within a transport stream is allocated 9600bps.

It includes separate channels for NTSC (608) and DTVC (708) caption data.

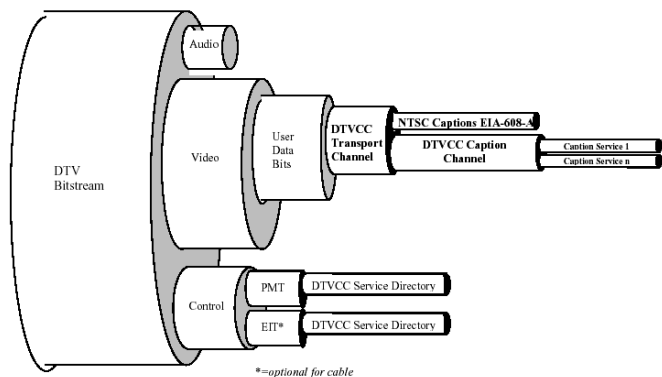


Figure 2, EIA/CEA-708B

NTSC Caption Data Channel

The purpose of the NTSC caption data channel is to provide a simple method to "tunnel" the much lower data rate Line-21 caption data (also referred to as "608 compatibility bytes") from existing NTSC sources to existing NTSC display devices and peripherals.

It is clearly described in EIA/CEA-708B, Sec. 4.3:

"The consideration for NTSC captioning (EIA-608-A) exists to facilitate the transcoding of the DTV video to NTSC video, and to preserve all line 21 data during the transcode process."

An additional CEA Engineering Bulletin (CEB-8) provides guidance on the use of Line 21 data within a DTV construct.

DTVC Caption Data Channel

The purpose of the DTVC (708) caption data channel is to provide a much higher data rate to the closed caption decoder in a DTV receiving device.

This enables the extended feature sets, services and viewer control over the display described in EIA-708-B, and defined and required by a related FCC Report and Order (FCC-00-259) adopted on July 21, 2000.

An additional CEA Engineering Bulletin (CEB-10) provides EIA-708-B implementation guidance for caption authors and decoder manufacturers.

Who Uses What?

As of July 1, 2002, the FCC requires all new DTV receiving devices to include a 708 caption decoder, defined by a Report and Order (FCC-00-259) adopted on July 21, 2000.

DTV receivers with caption decoders built to the new requirement very likely will look only for the DTVC (708) caption data in a DTV broadcast, and ignore 608 data completely.

The FCC Report & Order describes this in detail in Paragraph 52, "Dual Mode Receivers". Dual-mode receivers are "devices that receive and display both analog and digital programming", either integrated receiver/displays or set-top boxes with multiple tuners.

The Report states:

"When operating in the digital mode, these receivers must display captions formatted pursuant to the rules we are adopting here."

Those rules, "Closed Caption Decoder Requirements for Digital Television Receivers and Converter Boxes" [47CFR§15.122], cannot be satisfied by 608 compatibility bytes in the NTSC Caption Data Channel.

While the NTSC Caption Data Channel remains a significant part of caption delivery, particularly through the transition, by providing caption data to downstream NTSC devices, it does not meet the full requirements for DTV.

DTV closed caption decoders require the use of data formatted according to FCC Rules Part 15.122, and carried in the DTVC Caption Data Channel.

You should note that the FCC rules go beyond the minimum receiver requirements of EIA-708-B, Section 9 and supercede those specifications.

DTV Captioned Programming Requirements

Under the DTV Captioning Report and Order, as of July 1, 2002 all programming published, exhibited or formatted for display on digital television receivers must be captioned under the existing FCC requirements and schedules.

The Report and Order set July 1, 2002 as the "new programming" date for captioned digital television programs, following the requirement of the current FCC captioning rules [47CFR§79.1(a)(6)(ii)].

The current captioned programming requirements call for a minimum number of hours on a per-channel, per-calendar-quarter basis, on a progressive schedule culminating on January 1, 2006, when virtually all programming must be captioned. Certain exemptions do apply.

Current requirements (as of October 2002) amount to roughly 10 hours of captioned new programming per day, per channel.

"Pre-rule" programming - in the case of digital television, programming published, exhibited or formatted for display on digital television receivers prior to July 1, 2002 - follows a separate schedule with a 75% requirement by January 1, 2008. Existing "no-backsliding" rules also apply.

Importantly, the July 2000 Report and Order modified the Part 79.1(a)(4) (captioned programming) rules by striking the previous reference to the Part 15.119 (analog caption decoder) requirements.

Instead the rules now require programming to be captioned "in a format that can be recovered and displayed by decoders meeting the standards of Part 15 of this chapter".

By the current rules then, digital television programming must be delivered with captions that meet the Part 15.122 "Closed Caption Decoder Requirements for Digital Television Receivers and Converter Boxes" requirements.

Also importantly, the FCC stated in the DTV Captioning Report and Order, Paragraph 63:

"We clarify, therefore, that in order for programming distributors to count captioned digital television programming toward their closed captioning requirements in 47 C.F.R. Section 79.1,

they also must transmit captions that can be decoded by the decoder in that analog set".

So current rules require both 608 and 708 caption data be present in digital television broadcasts to meet the current captioned programming obligations.

How Do I Put The Captions In There?

Using existing captioned NTSC sources (tape libraries, analog or 601 plant routing, analog air signals, caption files), you can use a number of methods to extract Line 21 caption data and provide both the 608 and 708 data you need.

Currently, most MPEG encoders provide Line 21 extraction ability. However, this only solves part of the problem, and some early models may use proprietary systems that are not ATSC compliant.

Very few MPEG encoders will provide both Line 21 extraction/embedding and 708 translation as a built-in feature.

As of October 2002, some MPEG encoder manufacturers have indicated they will be providing this as a feature in future product, and this bears watching. Make sure to ask before you buy.

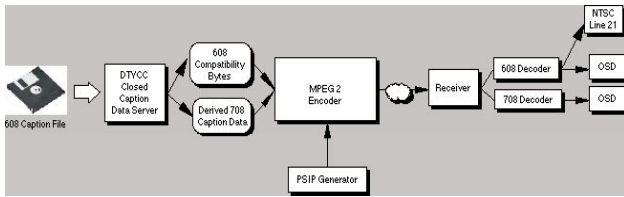
Helping Out The MPEG Encoder

In the meantime, you will probably have to use an external caption encoder. In all cases, make sure you're actually providing 608 and 708 data for both your SD and HD signals.

Caption encoding hardware from EEG, Evertz, Norpak, Ultech and other vendors can transcode and translate Line 21 data and hand it in the proper formats to an MPEG encoder for insertion into the NTSC and DTVC caption data channels. Typically this is done in real-time, through a serial connection to your MPEG encoder.

These encoders will take Line 21 caption bytes and embed them in the video elementary stream, following the EIA-708-B and ATSC standards and FCC rules, for use by downstream devices for re-insertion as Line 21 data on any NTSC out signal.

These DTV caption encoders can also process these bytes using 708 translation software and create EIA-708-B compliant data and services for the DTVC caption data channel. Make sure yours does this as well.



Using Line 21 Data to Provide 608/708 Captions

While these translated or "derived 708" captions maintain the basic look and feel of Line 21 captions when the receiving decoder is in a default setting, a viewer equipped with a 708 caption decoder will be able to over-ride these settings and change the font style, font size, color and background to any of the features required by the FCC rules.

This method can be used when upconverting an NTSC signal to HD, or when bridging caption data from an NTSC source with identical HD program material for encoding to an ATSC transport stream.

"Data bridging" must be done carefully to correct for latencies in related encoding or decoding cycles, and assumes that the program content and caption content of the two sources remain identical.

Putting It In The VANC

Recently, a method has been developed to encode caption and other data in native HD tape formats, and for distribution and switching through HD-SDI (292) plants.

Using the vertical ancillary (VANC) data space according to SMPTE-334M, product is now on the market to support this feature. Both Panasonic and Sony demonstrated HD-D5 and HDCam decks with VANC data record capability at NAB in April 2002.

Norpak, Evertz, and other manufacturers are now providing equipment to bridge caption data in and out of the VANC. These will extend the development of DTV captioning by providing Caption Distribution Packets (CDPs) as defined in EIA-708B, including NTSC caption data, DTVCC caption data and caption service information in a single wrapper.

At the end of the chain, one of these devices hands the data off to an MPEG encoder, as described above.

Getting It From The Network

Manufacturers of professional ATSC decoders and IRDs have also begun to support VANC and caption data to extend support throughout the distribution chain.

Caption data is processed from the source and re-inserted in the appropriate VANC or Line 21 form in each of the HD-SDI, SDI or NTSC component or composite outputs. Data support using AES-3 audio links has also been considered.

While these products are just coming to market, they will be critical to support caption and other data needs through the broadcast facility.

Storing It and Getting It Back

Server technology is another important step in the process, and caption data need to be preserved through ingest, storage and playout. Numerous vendors have solutions to preserve Line 21 caption data in separate file structures, and these need to be extended to preserve-708-B data as well.

Getting The Captions Made Today

For programmers and producers, these solutions provide opportunities to extend caption services to digital programming today.

Using existing caption authoring systems, caption services can be created for NTSC analog and both SD and HD digital broadcasts.

Typically, network DTV submission requirements will include a captioned NTSC master as well as an HD (or SD widescreen) master. A caption agency can use an NTSC letterboxed dub of the DTV master to create a standard caption file to be encoded through any of the methods described above.

Depending on the network requirement and the technology available, the caption file can be encoded onto tape or data-bridged at the network operations center or the local facility. The same caption file can be used for NTSC broadcasts and for both 608 and 708 data channels in DTV broadcasts.

If both the 608 and 708 caption data channels are used, all of the intended outcomes of the new standards and rules can be met.

The DTV broadcast will simultaneously support all legacy NTSC devices downstream, and will provide those viewers with advanced DTV caption decoders an enhanced experience and the ability to change the font style, font size, character and background color to their own preference.

How Does A DTV Receiver Find The Captions?

After going through all of this to put captions in your DTV air signal, you probably want to make sure the DTV receiver knows they're there.

The ATSC's Program and System Information Protocol (PSIP, ATSC A/65) provides program metadata to help a DTV receiver "name, number and navigate" the content of a DTV signal.

Early receivers didn't handle PSIP particularly well, if at all. So they typically didn't know about anything deeper than high-level (major/minor) channel information and a PID list from the service_location descriptor in the Virtual Channel Table.

New receivers are starting to get more PSIP aware, and are beginning to look deeper for PSIP data.

In fact, many new receivers will look for the "caption_service descriptor", a descriptor loop that identifies each of the caption services present in a video elementary stream.

The caption_service descriptor lists each instance of captions, and whether it is a Line 21 or DTVCC service, its language, and its format. It used by the receiver to "name, number and navigate" the caption services, and to present to the viewer the choice of services in a given program.

```
caption_service_descriptor
0 {
0   descriptor_tag = 134 (0x86)
0   descriptor_length = 26 bytes
0   number_of_services = 4
0
0   language_code = eng
0   cc_type = 0
0   line21_field = 0
0   easy_reader = 0 (not tailored to the needs of beginning readers)
0   wide_aspect_ratio = 0 (formatted for 4:3 aspect ratio)
0
0   language_code = spa
0   cc_type = 0
0   line21_field = 1
0   easy_reader = 0 (not tailored to the needs of beginning readers)
0   wide_aspect_ratio = 0 (formatted for 4:3 aspect ratio)
0
0   language_code = eng
0   cc_type = 1
0   caption_service_number = 1
0   easy_reader = 0 (not tailored to the needs of beginning readers)
0   wide_aspect_ratio = 0 (formatted for 4:3 aspect ratio)
0
0   language_code = spa
0   cc_type = 1
0   caption_service_number = 2
0   easy_reader = 0 (not tailored to the needs of beginning readers)
0   wide_aspect_ratio = 0 (formatted for 4:3 aspect ratio)
0
```

Sample Caption Service Descriptor Loop

In fact, some receivers will not go any further than the descriptor, and if it's not there, will ignore any caption data and give the viewer an on-screen prompt saying "This feature is not currently available".

So you should make sure you have a "caption_service descriptor" present for each program that has captions, or you run the risk of them never getting to the screen.

For a terrestrial broadcast signal, the caption_service descriptor must be located in the Event Information Table (EIT), and is optional in the Program Map Table (PMT).

As luck and politics would have it, the requirements for cable use of PSIP are exactly the opposite, mandatory in the PMT and optional in the EIT.

Table 6.16 List of Descriptors for PSIP Tables.

Descriptor Name	Descriptor tag	Terrestrial				Cable			
		PMT	MG1	VCT	EIT	PMT	MG1	VCT	EIT
stuffing descriptor	0x80	*	*	*	*	*	*	*	*
AC-3 audio descriptor	0x81	M			M	M			O
caption service descriptor	0x86	O			M	M			O
content advisory descriptor	0x87	O			M	M			O
extended channel name descriptor	0xA0			M				M	
service location descriptor	0xA1			S				M	
time-shifted service descriptor	0xA2			M				M	
component name descriptor	0xA3	M				M			
user private	0xC0-0xFF	*	*	*	*	*	*	*	*

ATSC A/65 PSIP Standard

So if you're thinking that your DTV signal may be received both over-the-air and through a cable plant, you should make sure you have appropriate caption_service descriptors in both the PMT and the EIT.

Check with your MPEG encoder/mux and PSIP manufacturers to make sure these functions are available in your system.

Developing Advanced Caption Authoring

DTV captioning technology is developing along with the DTV industry.

Now that DTV caption decoders are coming to market and caption services are starting to be provided on DTV programming, solutions will be developed to provide advanced authoring capabilities.

Using the full feature set of EIA-708-B, a program producer and a caption agency could develop a "caption style sheet" to create a distinctive look and feel of captions to match a program's production values.

Color and fonts could be used (judiciously) to highlight words or phrases for emphasis and educational uses.

Using the additional data capacity of the DTV Caption Data Channel, simultaneous multilingual caption or subtitle tracks - like those on a DVD - can be delivered more readily.

Efforts are underway at WGBH's Media Access Group, other caption agencies and within industry standards organizations to develop the tools to support these services in the professional broadcast environment.

Initial proposals include a universal file format for delivery of caption data to a caption encoder, to support multiple streams of caption data for multiple platforms.

This 'bit bucket' approach would allow a flexible and extensible approach to deliver 608, 708 and other caption data streams within a single wrapper.

It is expected that new caption authoring workstations will extend current capabilities and use computer-based, file transfer technologies and WYSIWYG user interfaces.

Using the "caption style sheet" approach, content can be captioned by capturing text and timecode, and applying the attributes needed to render 608, 708 or other caption streams.

Related Industry Efforts

CEA closed captioning activities are conducted within the R4.3 WG1.

ATSC closed captioning activities are conducted within the IS Closed Captioning Working Group.

References:

ATSC Standards

<<http://www.atsc.org/standards.html>>

EIA/CEA Standards

<<http://www.global.ihs.com/>>

SMPTE Standards

<http://www.smpste.org/smpste_store/standards/>

Caption Encoder Manufacturers:

EEG - <<http://www.eegent.com>>

Evertz - <<http://www.evertz.com>>

Norpak - <<http://www.norpak.ca>>

Ultech - <<http://www.ultechvideo.com>>

FCC Captioning Information

<<http://www.fcc.gov/cgb/dro/caption.html>>

DTV Access Project

<<http://www.dtvaccess.org>>

For More Information

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About NCAM

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