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The sound of science

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Lars Liljeryd woke up one morning in 1996 with a hangover and an idea that would transform the science of digital audio.

A Swedish inventor and erstwhile rock drummer, Liljeryd had toyed with ways of compressing and transforming audio for years. That morning, he came up with a way of radically shrinking the amount of information needed to store a song or speech in digital form.

The idea led to a handful of patents and a new business, ultimately attracting the crack engineering team largely responsible for creating the popular MP3 and Advanced Audio Coding (AAC) digital music formats. Liljeryd and his company [Coding Technologies](#) are still far from household names, but they've helped move the industry standard for digital audio technology beyond what many researchers had thought possible.

"A lot of times you look at what you've achieved and say, 'That's the end of the road, you can't get any farther,'" the 53-year-old inventor said. "But then another guy comes along with another way of looking at things. We've sidestepped traditional thinking in many ways."

Coding Technologies is one of the few small start-ups that have made a significant mark in a digital audio, a field that is increasingly dominated by giants such as Microsoft, Sony, and Germany's Fraunhofer Institute for Integrated Circuits. The company's growing success shows there remains ample room for unconventional thinkers and iconoclasts to shake up the industry in unexpected ways.



LARS LILJERYD
CHIEF SCIENTIST,
CODING
TECHNOLOGIES

Liljeryd's original idea, which was honed and extended by the team of audio researchers that joined him later, helps increase the compression offered by other audio compression techniques--even those that researchers had thought fully "squeezed"--by a third or even by a half. For online audio and, particularly, for mobile phone networking and satellite broadcasting, that can be a godsend.

The technique is being adopted rapidly. The [XM Satellite Radio](#) service uses its format, as do cell phone operators in Korea and England. Coding Technologies is helping China develop a [digital multimedia platform](#)

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that will become that country's version of the DVD. And a year ago, the Motion Picture Experts Group (MPEG) officially adopted the company's work as an **official industry standard**, all but assuring its use in a wide variety of applications.

"I believe that this is the most significant audio coding technology to come out of MPEG since Advanced Audio Coding (AAC)," wrote Schuyler Quackenbush, an audio technology consultant and chairman of the MPEG committee overseeing audio compression, in an e-mail interview. "It has set the pace for improvement over prior technology in MPEG audio coding."

From deep sea diving to the Net

Many audio pioneers get their start in a university or another research institution. Liljeryd, then a recording engineer and consultant with a few inventions already under his belt, got his big break when someone from the North Sea oil wells stopped by his offices in the mid-1980s.

"You know anything about diving?" the man asked. Liljeryd said he didn't, or not much--but in reality the visitor was looking for someone who knew more about audio than about deep-sea diving. His project's divers were going deep enough to need large amounts of helium mixed in with their oxygen, turning their voices while diving into high-pitched squeaks. That made communicating with the surface difficult, the visitor said.

Liljeryd created a digital pitch-shifter that would transform the divers' voices back to comprehensible levels. He worked on the project for the better part of a decade, while his outside interests in digital audio compression and transformation grew. He worked on a hearing-aid project until he ran out of money. And then in 1996, he woke up in the bunk of the boat he lives on with the headache and the new idea.

Ever-smaller packages

Most compressed digital audio formats, also known as "codecs," shrink the large digital files found on CDs using a technique known as "perceptual audio coding." Essentially, that means they throw out the parts of the original audio file that will be least missed by the human ear.

That's a complicated and often extremely subjective task. But one rule of thumb is that to get small files, the very high and very low frequencies are shaved off or thrown out altogether. Typically, that retains all the notes in a song, but makes the audio sound much thinner than in the original.







Liljeryd's idea was a twist on this. He reasoned that much of the information in the high frequencies of an audio file could actually be derived from the lower frequencies. So, abandoning the traditional approach, he came up with a method that shrank files by leaving out the high-pitched part and sending instructions about how to recreate the lost sound from information contained in the low frequencies.

It's a little like sending a picture of half a person's face along with hints for reconstructing the other half: A full portrait can then be recreated from those instructions.









Bringing on the MP3 team

When he started filing for patents on his process, Liljeryd was already a member of the MPEG standards-setting group. He started












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attending meetings, looking for "hotshots" in the audio business, he said. There he met Martin Dietz, who led the team of researchers at Germany's Fraunhofer Institute that had done most of the work to create the MP3 and AAC audio standards.



The first time they met, Liljeryd was in a pickle, however. He hadn't finished the patent-filing process, and so he couldn't actually explain how his technique worked. He pulled Dietz aside and said he could improve on AAC (the technology that the Fraunhofer team had worked on for years). He just couldn't say exactly how yet.

Dietz was skeptical, but the two were soon thrown together again. Liljeryd joined the **Digital Radio Mondiale** coalition, a group trying to rescue the AM radio spectrum from obsolescence with digital broadcasting techniques, in part using Fraunhofer's AAC technology.

"I thought if I joined, it would force us to work together," Liljeryd said. "It was a simple little strategy, but it turned out very well."

After a close look at Liljeryd's technology, Dietz and his team were convinced. With a little more exposure, they decided to join forces. The Fraunhofer engineers agreed to leave the prestigious research institute to merge their audio know-how with Liljeryd's ideas.

"(Liljeryd) is the prototype of an entrepreneur," Dietz said. "He didn't study engineering; he is very much a self-made man. What is special about him is that he can get a lot of information from a lot of different fields. But he needs a big and skilled team to turn his ideas into reality."

Dietz became chief executive of the new company, which took Liljeryd's company name of Coding Technologies and which was based in Germany with most of the Fraunhofer team. Liljeryd took the role of chief scientist, remaining in Sweden.

Moving forward

The ensuing years have been ones of steady progress. Dietz and his team applied Liljeryd's process to their MP3 codec and licensed it to Thomson as MP3Pro. With AAC, the company decided to keep the licensing and marketing in-house. It called its version AACPlus, and it has had considerable success licensing the technology to satellite broadcasting, mobile phone and Internet companies. AACPlus has even been added to the MPEG's standard set of audio tools.

While Coding Technologies is still a small company competing against giants such as Microsoft, it does have a few advantages. One is the support of MPEG's standards group, which has led streaming media companies such as RealNetworks to support its version of the AAC codec.

"We've been very happy with them," Sherman Griffin, RealNetworks' marketing director, said. "Their AAC implementation was the highest quality of the ones we tested."

As well as marketing its own codecs, the company potentially has the power to apply Liljeryd's ideas to any other audio formats that exist, such as those from Microsoft and Sony. Those companies have shown little sign of moving in that direction today, but as competition

grows tighter in the audio business, the option remains.

Liljeryd himself just sailed back from Majorca, Spain, where he bought a new 90-foot yacht to live in. His old 58-foot boat was "drowning" in computers and audio cables, he said.

He's got a few new ideas that he's not quite willing to discuss yet. They may or may not find their way to Coding Technologies. He gives most of the credit for turning the ideas into practical applications to Dietz and the other engineers, however.

"I'm trying to be one that creates the basic ideas, then relying on the scientists to (develop them)," he said. "That's usually how it works. I don't want too much credit. But I did start off the little tricks."

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