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As my first mini-report was being finished, I was faced with having to choose the subject of my final report. I wanted to undertake a study that was related to my research on Tascam's new high-resolution 24-bit DAT player. A natural outgrowth of the 24-bit DAT, I thought, would be 24-bit digital recording in general. So I settled upon this topic. A look into the 24-bit revolution in digital audio, of course, requires investigation on a few fronts. Specifically, these fronts include: 1) what kind of 24-bit products are being introduced into the marketplace? 2) how compatible are new 24-bit machines with other 24-bit machines and their older 16-bit counterparts? 3) how necessary is this 24-bit revolution considering the widespread consumer satisfaction with 16-bit "CD" quality? 4) what are the ramifications on the consumer audio market (which seems quagmired in this 16-bit CD format) with the proliferation of 24-bit technology in the professional world? 5) how is 24-bit technology implemented in new digital recorders? And so on. Presumably more questions about the influx of 24-bit audio products will pop up during the course of my investigation.

The first question I tackled this week was the value of 24-bit resolution in the professional field considering the 16-bit limitation of the final consumer product. In other words, why bother with 24-bits if it is only going to be squashed to 16-bits anyway? The best place to go for the answer to this question is obviously the mastering engineer, for he/she is the one concerned with the transfer of a high quality master to the CD standard. Apparently, the main reason for using 24-bit machines throughout the recording process is to maintain the highest possible integrity of the audio signal until the very last moment when it has to be transferred to compact disc. Quantization noise, much like the noise introduced into an analog system, has the tendency to accumulate with each successive generation. Mastering engineer Glenn Meadows reasons that, "every time we redither or truncate....we limit the resolution, and it compounds down the line." (De Lancie) Another mastering engineer, Ted Jensen, puts it another way: "As you go stepping through the [audio] chain using 16 bits each time, you rapidly start losing dynamic range and resolution and other nice qualities of the sound." (De Lancie) Mr. Jensen does have a point. Digital recorders are not free from inherent noise in the processing of audio signals. Just look at the specs of any digital recorder (a simple DAT machine, for example) and one will find a clearly printed signal to noise ratio. If one stays completely within the digital domain, this noise is prevented from building up. But whenever a transfer to the analog domain occurs (as so often happens during mixing these days), an increase in the quantization noise results from the dithering DAC and the following re-quantization.

Many recording studios are moving towards operating completely in the digital domain, however, which causes the digital noise argument to be moot. The real question is whether 24-bit audio actually sounds better than 16-bit. This point is a very controversial one since the definition of what sounds "good" varies from person to person. Many people, for example, will say one rock band sounds "good" and another "bad" while a different group of people will say just the opposite. The definition of what sounds "good" therefore is purely a matter of opinion. One thing that can be said about 24-bit audio, however, is that it sounds clearer and more precise to the original sound which it is capturing. Glenn Meadows comments again, "You can hear in the finished CD which one came from the high-resolution mix source. You can hear the

improved detail." (De Lancie) It is this increased sonic "detail" which attracts recording engineers to the higher-resolution format.

A question which naturally arises out of Mr. Meadows previous comment is how a 24-bit source could even be perceived as having more detail than a 16-bit source on the compact disc format when the compact disc is only 16-bits. The answer is that companies have invented ways of coding and shaping high resolution information so that its quality is transferable to a lower resolution. Some of these processes deal with psychoacoustics and the equal-loudness contours. Since other members of our class are exploring these areas, I won't delve into their mysteries. A basic example of how 24-bits can be transferred to a 16-bit format, however, is to merely use limiters to push the average level of the program up to the full bit level (0 dB) and push down the transient peaks which were causing the program to require a headroom. Some of the methods of high-resolution to compact disc transfer include Sony's Super Bit Mapping (SBM), Pacific Microsonics' High Definition Compatible Digital (HDCD), and UV22. According to mastering engineer Steve Hall, "You go through the HDCD and you basically cannot tell the difference between the master and the 16-bit processed output." That's good news for 24-bit manufacturers!

Who are these 24-bit manufacturers and what products are they manufacturing? For the answer to this question, we will have to wait until a further research report. Some preliminary exploration shows a wide range of 24-bit products currently available in the marketplace. At the 100th Audio Engineering Society's Show in Denmark (2 years ago), Sony was already displaying a full 24-bit production line, including the OXF-R3 24-bit digital mixing console, the 24-bit capable 48-track DASH recorder called PCM 3348-HR, and a 24-bit portable DAT with timecode. Said Sony pro audio general manager of these new products, "With these advanced production tools, recording studios are able to benefit from the 24-bit production process that represents a quantum step forward in audio quality." (Schoepe) Apparently, the sonic difference between 16-bit and 24-bit resolution represents a "quantum step." We should feel privileged to live in such a warp-speed era!

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