Mastering the new challenges for encoding compressed audio

No longer the stepchild to the CD, compressed audio formats such as MP3, AAC and WM-9 are coming into their own as primary mastering considerations, and the mastering industry's burgeoning second-tier seems poised to take the lead on this significant shift.

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The Internet is becoming increasingly better as a resource for music distribution. The question is, will it start sounding better, too?

The apparent success of Apple's iTunes online distribution venture, which sold one million downloads at 99 cents each in its first week, may have provided the music industry with a long-sought new business digital-age model. The EU's antitrust ruling in March against Microsoft, which totalled a record €497 million (US$613 million), specifically noted that the bundling of the software giant's Media Player presents unacceptable challenges to other online content providers. This underscores the extent to which downloaded music has become a force in the entertainment business globally. Furthermore, also in March, Wal-Mart, which tops the Fortune 500 list of companies, introduced its own music download operation, with songs priced at 88 cents (€0.73), undercutting the 99-cent rate used by iTunes, Roxio and RealNetworks.

This relatively quick establishment of a viable online retail infrastructure for music is having a technical side effect: the legitimisation, in the eyes of the musicians and mastering engineers of compressed audio formats as legitimate music carriers. Often derided for its sound quality by audiophiles, MP3 has nonetheless made the jump from ripping to retail.

As the online music distribution experience gains momentum, other file formats have come along. These include Advanced Audio Coding (AAC), part of the MPEG-4 specification and

Apple's iTunes boosting downloads

the one used by iTunes; and Windows Media Audio (WMA), aimed at the PC market, whose latest iteration, WM-9, is being heavily promoted by Microsoft for a number of applications including HD-DVD. All have technical differences, but by offering higher resolution and sampling rates in even smaller

Parallelling the attention that second-tier mastering facilities have paid to compressed audio mastering, alternative music producers and independent recording artists are among those most actively advocating approaching compressed formats as their own distinct entities.

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file sizes than MP3, each will form part of the fabric of music distribution and something that mastering engineers will have to address in an era of digital format diversity.

Key to this shift to using compressed audio for quality online distribution, though, is the fact that each of the popular codecs has its own sonic 'personality' and processing moves, such as equalisation and compression. Even the application of effects, such as reverb and delays, produce different sonic results from one codec to another.

"We all mix to accommodate a format to one degree or another, be it MP3 or a CD," says Pat Dillett, producer for artists including They Might Be Giants and Mono Puff, and a longtime critic of compressed audio formats. "But I am glad that the file formats that people are looking at for distribution are improving sonically."

Mastering engineers are beginning to encounter compressed formats not as afterthoughts, but as primary considerations. Independent recording artists are demanding it, as many have come into the profession with MP3 and other formats being

as familiar a way to access music, as a CD has been for 20 years or vinyl before that was. In the process, they're realising that these formats have their own issues.

Mastering engineer Dave Kutch, whose discography is heavily weighted with alt rock, punky pop (like Pink) and hip-hop, recently heard a track he had mastered played back, but was unaware he was listening to an MP3 file.

"I listened and it sounded OK, but there was something that wasn't right," he recalls. "Then I realised the stereo image was narrow and shallow. There was no depth to the track. It was fine in terms of frequency response being there. There was bottom on the track. But the image was skewed."

Brent Lambert of Kitchen Mastering

No hard-and-fast rules

There is no rule-book when it comes to mastering for these formats. Rather, mastering engineers are learning as they go along. For instance, the issue that Kutch raises is becoming a common one.

Robert 'Void' Caprio, an engineer who works mostly with emerging artists, says he has gotten feedback from mastering engineers about the problem. He has responded by adapting his mixes when he knows that the artist is going heavily into distributing his music by downloading.

"Exaggerating the stereo image in the mix addresses this issue, but the process is so recent that there's no hard-and-fast guidelines for how much to compensate," he says. "Those will likely evolve the way 5.1 techniques have – by trial and error. I've found that adding more reverb to everything helps. Most reverbs are stereo and won't come across in mono unless you boost them. That seems to apply to all ambiance processing for compressed file formats, as well. But it's really all a matter of listening to the music in a few download formats, then experimenting."

Low frequencies pose a particular challenge for the compression/computer combination. Caprio's response is to use pitch shifting and create an octave-higher clone of the bass track and 'ghost' it in with the original.

Brent Lambert, owner and chief mastering engineer at Kitchen Mastering in North Carolina, is typical of the second-tier facility catering to independent artists and which are experiencing increasing demand for codec-specific mastering. He also agrees that there are no resources other than empirical experimentation from which to draw expertise. Much of the techniques Lambert uses he also developed by trial and error, and curiously, many revolve around 'fooling' or spoofing the encoding process. For instance, if the information from a stereo source is relatively static (for example, there is little in the way of panning and information assigned to left and right channels stay in those channels), MP3 encoders will often attempt to sum that information to mono, particularly lower-frequency information. Lambert's response is to use a Cranesong analogue dithering CD that is essentially a subsonic LFO that modulates constantly in stereo to maintain the illusion of movement between channels.

David Hill, owner of Cranesong, was surprised to hear of this novel use of his product, which is normally used to dither digital files from 24 to 16 bits. "I never thought of it for that application, but theoretically it certainly can work," he told *One to One.*

Conversely, if Lambert knows the track is headed primarily for a computer playback environment, he'll enhance its

monaural aspects, which he says will give it more punch in computer speakers.

Robert Caprio has also discovered that the computer monitoring environment adds yet another dimension to the issue, one as much perceptual as quantifiable. "There's a tendency to want to hype things significantly, because you feel you need to compensate for the monitoring environments that usually come with computers," he explains.

Lambert also seeks to minimise what is known as the 'gill effect' – the inclination of encoders to want to break up incoming information into segmented frequency bands for analysis.

"When the frequency bands are put back together again it can create peaks where they overlap, which creates information 'bumps' that exceed the amount of information that was inputted," he says. "It can produce up to 6dB of clipping where the bands overlap. So what I'll do is typically reduce the gain structure going in, but between 3–4dB."

Another technology trick Lambert likes is to use a Pacific Microsonics HDCD compression system to raise the level of certain parts of the digital word, which are treated less than equally by the codec. "Low-level stuff begins to disappear when the codec is processing it, and that will distort the stereo imaging," he says. "The HDCD engine brings up information contained in the 9–16th bit."

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"Sometimes," Lambert continues, "the amount of overlap is program-dependent. In fact, that is the case with almost everything, since the amount and type of information being encoded will also affect the 'personality' traits of the codec. You really have to listen for it. It's difficult to predict how any given set of information is going to be affected by a given codec."

A new and quickly growing sector in downloaded music is the live-show MP3. This has become a bread-and-butter revenue generator for Airshow Mastering in Boulder, Colorado.

In an interesting trend, one that may help define the codec landscape in years to come, the audience for an array of jam bands including Phish, String Cheese Incident and Yonder Mountain String Band, has centered on the FLAC lossless codec as its format of choice.

David Glasser, Airshow's chief engineer and owner, says he was skeptical of FLAC initially. This was until he ran a test using an HDCD-encoded master, which was then encoded into FLAC and posted to an FTP site, then retrieved it and found that the extraction maintained fidelity to the original.

More listeners are turning to MP3 players

"It reduces the file size by 40–60%," he says. "This combination of lossless compression and smaller file sizes has made FLAC widespread with fans of jam bands. For people with a broadband connection who want higher audio quality than an MP3, this is a good choice." FLAC's lossless nature also means mastering is done as it would be for a CD, Glasser adds.

Lorenz Vauck of XARC Mastering

Brad Serling, CEO of nugs.net, the portal site for many of the jam bands' live concerts and for artists including Metallica and Dave Matthews Band, agrees that his site's audience has recognised the need for lossless compression formats. "Making 'lossy' compression sound good takes work," he says. "You're constantly trying to get maximum usage out of each sample size, and you're always trying to fool the codec."

The codec landscape

Sony is planning to roll out its next generation codec, which was originally used for the MiniDisc platform. ATRAC 3plus is expected to be ready sometime later this year. Sony declined to discuss the format in depth. However, a source at the company's e-Platform Technology division confirms that it's designed to function optimally at low bit-rate levels, intended apparently to address the fact that much of the download music torrent will continue to pour through non-broadband portals for the foreseeable future.

"The emphasis seems to be less on the quality of the download than on how many songs you can fit onto one piece of media," the source observes. The 64kbps transfer rate is considered to be a 'sweet spot', the source noted, and that ATRAC 3plus will optimise itself to approximate the 128kbps rate of AAC, the codec used with Apple's iTunes format.

The introduction of ATRAC 3plus is intended to coincide roughly with the launch this year of Connect, Sony's online music distribution service. In anticipation of that, Sony is expanding the number of labels it is supplying with the ATRAC codec (Warner's has had it for some time already). In addition, Sony has been encouraging the development of third-party toolsets for the codec. Sonic Studio LLC, the audio spin-off from Sonic, is ready with Encode, a plug-in-type utility aimed, in part, at the mastering market. While Encode will provide some level of parameter adjustments for mastering engineers, it's not a significant departure from the batch-processing approach taken by major labels towards codecs.

"Encode is made for the production level," says Eric Jorde, president of Sonic Studio. "The type of adjustments it's capable of are not at the same level as variable-bit coding. It's meant to process of a finished CD master."

However, mastering specifically for a compressed format will not necessarily remain a small niche. The source at Sony expects to see the issue of quality control of compressed masters migrating upstream to the record label level. He further suggests that compressed downloaded music could tier itself in much the same way that CDs have, with 'premium' mastered editions, such as Pink Floyd's *Dark Side of the Moon* collector's edition, selling for more than standard versions. "We're at the batch level of processing now," he says. "The next step is to engage the mastering engineer."

Bob Ludwig (pictured, p49), owner of Gateway Mastering in Portland, Maine, and considered one of the deans of the mastering elite, hasn't seen much demand for compressed-format mastering. Ludwig agrees this is typical considering that the bulk of his business still rests with major labels and CDs. "But it could start tomorrow," he notes.

Anticipating a time when it does go more mainstream, Ludwig has already experimented with compressed-format mastering. His findings match those of others. Referring to the original ATRAC codec, he says: "You would hear changes in timbre when you compressed the material. But when you went in to adjust for that, that move would change other things."

Ludwig established a methodology to test how various codecs affected music files: he used a realtime FFT box made by Gotham Audio that had a sufficiently large internal buffer to store two versions of the same song. The FFT algorithm would then do a subtractive

analysis of the compressed and uncompressed versions. The findings were somewhat confusing.

"From a purely mathematical point of view, any changes the compressed version encountered were averaged out over the course of a minute of music," he reports. "But you would still hear this 'ripple' effect on individual elements of the song: if a high bell sound was introduced, it would affect the sound of the vocal." In a way, the unpredictability of a codec on a given piece of music reminds Ludwig of working with tape. "We have EQ and compression, but we don't have a resolution knob," he says. Another technique Ludwig has used is to truncate a file's bit rate prior to mastering, using a dB Technologies' sample rate converter and a DCS 974 digital-to-digital converter. "I'll lower it to 22.5kHz for starters," he explains. "True, you're losing information, but by using professional boxes you're losing it in a more musical way."

These issues do become less problematic at higher bit rates, but the market landscape at the moment, and for the foreseeable future, argues that downloads will have to be compressed and distributed at lower bit rates, as the majority of users will not have broadband for many years.

None of the mastering engineers interviewed had yet experimented with streaming digital audio. However, recent experiments with digital satellite radio, which was launched in the US a little over a year ago, indicate that mixing various bit rates in a stream – such as low-bandwidth talk radio and high-bandwidth classical music – creates its own averaging effect, in the form of a preconditioned signal. "The frequency response [of the music] goes just to a certain point and then there are no longer any natural harmonics," says one engineer familiar with the effect.

Codec-specific mastering has yet to become a widespread phenomenon. But mastering engineers, whose livelihood rests largely on their traditional positions as the last resort of quality prior to mass manufacturing, are beginning to realise that any mastering for the download sector is better than no mastering at all, or botched mastering attempts using mass-market software.

Allen Tucker, owner of Foothill Digital in New York, is resigned a time in the not-too-distant future in which mastering becomes one more audio recording process that remains completely inside the computer. "I can see a point when it never gets to the physical media stage," he says, echoing a lament many mastering engineers share. "But like everything else having to do with digital, I think the outcome of where it's all going is no longer in our hands." ∎

ONLINE PERSPECTIVE

Lorenz Vauck is the owner of online mastering facility XARC Mastering in Dresden. Vauck's clientele is completely Internet based, he says, with 180 clients in 25 countries sending mastering in via non-physical means. He suggests engineers check out the Lame MP3 encoder found at http://mitiok.free.fr/, which is a piece of constantly revised shareware that gets what he describes as 'psychoacoustic optimisations on a very regular basis,' and which has over 100 modifiable parameters.

"I also always prefer VBR encoding to allocate more bits for more complex parts of tracks," he explains. "The Lame handles this perfectly and VBR is no longer the inferior-sounding option compared to CBR. I can reach results at 192kb (average VBR), which have frequency response fluctuations of less then +/-0.2 dB in the 20–18000kHz range and +/-1 dB above and a perfectly maintained stereo image compared with the original uncompressed master." Going any lower in bit rate dramatically drops the quality, which is in the nature of the format with every encoder, says Vauck. "The biggest downside about encoding is that any peak limiting will be lost and the song can clip. This is why I often reduce the volume of the song by -1dB to compensate for this. Also, the Lame MP3 encoder also carries a hidden feature that allows you to use experimental psychoacoustic tunings from Naoki Shibata. They really improve the overall sound quality."