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THE DTS SYSTEM

BY

JOHN F. ALLEN

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FIRST IN DIGITAL STEREO

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This past summer's release of JURASSIC PARK marked the first time in cinema history that all the release prints of a feature film were encoded for digital stereo playback in theatres. With 900 installations, this marked the largest number of theatres equipped with a digital processor to present a film. These first 900 units were built and installed in only 90 days. This miracle was accomplished by Digital Theatre Systems, Inc. (DTS), a company that was officially founded only last February. Obviously this all didn't happen in just three months. It was actually more than two years ago that DTS founder Terry Beard began to develop his digital motion picture soundtrack. Though new to the theatre equipment business, at least on such a large scale, Terry Beard is no stranger to motion picture sound. For many years he has operated the Los Angeles based company Nuoptix. At Nuoptix, Terry has devoted much of his time to the research and development of improved optical soundtracks. The most notable of these was the Vistasonics system used for POPEYE and DRAGONSLAYER. Additionally, Nuoptix builds one of the best analog optical sound recorders in the business.

My own HPS-4000™ trailer was purposely recorded on one of Terry's recorders installed at Warner Hollywood Studios. Though I only met him recently, Terry Beard is a man I have known of and respected for a very long time. In the midst of the two year DTS development, Beard had a chance encounter with Steven Spielberg where he described the digital system he was working on. It was intended to be a simple, low cost and yet still high quality digital sound format. Several months later, in August of 1992, Spielberg called Beard to talk about JURASSIC PARK and to inquire about the project's status. Beard assured him that the system would work and that 1,000 units could be readied in time for the film's release in June.

Together, they approached Universal Pictures and proposed the idea. Universal was skeptical and needed proof of the system's viability, not to mention assurance that the manufacturing schedule could be met. By December, 1992, Universal had been convinced, and a deal between Beard, Spielberg and Universal was made. With the release date rapidly approaching, Beard had to scramble. On February 1, 1993, Digital Theatre Systems, Inc. was officially formed along with other investors, including Steven Spielberg. They started off with an inventory of about 20 prototype DTS units. Working first out of a borrowed office with a borrowed telephone, newly hired vice president Bill Neighbors had the job of equipping the theatres for JURASSIC PARK. Following a

successful demonstration at ShoWest in March, deliveries of the DTS processors began in May of 1993. By the second week of the JURASSIC PARK run, over 900 theatres were operating with the Digital Theatre Systems digital sound processor.

Needless to say, the 35 MM motion picture release print was not designed with digital sound in mind. Retrieving so much information from a film requires a complex reader and processor. Terry Beard approached this dilemma by employing as much “off-the-shelf” technology as possible. He came up with a double system (of all things) with the digital sound information stored on one or two CD-ROM (Compact Disc Read Only Memory) discs. A special DTS time code that identifies both the reel number and each frame, is placed on the print between the picture and the normal analog soundtrack. This is read by a very simple reader installed at the top of the projector. The DTS processor is essentially, then, a computer. Its task is to know where the sound is stored on the CD-ROM discs at all times and using the DTS time code as a guide, to make certain the sound is synchronized with the picture. I find it somewhat remarkable that a double system, even one as good as this one, would be so readily accepted. Our pioneering 1985 digital presentations of FANTASIA were accomplished using a double system. I remember people asking me “You aren’t really proposing a double system, are you?” I’d say, “No! What I am proposing is digital sound. We used a double system because we had to.” “Well,” they’d say “you know the industry will never accept a double system.” Right! Even as the DTS system was being unveiled, many skeptics, including myself, questioned whether it would prove reliable. However, the demonstrations were compelling as the system has the ability to synchronize itself at any point and anytime during the running of the picture. The computer provides something we surely lacked in 1985, a highly reliable means to maintain interlock with the picture even with missing frames, or missing reels for that matter. So far, I have personally never seen it fail. I must admit that as our installed units have all continued to perform flawlessly for months, I have retreated from my rather blind opposition to double systems for theatres. If a double system is essentially no more complex than a single system and works this well, why not use it?

DIGITAL AUDIO

Whether its a digital compact disc, a DAT or a feature film, digital audio differs fundamentally from analog recordings in that no actual audio information is recorded. Digital recordings are nothing more than storage systems for mass quantities of numbers, namely ones and zeros. For every second, the sound signal is divided into 48,000 samples. For every one of these 1/48,000 th of a second samples, the signal is measured. Its amplitude is recorded as a code of 16 or 18 bits. Eighteen bits times 48,000, times six channels for a film’s soundtrack, times two hours or so becomes “billions and billions” of

ones and zeros (nearly 32 billion in fact).

DATA REDUCTION

In order to store six channel digital soundtracks on the film or even on two CD-ROMs, something must be done to reduce the amount of data as it exceeds the practical storage capacity of either medium. Data reduction schemes as high as 16 to 1 have been developed in recent years, some better than others. They are typically based on the masking principle that in any sound, there are things we hear and things we don't. As an extreme example, we usually cannot hear musicians breathing because that sound is masked by virtually everything else that is going on. This is a tricky business. Equipment designers have spent years figuring out what sorts of sound information can be thrown away without audible deterioration. Unlike the compact disc, which is a linear or un-reduced digital medium, systems employing data reduction schemes do not give us back the full information that was originally recorded.

THE DTS-6 DIGITAL THEATRE STEREO SYSTEM

The DTS system uses a simpler 4 to 1 data compression scheme called the apt-X 100 to reduce the data storage requirement. The apt-X 100 is a product of Audio Processing Technology (APT) of Belfast, Northern Ireland and Los Angeles, California. Beard found this system particularly attractive because it uses no masking techniques and throws away no audio. Rather, the apt-X 100 process takes the digital information and reduces it by a factor of four. A set of predictive tables is used to reconstruct the original digital information on playback. You might say this approach sacrifices an extremely small amount of amplitude accuracy in favor of keeping all the sound intact. Indeed, APT claims they have passed audio signals through their process up to 12 times with no audible degradation. The system is said to be so robust that no bits are required for error correction and none are used. The apt-X 100 has also been adopted by NHK and others in Japan to digitally transmit audio signals over their studio to transmitter links. How important is this? To a purist, the existence of any compression scheme and its function may seem like a critical issue. But since at least some of the more elaborate digital compression schemes seem so transparent, the practical difference in a theatre environment has proven, so far at least, to be very small. Terry Beard agrees, but maintains that keeping the data reduction as simple as possible, offers significant advantages in smaller venues such as home systems.

TWO TRACK AND SIX TRACK

Originally, DTS was available in two different formats. In addition to the familiar (left, center, right, bass plus left and right surround) six track format, a two-track format was also introduced. Designed as an economy version, the two tracks were digital versions of

the left-total and right-total optical tracks. These were fed into the cinema processor's optical preamplifiers and decoded in exactly the same way as a stereo optical soundtrack. This two track format became the focus of many poor presentations and a lot of misunderstandings. Many of these processors were installed in theatres that, to one degree or another, were poorly equipped for the dynamic range of digital sound. Not only do the speakers and amplifiers in such theatres lack the required dynamic range, but older cinema processors can also be ill-prepared for digital soundtracks.

DTS itself added to the situation with the unfortunate omission of a critical step in their two-track alignment procedure. The two-track setup disc begins with a 1000 Hertz tone segment, followed by a 10,000 Hertz segment. The installers are instructed to adjust gain and high frequency controls respectively for the calibration indication on the cinema processor's meters. The metering circuits were not designed to be used with the noise reduction circuits engaged. The meters are accurate only when the processor is in the mono mode. This was left out of the manual and some systems were calibrated in stereo. The error in the stereo mode at 1000 Hertz is small. However, the error at 10,000 Hertz is quite large, resulting in a sound presentation that is far too bright.

This sets off a chain reaction of events. The excessive high frequency level over-excites the surround channel, making the surrounds too loud as well as too bright. All this caused the sound level to be turned down in the theatres where this occurred. The reduced level diminished the dialog to the point of unintelligibility in many cases. Adding to the problem was the fact that the two track DTS system uses a fixed subwoofer output level. In other words, there is no fader control for the DTS subwoofer channel. With reduced fader settings and a fixed subwoofer level, the bass balance is automatically off, reducing dialog intelligibility even further. This is because, unless set extremely carefully, optical subwoofer circuits can cause dialog to bleed through the subwoofers, quickly leading to intelligibility difficulties.

Some of the two-track installations were disasters. Some were criticized in the press. However, those who simply said that the DTS system was completely at fault were wrong and failed to do their homework. Properly installed, calibrated and played through a truly digital-ready sound system, the two track system produces excellent results. Though obviously not as discrete or dynamic as a full six-track system, the sound is superior in every way to analog.

In the final analysis, DTS underestimated the true demand for the more expensive six-track units and so most of the first 900 installations were originally done with the two-track version. Since then, the six-track demand has remained so strong that DTS has

decided to drop the two-track format altogether and concentrate on the fully discrete six-track systems. Theatre owners are encouraged to take advantage of DTS' attractive upgrade offer and switch their two rack installations to six track as soon as possible. Once all the theatres are upgraded, the two-track CD-ROM soundtracks will be discontinued.

One note about the present DTS six-track system: In order to avoid overloading the vast majority of the existing installed surround speakers (not ours, of course), the bass octave is rolled off in the surround channels. The subwoofer information is then stored in the bottom octave of the left and right surround channels. Thus the six-track storage system is, for the time being, actually a five channel recording. The room for the data required for a separate subwoofer channel is available, however. It remains to be seen if exhibitors will equip their theatres with surround speakers that can deliver a solid bass response.

INSTALLATION TIPS

For best results, the DTS system should be considered no different than any other digital format. Any and all the digital upgrades recommended by the cinema processor manufacturers should be included with any DTS installation. In addition to assuring the cleanest sound, these upgrades often allow the DTS subwoofer signal to be fed through the bass card, as it should be, thus providing full fader control. The sound system should always be wired for (left and right) stereo surrounds. Of course, most theatres require all new speakers and amplifiers, quieter ventilation systems as well as better sound isolation between auditoriums, in order for any digital stereo format to be fully successful. But that's another article. (See BOXOFFICE July, 1993, page 40). One final installation item: Installers should be aware that the original DTS six track setup discs were recorded 3 dB too low. Unless a later corrected setup disc is used, all six-track calibration levels should be reduced by 3 dB. This will allow the fader to remain unchanged for both analog and digital presentations.

RUMORS

Making the leap from a few prototype units to over 900 in one giant step is risky for anyone. Little oversights suddenly become major headaches. All things considered, it seems fair to say that DTS made this leap fairly well. There were a few problems that were confined to a few units, but no massive failures or defects. Where problems did arise, DTS responded quickly and honorably to correct the situation. Still, no one is immune to rumors. Inaccurate tales of DTS "crashes" were making the rounds for awhile. Claims that the discs were too vulnerable to be used in a "dirty" projection booth and that the disc drive would only last a month seemed the most ridiculous. The discs are contained within a protective cover. Each disc, cover and all, is placed into the drive unit and a door

is closed. If such protection is inadequate in a booth, then what is the film doing on an open platter?

SERVICE

A personal comment: During the installation of two DTS-6 units in the Chicago area, I found that the digital to analog switching wasn't working. The commands were there, but were coming out of the wrong terminals. When I called DTS in Los Angeles at 8:00 p.m. on a Friday night, they were shocked to hear my report. Within 10 hours, DTS engineer Jim Ketcham had flown overnight and was at the theatre to see for himself. It turned out that their cable manufacturer had simply installed a connector backwards. The problems were corrected within an hour. Most impressive. We have all experienced manufacturers of various products blaming their customers for defects. I have found DTS personnel to be both responsive and responsible with a very refreshing lack of arrogance. Commendations to DTS, Bill Neighbors and Jim Ketcham for providing such great and professional service.

SOUND QUALITY

Certainly the most important issue of all: How does it sound? At this writing, I have experienced three films in DTS as well as DTS' demonstration film. As one should expect from digital sound, the quality is excellent. Perhaps the most startling experience was HEART AND SOULS. It's easy to expect and understand how digital's wide dynamic range and low distortion would add to an "effects" film. But HEART AND SOULS was mostly a dialog picture with a few effects as well as lots of music. What a difference digital sound can make for a film like this. It exceeded my own expectations. I left the theatre with the same satisfied feeling I normally get in a live concert hall. I was truly amazed.

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