



A post production primer

Thanks to Dolby Digital (AC-3) audio coding, discrete multichannel digital audio is now available to consumers worldwide via broadcast formats that include digital TV, digital cable, and direct broadcast satellite. As a result, post production facilities serving the broadcast industry are being given the opportunity to deliver more and more programming with multichannel audio.

Dolby E at a Glance

- Simple, cost-effective conversion of two-channel broadcast facilities to multichannel audio
- Distribution of eight channels of high-quality audio and Dolby Digital metadata via AES-3 or digital VTR audio track pair
- Ten or more encode/decode cycles without degradation
- Audio frames match video frames for smooth editing
- Compatible with international video standards
- A variety of programs and mixes, including 5.1-channel audio, can be supplied on the same video tape

TV broadcast infrastructures, however, have been geared almost exclusively to two-channel audio, making the distribution of multichannel audio prior to final transmission daunting. To meet this challenge, Dolby Laboratories has developed a new professional audio coding system, Dolby E, that allows the distribution of multichannel digital audio within existing two-channel infrastructures (see Figure 1). With Dolby E, up to eight channels of broadcast-quality audio, plus metadata, can be distributed via a single AES-3 pair, and recorded on just two audio tracks of a digital video tape or video server.

As more and more broadcasters convert to multichannel audio using Dolby E, postproduction facilities will also be able to take advantage of Dolby E. Specifically, it will enable the delivery of a completed program on a single digital video tape carrying a variety of sound mixes, including discrete 5.1-channel audio destined for Dolby Digital transmission.

Advantages of Dolby E

Dolby E offers a cost-effective, practical solution to the multichannel distribution dilemma.

- By adding economical Dolby E codecs, most of the equipment, including VTRs, and two-channel digital audio signal paths in the

broadcast infrastructure can be converted to eight channels without the need for costly new multichannel equipment or rewiring.

- Dolby E coded audio is designed to withstand ten or more of the encode/decode generations typically required during the distribution phase of DTV programs, thanks to a sophisticated algorithm with a higher bit rate.
- The frame rate of Dolby E matches that of the video it accompanies, enabling insert or assemble edits on tape, and audio-follow-video cuts between programs, without pops or clicks (see Figure 2).
- Dolby Digital metadata is conveniently transported within the Dolby E bitstream (see sidebar on page 4).
- Nothing changes in the post-production process right up to recording the final video tape for delivery to the client.
- It takes exactly one video frame to encode and one frame to decode Dolby E audio, simplifying audio/video synchronization.

Without Dolby E, delivering a finished program with multichannel audio requires accompanying the video tape with a separate digital audio tape, or supplying the video tape with a

multichannel mix already coded to Dolby Digital on two of its audio tracks. The former approach is cumbersome, while the latter is impractical and not recommended, since Dolby Digital audio is intended for only one encode/decode cycle, and editing is difficult since its frame rate does not match that of the video.

Variety of mixes on the same tape

Dolby E works with most standard video frame rates, 30, 29.97, 25, 24 and 23.98 fps, at a 48 kHz sample rate. Any digital VTR that can record 20-bit or 16-bit audio words can accommodate Dolby E. Using Dolby E, 20-bit audio words support up to eight audio channels, while 16-bit words support up to six audio channels.

With four-track video tapes, program producers can provide a variety of mixes tailored for different audiences on the same tape. For example, both a 5.1-channel and a Dolby Surround Lt/Rt or alternate language mix of the program can be encoded with Dolby E and carried on one pair of tracks, while the second pair can carry a PCM Lt/Rt mix optimized for NTSC or PAL analog transmission. This allows program providers to use a single tape format to deliver programs for both multichannel audio DTV and two-channel analog TV broadcasts.

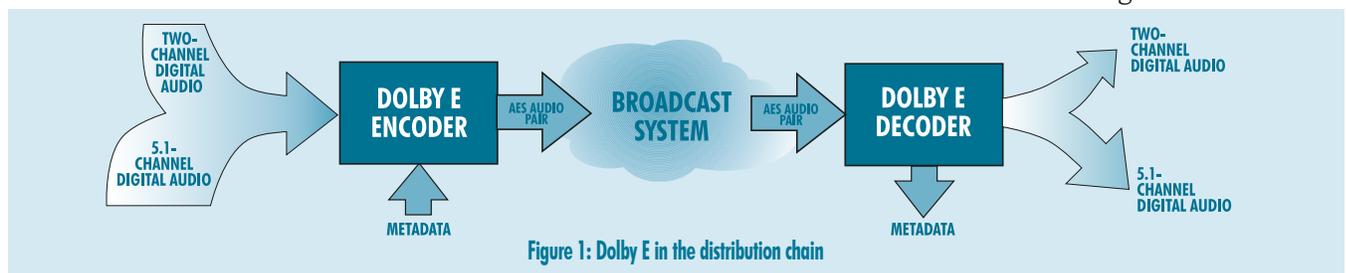


Figure 1: Dolby E in the distribution chain

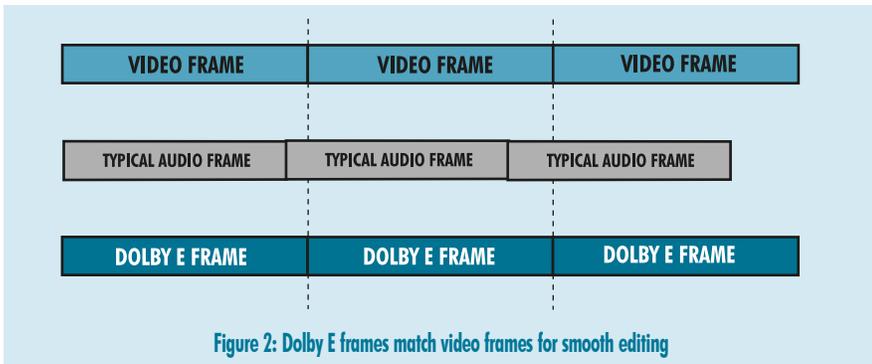


Figure 2: Dolby E frames match video frames for smooth editing

Keeping audio and video in sync

To prevent the accumulation of sync problems prior to final transmission, each time a digital program undergoes encoding and decoding, audio and video should be in sync before passing the program along to the next process. Therefore, it is necessary to compensate for a one-frame delay imparted by encoding PCM audio to Dolby E, and an additional one-frame delay imparted by the subsequent decoding.

SMPTE time code (including the drop-frame flag and user bits) is also multiplexed into the Dolby E data stream and recovered by the decoder. It timestamps the associated blocks of audio, further aiding the re-synchronization of audio and video.

High-definition VTRs such as Panasonic's HD D5 and Sony's HDCAM take one frame each to encode and decode the video.

To maintain audio (PCM) and video sync, they incorporate a one-frame audio delay on both recording and playback. With Dolby E audio, this delay needs to be bypassed, because of the one-frame delay inherent in Dolby E encoding and decoding. If audio and video are in sync prior to Dolby E encoding and recording onto tape, they will remain in sync both on the tape and after playback with Dolby E decoding.

Standard-definition VTRs do not delay the video, making it necessary to compensate for the delay imparted by Dolby E in one of two ways.

Adding a one-frame video delay whenever the audio signal is encoded or decoded is the ideal solution, ensuring sync both on tape and after playback.

A convenient alternative for presentation facilities is to advance the PCM audio by two frames prior to Dolby E

encoding and recording so that audio and video will be in sync after playback and decoding. This means that the encoded audio on the tape will be one frame ahead of the video, so edit points should be monitored and adjusted if necessary (see Figure 3).

Of course, the postproduction facility should supply the finished program conformed to the customer's preferred solution, and mark the tape accordingly.

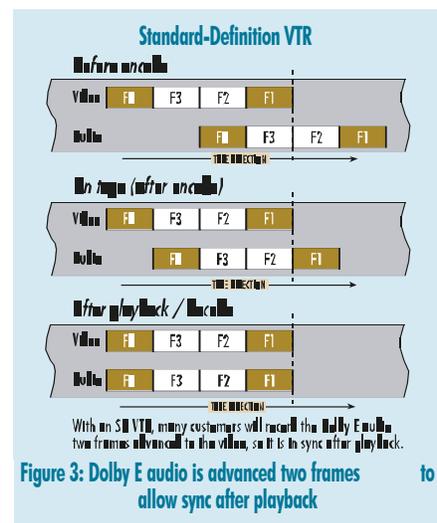


Figure 3: Dolby E audio is advanced two frames to allow sync after playback

Equipping for Dolby E

For many postproduction facilities, the addition of a DP571 Dolby E Encoder and a DP572 Dolby E Decoder is all that is required to create content with Dolby E audio. The DP571 is used at the final stage of the production process, for recording the completed mix(es) onto digital video tape or a video server. The Dolby E audio is decoded back to baseband PCM by the DP572 in the digital broadcast facility where it is then re-encoded to Dolby Digital just prior to DTV transmission (See Figure 4).

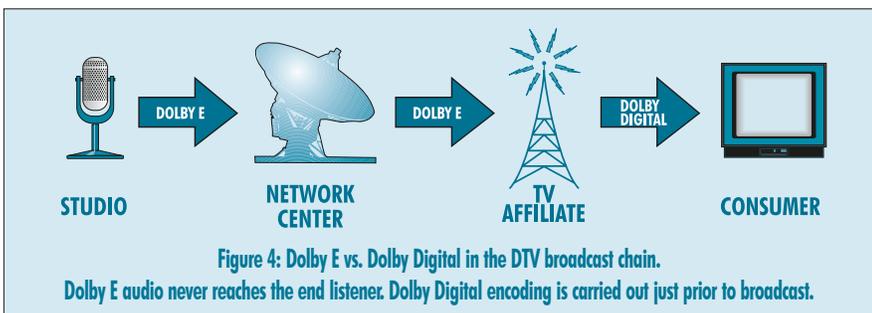


Figure 4: Dolby E vs. Dolby Digital in the DTV broadcast chain.

Dolby E audio never reaches the end listener. Dolby Digital encoding is carried out just prior to broadcast.

The DP571 encoder accepts up to four AES-3 channel pairs of PCM audio, and outputs Dolby E encoded audio, and metadata, as a single AES-3 pair. The DP572 decoder accepts an AES-3 formatted Dolby E encoded input signal, and outputs up to eight channels of PCM as AES-3 pairs. Recovered metadata is delivered via separate output (9-pin D connector).

Features of both the DP571 and DP572 include a color-black reference input to keep audio and video frame rates locked; connections for SMPTE LTC and VITC timecode; remote-control connectors (RS232 and RS485); an alphanumeric display and menu navigation buttons to facilitate operation; and channel-activity LEDs. The DP572 also has a front-panel headphone jack.

For inputs and outputs, the DP571 and DP572 units feature BNC female connectors with loop-throughs meeting the AES3-id-1995/SMPTE 276M standard (see Figure 5).

These connectors are commonly used in the video and broadcast industries today. Since 75-ohm, unbalanced BNC connectors are used for the AES-3 audio inputs and outputs of both encoder and decoder, transformers may be required when interfacing with other studio equipment providing 110-ohm AES/EBU balanced connectors. (Suitable transformers are available from Canare and Neutrik.) The loop-through BNC connectors for inputs on both units require the installation of standard 75-ohm video terminators if they are not being used to feed additional equipment.

For more information

For more information and a demonstration of Dolby E products, contact your Dolby professional equipment dealer, or visit www.dolby.com/tv/audio. You can also sign up at this address for a free email subscription to DTV Audio Update, a nuts-and-bolts newsletter covering digital broadcast audio issues.

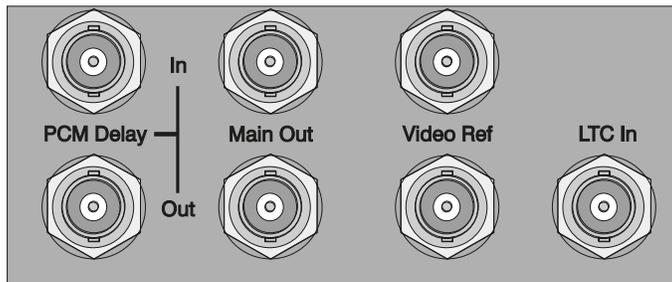
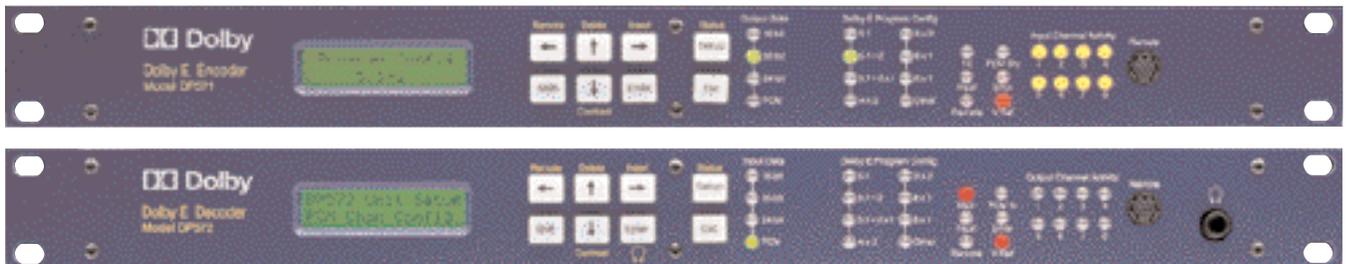


Figure 5: AES3-id connectors on the back panel of a Dolby E unit



Dolby DP571 Dolby E Encoder and DP572 Dolby E Decoder

What is metadata?

The Dolby Digital transmission coding system was designed to satisfy all viewers, from those with mono TV sets in noisy environments to those with elaborate multichannel home theater systems capable of a wide dynamic range.

To this end, the program producer can incorporate within the Dolby Digital bitstream auxiliary information called metadata (i.e., data about the data) to control aspects of the decoding and reproduction of the audio at the viewer's location. Listeners can then apply, partially apply, or ignore these parameters as appropriate to their equipment and preferences.

One metadata parameter can, for example, signify the program's number and type of channels (audio coding modes). Another called Dynrange can be used to compress the audio's dynamic range by a predetermined amount when appropriate (such as late at night), yet allow listeners to opt for full dynamic range when they prefer. And Dialnorm is used to automatically adjust the consumer decoder's output level to produce consistent playback loudness on all programs, including commercials.

Metadata can be created during postproduction and incorporated in the Dolby E bitstream on programming supplied to the broadcaster. There it passes unchanged through the various distribution stages, and reaches the consumer via the transmitted Dolby Digital signal.