TVTechnology

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Digital Audio: Getting From Here to There

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This month we will describe how each of the major terrestrial networks has chosen to distribute multichannel audio to their affiliate stations.

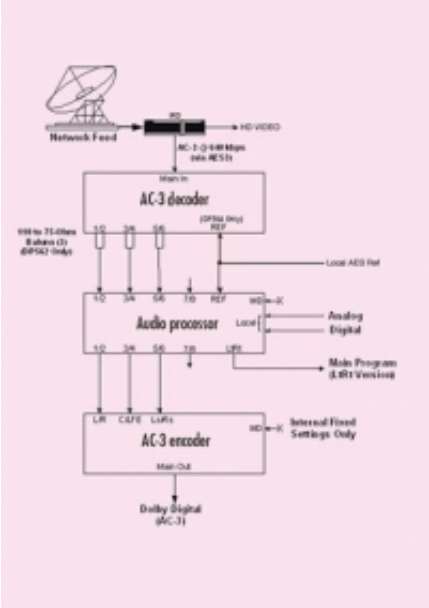

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Fig. 1: Possible implementation of multichannel audio at an ABC affiliate station. Note that for all the networks there are many ways to implement this and that not all equipment will be required at each station.

Previously, we discussed the entire signal path from post production all the way to the consumer. To simplify the discussion, we generalized a bit and described the overall goal without describing the details of the operation. While the results enjoyed by consumers are basically the same, it turns out that the methods employed vary substantially from network to network.

ABC AND NBC

ABC network was the first to carry multichannel audio. It began with their inaugural HD broadcast of "101 Dalmatians" at the dawn of digital broadcasting in November 1998. As the commercial use of Dolby E would not be possible for another year, ABC decided to use Dolby Digital (AC-3) running at the highest rate possible, 640 kbps. Its distribution encoders and decoders would pass the AC-3 signal with no problem, and by using a Dolby DP569 encoder and a DP562 (now DP564) decoder they would effectively have three AES pairs from the network to the affiliate stations. Fig. 1 is a conceptual drawing showing how this might be implemented at an ABC affiliate station.

The only drawback of the system is that it currently does not allow metadata to be passed, but this has had little negative effect on the broadcasts as the audio is simply matched to preset metadata values. Much of ABC's primetime programming is presented in 5.1, and their years of experience have proven that it can be done perfectly in this manner. The recent Academy Awards broadcast proved the success of this approach: the audio was simply spectacular. My hat is off to Ken Michel, Randy Hoffner, Robin Thomas, Mike Strein, the venerable Charlie Repka, and the rest of the ABC gang for a complex job well done.

NBC provided 5.1 channel sound with the broadcast of the Opening Ceremonies of the 2002 Salt Lake City Olympic Games. Additional selected events were also carried with 5.1 channel audio and the results were very good. Jim Starzynski, Tom Duff and Peter Smith at NBC had the foresight to order their distribution system with the built-in capability of handling eight channels of audio. The system accepts eight channels of audio via four AES pairs fed to the encoder, and via four stereo MPEG compressors, delivers those channels to the affiliate decoders, which then turns them back into four AES pairs. Although theoretically there is a chance of phase variations from pair to pair due to the independent MPEG compression of each pair, the channels are grouped as Left/Right, Center/LFE, and Left Surround/Right Surround, and in practice this has not been a problem at all. Like the ABC system, this one lacks the capability of sending audio metadata, but with proper audio practices this should not be an issue for NBC either. Fig. 2 is a conceptual drawing showing how this might be implemented at an NBC affiliate station.

CBS AND FOX

CBS has implemented a system that allows Dolby E to be carried from the network to each affiliate station. Although Dolby E provides a method for carrying the audio metadata, CBS has implemented an alternate approach where it is inserted into the vertical ancillary (VANC) space of the HDSDI signal. This allows the network to pass around an HDSDI signal that contains baseband audio, metadata (audio and other), and only use the Dolby E system to transport eight channels of audio through the satellite link. After the affiliate receives the feed, Dolby E can be decoded into four baseband AES pairs (eight channels), and then re-embedded into the SMPTE 292M HDSDI signal for routing through the plant. Master control products from Thomson Grass Valley and Utah Scientific can accept, process, and output this complete HDSDI signal, and just before ATSC encoding, de-embed the signal into the requisite pieces with audio ending up as four AES pairs and audio metadata as an RS-485 signal. This is exactly the form required by subsequent audio processors and the Dolby Digital (AC-3) en-coder, although fut-ure products will hopefully be able to simplify things further and accept the full HDSDI signal. Fig. 3 is a conceptual drawing showing how this might be implemented at a CBS affiliate station.

Fox is currently also distributing Dolby E to its affiliate stations, and is using its capability for carrying the audio metadata as well. The Dolby E signal can either be decoded to four baseband AES pairs allowing all other operations to occur in a

similar fashion to any other affiliate, or the signal can be kept as Dolby E and routed, switched and stored until it is finally decoded back to baseband for processing and Dolby Digital (AC-3) encoding and transmission to consumers.

Soon, Fox will be radically changing its distribution model. They will end up looking more like PBS than CBS, and the benefits could be plentiful for both Fox and its viewers.

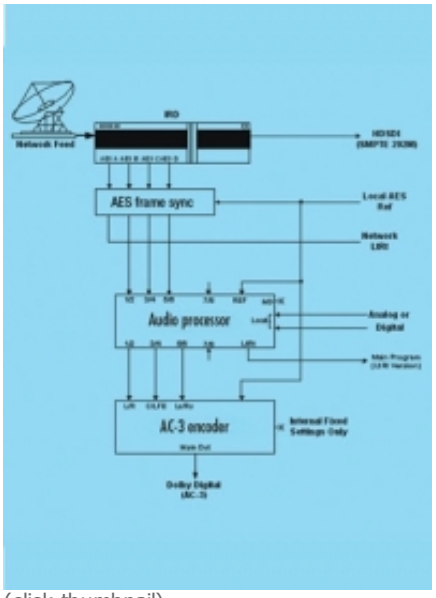

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Fig. 2: Possible implementation of multichannel audio at an NBC affiliate station.

PBS (AND FOX TOO)

From the beginning of its entrance into HD, PBS has used a model known as transport stream distribution to get HD video, 5.1 channel audio, and other features of the ATSC system to as many viewers as possible. As public broadcasters have faced new funding requirements and challenges over the past decade or more, this is no small undertaking. The basic structure of the system is that PBS does the ATSC encoding at its network headquarters on the east coast and sends the resulting transport stream to affiliate stations. In this manner, all that is required for a station to get on the air is a transmitter (with the 8-VSB modulator) and an antenna. The complex and expensive task of encoding HD video and 5.1 channel audio is now done once by the network for a given feed, with affiliate stations only having to modulate, amplify, and emit the signal.

When PBS first began down this road, I remember speaking to Andy Butler and scratching my head wondering how and if it could all work. Looking at it today, the solution is both elegant and highly effective. As with any distribution system, the major hurdle is the integration of local programming and branding. In the case of transport stream distribution, this could mean decoding the audio and video signals back to baseband, inserting local content, then re-encoding the signals back into a transport stream, which has the potential for causing degradation. Speaking just for the audio side, it will probably work reasonably well in most situations, but there may be noticeable artifacts that occur in unpredictable locations.

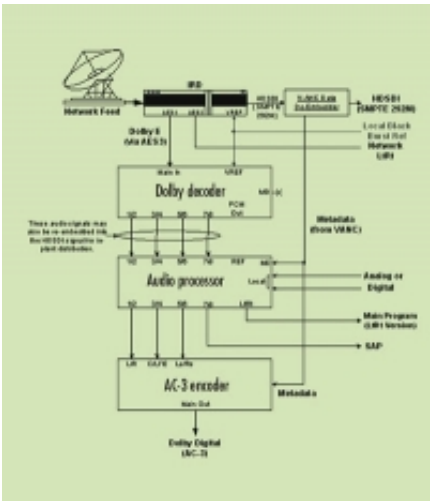

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Fig. 3: Possible implementation of multichannel audio at a CBS affiliate station.

Luckily, this approach has also become very popular in digital cable systems, where insertion of local ads is a mainstay of the industry. Many advances have been made, and today it is not only possible to switch in locally generated transport streams, but amazingly, station logos or bugs can be inserted into the network transport stream in the compressed domain-no need for a decode/re-encode. Still, for an audio voiceover to take place, the compressed audio must be decoded, the voiceover performed, and the result re-encoded. This should generally not be a problem, especially if the network chooses to take advantage of ATSC support of 448 kbps for complete main Dolby Digital (AC-3) signals. Further, I fully expect future audio products to embrace the transport stream distribution philosophy and provide a means by which audio generations and possible artifacts can be minimized.

Not surprisingly, Fox has also announced that it will adopt a similar model based around a product whose roots are in cable and satellite. The Terayon BP 5100 is based on its Network CherryPicker platform, which has been successfully deployed for a number of years by cable and satellite companies. This approach will undoubtedly allow more Fox affiliates to get HD programming (with 5.1 channel audio) on the air as it will be very cost-effective. Integrating local programming other than logo insertion will still require full audio and video encoding, but like PBS, stations can add this capability when they are able to do so but not impede the carriage of primetime HD programming.

My thanks to the network engineers mentioned above and to Rich Friedel and Jim DeFilippis of Fox and Paul Berger, Bob Seidel, Greg Coppa, Jay Bergman and Hank Mahler of CBS for being open and patient when explaining how their networks are making all of this work. It is a tall order to get these signals from Hollywood (or New York) to all the affiliate stations and then out to consumers, but they are getting it done. **Print Page**