



## Security scheme doesn't hold water(marking)

**O**N SEPT 24, while I was at the AES (Audio Engineering Society) conference, Verance Corp invited me to Sony Music Studios in Santa Monica, CA, for a critical listening test of their watermarking technology.

Audio watermarking inserts media identification data within the bit stream, using techniques that its advocates

claim are inaudible (**Reference 1**). A number of watermarking alternatives exist, including spread-spectrum approaches and perceptual coding; Verance employs perceptual coding. As its name implies, this technique is similar to those found in MP3, AAC (Advanced Audio Coding), and other perceptual audio-compression algorithms, with similar potential artifacts.

The half-hour audition Verance gave me was an abbreviated version of the testing it had been conducting with a large number of listeners for several months, as the company fine-tuned its algorithms. Verance invited me to choose from several audio clips representing different music genres. Ten times, I listened first (for as long as I wanted) to “clear” original audio (Sample A), then to watermarked audio (Sample B), and then to an unidentified Sample X. After each three-sample audition, a Verance engineer asked me to determine whether Sample X matched Sample A or Sample B. Not surprisingly, this evaluation method is called ABX testing.

First, the qualifiers. I know that perceptual watermarking probably produces perceptual compression-like phenomena, for which my ears are already tuned from my audio-codec work of the past few months. I also intentionally picked a jazz passage with lots of high-frequency energy and sharp percussive transients. I felt that this selection,

of all the options that Verance offered me, would best accentuate the presence of watermarking artifacts.

Now the results. In all 10 cases, I could clearly identify differences between samples A and B, such as less distinct, more muddled transients in Sample B, as well as less high-frequency information and a narrower stereo image. To be fair, I

### BEWARE THE STENCH OF HOLLYWOOD HEAVY-HANDEDNESS.

need to point out that results such as these are inherently suspect, because your ears and brain can convince you of the presence of things you expect to hear, when in reality these things may not exist. Therefore, more importantly, in eight of 10 attempts, I correctly matched Sample X to either Sample A or Sample B. This success rate translates to an only 5% probability that I was “guessing.” And that probability could have been lower. One of the two attempts I missed was the tenth, last comparison, when listening fatigue probably diminished my accuracy.

Verance was obviously unhappy with the outcome of this experiment. Here's how I predict the company will dispute my results. First, they'll claim that if I participated in the experiment again, my success rate might be lower. I can't dispute this possibility, but my success rate might be higher in the next go-around, too.

Second, the company will claim that I was predisposed to hearing the perceptual artifacts because of my previous lossy-compression experience. This mindset I can more readily challenge. In fact, much of the criticism directed at Verance to date centers on the opinion that the company pulled people “off the street” and ran the tests without training them. The errors that both audio and visual lossy compression create become more noticeable as consumers spend more time with the technology. For example, I notice more MPEG video-compression artifacts now than when I watched my first DVD. In my critical listening test, I may have, in fact, given Verance an early warning of artifacts that a lot more listeners will complain about down the road.

Third, Verance will assert that the audio material I chose was worst-case and not indicative of results across the broad spectrum of music genres. Again, without a more extensive listening test, I can neither refute nor support this viewpoint. In Verance's defense, the watermarking effects were more subtle than those created by, say, 128-kbit MP3 compression, and they would probably be rendered inaudible on low-cost portable audio players, by the reduced dynamic and frequency range of an automobile listening environment, or by low-quality home-stereo equipment. Also, Sample B never sounded “bad,” and without a “clear” Sample A to compare it with, I'd probably be perfectly happy listening to Sample B.

But absolute reality isn't the point here. Verance's watermarking will debut on DVD Audio discs that target discriminating audiophiles. Why would these folks pay thou-

sands of dollars for equipment and dozens of dollars per disc to listen to media that they perceive has less-than-optimal quality because of a watermark? I don't dispute the music industry's right to protect media from copyright infringement, but watermarking is a technology that appears to benefit only sellers and, in fact, is a detriment for buyers. As such, from where I'm sitting, watermarking seems destined to fail. In fact, backlash against DVD Audio may prove to be a boon for DTS (Digital Theater Systems), which for several years now has been promoting multichannel surround-audio CDs. Ironically, DTS uses perceptual audio compression, but it's of a high quality and is untainted by the stench of Hollywood heavy-handedness.

None of the Verance or record-label representatives will give me a straight answer about whether their watermarking plans extend to conventional Red Book audio CDs.

From past experience, this kind of behavior often suggests that I'm getting close to the truth. I'm equally skeptical of audible watermarking's chances here. On the one hand, you could make a credible argument that the average audio CD listener has less stringent listening standards than an audiophile. On the other hand, there are a lot more potential audio-CD customers than DVD-Audio customers. As Intel learned with its Pentium floating-point debacle of a few years back, perception without reality still effectively mobilizes public backlash. Should the record labels attempt to shove watermarking down consumer's throats, they might be surprised at what comes back at them.

About the only chance I see for the type of watermarking I heard at AES is for use with already lossy-compressed audio intended for playback exclusively through cheap speakers and headphones. In this case, far more egregious distortions

would conceal watermarking effects. Speaking of lossy compression, isn't the whole point of this technique to "throw away" material that the encoder deems inaudible or barely audible? Verance may claim that its watermark survives multiple iterations of today's lossy codecs, but no one can guarantee, unless crystal balls really work, that watermarking can withstand the more advanced compression algorithms of the future.

You've heard the expression "You can lead a horse to water, but you can't make him drink?" Well, you can also drag a consumer to the watermark, but you can't make him or her stop thinking. Buyer beware.

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#### REFERENCE

1. "Media security thwarts temptation, permits prosecution," *EDN*, June 22, 2000, pg 101.

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