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A Look at AC-3 Enhancements

1/19/2005

This month, I'll take a look at an enhanced version of AC-3 (Dolby Digital), the coding standard developed primarily to support the new enhanced version of the ATSC digital television standard.

Enhanced, you say? Yes, indeed, enhanced. I will also give my two cents on some recent 99-cent purchases of online music that is bit-rate-reduced (i.e., compressed).

DOWNLOADING FOR $$

I know, it is all the rage, and yes it is a huge step up from the typical MP3 download quality. In case you did not know, you can download music from several different places these days for around 99 cents per track.

I will report on iTunes because that's the service that I happen to use, but there are others out there. The system uses a version of AAC that incorporates digital rights management, but like any top-quality system that protects the rights of musicians, this functionality is active but not intrusive.

After thinking I heard some slight strangeness on one or two recently downloaded cuts, I investigated further and found that the downloaded bit-rate is 128 kbps. AAC is light-years better than MP3, but this is still quite a reduction from the original. I purchased the original CD of at least one of the downloaded cuts. Is it different? Yes, slightly, but I also have no idea if this CD version is the same one that was encoded, nor do I know if there was any pre-processing, so it's hard to make a good judgment. It sure was more convenient to buy the download though.
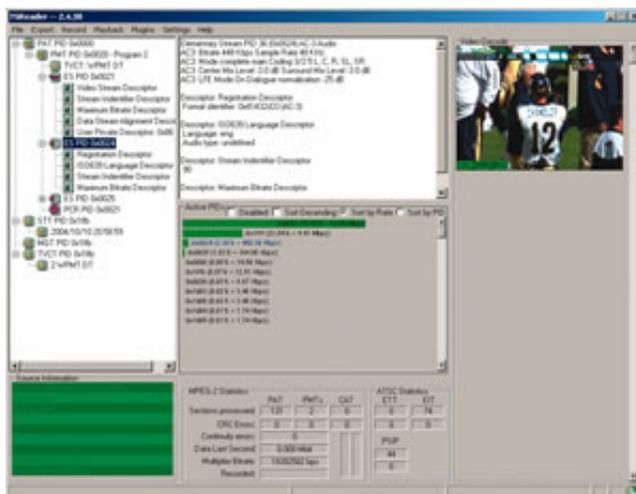
(click thumbnail)
TSReader, analyzing a local DTV broadcast

In short, it would seem that for a given album, you pay almost full price for a very convenient download, but at 128 kbps you are getting less than 10 percent of the original bit-rate of 1.411 Mbps (16-bit x 44,100 x 2 channels). Is it evident? Not always, but therein lies the trouble--it is audible sometimes under certain conditions. Maybe these services could offer different download qualities for a different fee--pay more for more bits.

Then again, maybe I could stop being lazy and go buy the CD, (have you heard Pink Floyd's "Dark Side of the Moon" remastered by James Guthrie yet?) or DVD-A, or if I am lucky, the LP!

The good old ATSC standard is being expanded to incorporate some nonbackward-compatible enhancements to the audio, video and modulation portions of the specification for a so-called "robust mode." Everything is not set in stone yet, but Dolby Laboratories has added some useful features to the AC-3 system and as "Enhanced AC-3," it has been selected as the candidate standard for audio.

These new features have enabled it to compete and win against newer technologies such as Windows Media and AAC Plus from Coding Technologies, which until now have been able to claim better efficiency than AC-3, meaning that for a given quality of audio, these other formats can run at lower bit-rates. There are some very logical reasons why Enhanced AC-3 was chosen, and it is much to the benefit of consumers who have already invested in home theater equipment that it has turned out this way.

Just a few sentences back, I said the enhancements to the ATSC system for robust mode were nonbackward-compatible. This is true with regards to the modulation scheme, but not exactly the whole story with Enhanced AC-3.

As Jerry Whitaker described recently in his "ATSC Update" column ("Important New Standards Published," TV Technology, Sept. 8, 2004), the new candidate standard has features that bring about better efficiency, the capability of more than 5.1 channels (gulp!), and better overall quality.

Most importantly, Enhanced AC-3 is backward-compatible--sort of. To comply with the millions of ATSC receivers and cable and satellite set-top boxes, a standard Dolby Digital (AC-3) bitstream must be carried, but for any new service or system that also includes Enhanced AC-3, a fully compatible standard AC-3 stream will be available for output over the standard IEC61937 (i.e., S/PDIF) connection, hence the name Dolby Digital Plus.

New decoders can take advantage of the "plus" portion, while a standard AC-3 bitstream is made available for use by the millions of outboard decoders present today. A copy of the candidate standard (CS/52B) can be obtained on the ATSC Web site at: www.atsc.org/standards/candidate_standards.html. It is technical, but readable.

One area I was surprised was not revisited was that of dynamic range control, or DRC. In the original version of AC-3 (Dolby Digital), a wideband system was implemented and it has proved to be useful, but arguably not as effective or artifact-free as a proven multiband implementation.

With Enhanced AC-3, the problem could be remedied as optional control bands are added and used by capable decoders. This could eventually lessen the need for external dynamic range control systems being installed prior to the encoders and permanently altering audio levels. The system would work exactly like the current DRC system, where control words are generated in the encoder but only applied by the decoder, except in the new system, multiple bands of control data would be sent. In this manner, low, mid, and high frequencies (and in between) can be gain-controlled separately. I have passed these ideas on to the folks at Dolby Laboratories, and I will rely on their good judgment to see if Enhanced AC-3 is enhanced further.

TRANSPORT TOOLS

As part of some recent work, I was searching for an inexpensive way to take apart a given transport stream and display the data. There are many expensive ways to do this, but I was hoping for a way to get some basic information in a cost-effective manner. I was both shocked and pleased to find an amazing product at www.coolstf.com that fit the bill.

TSReader is a thorough tool that allows an investigation into all required tables, and showing the structure of the stream including video and audio packets, hidden or otherwise.

While a "lite" version is available for free, several additional and useful features are included with the full version; at $99, I simply could not argue. The "lite" version alone is worth far more than this paltry sum.

I have been in contact with TSReader's creator, Rod Hewitt, and he has recently added the ability to display certain key audio metadata values such as data rate, dialnorm and audio coding mode to the latest version.

With the addition of an inexpensive ATSC PCI receiver card, or better yet, a USB receiver, a station has a very inexpensive way to monitor the signal it is transmitting, and just as importantly, the signals its neighboring stations are transmitting.

The software will also interface to a host of other cards, including one from Computer Modules (aka Linear Systems of Canada), which will allow DVB-ASI streams to be directly captured and analyzed. I would definitely recommend a trip to the Coolstf Web site, which has a bunch of additional useful information.

Fig. 1 shows a typical screen from TSReader captured from a local DTV station, and the amount of detail that can be gleaned with this application should be quickly evident.

It is with a heavy heart and only after a great deal of reflection that I must report that this will be my last regular column for TV Technology.

After much soul searching, I have decided that I must spend more time practicing what I have been preaching for the last three years.

About two years ago I started a small firm called Linear Acoustic Inc. (www.LinearAcoustic.com) to research and develop practical, real-world products to solve some of the issues that we have discussed in this column.

Our products include multichannel dynamic range processors to guard against loudness problems in surround; upmixers to keep surround field images consistent; and our latest technology, which enables up to four 5.1-channel Dolby Digital (AC-3) programs to be transported in a single 20-bit AES pair. More importantly, it is designed to provide seamless, frame-accurate AC-3 splicing that can be used to alleviate any concatenation issues that some networks might have.

We believe that television audio needs to be squarely pointed toward better efficiency and less complexity--not the reverse. This can be accomplished by making better use of standardized technology such as Dolby Digital (AC-3).

Many thanks to the good folks at TV Technology for giving me a great platform, and to everyone who has read the column. I hope it has been useful, and to be sure, I have learned quite a bit from you. I want to assure everyone that I am still available via e-mail or phone; if you happen to come across any one of the million vexing audio problems in digital television, I would be happy to add my two cents.

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