Audio compression can make or break fidelity of digital music files

by Jonathan Sidener

At the Kensington Vine wine bar in San Diego, an iPod sits on the corner of the counter, pumping sound to the stereo that runs speakers throughout the business.

SOUND GOOD? - Portable digital audio can be equal in quality to CD audio if you adjust the compression rate when you record it. CNS Graphic by Cristina Martinez Byvik. A BIT BETTER - Scott Owen, co-owner of Kensington Vine wine bar in San Diego, holds his iPod. The former Kyocera engineer filled it with songs ripped from CDs at an enhanced compression rate, and then wired to the wine bar's audio system. CNS Photo by Nancee E. Lewis. Portable audio - digital music files compressed to fit on a mobile device - might not always be up to the task of filling multiple rooms with sound. But in this case, it sounds pretty good.

It has something to do with the fact that co-owner Scott Owen knows a lot about digital audio from his former job as a Kyocera engineer.

Once upon a time, a song was a song. The longer it was, the more space it took up on the vinyl or cassette. With digital audio, that's no longer true. Portable digital audio can be equal in quality to CDs, nearly equal to CDs or of lower quality than CDs. Each version results in a different file size.

Audio compression - which determines the size and quality of the portable file - remains a mystery to many people, including many fans of iPods and other music players.

Further complicating the matter are emerging formats that store music at higher-than-CD quality, sometimes called high-definition audio.

Consumers ignored earlier attempts at high-definition audio, but two new formats are finding a home on

Blu-Ray and HD-DVD high-definition movie players.

In many ways, audio compression is comparable to digital photos, which degrade in quality as the amount of digital information is reduced. A low-resolution, compressed photo may look fine as a small image on a Web page, but try to enlarge it or print it and it won't look so good.

Similarly, a song from iTunes or other online music store will sound good on a morning jog, bus ride or other less-than-perfect acoustic setting. But to audiophiles, the portable tracks sound flat when played on a good stereo in an otherwise quiet room. As with the Web photo, the online track has had information removed to create a smaller file.

In the wine bar he owns with his brother Lance, Owen doesn't play any songs from the iTunes store. Instead, he has filled the iPod with songs ripped from CDs. That way, he controlled the compression process and limited how much information was removed from the songs.

"It was a trade-off," Owen said. "I wanted near-CD quality. I got higher quality, but that meant bigger files, so there was room for fewer songs."

One of the main factors in audio compression is the data rate, or bit rate. Like the megapixel measurement in photography, the data rate tells you how much digital information is in a file.

Music on a CD is uncompressed and has a bit rate of 1,410 kilobits per second. A four-minute song takes up about 40 megabytes of space on the CD.

In the early days of MP3s and Napster, files were often compressed to a bit rate of 64 kilobits per second, or

64k. That reduced a four-minute song to about 1.6 megabytes, but with a significant loss of quality.

As high-speed Internet connections became more common, and cable and DSL services grew faster, it wasn't as important to compress the files so much. A bit rate of 128k became much more common. Apple's iTunes store compresses all the songs it sells to 128k. A four-minute song at 128k takes up about 4 megabytes.

Apple said that in May, music licensed from EMI will be available in a higher-quality format - 256k.

For many portable-music fans, 128k compression comes close enough to the original CD recording that they're happy listening to iTunes tracks on home stereos.

To others, such as Owen, there's a discernible difference between CD quality and a 128k file. Using iTunes software, he compressed his CDs to a bit rate of 192k, which is widely considered to be very near to CD quality.

Some audiophiles use something called "lossless compression" for their files. This reduces the file size slightly, without losing any data.

Compression technologies attempt to eliminate portions of the audio file that people can't hear, using the science of "psychoacoustics."

One way to understand psychoacoustics is to think of a conversation held in a car traveling down a noisy street, said Francois Thuiliere, director of marketing and business development for audio and MP3 licensing for media company Thomson. Thuiliere and other Thomson employees develop and market the music system from the company's San Diego offices.

The acoustics in the car aren't good, yet people are able to carry on a conversation, tuning out background noise. The brain is able to compensate, and conversants might say they could hear each other perfectly when they couldn't.

Compression technologies make files smaller by saving the key parts, letting the brain complete the sound, Thuiliere said.

"We analyze the signal and decide which frequencies the human ear wouldn't hear," he said. "We throw away a bunch of information that you can't hear."

Thuiliere said that few, if any, people can hear the difference between CD songs and compressed music at 160k or higher. "In listening tests, nobody can hear the difference," he said. "I've never met anyone who can pass that test."

While portable-music fans wade through, and debate, audio compression, movie buffs face another pair of audio technologies. High-definition movie systems Blu-Ray and HD-DVD are capable of playing either Dolby's TrueHD audio or Digital Theater System's DTS-HD, or both.

The two technologies are considered "better than CD" quality because they more precisely record an analog sound wave. In addition, they provide lossless audio for movie soundtracks, as opposed to today's DVD audio, which loses data when soundtracks are compressed.

Multichannel lossless audio will improve the home-theater experience, said Jack Buser, Dolby's TrueHD technology evangelist.

"Certainly it will make a difference," Buser said. "Twenty-four-bit audio (compared with a CD's 16-bit audio) will provide subtle gradients in sound that will be critical to re-creating natural sound.

"Of course, it depends on the listening context. You're not going to notice the difference if you're just listening on a pair of small TV speakers."

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