Digital Production in Live Sound ⊙ Wireless and HDTV

AUDIO 2000

A PRIMEDIA Intertec PUBLICATION WWW.MIXONLINE.COM JANUARY 1999

The Future of Audio

Developers Reveal Their R&D Plans

⊙ ⊙ ⊙

Music Delivery On the Web

What's Legal, What's Next

⊙ ⊙ ⊙

Technology Free-for-All

Mix columnists Stephen St.Croix and Paul D. Lehrman Go Head to Head

A Supplement to MIX

World Radio History

5.1 Surround Sound...

It's a jungle out there

Mixing six or more discrete channels of audio for film is already well established but the scope afforded by 5.1 surround for music and broadcasting has yet to be realised. There are no rules. There are challenges, there are opportunities - but there's only one certainty - it's on the way.

Before venturing into the unknown, be comforted to learn that Solid State Logic consoles are already equipped to tackle the surround sound future - in all current and envisaged formats, including DVD. And, come the 5.1 revolution, the enormous advantages of proven SSL technology such as snapshot and dynamic automation, instant reset and unparalleled audio quality will be even more apparent.

Clear your path through the surround sound jungle with cutting edge technology from SSL, the world's leading console manufacturer.

SL 9000 J Series - The ultimate analogue console that's become the benchmark for the international recording and film scoring communities.

Axiom-MT - The in-line digital multi-track console with a control surface so intuitive it could be analogue.

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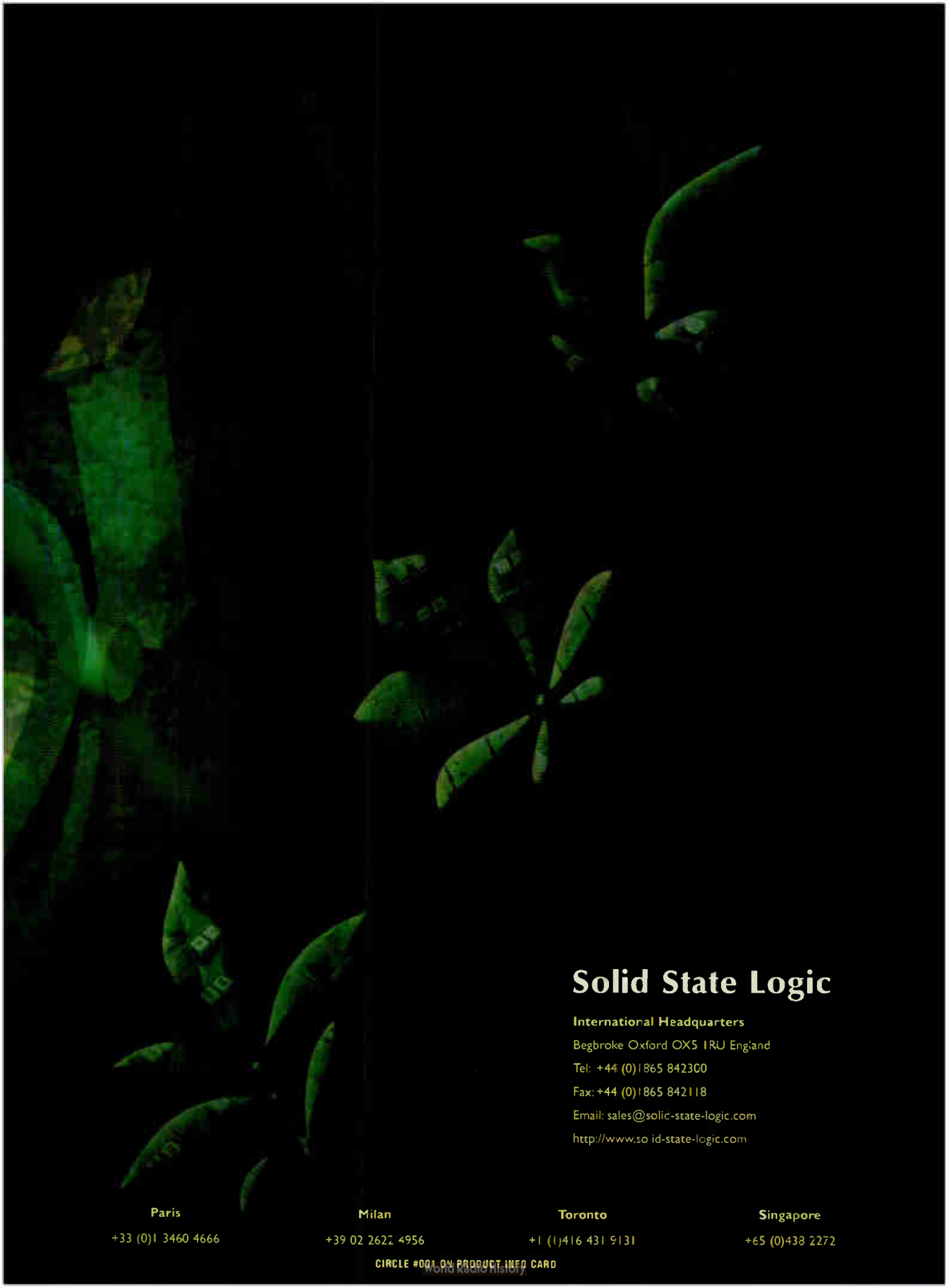

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CIRCLE #001 ON PRODUCT INFO CARD

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For those days when the road ahead seems a bit bizarre.

Like every day.

There's no way to know what's on the road ahead. You can't predict when lighting will strike. Or whether it will result in a windfall or an extraordinary challenge.

In our fifty years, we at Studer have learned that there's really no such thing as an ordinary session. And even in the best planned situations, hardly anything goes according to plan. For these times there's the new D950, the Studer of digital consoles.

The D950 grows from Studer's heritage of unparalleled excellence in sound. Synonymous with Swiss precision, its design is a blend of astonishing capabilities, meticulous construction and renowned reliability.

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Considering the unpredictability you face every day, surprises are the last thing you need from your console. And for all the D950's remarkable achievements, perhaps its most comforting is Studer's unfailing lack of surprises.

So if the road to the future of audio is confusing, let us offer directions— The Studer D950. Built for the road unexpected. The one you travel every day.

Introducing The D950.
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5.1 SURROUND

The unique Tannoy Dual Concentric point source technology offers the professional recording engineer a strategic advantage when mixing and creating effects for film and music in the 5.1 surround format.

True surround sound is a virtual 3-dimensional sound stage that demands linear phase and amplitude response vertically as well as horizontally to be convincing. The smooth, conical dispersion of the Dual Concentric propagates a naturally holistic wavefront in all directions into the mixing environment, empowering the engineer with accurate 3D spatial imaging for superior results.

Unlike stereo which only has to create an accurate image between and somewhat to the sides of the mix position (usually a small sweet spot), convincing 5.1 surround mixing and scoring demand much more from your monitoring system. The environment must be transformed into a totally 3-dimensional sound stage to be done effectively. This relies on a linear response from the loudspeaker both on and off axis in both the horizontal and vertical planes.

This is simply not possible with conventional multi-driver discrete loudspeakers, which pose a plethora of problems with amplitude linearity, especially off-axis in the vertical dimension. While they might work fine in a fixed position for stereo music production, they just cannot compete with the Tannoy Dual Concentric's ability to reproduce accurate imaging and placement in a 3D stage requiring a linear response on all axis.

If you're interested in superior results when scoring, producing and mixing 5.1, you should know what the best in the business have known for years, Tannoy Dual Concentric point source constant directivity driver technology can accurately steer your next surround project into the big time.

Please contact TGI North America for more information.

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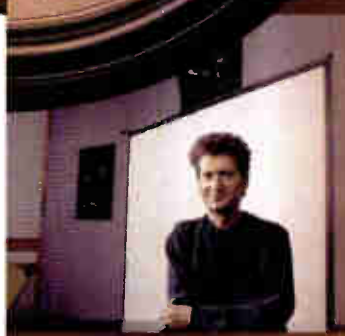

Whether I am creating a pounding action cue or a subtle mood piece, it is essential that I know how the music truly sounds. The detail and accuracy of the Tannoy Dual Concentric gives me complete confidence that my score will bond seamlessly with the scene and the characters and not clash with the dialogue or the sound effects.

Brad Fiedel

Credits: *Terminator II • True Lies • Striking Distance • The Accused • Tom Hanks 'Earth to the Moon" • Blue Steel*

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Frank Serafine

Credits: *Orgazmo • Field of Dreams • Hunt for Red October • Flight of the Navigator*

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EASIEST TO USE *"It acts, walks and talks very much like an analog console."* – Bruce Nazarian, Virtual Post, Burbank Ca • *"With some digital consoles, you feel like you're working on a computer. The [D8B] feels just like working on a regular, analog console. Right out of the box, it's so easy to use, I couldn't believe it."* – Brian Foraker Recording Engineer for Yes, Heart, and Oingo Boingo • *"With the Digital 8•Bus, you just go for it. It's very much like analog boards—not a lot of pages to step through. You can keep your mind on the music and the task at hand."* – Steve Boyce, Audio Dept. Manager, Redmond, WA • **MORE D8B DETAILS** 12 discrete high- definition mic preamps • Support of all SMPTE frame rates and MIDI Machine Control • Full 5.1 and 7.1 surround sound capabilities • **SUPERIOR AUDIO QUALITY** 24-bit, 128X oversampling D/A and A/D converters • 32-bit internal processing • Apogee UV22™ Super CD Encoding

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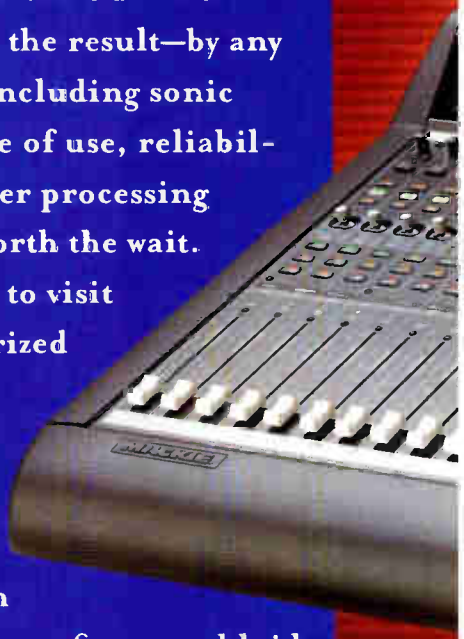

Greg Mackie, Founder

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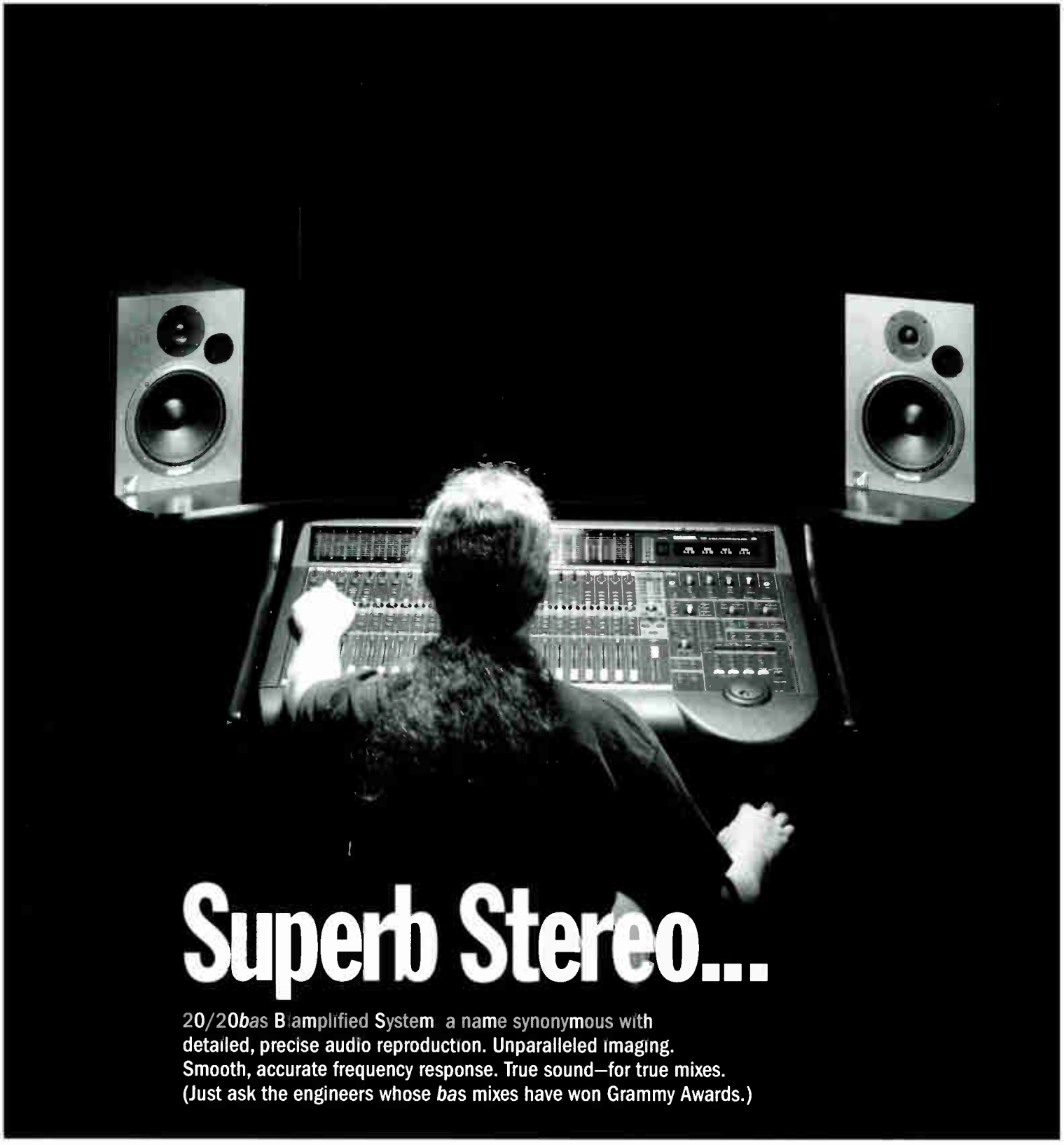

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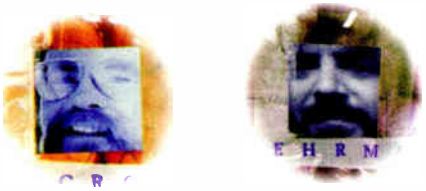
10 From the Editor



12 The Fast Lane Meets Insider Audio

In Which Mix's Columnists Take Stock and Debate What's Coming for Our Changing Industry

Learn a bit more about Stephen St.Croix and Paul D. Lehrman, longtime *Mix* columnists and audio industry raconteurs, as they go *mano a mano* in a wide-ranging debate about the past, present and future of recording and technology. Love 'em or hate 'em, their opinions are always provocative.

36 Electronic Music Delivery

Major Players Look Ahead to the Future of Internet Audio *by Philip De Lancie*

Mix media and mastering editor Phil De Lancie delves into the myths and technical realities of downloadable music—as it stands today and what it promises for the future. Hear from those at the forefront, including Gerry Kearby, CEO of Liquid Audio; Howie Singer, CTO of a2bmusic; Tom McPartland, CEO of TCI Music; and Ted Hooban, director of digital products for online record retailer CDnow.

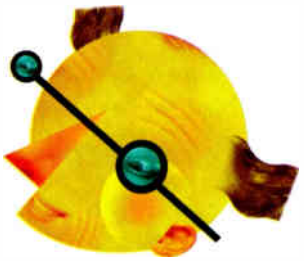
50 The Music Industry and the Internet

In the Online World, Piracy and Protection Are the Hot Topics *by Sarah Jones*

The labels are scrambling to protect artists, while breaking bands search for ways to get their songs to the masses. The RIAA is suing manufacturers that don't copy-protect their systems. And companies are feverishly trying to figure out ways to watermark original material. The brave new world of electronic music delivery is not as simple as uploading/downloading a song—there are basic artist rights to consider.

58 Audio in the Year 2000

A Behind-the-Scenes Glimpse at Technologies for the New Millennium *by George Petersen*



How does the manufacturing community plan for a future that may or may not be obsolete? Who can predict what technologies will make their way into daily use five years down the road? When will terabyte storage make its way into facilities, and why are they already talking beyond 5.1? *Mix* editor George Petersen talks to industry technologists and finds out where we are all headed.

84 2001, A Live Sound Odyssey

The Future Is Digital *by Mark Frink*

It doesn't take a rocket scientist to figure out that the future of audio lies with digital technology, but in the sound reinforcement industry, it's been a piece-by-piece transition. *Mix* sound reinforcement editor Mark Frink takes a look at the signal chain and predicts how the live sound systems of the future might shape up. Hint: It's more than just computer control!

96 Ad Index/Product Information Card

98 Wireless in the Age of Digital TV

Mic Makers Respond to Spectrum Changes *by Ty Ford*

The arrival of digital television in major markets this past fall has ramifications far beyond new sets in the home. It has created a jungle in the airwaves, and FCC guidelines regarding the broadcast spectrum affect everything from emergency response systems to wireless mic frequencies on tour. Learn what's going on in the UHF and VHF bands, and what you can do to make life easier the next time you pull into Atlanta…or Chicago…or Los Angeles.

Cover illustration: Tim Gleason

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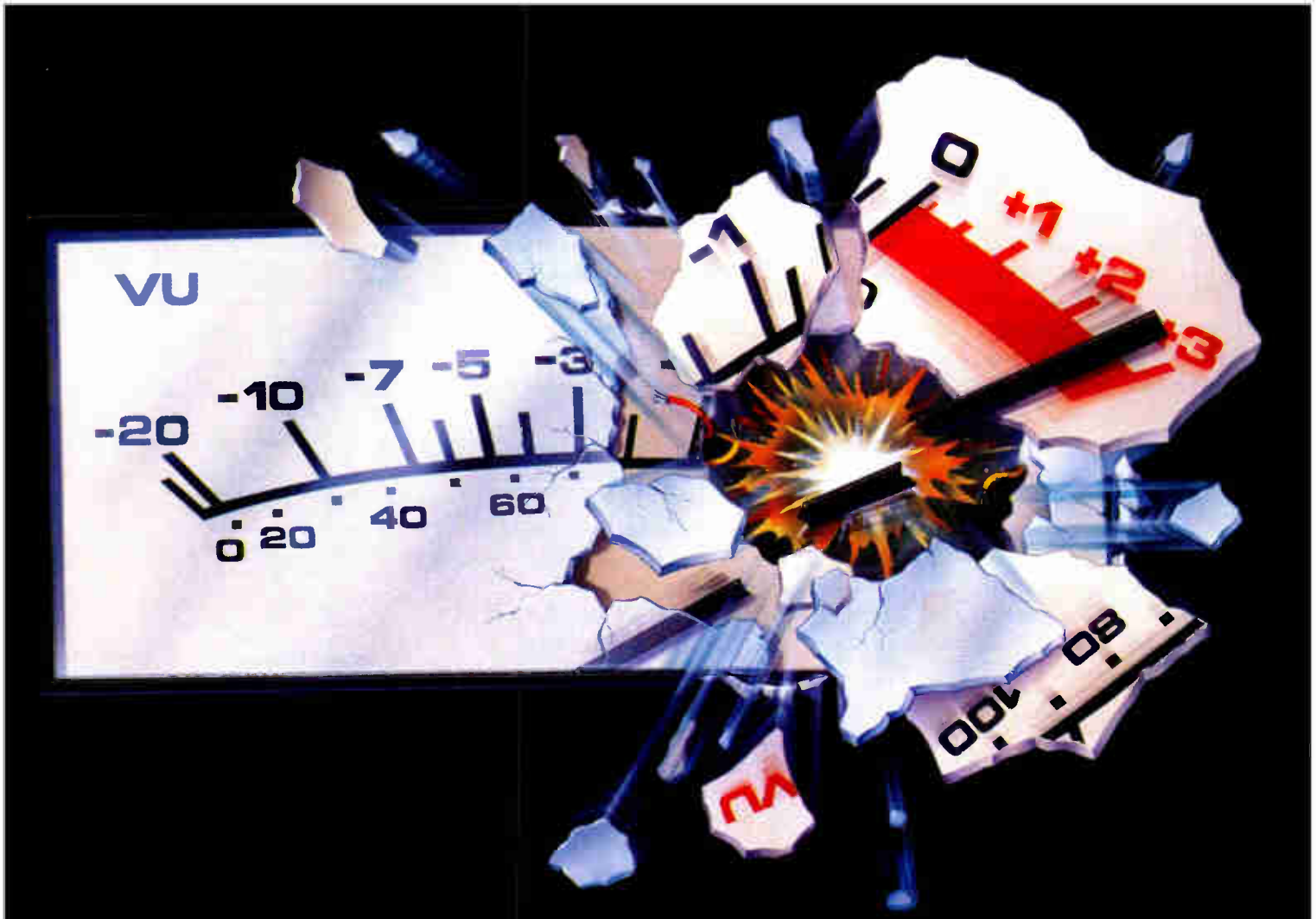

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Checklist for the New Millennium

THERE ARE ONLY 365 DAYS TO GO UNTIL THE BIG BLOWOUT, BUT BEFORE YOU START buying party hats and stocking up on magnums of '88 Louis Roederer Cristal Rose for the celebration, here are a few suggestions for the audio industry. And if we can pull together and accomplish half of these before our chronometers read 00:00/01:01:00, this audio world might just be a more beautiful place. Ready? Here we go!

1. Hardware manufacturers: Start *really* using the Web! Forget the cute animated gifs and give us specs, data sheets, schematics and service information on both the gear you build now and what you once built. And don't use the old excuse that publishing schematics gives your competition inside info: They're *already* building knockoffs of your gear, so what's the point?

2. Software companies have to improve tech support. But beyond merely adding phone lines, this could also involve placing troubleshooting menus for common complaints on Web sites, or maybe just making the darned thing easier to use in the first place.

3. Congress could improve the quality of product tech support by passing legislation requiring users to actually consult manuals before calling tech support. Now again, if the manuals were a little better...

4. Sooner isn't better! Manufacturers: Don't ship us your half-finished products. Take the heat for being late, but get the bugs out first. Thanks!

5. Also, let's make 2000 a goal for looking at real standards for issues such as plug-in architecture and file format exchange.

6. Engineers: Whether you're in the control room or packed arena, turn it down! You might not need it now, but once you retire, you'll need your hearing to detect errant drivers who might run you down (maybe they've heard your mixes).

7. Speaking of mixing, go easy on the joysticks when making surround panning decisions! If a solo sounds great, it'll sound even better when it stays in one place for 20 seconds or so.

8. Take the simple approach once in a while. Rather than placing 17 mics on a drum kit, try a pair of overheads and a kick mic. *Hear* the difference!

9. Get a life! Instead of spending hours on Internet newsgroups ranting that the lack of spare parts for Scully recorders is some kind of government plot to force us to buy digital gear, forget technology for a while: Take a walk. Watch a sunset. Attend a symphony. Read...

10. And most importantly, don't let all this millennium hype get out of hand. Consider the fact that due to errors in the Gregorian calendar, we're about four years out of sync, so all this new millennium nonsense actually took place in 1996 and you missed it! In any case, 1999 may still be a good time to reflect on where we're at, where we're going and when we should start thinking about the Y10K problem...

Let's keep looking forward.

George Petersen
Editor

BPA SPARS ABP American Business Press

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Mix was founded in 1977 by David Schwartz and Penny Riker Jacob

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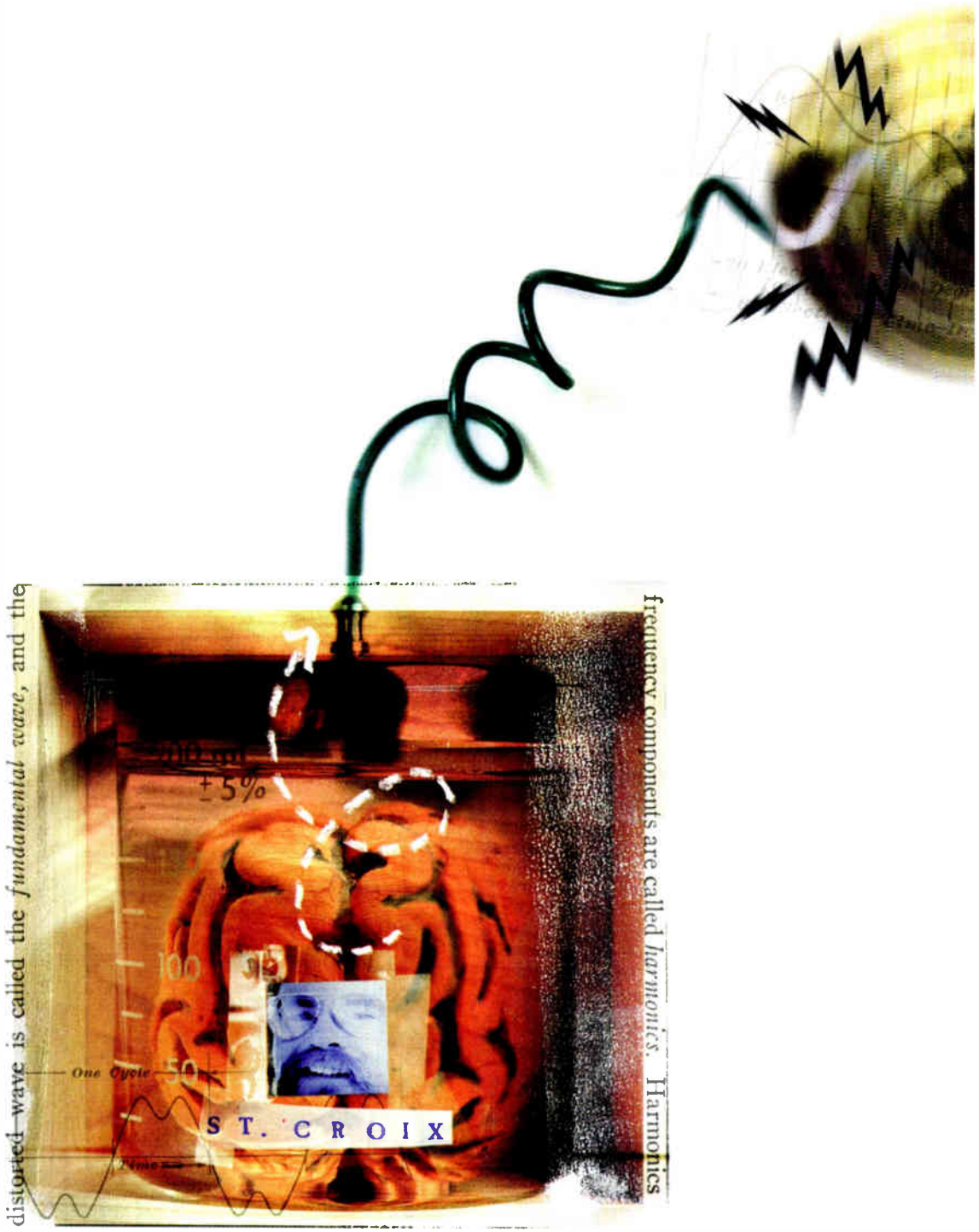

The Fast Lane Meets Insider Audio

For more than ten years, Stephen St.Croix has occupied *Mix* magazine's pole position, the "Fast Lane," right there on page 20, putting forth irreverent monthly commentary on the audio industry in his inimitable style. Half our readers love him; half our readers—well, let's just say they don't always agree with what he has to say. Paul Lehrman moved into the "Insider Audio" spot about three years ago, taking over for Ken Pohlmann and exceeding our wildest

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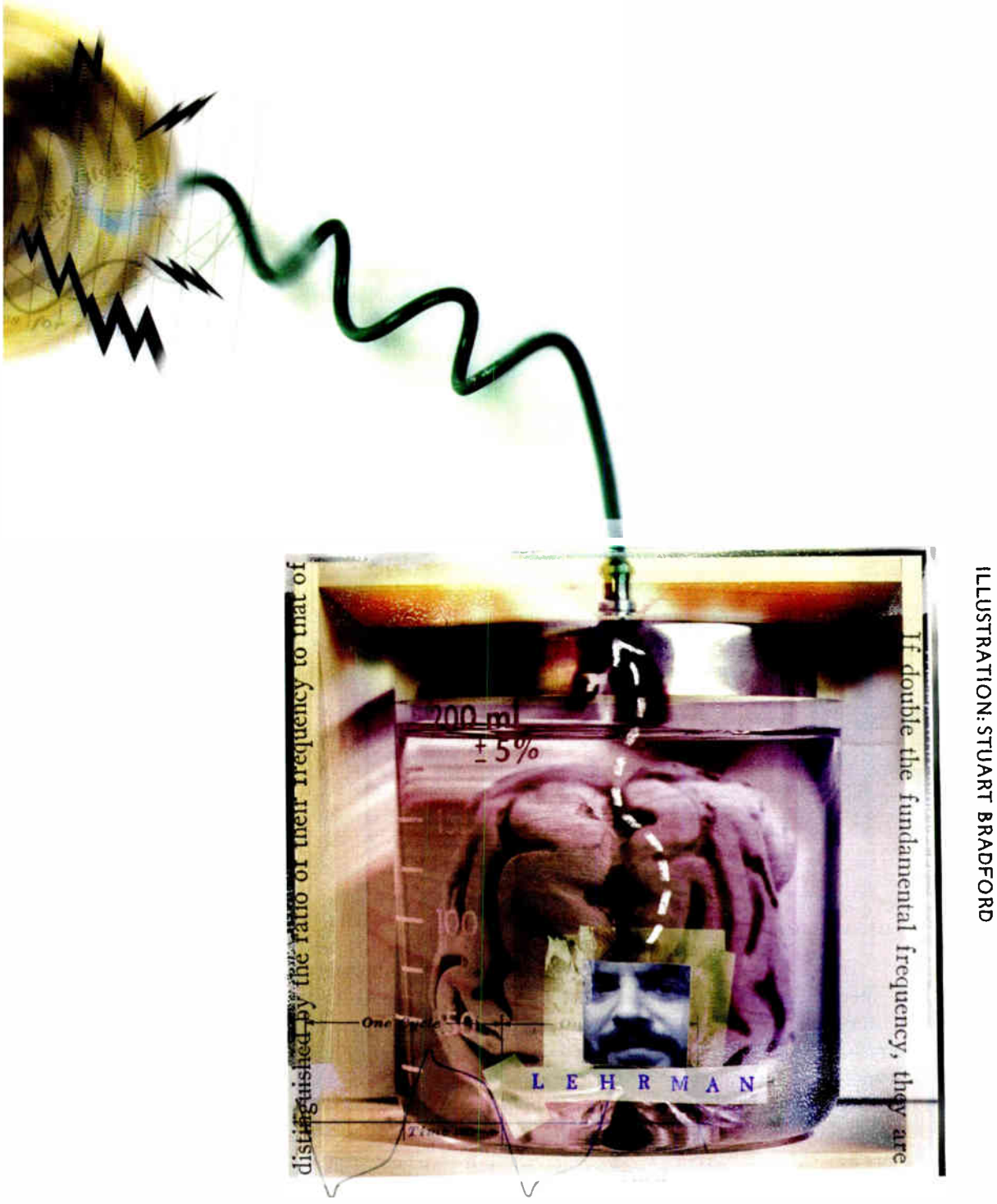

ILLUSTRATION: STUART BRADFORD

In Which Mix's Columnists Take Stock, and Debate What's Coming For Our Changing Industry

expectations about what a columnist could deliver. His wit and his depth of knowledge are unequaled in the audio press, except perhaps by Stephen.

Paul was born 46 years ago on Long Island, N.Y., to "a proto-typical New York Jewish overeducated family." His father is a doctor, and his mother resides in academia, making use of her two master's degrees. His brother is a composer, and his sister is a professional storyteller and children's theater director. He

World Radio History

The Fast Lane Meets Insider Audio

spent two years at Columbia University, majoring in electronic music composition while trying to find a way to minor in recreational pharmacology, but he left when he realized electronic musicians were only playing for other electronic musicians. He dropped out and went to a hippie commune in Virginia, where he hooked up with a country-rock collection of locals. Then it was back to New York and a conservatory degree, and a brief career in radio engineering and production that brought him to Boston. Today, he lives in the Boston area with his wife, Sharon Kennedy. He teaches recording at UMass Lowell, directs the editorial for Mix Online and is currently putting together a revival of the heretofore-never-performed first (1925) version of George Antheil's "Ballet Mecanique," which calls for, among other things, 16 synchronized player pianos and three airplane propellors.

Stephen recently celebrated the angst of turning 50 in print. He was born in Maryland, but was removed from his home at nine to be raised on a series of Air Force bases throughout the West, then on an Pima Indian reservation in Arizona, where he grew his hair long. To make money, he raced dragsters ("I was 6-foot-2 and 110 pounds, so I won a lot."), but after crashing and ending up in the hospital a few times, he opted for the quieter life of rock 'n' roll. First drums, then guitars and keys. Later he entered Carnegie for a degree in Fine Arts and Commercial Design, but he left after the first year when his teacher said, "Everybody who thinks they're going to get rich in art, raise your hand. Now all of you with your hands up drop out." Everything he learned in audio, electronics and design came from the street. Today he lives in Maryland, with his cats.

Both Stephen and Paul remain active performers and/or musical creators. They are working professionals, and each, in his own way, is an educator—Paul in the more formal sense, Stephen more in the street sense. And while they share a nerd's-eye view of technology developments, each recognizes the glory of true art. Other than that, they couldn't be more different personalities. When we set out to create *Audio 2000*, we thought it would be a good idea to let our readers know a bit more about these two and their views of the future, so through the miracle of modern technology (a conference call), *Mix* moderated a dialog between two of audio's dedicated muckrakers. Love 'em or hate 'em, they always make you think.

The Formative Years

Lehrman: I gave up composing as a career choice at age 20, because there was no way I could own my own electronic music studio. So, after I blew my health and my bank account in Virginia, I ended up in a place called SUNY at Purchase, which had just opened and had implemented a really intense, traditional conservatory-style music curriculum, but they had no composition program. So I decided to try out being a bassoon player. I had played the bassoon since high school, and so at Purchase I really concentrated on it for two years and actually got quite good at it. I was told when I graduated that I could probably be a professional bassoon player if I really wanted to. But I didn't want to. So I put it away and never really played it again. And while I was at Purchase, I taught myself a lot about radio. I had been a ham radio operator when I was a kid, but I taught myself a lot more. I built the campus radio station, built the sound system and recording system for the campus concerts—simply because it was such a small school and it was brand-new. I knew a little bit about this stuff, and nobody else knew anything. And that was great fun. The radio station I built had a couple of Revoxes and a Low Power Broadcast board. And everything I did was unbalanced. But it was AM carrier current, so nobody cared. You couldn't hear it anyway.

St.Croix: I'm sorry to interrupt. I just like that statement: "Everything I did was unbalanced."

Lehrman: Well, it certainly was. [Laughs] I learned a lot about carrier-current radio and why you shouldn't do it. Because it just doesn't work. I made a tremendous amount of mistakes but learned my way around. And I also learned classical recording because I found myself being the resident student recordist for the music department, and I got a very fast education in how to record classical ensembles in less-than-ideal spaces, because two-thirds of the school hadn't been built yet. So we were performing in these very weird spaces, and we were trying to get good recordings of recitals and concerts. I learned how to do that, just from microphone placement. We didn't have any fancy equipment, and that was really quite a wonderful education. After school, I spent a couple of years in radio, recording classical concerts, which was good because the equipment was much better, but I was also doing things like transmitter maintenance and rebuilding cart machines, which didn't interest me in the least.

We were performing in these very weird spaces, and we were trying to get good recordings of recitals and concerts. I learned how to do that, just from microphone placement. We didn't have any fancy equipment, and that was really quite a wonderful education. –PAUL LEHRMAN

St.Croix: Well, I went to way too many schools—none of them too impressive, so I ended up doing sort of a street-level education. I had to work to learn, and that may not have been so bad. I had taken German in high school in the desert, and it was pretty easy. When I eventually moved to Europe and settled in Switzerland, my school classes were taught in Italian, French and German—

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not in English. I was pretty comfortable there, and for some forgotten reason I decided, well, I'd be an EEC translator. I mean, earphones were already in my life anyway.

Before that, when I was living on the reservation, I raced dragsters on a forged license to buy my way out. It was a natural for me because at 14 I was 6 foot 2, weighed 110 pounds, and I would ride a top-fuel dragster without the required 200 pound flywheel scatter shield. I was light, and I was crazed—so I would win. I would also crash. However, I met girls. And this was very cool. When I turned 15 I had won enough money to get off the reservation and build a house.

Once, while I was in the hospital after violently losing a race, a friend came to me and said, "Why do you do this?" I answered, "Well, I get paid, and I meet girls." And he said, "I'm going to share a big secret with you. There is another way to meet women where you'd probably bleed less. Music." So I got into music only to get laid. I was working nights at a place called the Peppermint Lounge—not the New York one, but in Phoenix. I was sweeping up and cleaning after hours, and I talked the manager into letting me bang on the band gear because these guys owed the club money. You had to be a live player in those days to understand how you can be a working band, a popular band, yet owe the place you work money. So they owed, they left their gear there 'cause he wouldn't let them take it home 'cause they might skip. So I went for the instrument I thought I could get onstage the soonest with—drums. I practiced at night until one day I thought I was better than the band's drummer. I challenged him in front of everybody and said, "Look, I can play better than you." And the band, being a typical dysfunctional family, said, "Well, get up here and try." There's only 200 people in the audience. I did and I got the drummer's gig. The guy was right. Women went home with me, and I didn't have anywhere near as many splints or bandages as I did when drag racing. So I thought, "Oh man, this is great." And then as I continued to play drums, I began to notice the guy standing in front of me with the guitar...

So I decided I needed to be a lead guitarist, and so it took several more months until I became their lead guitarist. And that is how I started. And an amazing thing happened. About that time, I suddenly woke up and realized, "Oh—I actually like music." It had never occurred to me. I was in it strictly to get laid and get off the track. I didn't start as a tech at all. I didn't start fumbling things together until I lived in London and designed and built little fuzz boxes and amps in Piccadilly Square. But that came much later. I was playing big time before then. Not big time financially, but all the time. All day and all night.

> My first studio, I used to go in at night and lock the doors and just sit there and look at all the gear and the lights, and I realized that my whole life I wanted a rocket ship and this was as close as I was going to get. I swear, I'd pick limiters for the number of lights on the front panel.
> —STEPHEN ST.CROIX

Lehrman: Let me also say that, so you don't think I'm strictly this classical guy, I was also into jazz, folk and theater music. I was all over the map. At one point, I considered myself fluent on something like 12 different instruments. But the one thing that I discovered—because my family was very culture-oriented and we were listening to music all the time—which was my own, which nobody else was interested in, was, of course, rock 'n' roll. And so I had a little band at the age of 9. And there were three of us who dressed up in sort of Dave Clark Five outfits. And turtlenecks and leather jackets as much as we could get away with. We ran around the school playground pretending to take pictures of each other for our next movie. Worked out "She Loves You" for two acoustic guitars and snare drum. But when I was in high school, I started playing some real music, and I was in a lot of bands that were very seriously into Jefferson Airplane and the Grateful Dead and Hendrix, and the Blues Project.

St.Croix: That was the recreational pharmacology thing.

Lehrman: Absolutely. You can't sit and do a four-hour jam on "Dark Star" without some kind of chemical influence. And I started playing in clubs as soon as I was old enough to do so.

The Technology Bug

St.Croix: When I started doing electronic development, it wasn't because I wanted to provide electronics to the world, or even that I was curious. In fact, it was the same backhanded type of reasoning that got me into music: I got into electronics strictly because I couldn't get my guitar loud enough to be the only thing the audience could hear without my band yelling at me. So I thought the answer would be in electronics, and I developed a particularly nasty fuzz box. I was actually working part time at Vox in the UK at the time, a day job. I developed electronics experimentally, strictly for my own use, to give myself a different sound than anyone else. I had no real interest in designing, but you couldn't go buy this stuff, and I needed to cut. I really needed to cut. And I needed sustain. I needed all the things everybody thinks they need. And you couldn't just go to the store and buy it. So I got these germanium transistors and hacked them together and got what I wanted. And then guys with money would ask if I would build them one, too. And I would say, "Sure," for a price that I thought was insane, and they'd go, "No problem." And I saw the light. So that's how I got in. The interest

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only developed slowly over the next years as I realized I could cut out a position in the market for my own taste in design. But I never intended to. It was definitely out of necessity—not curiosity. As soon as I got the sound I wanted, as soon as I got the thing to work, I'd wrap the circuit in masking tape, shove it in my pocket, and walk back out on stage. I wouldn't even draw out a schematic. I didn't care.

Lehrman: I don't play out very much anymore. And the reason I stopped is that I got into the one-man band-in-the-studio bit. You know, '83, '84, the computer-based synthesizers and the dawn of MIDI. I got into electronic music in the first place because I wanted to create music by myself without depending on other musicians. But I couldn't do that for ten years or so. Then in the '80s we had all this desktop music production stuff come out, and I just glommed onto that. And that became my medium of expression. So, do I play out? Except for jam sessions on the back porch with some great players who happen to live in my neighborhood, no. But do I still compose? Absolutely. So, in fact, I'm playing all the time, but it's in my own studio for my own purposes. The bulk of my work these days has to do with film soundtracks and music for live performance backing up other types of performers, not musicians.

The more technical side wasn't born out of frustration, but out of necessity. And also out of curiosity. I liked the idea of mixing sound for live bands. And so I learned how to do that. And I was always interested in the technical stuff. As I said before, I was into ham radio when I was a little kid. I just loved the technology. I just loved the idea that this stuff could be used for creative purposes. So I never really felt like there was a dichotomy, and I never felt much frustration. It was just, "Wow, let's try this new toy and see what it can do." As I got older and had more access to cash, I could get bigger and louder toys. The technology became my expressive medium. I've always been more of a user and a consumer than a designer, although I've done a little bit of design work. Not nearly as much as Stephen. It's always been, "Wow, how can I take this and turn it to my creative ends and make whatever it is I'm doing cooler?" What I've got now—and what I've had really for about ten years—is everything I've always wanted. [Laughs] Except, of course, the time to sit down and be able to use this stuff.

> There will still be professional, expensive places, but they'll be tiny. They'll be boutiques—the types of places where you've got a little office building on 27th Street with six Pro Tools rooms, each of which is run by a guy with a different color earring because he's got a different specialty. —PAUL LEHRMAN

Mix: That's interesting. Larry Blake's column this month [Sound for Film, in "Post Script] is about the fact that he doesn't really have a Christmas wish list because he basically has everything he needs. Have either of you reached that point?

St.Croix: That's when you change industries.

Lehrman: I think I reached it when I got my Kurzweil 2000 because that was everything I'd always wanted. It's not the perfect machine, but it's a great machine. Everything I'd always wanted in a synthesizer was right there. And what I needed was a stack of those and a lot of alternative controllers to play it with, and then a lot of time to just explore what was in there, and to figure out what I could get from there. That was about seven years ago, believe it or not.

St.Croix: If you get to the point where you've got all the toys that you want and everything's set, and now you're sitting there looking at them—and I don't mean this against Paul—I think you already might have lost touch with why you got all those things. So far I haven't reached that point. In the beginning I started to amass an arsenal, as we all try to do. We go into studios, we rent a little time, we see how it works, and we think, "I could do this. I could do this better. I just need this toy and this toy and this toy." And then there's a new toy, and—discounting the race to get the model XR1000 replaced by the model XR1000B and then model XR1200—getting a workable system together was a goal at one point in my life. But luckily, I started getting a lot of work: a lot of production work, a lot of studio work, a lot of engineering work, a lot of tracking work and a lot of playing work. As I got more and more work, this need for the newest gear, and the need to amass the ultimate arsenal, dissipated.

I've found my purchases becoming more immediate to solve the problem at hand: "Well, we're doing drums today, and I need to gate this 'cause the cymbals are bleeding, so today I gotta buy gates. And now we're doing synths and we hit eight notes and we can't do any more chords, and so I guess I need a more polyphonic synth." And when my purchases became track-driven—I mean, specifically to solve the problem at hand on that track—two things happened: The concept of the dream arsenal disappeared, and with that disappeared the anxiety and the economic strain involved in that. My first studio, I used to go in at night and lock the doors and just sit there and look at all the gear and the lights, and I realized that my whole life I wanted a rocket ship and this was as close as I was going to get. I swear, I'd pick limiters for the number of lights on the front panel.

Lehrman: [Laughs] I'm with you on that. I understand that completely.

St.Croix: And it was wonderful. You'd sit in there at night and think, "Damn. This is cool." But then as work became more project-oriented, that went away. I would only buy the gear that the project would

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pay for. And at the end of the project, if I liked the gear I would keep it, and if not, it would go away. And I started ending up with very different equipment than when I was building my dream arsenal. But the whole angst of keeping up, of being leading-edge...At first I was actually buying gear in anticipation of needing it in the future, to chase technological advancement, but that's like buying bread thinking you might need it in three weeks. Finally I only bought what I needed, and I only designed what I couldn't buy.

Breakthrough Technologies

Lehrman: The most important technological advancement to me and my work, far and away, is MIDI. Not that I like it so much—although I do, but I do recognize its limitations—but it has made what I do possible, period.

As for the industry, I think the most important thing that's happened in the last 50 years has been multitracking. And that's a very wide field. Do I mean multitrack sequencing or multitrack tape or multitrack hard disk? The answer is yes, all of those. I think that multitracking has simply made it possible for music to be created in a totally different way than it used to be. And that's all there is. The live music session no longer exists; music is just not created that way any more because of multitracking technology. Secondarily is probably hard disk recording and the freedom that gives to the entire editing and production scene; I think that's probably the second most important thing that's happened in the last 50 years for the industry in general.

Now, all these things have dark sides. As things get easier, people get lazier. And that's a very nasty side of all these developments. As the technologies become more accessible, people decide to do less with them. And people jump in and do what can be done easily. When I teach sequencing, I don't let my students quantize for a while. When I teach sampling, I don't let them loop until I know that they know what they're doing, because those things are so easy to do, and it's so easy to create stuff that sort of sounds okay but is basically mediocre. And I think that what we hear in large part on the radio is a result of that, and I think it sucks. On the other hand, the technologies have their wonderful sides.

St.Croix: The biggest breakthrough for me personally is what we're getting into right now—the successful transition to digital audio. It terminated my analog design career and forced me to phoenix. I was Mr. Analog. I had the Time Modulator, which was one of the most successful pro analog delay products on Earth. I was king. I had technology that I owned, I had patents that I owned. I was set. I understood the analog world. My design chops in analog were quite good. If I thought of something, I could hear it in my head. I could make that happen in design. I knew the bullshit tricks. The games with different types of capacitors. How to push parts in totally illegal ways to get results no one else would even go for. I had no formal education, so my designs were totally maverick and extremely difficult for someone to copy and reverse-engineer. So I had built-in protection in my unorthodox approach to analog design.

But one day I saw the writing on the wall—specifically ones and zeroes. The transition to usable digital—not necessarily acceptable-sounding, but usable—was so fast that I found myself faced with, "Do I leave the industry or do I relearn?" Well, I decided to relearn, and that phoenix process opened an amazing, amazing world where every time I finish a design, I know that the next design won't share a single concept because the technology will have moved ahead that much. And if I tried to do a design that was too complex back in the real world days, I either had to give it up or hang in and spend years on it. Now, I just wait six months, computers become four times as powerful, and my original complex design runs easily. So it's like surfing. I'm being pushed along by the wave, the swell of technological advancement. Now I even enter into product designs, whether it be hardware, firmware or software, that I know cannot be completed. The world just isn't technically ready. But at the end of say, four months, when the dev cycle is done, there'll be enough horsepower out there to run the design. I've done that twice and have not been caught. It's an incredible feeling to have the world of technology pushing you, so you go on the ride and just concentrate on steering.

> Surround mixing, right now, is very similar to cocaine in 1970, in that you've gotta go into a lot of studios to find somebody grown-up enough to say, "I just need a little."
>
>
>
> —STEPHEN ST.CROIX

As far as the whole industry, I'm right there with Paul. Multitrack recording changed the fundamental rule: If you want it done, you have to do it. You don't have to anymore. If you want a brass section, it doesn't have to exist. You can have one horn player do ten overdubs. You can play with it, you can copy it, you can sample it. Nothing has to be real. You no longer have to play by the rules. You no longer have to play straight through without mistakes. You no longer have to play with anybody. You no longer have to play at all, actually. Anything you can think of, you can do. That's a pretty fundamental change—the concept that you can actually record without playing live. This is a huge, huge jump, to be able to think this way. When I hear a song in my head now, I don't even hear all the pieces at the same time. I even create, I conceptualize in out-of-real-time multitrack. And so does the world, to some extent.

24/96

Lehrman: Years ago, when 16/44.1 first came out, I was working with a fellow on an article for the late, lamented *RE/P*, in which we were talking about doing a 24-bit system. CDs, we argued, were not going to be enough, and we had some

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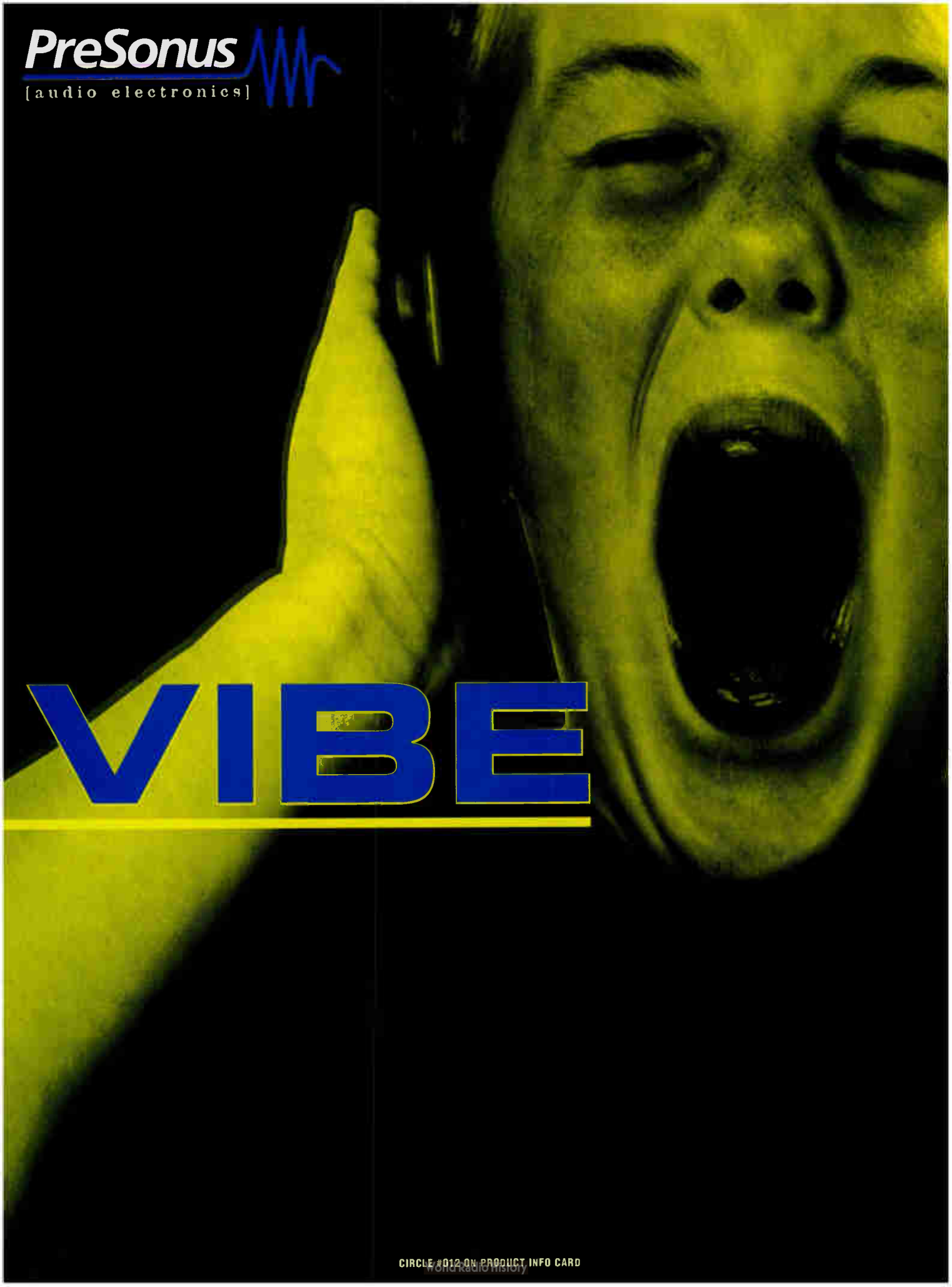

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demonstrations of how reverb tails were going to disappear and things like that. So this is something I've been thinking about for about a dozen years or more. I think that 20-, 24-bit systems do make sense as production systems. I don't think 96k makes any sense at all because of the enormous waste of resources that's involved. On the other hand, I also don't mind CDs. There are certainly some CDs that sound like shit, but for the most part, I like the way CDs sound. I think there are obvious situations where people are cutting corners and are doing bad jobs with them. But I think for 99.99 percent of the consumers who are listening to music, which includes me, that 16/44.1 is perfectly adequate. On the other hand, just as TV-makers like working in film better than they like working in video because of the increased resolution and various other aspects of it, we want our production facilities to be better than our delivery systems. And I think that that's why it makes sense to go 20-bit, 24-bit.

St.Croix: I agree with Paul. CDs sound great. I buy CDs, I stick them in the little slot, they spin around, I hear music. "Damn!" When I hear bad music from bad production houses, bad studios or bad mastering houses, I'm not hearing a bad CD. The technology works. The early broken-glass CDs are generally gone. If the CD sounds bad today, you really have to look for the problem elsewhere than the design and the spec and the technology. For most things, 16/44.1—if the 16 is really there—is quite acceptable.

However, there's no question that 24-bit yields truly audible improvements. True 24 doesn't happen yet, but 24-bit converters that are trimmed out properly to do 20 and not latch the last couple bits, so that they really move independently, sound beautiful. They're really getting good. But 96? I guess the people

I think the biggest boon to my growth, the biggest tool, the biggest advancement in technology is the button "undo."
–STEPHEN ST.CROIX

who mine iron want us to use 96 so that we need more magnetic media. What the hell is this 96 stuff? I don't get it. Bit depth, going to 24, counts in the frequency domain. Certain types of processing really benefit from this. However, higher resolution in the time domain?

I have heard common arguments from multiple independent sources for why dramatically higher time resolution counts. These are people I respect. These

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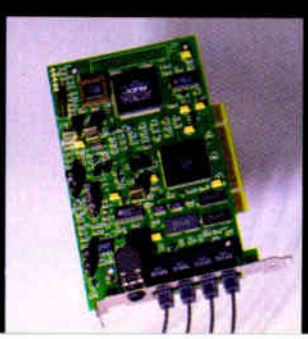

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The Fast Lane Meets Insider Audio

are the people who do mathematical design behind the silicon design of coming chips. They are serious. These are people I do not want to have dinner with, or even ride a Harley with. I listen to them, but I'm not inviting them over to swim. What they're talking about is logical, and it's real theoretical, but I think there are other issues at hand that far overshadow what we could possibly get out of 96. Look at what it's going to cost, in data bus loading, in transmission time, in what's going to happen when the real world needs to market this stuff and compresses it. And why 96? Why not 88.2? Look at what's going to have to happen in the advancement of gearboxing technology to make 96 sound as good as 44.1—our present consumer format. Because nobody gearboxes and gets away with it. Nobody. I think somebody's let go of the helm here and we've gone astray. This is wrong.

Lehrman: Well, there's a couple of forces at work. Probably one of the biggest is the fact that the manufacturers have to keep coming up with reasons to keep selling us things.

St.Croix: Right.

Lehrman: And that means that what we have has to be pictured as being inadequate to whatever it is that we really need. At a certain point, there's a point of diminishing returns at which that's no longer true, but we just don't know where that is. As long as the hype machine is continually pushing us to feel as if what we have is obsolete and inadequate and needs to be replaced and will not do the job that people are demanding of us... at a certain point we have to turn around and say, "No, that's bullshit. I don't need to do that anymore." But we don't know where that point is, and unfortunately, because the audio press is a commercial entity and is dependent on advertisers for their income, it's hard to get a really objective debate or objective discussion going, in which we can look at this stuff and say, "Do we really need this?"

St.Croix: I disagree with Paul on one thing and that is we don't know where that point is. I know where that point is. That point is 16/44.1. [Laughter] We're past that point.

Remember what started this: Filters sucked. They sounded horrible. Conversion was a disaster because we were operating at 44.1, and in trying to use a sampling frequency this close to the usable band, the filters had to be brick walls. They were analog filters and they all had these horrible time-domain problems. We needed to somehow move the filters out of the way. Oversampling finally came along and allowed filters to be moved out of the way so there can be, even in the analog domain, a milder slope. Butterworths with a pleasant amount of phase shift. And then somebody else said, "Look, now we can noise-shape. We can move the noise out of the way too—way out at the extreme high end of the passband, where humans tend to miss it." And all this meant that there was more breathing room, less conversion artifact, and a more stable, predictable system that would even be easier to manufacture once technology allowed clocking in and out higher rates.

Who uses linears now? Everybody uses delta-sigmas. Everybody's oversampling. But the freight train was already moving—the clocking race continues. I think the number one reason for these higher sample rates has already been dealt with, so that reason's gone. But the marketers still tell us, "Higher is better. More is better." And it's carrying us on into the absurd. The first time I ever heard all 16-bits A-to-D convert correctly, which was very recently, I was stunned at what 16-bit could do, because nobody had been delivering true, accurate16 bits in their 16-bit converters. And it'll be a long time till we see a 24th bit move by itself. But 20 and 21 moving by themselves sounds...

Lehrman: What is the sound of the 24th bit moving?

St.Croix: Right, unknown. But I know it borders on criminal, the 96. I just don't get it. These people who were telling me about how wonderful this time resolution is for certain time domain things like digital compressors and limiters, they're forgetting the point. And the point is that they want a consumer final format of 96. And until that happens, all this is bogus. They're still going to be converting to 44.1. They're still going to be gearboxing.

Compression is here to stay—sadly. Look at DVD, how compressed it is. I for one hope desperately...never have I wanted a concept or format to succeed as much as I want DVD. But, in the same breath, I must say that you could go out into the world and spend years looking and not find anybody as violently against lossy compression as I am. However, I am going to lose that battle. And I would rather have a very high-quality lossy compressor squeeze my 44.1 to whatever than I would have it squeeze my 90-plus bullshit down to the same end result. I want the actual human engineers to be in control of every track at every bit rate. Since compression is going to take place, I'm a believer in staying at the target sample rate whenever possible, for as many stages of generation of material and processing as possible. Of course, maximum possible word length for DSP headroom is another story. Always use the biggest word you can get.

I think for 99.99% of the consumers who are listening to music, which includes me, that 16/44.1 is perfectly adequate. On the other hand...we want our production facilities to be better than our delivery systems. And I think that that's why it makes sense to go 20-bit, 24-bit. –PAUL LEHRMAN

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St.Croix: Surround mixing, right now, is very similar to cocaine in 1970, in that you've gotta go into a lot of studios before you'll find somebody grown-up enough to say, "I just need a little." When everybody else is saying, "Look what I can do! Let's do it all!" Sure enough, it's nauseating. I'm sure there's as many deaths today from overuse of 5.1 as there were back then from overuse of cocaine hydrochloride. However, in the right hands, I'm sure cocaine can be a beautiful thing. [Laughter]

Mix: Thanks, Stephen, we just lost three readers from Salt Lake City.

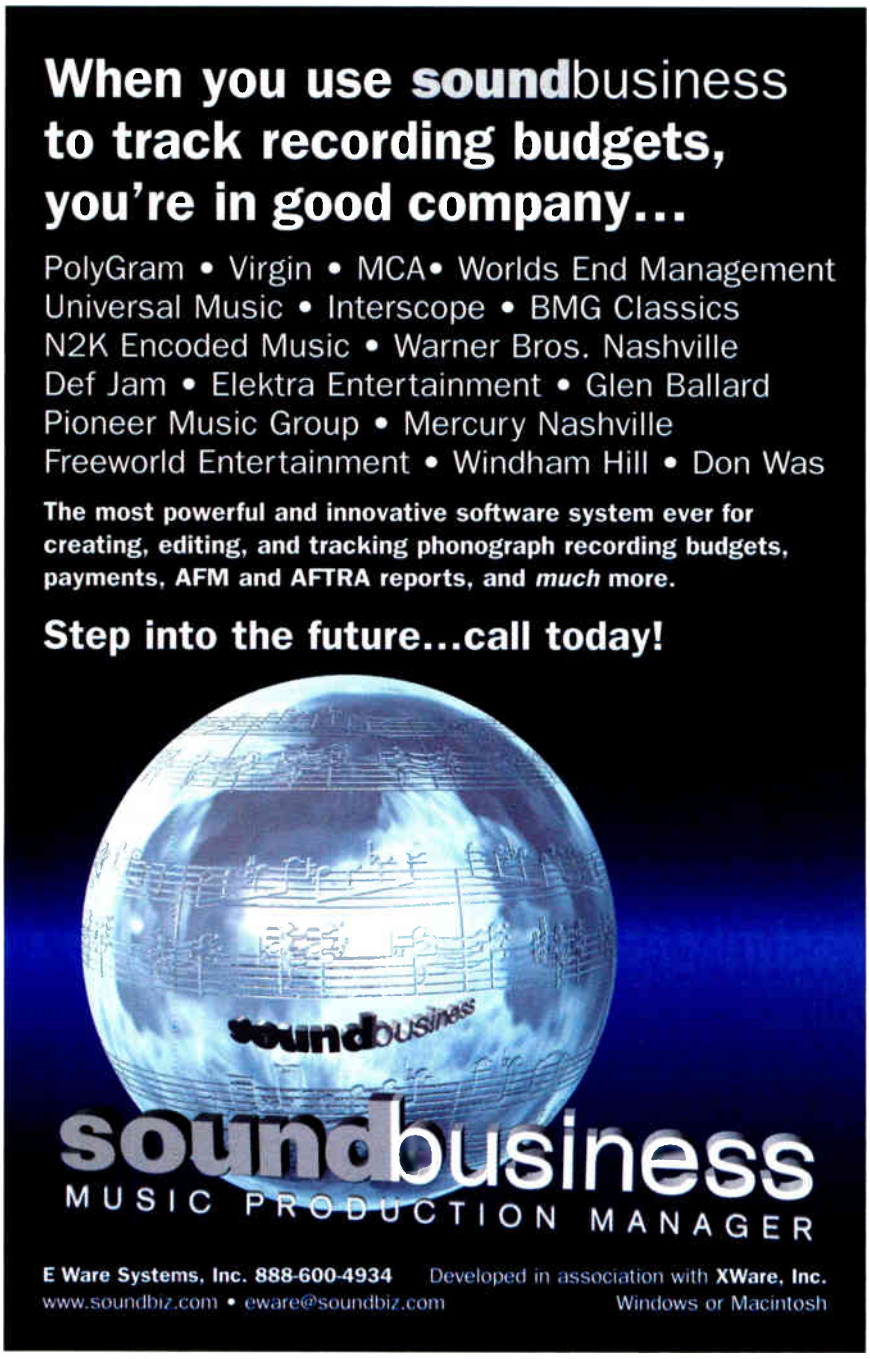
St.Croix: And so can 5.1. I believe in surround. When you hear a score and effects done for film by sane people, it is thrilling. So I like it. But unfortunately I can go out and buy the new DVD releases that came out this month, all four of them, play them all, then do it another month, then another month, and maybe one out of those dozen is not a freak show.

Lehrman: I agree with Stephen to a certain degree, that when it's done well, it's fantastic. When you can hear it in a theater, in a well-designed theater where they're not using Frazier black boxes in the back, but real speakers, it's amazing. On the other hand, I think that the number of people who are actually going to be able to benefit from this is so extremely small, and it's smaller than they think they are. I mean, how many millions of people have stereo systems set up in which there's no stereo image, because of the way the speakers and the room are set up? Now, they're ostensibly going to be a little bit more careful with their 5.1 system, but are they really? Where's the couch going to go? Where are the curtains going to go? How many of them are going to actually be able to present a decent listening environment for themselves? I think that we're sort of kidding ourselves if we really consider this to be a mass-market item.

St.Croix: But don't we have to design for best-case?

Lehrman: No. Because there's a point of diminishing returns at which point you're throwing lots of money after very little. I don't think that most CDs on the market are designed for best-case. I don't think they're designed for people with astounding stereo systems. I think they need to hold up under those conditions, and you don't want to hear garbage coming out of your speakers under those conditions.

But I think that for the most part, you're mixing for a middle ground. Why the hell do people use NS-10s all the time? You're mixing for a middle ground. And I think in 5.1, there sort of is no middle ground. Either people do it right or they do it wrong, and I don't think there's much in the middle that says, "Well, this is sort of okay. And it's sort of worth doing."



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The Fast Lane Meets Insider Audio

I may be wrong on this. There are people who tell me that the hottest items at the stereo stores are now surround-sound systems for home theater. And I can believe that. On the other hand, I can't believe that people are setting them up correctly, I can't believe that people are going to have them set up correctly for more than a few months before somebody else moves the furniture around and screws up the whole thing. Even more important for me, and this takes it into a larger arena, is when the hell are people going to have time to listen to this stuff? Nobody I know has time to listen to any music anyway.

St.Croix: I disagree. I think it is, of course, the new responsibility, as the technology grows, to mix, as Paul says, for what is projected to be the median market. Obviously. Who's going to fund you if you don't? But I also think you should produce a mix designed so that when a guy breaks up with his wife and then sits around listening to music for two months, until he finally decides, "I'm going to set this system up right," and he moves all his stereo shit around and listens, that he gets a reward. That the mix on the product does yield noticeable, better results when played with a noticeably better system setup. I think we owe it to ourselves and to the market to have that audio Easter-egg hidden in there. Although, Paul's right. It's hiding for the one percent. But I want a reward in that media. I do mix for that. I will do tricks like, putting a bass track down, then doubling that bass track with a synth, and the synth will be full, easy to listen to, no real low information, lots of even harmonic stuff so that on a mediocre or average system, it's got a solid bass line the victim can relate to and understand. And it's 10 dB down from the real bass line, which he never hears. But when you play it on something real, suddenly it wakes up with a nice Alembic bass, very full and organic. When the listener drops it into the system he hawked his house for, he hears it—he feels it. I feel very strongly that we should do that for him.

Recording Studios of the Future

Lehrman: I think the high end is going to shrink even more. I think we're going to find ourselves with far fewer really large studios, which will exist for specific purposes only, like film scoring, soundstage stuff. There will still be professional, expensive places, but they'll be tiny. They'll be boutiques—the types of places where you've got a little office building on 27th Street with six Pro Tools rooms, each of which is run by a guy with a different color earring because he's got a different specialty. Doing advertising work, dance remixes and that kind of thing. The home studio, obviously, is going to continue to burgeon because people want to be able to work at home. But I think that the larger studios are really going to become even rarer, and for very, very specific purposes where that kind of physical space is needed.

St.Croix: What he said, with one exception. I think that there will be a couple mega-studios, but they won't be directly available to the world. CBS, Disney and Sony will have vertical production centers that have huge, internally staffed facilities for every step from tracking to mixing, mastering, and distribution, including alternate-language. Other than that, it's going to have to go boutique—no middle.

All techno-industries seem to follow classic sociological city models. A city center starts, the city grows around it, it ages, suburbs appear, then the original core eventually burns out, so that there's no longer a living center. Everything centrifuges. The middle of everything goes away. So you'll have incredibly competent home studios, very powerful ones, because computer technology doubles in power and halves in price every six months. Home studio options are becoming very serious. And the boutiques, as Paul pointed out, will exist.

There'll always be some name that's hot enough that he can sell himself. And he'll have that, "Well, let's get that Bob Clearmountain's kid to do this in his new place." These very high-dollar places will exist. But the middle, the upper-middle pro, will go away completely. It always does, in all technologies. It's going to be a loss in one way. The experience of those who used to run those facilities will be lost. There will be a lot of lost art here. But as far as capabilities, technically, the new baby DAW systems outperform the majority of 16-track studios of a decade ago, and half the 24s of today. It's already happened.

Manufacturing

St.Croix: Because the Marshall Time Modulator falls into the historic category, I get people who come up at conventions and say, "I want to start designing products. What would you recommend?" What I recommend is very simple, one word: Don't. I'm not sure it's possible to do a boutique design in hardware, or hardware/firmware, today and get the dev cycle short enough so it can properly hit the market that is perceived to exist when it started. Nor do I believe that, with as dynamic and complicated a growth pattern as we have now, that you can accurately project the market far enough ahead to do a long dev cycle for a really solid product.

Lehrman: What about software?

St.Croix: Well, there you go. Another world has come to be. At Intelligent Devices, I am surrounded with young

I got into electronics strictly because I couldn't get my guitar loud enough to be the only thing the audience could hear without my band yelling at me. So I thought the answer would be in electronics, and I developed a fuzz box.
—Stephen St.Croix

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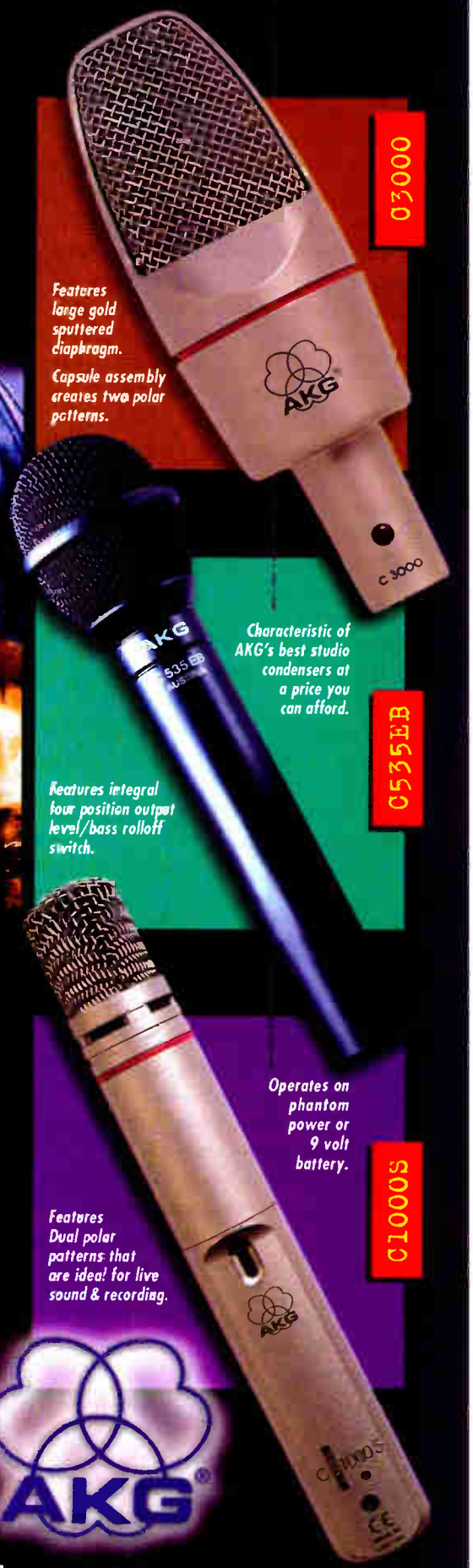

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guns that kick ass in areas where I can't even find the asses to kick. But my design concepts—what I want it to sound like, how I want it to act— are translatable, so I have now totally, completely forsaken hardware. I don't touch it. All I do is software. Right now I'm doing the Time Modulator in software. One month ago, we finally succeeded in creating the sound. I got it to sound like the original physical Time Modulator—warm and distorted and screwed up, just the way I wanted. And that was a real milestone, because I now believe that DSP—on-the-street, cheap DSP—is big enough, powerful enough and architecturally sound enough that I can do pretty much anything I want, if not everything I want.

So I've switched to software, and I cannot see that ever changing. Right now, boutique software houses are doing well. There's always some new weird-ass little plug-in coming out. This is wonderful, because the guy that once had to come up with ten grand to do a physical boutique stomp box can do a software version for the price of packaging and distribution, if he can afford to feed himself while he develops. And if he doesn't want to do that, he can start off slower but safer on the Web with no packaging, as a challenge-response download. So I think it's a wonderful change, and there's more opportunity for boutique development than ever before. But only in straight software. And by that I mean not even DSP-specific. Host software. Stuff that runs on Pentiums and Power PCs, not Motorola chips.

Lehrman: I'm pretty much in agreement. I think that there has been, for the last year or two, a niche market in terms of small, high-powered, tube-oriented recording channel thingies. You know, the Manleys and the Joemeeks and stuff like that. And I think that those are great, but I don't think that that's going to expand. And I think that anybody looking to get into that area is kidding themselves, because that's just not going to be a growth segment. I think that the way to do it is with software. Not meaning to brag, but I was doing this 15 years ago. Of course, I failed, but we had a good time.

St.Croix: Everybody failed who was doing it 15 years ago.

Lehrman: That's not true. Opcode and MOTU are still around. And the companies that have a really solid base in hardware are getting into software, like Lexicon and TC Electronic. And I think this is definitely the way to go. There are livings to be made, not fortunes, but livings. Just don't buy Version 1.

St.Croix: Any new technology sucks at first. Each new audio technology sounds like broken glass when it initially appears. This is no different. He's right. What he said is THE standing joke. Don't buy V-1. Nobody who actually tries to record a song with a buggy plug-in uses that plug-in again. But the alternative is painfully slow growth, with nobody publishing experimental plug-ins. I like it the way it is now—everybody gives it a try, and their ideas get out there. And even if a good idea comes on the market as a buggy plug-in, it still does the world good because somebody else will immediately steal the idea and make a plug-in that does work.

Lehrman: Actually, the problems are not in the plug-ins. The problems are in the systems themselves. We're reliant on an industry that not only weren't we relying on before, but really couldn't give a flying f— about us.

St.Croix: Yes, we are dependent. But, when you look at what you get for your money, when you look at the fact that there's a platform that is a commodity, the dependence is a necessary evil. Look what we get for it. Look what you can do in your home for 3,000 bucks today. I'm okay with it. At least right now there's two competing forces keeping everybody honest. I don't know how much longer the Macintosh will be able to survive, but right now I like the fact that there's two systems that are so fundamentally different.

Lehrman: I think it's crucial. I think if we ever get to a point where there's only one, we're going to be in real trouble.

St.Croix: Any galaxy or world or city or even automobile run by Billy Gates alone scares the hell out of me. I don't care what the second system is, I'd bring back CPM if I had to keep Little Bill from being alone out there.

Lehrman: I understand they're working now on the Amiga again. [Laughter]. But seriously, the model becomes no longer purchasing the product; it's purchasing a subscription to a product. Manufacturers are going to have to figure out how to get a revenue stream out of that, because how do you make money by signing somebody up and then giving them a free subscription for life? On the other hand, how do you convince people to spend money on upgrading something when they spent a lot of money, or what they think is a lot of money, to begin with? I don't know the answer to that. Bill Gates had this brilliant idea about six or seven years ago of telling everybody who had an illegal copy of Word to register it. And he wasn't chasing after pirates, he was trying to sell them subscriptions, and it worked. And then everybody became legal owners of Word and then would spend, instead of $300 on the program, would spend $65 on an upgrade every year. And I think that's a model that other manufacturers are going to have to look at and say, "Well, how can we do that? And how can we do that without pissing off the customers?"

The Future-Future

Mix: Stephen, a lot of your columns deal with concepts like crystal memory and acoustical heterodyning speakers, stuff that would make many of our readers say, "He's crazy. Not in my lifetime." Paul, do you think Stephen's crazy?

Lehrman: I ain't gonna touch that one. [Laughter] Do I think Steven's crazy? No, I love this stuff that Stephen writes about that may or may not exist. And 20 years ago, I was writing about laser turntables, which seemed to be an awfully good idea at the time. Why not? Why don't we write about these things that people are trying to make happen and that may or may not happen?

St.Croix: I'm the first person in my family to not be a doctor. My father's past connections with the government, Bell Labs,

World Radio History

and other spookier places have gotten me in some very interesting situations. One of my companies does forensic law enforcement—extreme spy shit, big tech. That also puts me in interesting places. I have spent time at NASA and Bell Labs, where people are really doing a lot of "blue sky." This crystal memory thing is absolutely going to happen. These things…I like to break them early, and I sometimes break them early enough that my credibility is flexed at best.

Mix: You knew about the ban on CD players in aircraft before the FAA.

St.Croix: Yeah. I do actually research these things. And whenever possible, go there to touch them and play with them. I actually do a lot of traveling to check out these bozo things I write about. Whether or not they're aborted later—like the crystal thing was aborted after I first wrote about it, but another company picked it up later. And it is now, due to higher-frequency lasers, coming back, it will exist. There'll probably be an xyz three-point, converging laser array—giving you 150 terabytes in a little less than one cubic inch. And access time should be unbelievable. It's a doped crystal lattice that retains quantum orbit shifts, and doesn't require power to remember. It's true static memory. No refreshes. This is happening. I don't think up this shit. Somebody shows it to me, and I go, "Oh, cool. I'm going to tell my readers." When it comes, that's the question. But I guarantee you the stuff I write about is stuff that I've either seen or read the white papers on, or the patents on, or talked to the designers about.

Lehrman: You're right, this is stuff that comes out of industries where tons and tons of money is being spent, and of course it's going to have spinoffs into the consumer industries. And that's the way things have been going since they invented mechanized warfare. So why not?

Keeping It Fun

St.Croix: The fun for me is not what it was in the beginning—now it's creating the product I dreamed of. I think the biggest boon to my growth, the biggest tool, the biggest advancement in technology is the button Undo. [Laughter] I paint digitally. I do a lot of oil and watercolors, a lot of painting. And I sell my work. Of course I used to do it all on canvas. With oil colors, my biggest challenge was, "When do I stop? When is it done?" My teachers always said, "You'll know when it's done." They were wrong. You never know. I was always afraid to try the green lipstick because I was afraid it might mess my painting up, and I would never be able to get the tint right again.

> The model becomes no longer purchasing the product; it's purchasing a subscription to a product. Manufacturers are going to have to figure out how to get a revenue stream out of that because how do you make money by giving somebody a free subscription for life?
> —PAUL LEHRMAN

On a computer I try anything I want. If only real life had a big Undo button! To me, the fun is in accomplishing my goal: the piece of art, the painting, the song. When I stick a CD in the dash of the car and turn it too far up and listen on the way to dinner and go, "Damn! That's what I wanted to hear." That's fun. Especially if the car is real fast.

Lehrman: What keeps it fun for me? Finding something that someone has done that really makes sense, in terms of a new tool. Finding that plug-in, that piece of software, that piece of hardware that I go, "Yeah, I can grab onto this, and I can use this, and I can make this my own really easily." That's the fun. It's also in the final product, listening to it, sitting back and saying, "This is what I wanted to say. Here it is." But not just the final product; it's the journey, too. If the journey is a good one, if it's filled with little points along the way where I look at what I'm doing and say, "Yeah, this is what I should be doing. This is the right piece I'm working on. This is the right approach I've taken to working on this particular project." If I can sit back every once in a while and look at it and say, "Yeah, this is right," that's where the fun is.

And sometimes that becomes a question of being one with the tool, and being happy with the tool that I've got, whether or not it's a new one. You know, I put a new version of a sequencer in and I say, "Oh my God, they fixed that, isn't that wonderful?" And all of a sudden my entire chain, my entire methodology of doing a particular task changes because I now have a better way of doing it which I like better. And that's incredibly exhilarating, and gets the endorphins really kicking.

St.Croix: I have sacrificed a great deal of money, and certainly other unknown theoretical desirables, to build a lifestyle where no two days are the same. I don't want a pattern. I'll do design for several days, or a week or a month, and then I'll do a Harley engine mod design, or a turbine design, and then I'll paint, or I'll plant a tree or I'll play with a boat. Delta. That's it. Delta, delta, delta. Change, change, change. No matter how good anything is, it's never good enough to be immune to eventual modification. Or maybe it just gets to be time to do something new. Almost all the things I do make me happy, and I can't point to one and say, "That's my escape."

Lehrman: Well, my life sounds actually very similar to Stephen's, although I do have things I do to differentiate between work and play. Right now, because of a couple of projects I'm involved with, I know what I'm doing for the next 15 to 18 months, which is the first time since about 1977 that I knew that. And in 1977 I was wrong. I'm actually working on five completely different projects simultaneously, and bouncing from one to the next. That's my work life. I have another life which is that I have a wife, whom I do

World Radio History

The Fast Lane Meets Insider Audio

projects with, and whom I live in a house with. And the house is my project. I have a garden which is my project. I live in proximity to 8,000 acres of woods, and I have a mountain bike that I use extensively when I can. And I do a lot of hiking. And that takes me out of the studio, God knows, and puts me into a totally different kind of environment.

My wife is a storyteller, and exists in an environment which is so utterly completely opposite to mine. She actually bought her first computer last fall, a ten-year-old Mac, so she could do word processing. Up until that point, as we used to tell our friends, I'm working with all this high-tech stuff, and she's still drawing on the walls of her cave. She is very much steeped in ancient lore and the oral tradition. And yet, we do a lot of projects together. We just published a book together and we've done a couple of records that I've contributed to. And she's done some stage shows that I've done the sound design and music for. So that also keeps me in the studio, but it also takes me out of the studio. A lot of different things, a lot of balance, a lot of no two days the same. If I were ever to be in a job where I was doing the same things five days a week I would probably shrivel up and die.

St.Croix: You know, now that I listen to what he says, I have to be a little more conscientious of my answer and actually tell you a couple of things, non-audio things that I do. He did, and I realize that I too should be responsible. [Laughter] These items will in no way be, nor are they meant to compete with, the classiness and sheer solidity and comprehensiveness of Paul's. I like making land-based vehicles go as fast as possible. The Harley I ride is a radical alcohol burner. It's severe. I like petting cats. I like surfing. And I'm big-time into competitive body building. So these are really down and dirty simple-ass things, but that's when I do my thinking. All of those things are real physical, and you know why I like them? They resolve. Bodybuilding resolves when you take first place. That's resolved. I like that. Bikes? Easy, they resolve when everything red-shifts. There you go. Okay, I went fast enough. And the cats resolve when you pet them and they purr. And you feel it, "I've reached my goal. This living creature is happier because I'm playing with it." It's very simple. I rarely actually create when I'm working. Working is usually translating the creative thoughts I've had into something tangible.

Mix: What's in your CD changer? Right now.

St.Croix: Stevie Ray Vaughn, Stevie Ray Vaughn again *Diva*—believe it or not, Annie Lennox—Kentucky Headhunters, Dire Straits, and some weird-ass stuff you

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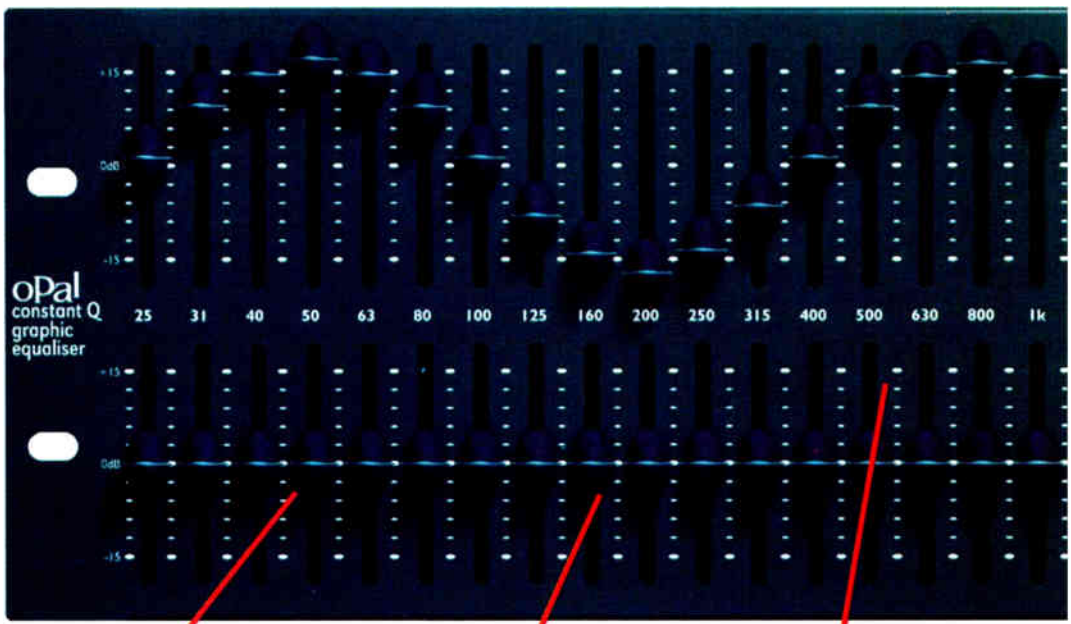

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wouldn't believe. The Mermen, and something else, I think it once had a title on it, but it came off.

Lehrman: I actually don't have a CD changer.

St.Croix: Ooh, I'm impressed. [Laughter] The man who wants to control his immediate destiny! Put them in one at a time.

Lehrman: Of the last five I put in, three of them were different recordings of Antheil's "Ballet Mecanique" because I'm working on it. So I don't know if that counts. The Mobile Fidelity pressing of *Who Are You?*, Enya's *Watermark*, the Incredible String Band's *The Hangman's Beautiful Daughter*, Joni Mitchell's *Misses* and the new Firesign Theater.

Mix: Favorite movie?

St.Croix: *Forbidden Planet*. The first movie that scared me, the first movie with special effects, and the first event in my life that showed me that man could create artificial realities. And the first movie ever made with a totally electronic sound track!

Lehrman: *The President's Analyst*. I was very into Cold War comedy. It was right after *Dr. Strangelove* and *The Russians Are Coming. The President's Analyst* was about everybody lying to you. And the ones who were the most dangerous were the ones with the best network.

Mix: If you could push rewind, where would you go?

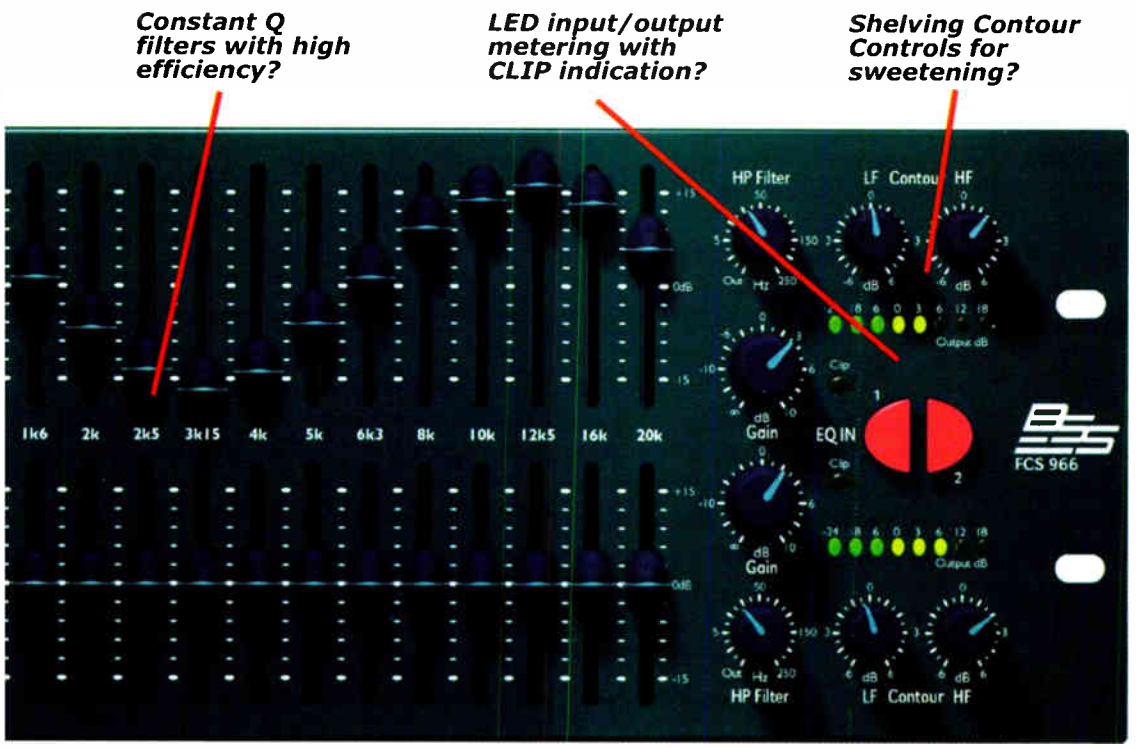
St.Croix: 1955. Things were little enough then that you could open your front door, walk down your sidewalk to the street, do a 360, and understand everything you saw.

Lehrman: 1968. A great year for crisis, as they said. A year in which there were tremendous possibilities, tremendous forward-looking, artistic and political action going on in which it really looked like the world was going to change. As Paul Kantner said on that wonderful PBS rock 'n' roll series, talking about 1967, he said, "But for a week there, everything was perfect." And in 1968, for a little while, for a couple of months, everything was really exciting.

Mix: Fast forward? Where do you want to go? How far into the future?

St.Croix: Two hundred years. If you're going to take a chance, take a big one. Everybody I know now has gotta be out of the way. [Laughter] I don't want to see any bogus life-support shit on my old friends. No *Brazil* face lifts. If you're going to do it, do it. If you're going to take a chance and roll the dice, why not roll for a big prize or a big loss?

Lehrman: That's pretty persuasive. I was thinking more like 25 years when my mortgage runs out. But yeah, probably about 100,150 years, when they've either solved the problems of whether we're going to die or not, or they've realized they can't solve them. ■



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CIRCLE #020 ON PRODUCT INFO CARD

Electronic Music Delivery

Major Players Look Ahead

by Philip De Lancie *Illustration by Jeff Foster*

Four years ago, the multimedia CD-ROM was riding high, while the Internet was all but unknown outside of government and academia. It's instructive to keep that in mind as we squint toward the future, trying to guess what form music delivery to consumers might take in the years to come.

On the one hand, we know that in general people like to own things and that collecting physical carriers such as records, tapes or CDs is a source of great satisfaction to music fans. On the other hand, the World Wide Web, though still in its infancy as a commercial medium, opens up the possibility of selling entertainment data without selling a physical object. As anyone with pay-per-view cable and a VCR will tell you, this isn't a new concept, but the interactive flexibility of the Web makes it possible to move from a broadcast model to an individually customized shopping experience.

Will electronic distribution—the selling of a music recording electronically, as opposed to selling a physical embodiment of that recording, such as a CD (even if the CD is ordered online)—make the traditional "brick and mortar" record retailer obsolete? Few expect that to happen anytime soon, if ever. In fact, research released this past summer by Jupiter Communications suggests that by the year 2002, digital downloads will account for a mere 2.2% of online music commerce, which in turn is expected to represent a growing but still modest portion of overall record industry revenues.

That said, companies such as Liquid Audio and a2bmusic have developed systems that address many of the technical, copy-protection and royalty issues that would have to be in place for a direct download system to work. And the concept is at least on the table at various major labels, partly in response to the rampant piracy evident at sites that post music in the MP3 format, giving away recorded music without compensation to those who created it. The portable

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MP3 players coming to market from companies such as Diamond Multimedia should force the labels to act not only defensively—as they have by suing through their trade group, the Recording Industry Association of America (RIAA)—but also proactively, assessing how best to exploit this newly developing market profitably while protecting their intellectual property rights.

For a look at how these factors might shake out down the road, we enlisted the aid of four active forces in the online and cable worlds. In addition to Gerry Kearby, CEO of Liquid Audio, and Howie Singer, CTO of a2bmusic, we spoke with Tom McPartland, CEO of TCI Music (a subsidiary of cable TV giant TCI), and Ted Hooban, director of digital products for online record retailer CDnow, which recently completed a merger deal with rival N2K.

What are the most important elements (i.e., copy protection, royalty tracking, audio fidelity, portability, etc.) that need to be in place for all interested parties (rights holders, distribution and sales entities, consumers, etc.) to be well-served by electronic distribution?

Hooban: A lot of the software needed to make this possible already exists. And I think those systems are pretty well proven to work effectively. However, it may not yet be to a level where record industry executives are comfortable, and they may not be comfortable with the fact that there are a couple of different incompatible formats around, and there is not one single standard that allows interchange. So I think that the technical and business model has not really shaken out to a sufficient degree to make all the labels jump onboard. Also, there is really not a compelling enough market there yet for a record company to go in and commit the resources to making their titles available for digital download.

Kearby: A commercially viable system for digital distribution of music over the Internet must address all of these elements. The Liquid Music System we have developed has components to address each of these areas, but we are particularly sensitive to the issue of security. Piracy costs the industry in excess of $5 billion a year, and we employ a multilayered approach to security that makes music delivered in Liquid Audio format actually safer than on traditional CDs.

McPartland: To get the major intellectual property rights holders to utilize non-physical distribution platforms will require a solid end-to-end system that ensures fidelity, data encryption, a portfolio of compression tools, downstream copy protection and, perhaps most importantly, a business model that essentially preserves the economic food chain that currently prevails in favor of the major labels. This last will be the most difficult to get all parties comfortable with, even more than all the technical components, many of which are already sufficient. Specifically, it would be less economically threatening for the major labels to wait until their own informal consortiums develop industry standards to facilitate this process. That would minimize or obviate any need for a Liquid Audio or a2bmusic to participate in the sale. It's analogous to how the banking industry ensured that their own cooperative developed the whole wire transfer process, thereby ensuring that Microsoft or IBM didn't wind up having the ability to levy a toll or tax on the banking industry because of their computer or software prowess.

Singer: For consumers, we believe the key items are audio quality, broad music selection, the right price, portability away from the PC and overall user experience. The protection mechanisms we put in place must not hinder the user's enjoyment. In some sense, the acceptance of MP3 among a certain community of users gives the industry a baseline that they must exceed, at least in some dimensions.

For the rights holders, the key issues are integrating downloading into the rest of their business, audio quality—artists may be pickier than the fans on that one—copy protection and royalty tracking. As far as protection goes, many rights holders will choose to give away their content for free, but that should be at their discretion and not easily circumvented by individuals who simply choose to make use of that valuable content without the appropriate payments. A successful system must support both alternatives, as a2bmusic does.

Even with the rapid adoption of digital distribution, the majority of music will still be sold the "old-fashioned" way: selling shiny physical objects that spin. Therefore, it is essential to make digital distribution a part of the overall campaign to sell music.—*Howie Singer, a2bmusic*

Even with the rapid adoption of digital distribution, the majority of music will still be sold the "old-fashioned" way: selling shiny physical objects that spin. Therefore, it is essential to make digital distribution a part of the overall campaign to sell music. That is why a2bmusic has put so much effort into including retailers in all our promotional efforts. As for distributors, they have to see a role for themselves in digital distribution rather than something that eliminates their role.

What are the primary obstacles or hurdles to electronic distribution?

Hooban: There are a number of issues on the consumer side. It's not really convenient to download anything at this point. And it is absolutely imperative that you make it portable, but there is no easy way to do that. It's do-able and affordable, but the technology is just not convenient. And instant gratification is not really there. It will take you less time to drive down to a record store and buy the product than to download it on a typical con-

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Electronic Music Delivery

sumer PC. People talk about broadband, and all that stuff will happen—people will have a fatter pipe to the home—but at this point, most people are on 28.8 modems, and it takes too long to download an entire album's worth of material, even in its compressed form.

Another issue is the selection: There really isn't much right now. It's kind of a chicken and egg problem. Labels haven't really stepped into this area wholeheartedly, because they don't feel there is a strong demand on the part of the consumer. Consumers haven't been demanding it because there hasn't really been much to choose from.

Then there is the customization issue: Can you co-mingle tracks, or buy a single track? You have to work out the economics of selling singles, breaking apart an album. That is an issue the record companies are dealing with, and who knows how they may ultimately resolve it?

Also, there is not really a very good pricing story there. After you pay for the CD-R and pay for your tracks, it's not much cheaper to download. The cost advantages are not really enough to overcome the inconvenience and the other issues.

Kearby: Bandwidth into the homes has certainly been one of the gating factors for widespread consumer adoption of the Internet as a shopping alternative for music. Let's face it, with current technology the listening experience online via a 28.8 modem is just barely in the range of being tolerable to most audio professionals. Sluggish download times have also been a problem. But the good news is that now we are seeing the beginnings of a significant push to increase bandwidth to consumers. The increasing availability of cable modems, DSL services, satellite distribution and other initiatives are a very positive sign for audio on the Internet.

McPartland: The hurdles are security, bandwidth and critical consumer mass through the distribution platforms that will have the capability of offering the service.

Singer: Without lots of content legitimately available, the early adopter consumers will continue to get the music they want, as they do today, from sites with unlicensed music. The MP3 phenomenon demonstrates the importance of bandwidth to making this a mass market offering. The industry must become convinced that legitimate digital distribution represents incremental business for them, both in terms of selling the digital goods and in encouraging the sales of physical goods. As that happens, more content will be released and the momentum can build.

How important do you expect electronic distribution to be to overall music indus-

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try revenues in five years?

Hooban: I think a lot of the issues will be worked out and the infrastructure will be there. The record companies are taking baby steps, but they are getting there, so the content will be there. I think it will be a substantial business.

Kearby: A number of different analyst reports are readily available, and their projections vary. Clearly, it will be an evolutionary process where the sales of downloadable music will begin slowly and grow. But the consensus among all the analysts is that record labels, both large and small, should leverage the Internet now to their best advantage. Whether it is used purely for promotion or as a sale and delivery vehicle, the informed label executive recognizes the exposure and efficiency potential of the Internet.

McPartland: Total U.S. sales by record clubs—basically Columbia House and BMG Direct—are approaching $2 billion annually. That is in the face of flat-to-declining total industry sales, using a print-based mail order business with intentionally delayed new releases and a sales methodology that does not permit the consumer to interact with the product in any way that would facilitate purchase. It is the central tenant of TCI Music's core strategy that electronic distribution will fundamentally change every element of the music business, from the way artists interact with labels to the level of economic participation that occurs at each link in the distribution chain.

Singer: The consensus seems to be that in five years, digital distribution will be a noticeable, but not very large, portion of retail revenues—still smaller than the record clubs' 10 to 15 percent.

To the extent that there is electronic distribution in the future, is the Internet the most likely vehicle, or do you foresee other approaches as well?

Hooban: I think the Internet will be a big vehicle, but there will also be alternatives, such as wireless satellite. But the Internet will be one of the strongest areas, because that's where people want to be. It's got the mindshare right now.

Kearby: Liquid Audio has traditionally developed software solutions in an open architecture environment, enabling us to quickly implement and integrate technological developments. If new, viable delivery options become available that have the promise to enhance the online musical shopping experience and develop significant penetration in the consumer market, you can trust that we will be among the first to deploy them.

McPartland: The Internet will certainly be one key avenue of electronic commerce. However, notwithstanding the efficiency of compression innovations, broadband avenues will also play a major role. This will especially be true should interactive cable set tops debut on time and at the scale currently anticipated. We believe that the cable box will allow consumers and record companies to download music products and services in a secure high-speed/high-fidelity environment. This will allow a large consumer base to experiment with the convenience and functionality of direct downloading of songs as well as whole albums or concert performances.

Singer: Internet protocols will certainly be used, but there will be networks used other than the Internet to get the goods to consumers. This is already true in a University where a server sits behind the firewall and students listen to music over the campus Ethernet.

To the extent that there is a role for electronic distribution in the future, will it be equally applicable to all types of music product—including new album releases—or mainly used for promotional singles, back catalog, obscure artists/genres and other niche applications?

Hooban: I think it will definitely be used for singles, back catalog and obscure artists or genres. For new album release, it depends how big a market it turns out to be. If a quarter of music industry sales were by download, then new releases would be sold that way. But I don't know if anybody knows the answer to that yet.

Kearby: All the options you mention are valuable marketing tools that the record industry has at its disposal when using Liquid Audio products. Our system is extremely flexible. The major labels can use it as an ideal promotional vehicle to drive traffic to their brick and mortar retailers and to online retailers. The Indies, who lack the same degree of physical distribution as the majors, are in the forefront of making their artists available on a track-by-track basis for purchase and download directly to consumers.

McPartland: Seventy-five percent of all online/nontraditional sales are currently directed to catalog releases. This is due to both the online demographic as well as the difficulty associated with getting deep catalog through traditional retail. In the future, I believe new artist releases will also be greatly facilitated by electronic commerce. However, we will also see the concept of music rental proliferating. Specifically, if the system through which you would download music is so efficient and dependable, why store it on your hard drive at all? Why not just call

Bandwidth into the homes has certainly been one of the gating factors for widespread consumer adoption of the Internet as a shopping alternative for music. Let's face it, with current technology the listening experience online via a 28.8 modem is just barely in the range of being tolerable to most audio professionals.

—Gerry Kearby, Liquid Audio

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up a portfolio of selections as needed for a nominal rental fee? I believe nonphysical delivery also means nonphysical storage and more of a play-on-demand relationship.

Singer: There are two segments that seem to be emerging as worthy of attention as electronic distribution begins to become a real business. For active music purchasers in high school or college—clearly a "hit driven" market—you can use it to help promote new releases. The back catalog and other material is probably of greater appeal to those who are somewhat older and less comfortable shopping in most traditional music retailers, which is why sales of jazz and classical as a percent of the total is much higher at online retailers than through traditional outlets. It is too soon to say whether digital distribution will apply equally to both these segments.

Do you expect the major labels to adopt electronic distribution only through their own sites, or will retailers (online) still have a role in the distribution chain?

Hooban: I think record companies are trying to figure out where they fit into the value chain, and what part of it they are going to assume. Do they act as the retailer and go directly to consumers, or do they work with online retailers to do that? That is an issue that is just being batted around. The real strengths of labels are their marketing and promotional muscle: They know how to break an act and take them big. But why don't record companies get into retailing, owning their own record stores? I think it depends on what the companies view as their core competencies. And running a successful online commerce site is not an easy thing. Maybe a couple major labels will get into it, and maybe the rest won't. It's hard to say.

Kearby: It's unclear to what degree the major labels will make any of their content available directly to consumers over the Internet. Undoubtedly, traditional retail will continue to retain their very important role in the distribution chain in the foreseeable future. What's important to remember is that the Internet is not an inherent enemy to the traditional retailer. For example, Liquid Audio was involved this past July in a promotion involving Tower Records and the Intel New York Music Festival. We recorded a live performance of one of the bands during the festival, encoded and published it to the Net and made it available at the Tower Records store in Manhattan the following morning. Anyone who bought a copy of the band's latest CD at that Tower location could then go to an in-store station where they could download the Liquid Track from the night before and burn their own CD, a very cool commemorative of the event. We expect to do more of these types of events in the future.

McPartland: I believe the labels will

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probably employ multiple channels of distribution and multiple site access, but through proprietary non-third-party technology processes.

Singer: As large, traditional retailers such as Tower or Best Buy grow their online presence, the labels must provide these important distributors with goods to sell. If most goods are still sold physically, then they must keep those entities in the picture, though the labels will sell directly from their own sites too.

Would you expect to see music electronic distribution in an "open" format such as MP3, or in one of the competing proprietary formats?

Hooban: I don't think the open MP3 format will work, because it does not have the required security features. It already has a negative image in the music business; it will always be associated with piracy. If anything is going to happen, it will be with the proprietary formats: a2bmusic or Liquid Audio. But they may need to come together on some kind of standardization so they are able to play each others' files while still addressing the security issues.

Kearby: Unfortunately, MP3 is so "open" that it has become the technology of choice for music pirates. MP3 is great news if you want your music for free; there is an abundance of free music being distributed illegally all over the Internet in MP3 format, much to the dismay of the RIAA and others. If you make your living from making or producing music it's very bad news. Apart from the audio, which is noticeably inferior, there is virtually none of the standard info you get with a conventional CD. On the other hand, the Liquid Music Player, also a free app, provides superior audio quality and provides all the info you get with a standard CD like album art, liner notes, credits, lyrics and more. Plus it includes the ability to allow consumers to burn their own CDs using a very simple, friendly interface. So it provides a great experience for consumers and implements safeguards that ensure complete accountability and payment for rights organizations, labels and artists.

McPartland: Distribution will be in a proprietary format to preserve the major label food chain but also to ensure to the consumer that buying into one "major label standard" will allow them to embrace the totality of electronic commerce.

Singer: We will continue to see both types of formats, and we can expect the majors to support the systems that respect their copyrights. That is what is important, not whether it is open or closed. Formats that allow individual consumers to decide whether or not they wish to put an artist's music up on the Net without permission are unlikely to be supported by the artist or the majors any time soon, if ever.

What impact do you expect the introduc-

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tion of portable MP3 players to have on the outlook for electronic distribution?

Hooban: MP3 players will accelerate the music industry's adoption of one of the proprietary formats that have the security and protection that the record industry needs. If hundreds of millions of dollars are being lost because people have MP3 files and portable MP3 players, then the record industry is going to have to address that issue rapidly to combat that piracy. Otherwise, people who download hot new releases are not going to place any financial value anymore on music, and may never go into a record store and pay for CDs.

Kearby: We believe open standards like MPEG-3, or the more advanced MPEG AAC [advanced audio coding], which we have just integrated into our Liquifier Pro V.4.0 encoder, can be correctly implemented in a way the record industry will embrace. We have been working closely with several manufacturers of these devices and other new consumer technologies. As they increase their penetration into the market, we have laid the groundwork to support them as delivery platforms for music in Liquid Audio format.

McPartland: The most direct impact of MP3 portables will be to further delay major label acceptance of nonphysical delivery, due to the industry's fear of lack of control and the large number of bootleg sites. What the industry should learn, however, is that MP3 shows consumer acceptance of digital delivery, albeit in an unauthorized mode at the moment.

Singer: Portable players are essential to consumer adoption. The music industry will not support such players until they are part of a system that protects the interests of the rights holders.

Do you have any concerns about the degree of data reduction used in current electronic distribution schemes? Are standards of audio fidelity being compromised in order to enable electronic distribution?

Hooban: I don't think that fidelity is a big issue. I don't think the typical consumer will be able to detect a difference in fidelity between the downloading formats, or between any of those formats and CDs. I listen to files compressed 11:1, just enough compression to make it go through the pipe fairly quickly, but not enough to where you start to hear sound degradation.

Kearby: Liquid Audio offers artists and labels the ability to deliver CD-quality music directly to fans over the Internet today, and we are constantly striving to raise the bar on the listening experience. Given the bandwidth available today, compression is required to complete delivery in a practical time frame. But our roots are in pro audio, so while we deal with the reality of the existing infrastructure, we also have a vision of what increased bandwidth will make possible in the coming months and years, and we are committed to being at the vanguard of implementing new technologies that make the Internet musical experience the best it can be.

McPartland: Fidelity and technology are no longer hurdles at this point. The hurdle is the business model, the preservation of the food chain.

Singer: We are using AT&T's version of the new MPEG-AAC standard. Independent test results, some published in the *Journal of the AES*, show that this compression scheme provides the best combination of sound quality and file size available anywhere. Furthermore, in blind comparisons the quality is in almost every case indistinguishable from the original CD. The quality we are shipping today provides better fidelity than other alternatives used by millions of consumers every day, namely audio cassettes and FM radio.

What is your company's current and planned role (if any) in the delivery of music to consumers in electronic rather than physical form?

Hooban: We will be in the direct download business one way or the other. It's just a matter of when is the right time to do that. We see digital download as being an additional product line, just another music product that we would sell. And our goal is to offer the broadest range of music products that we can.

Fidelity and technology are no longer hurdles at this point. The hurdle is the business model, the preservation of the food chain.
—*Tom McPartland, TCI Music*

Kearby: Liquid Audio has developed a secure, end-to-end Internet music delivery system. We provide the industry with a software-based infrastructure that provides the potential of instant global distribution combined with unsurpassed intellectual property protection.

McPartland: TCI Music seeks to be the quintessential delivery platform of digital music entertainment services and related products through multiple distribution channels. We believe music is one of the most likely entertainment forms to be able to take advantage of this new arena. Therefore, we have engineered our entire company around building the capability for our consumers to select audio, video and related information services in a totally self-directed manner through interactive digital distribution platforms of a quality second to none.

Singer: a2bmusic provides the record industry an approach and technology that meets the requirements that they have spelled out for participating in electronic music distribution. We have an approach that helps them sell records through various promotional efforts, our security is excellent, and the sound quality is great. We're talking to key partners to enable the creation of portable players that support the rights holders. We expect to continue to play the role that we have already established as one of the leaders in digital distribution. ■

Philip De Lancie is Mix*'s Media & Mastering Editor.*

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The Music Industry Meets The Internet

It's a simple fact: The Internet is changing the whole structure of the music industry. The people who have traditonally held power over how music is sold and distributed have had to smash their business models, as more and more music is sold on the Web. In fact, according to market research firm Jupiter Communications, music has become one of the biggest Internet retail markets: $81 million dollars in sales were forecast in 1998, and that number is expected to rise to $1.15 billion by 2002. After text, music is the second most popular content in Web commerce.

Like all Web content, audio needs a technical infrastructure to support programming and delivery. The music industry has been slow to embrace Internet technology as a means of promoting and delivering music, however, because of all of the complex associated issues, such as the international scope of the marketplace, ease of transferring content and the common, and dangerous, misconception that all content on the Web is free...

Piracy Online

Perhaps the biggest threat the Internet brings to the recording industry is opportunity for piracy. "If something is worth stealing, then there are unscrupulous people who will do that," says Bruce Colfin, an entertainment attorney and a 30-year veteran of the music industry. "And if something is easy to make copies of, and you can do it surreptitiously, and it's less dangerous than drug dealing and things like that, you can make a fortune in it." Colfin believes pirates are most dangerous to large corporations: "I don't think the pirates really care about something from the little guy unless it's really worth a lot of money; they are more concerned with the mass-market stuff, the stuff they know is a bazillion-seller," he says. "Pirates don't want to rip off somebody who's not well-known, because they're not in the business of marketing and publicizing. They want [a customer] who'll say, '*Titanic* for two bucks? I want that!'"

There are those who believe that consumers won't pirate if the alternative—a legitimate purchase—is acceptable to them. GoodNoise Corp., a record company using the Internet as a platform for selling and delivering music, operates on that philosophy. "The point that we're making [at GoodNoise] is that if you make it easy for people to buy, and you give them a good price, then 80 percent of people are going to do it the right way," says Steve Grady, a spokesman for the company. "There's no expectation that the music is free—most people want the artist to get paid for what they do,

Illustrations by Dave Ember

World Radio History

In the online world, **piracy** and **protection** are the hot topics.

by Sarah Jones

World Radio History

The Music Industry MEETS The Internet

for their intellectual property, and they will do it the right way."

Of course, the record industry has always dealt with copyright infringement and recognizes that piracy is not going away; however, the opportunity for illegal distribution is much greater in cyberspace. "The leakage that occurs in the ordinary course is not what we're talking about when the entire world is interconnected using converged technologies on global networks," says Cary Sherman, Recording Industry Association of America (RIAA) senior executive vice president and general counsel. "There, leakage of one recording can suddenly be accessed by millions of people around the world. It's the aggregate impact: It's not what any one person does in his or her home, it's when one person can become a worldwide publisher of somebody else's music that we've got a serious problem."

MP3: Opportunity for Promotion or Piracy?

"I have seen the death of the recording industry. It's name is MP3," wrote columnist Joshua Quittner in a recent online edition of *Time* magazine. An ominous statement, to be sure, but one that echoes the fears of more than a few record company executives. MP3, short for MPEG 1 Layer 3, is a popular format for audio delivery on the Web. An open standard, MP3 compresses digital audio files at a rate of about 11:1—meaning a typical pop song can be shrunk down from 40 to 50 MB to about 3 or 4 Megs, a manageable size for delivery across the Internet. But more than its ease of use, the aspect of MP3 that is seen as a threat to the music industry is the fact that the format does not incorporate a copyright protection scheme. At Music Tech East, an ASCAP-sponsored conference held in New York last October to explore ways to use new technology to promote and protect music on the Web, Jason Calacanis of the *Silicon Alley Reporter* declared MP3 "the music industry's Vietnam," citing high-speed access, affordability of CD burners, the fact that point-to-point communication has been easier to carry out and harder to track, and the music industry's hesitancy in responding to it as the main reasons the format poses a considerable threat to the record business.

I think the principles of the old law make perfect sense, even though technology changes. If something is protected by copyright and somebody finds a new way to make a copy or a derivative work—an unauthorized copy is an unauthorized copy.

Bruce Colfin, entertainment attorney

The technology itself is not the problem, say opponents of free MP3 use; what is troubling is the illegal use of MP3 as a vehicle to proliferate the pirating of copyrighted material. Indeed, an estimated 3 million people have already downloaded free MP3 players, and thousands of Web sites promote and distribute illegal MP3s.

And the MP3 format is just beginning to take off. A growing number of manufacturers are introducing systems that enable MP3 files to be taken off a PC and downloaded into portable, Walkman-type devices. (Even a car system is in development.) At press time, the RIAA was denied a preliminary injunction to prevent distribution of the Rio, one such MP3 playback device, claiming the unit is in violation of the 1992 Audio Home Recording Act, which prohibits the manufacture of home digital audio recording devices (remember consumer DAT?) without a Serial Copy Management System to prevent additional generations of copied material. Diamond Multimedia, maker of Rio, counters that the pager-sized Rio, which retails for about $199 and can store about an hour of MP3-format audio, is a playback-only device; therefore, SCMS requirements do not apply. Not true, says the RIAA, because in order for MP3 files to be played back in Rio, they have to be copied from another source, whether that source material comes from the owner's personal CD or is downloaded from the Internet.

The music industry has been slow to embrace Internet technology as a means of promoting and delivering music, because of all of the complex associated issues, such as the international scope of the marketplace, ease of transferring content and the common, and dangerous, misconception that all content on the Web is free...

Not everybody agrees with the RIAA's contention that distribution of unprotected music poses a major threat to the record industry, however. The Internet is growing as a viable marketplace, offering new distribution and promotional opportunities for small record labels and other independent groups. Critics of the RIAA feel that the group is acting with only interests of its major members, the "Big Five" record labels, in mind. These Big Five companies—Warner, BMG, Sony, MCA/PolyGram and EMI—account for 80% of the $38 billion global music market. But this share is down 10% from five years ago, and the Internet is greatly responsible for that shift, according to GoodNoise, which uses its Web site

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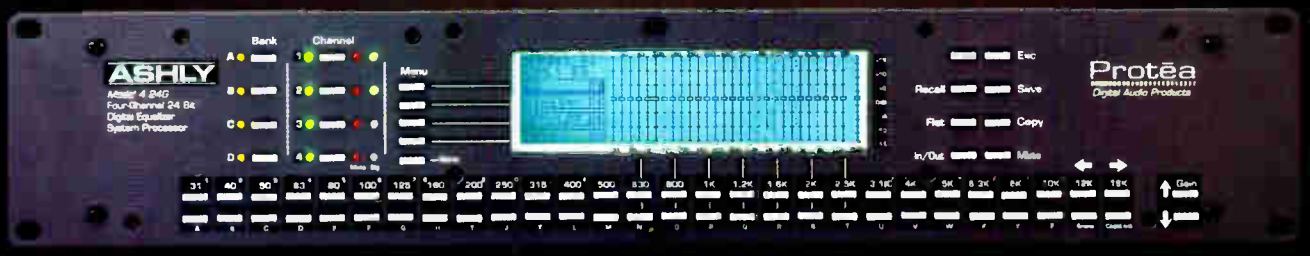

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(www.goodnoise.com) to publish music in MP3 form and bases its business on the theory that most MP3 traffic is legal and that the majority of MP3 users are fans, not pirates. "We feel that the whole argument that the RIAA and the major record companies are making about piracy is really a smoke screen," says Steve Grady. "What they're really afraid of more than piracy is digitally distributed music. [The major record labels] have a chokehold over the industry as far as distribution goes—they have controlled it for a very long time. [MP3] changes the whole fundamental structure of the music business and opens up new doors for artists who aren't established with major record labels to have an outlet to distribute their music." That poses a threat to the labels from a cost perspective, says Grady, because physical goods are no longer part of the equation.

The major record labels have a chokehold over the industry as far as distribution goes—they have controlled it for a very long time. MP3 changes the whole fundamental structure of the music business and opens up new doors for artists who aren't established with major record labels to have an outlet to distribute their music.
Steve Grady, GoodNoise

The RIAA defends its position, insisting that those allegations are "absolutely wrong. It isn't the technology itself, it's the fact the technology is being abused to take other people's music and disseminate it worldwide for free," says the RIAA's Cary Sherman. "People shouldn't be surprised that companies that try to make a living at making music and people that try to make a living making music have a problem with that. We didn't think a product should be put on the market that was going to exacerbate the already terrible problem of illegal MP3 files by encouraging more people to download them, because if that market took hold, and you were able to offer the consumers portability with respect to MP3 in the form of a device like the Rio, how can a legitimate marketplace compete?"

Rather, Sherman says, the RIAA is in favor of an industry effort to create an open, multi-industry security standard: "When you do that, you have opened up—far from closing—the distribution channel. Because that means any company, large or small, can get into distribution, because their artists' works will be protected. That means that the distribution channels will be broader, not narrower. And we wouldn't be doing that if the majors were doing what they've been criticized of doing."

Sherman adds that those who criticize copyright as an obsolete concept "really ought to go back to their roots and think about why it is that we've got the most vibrant mass culture in the world. It's in part because by giving people that statutory monopoly we are able to disseminate the largest number of products at the lowest prices. Otherwise we're going back to Mozart and having patrons who can afford to pay an artist to create, and the other people get the crumbs for free."

The RIAA's lawsuit against Diamond probably will set a precedent for MP3 and its role in online music delivery. In any case, it represents one of the first steps toward defining a new music business structure in cyberspace. Whatever the outcome, the solution will be based on the rules in place today. "I think the principles of the old law, and by analogy a lot of the stuff that is written down there, makes perfect sense, even though technology changes," says Colfin. "If you make copies, does it really matter what you make the copies on? If something—let's say a sound recording—is protected by copyright in the normal course of business and somebody comes along and finds a new way to make a copy or a derivative work—an unauthorized copy is an unauthorized copy."

Technology is being abused to take other people's music and disseminate it worldwide for free. People shouldn't be surprised that companies that try to make a living at making music and people that try to make a living making music have a problem with that.
Cary Sherman, Recording Industry Association of America

Web Earnings for Composers

"Basically, my background is as a composer, someone as an owner of copyright, so the whole issue has been a concern to me, even before the Internet," says Joyce Imbesi, a Los Angeles-based musician, composer, producer and founder of TuttoMedia, a company providing music and sound production for film, TV and new media. "It's been a big concern, how I am compensated when my music is performed, whether that be on broadcast medium, through television, cable, the radio, overseas, records sold, any of the typical copyright outlets. It's been very interesting to see how that's changed, because in my mind

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there were already some problems in tracking all of these works before we even had the Internet."

There are many ways for these royalties to be earned on the Internet, based on the legal framework currently in place: For example, streaming audio is defined by copyright law as public performance; many downloads earn mechanical royalties. Licensing and tracking have been a challenge, however. Several companies, such as Liquid Audio, AR IS and others (IBM is said to have a system in the works), already provide software solutions for protecting copyright and distributing royalties earned on music downloads. In addition to these embedded watermarking and tracking systems, another advance is ASCAP's EZ-Seeker tracking system, which identifies specific song titles performed on the Internet and will locate Internet sites using commonly available audio and video file formats. It then qualifies potential licensees, automatically issues license forms to appropriate sites and later tracks compliance with license requirements. EZ-Seeker can also decode various watermarks that may be employed by record labels, music producers and distributors to identify their works. BMI offers BMIMusicBot, a Web search and database application for identifying music and linking information with songwriter and publisher information.

Imbesi believes that education—of the composers as well as content providers and consumers—is needed for these tracking systems to work. "There are a lot of Web site owners who have music on their sites—whether it's background music or they're selling music—and don't have any knowledge of the fact that they are supposed to be paying, that this is something that is owned by someone and needs to be licensed," she says. "On the other side, since the technology has changed so much and anyone can sort of be a composer in the garage with a few boxes, a lot of young composers who are doing music for video games and that kind of thing really aren't educated as to what their rights are, that their compositions have a value beyond maybe what they are being paid to create them."

And although Internet technology seems to be outpacing legislation, steps are being taken to manage intellectual property across international lines, as well. One recent victory for the recording industry was the passing of the Digital Millennium Copyright Act, which allows for the implementation of the World Intellectual Protection Organization treaty, designed to protect copyrighted works over the Internet. The treaty represents an international copyright protection effort, making it illegal to manufacture or import any devices that circumvent Internet copyright protection technologies. In addition, the agreement raises the global level of copyright protection on the Web to U.S. standards, which are the highest worldwide.

Finding a Long-Term Solution

Just as the industry was not prepared years ago for the feasibility of home CD-burning, nobody can predict a timetable for the inevitable faster, better-sounding music delivery technology of the future. What should be done now to ensure a system is in place to address future mass-market systems? The answer varies, depending on perspective, but everyone agrees the solution begins with a heightened awareness level.

"The solution is marketing, not technology," says Steve Grady. "You have to market in the right way to the consumer base, make it easier to buy than to steal, and you have to give them an advantage for buying, to re-create that relationship with the customer."

Joyce Imbesi suggests a blanket license as a possible way to provide compensation to composers and artists; service providers could pass on their license costs as a small increase in rates. "And that would kind of make it invisible at the same time," she explains. "Because when people put the radio on, if they had to put a quarter in every time they would think twice about it. But it's being paid for: When you pay your cable bill, you're paying for all the services that you get through that cable line; when you go into a restaurant, part of your meal ticket is paying for the ASCAP or BMI license that's being piped in while you're eating your meal. We are paying for music in a lot of other ways, but they're made more invisible—which is part of the problem why the general public doesn't realize that this is property that needs to be paid for."

There are a lot of Web site owners who have music on their sites—whether it's background music or they're selling music—and don't have any knowledge of the fact that they are supposed to be paying, that this is something that is owned by someone and needs to be licensed.

Joyce Imbesi, composer

The RIAA advocates the idea of a long-term strategy for content protection, based on a consensus among the consumer electronics, computer and music industries. "We can't be addressing these issues on a product-by-product, technology-by-technology basis," says Cary Sherman, who adds that a coherent and comprehensive solution will require the consensus of all the affected industries and that it's time to come up with some mechanism to ensure that the content is protected, or that content won't be created. "And this is not a question of just copyright, this is a question of what is going to enable people to earn a living making music when they don't have the ability to control it anymore, or the ability to be paid for it," says Sherman. "And if they don't make money doing it, then they have to spend their time doing something else, and we're all worse off." ■

Sarah Jones is a technical editor at Mix.

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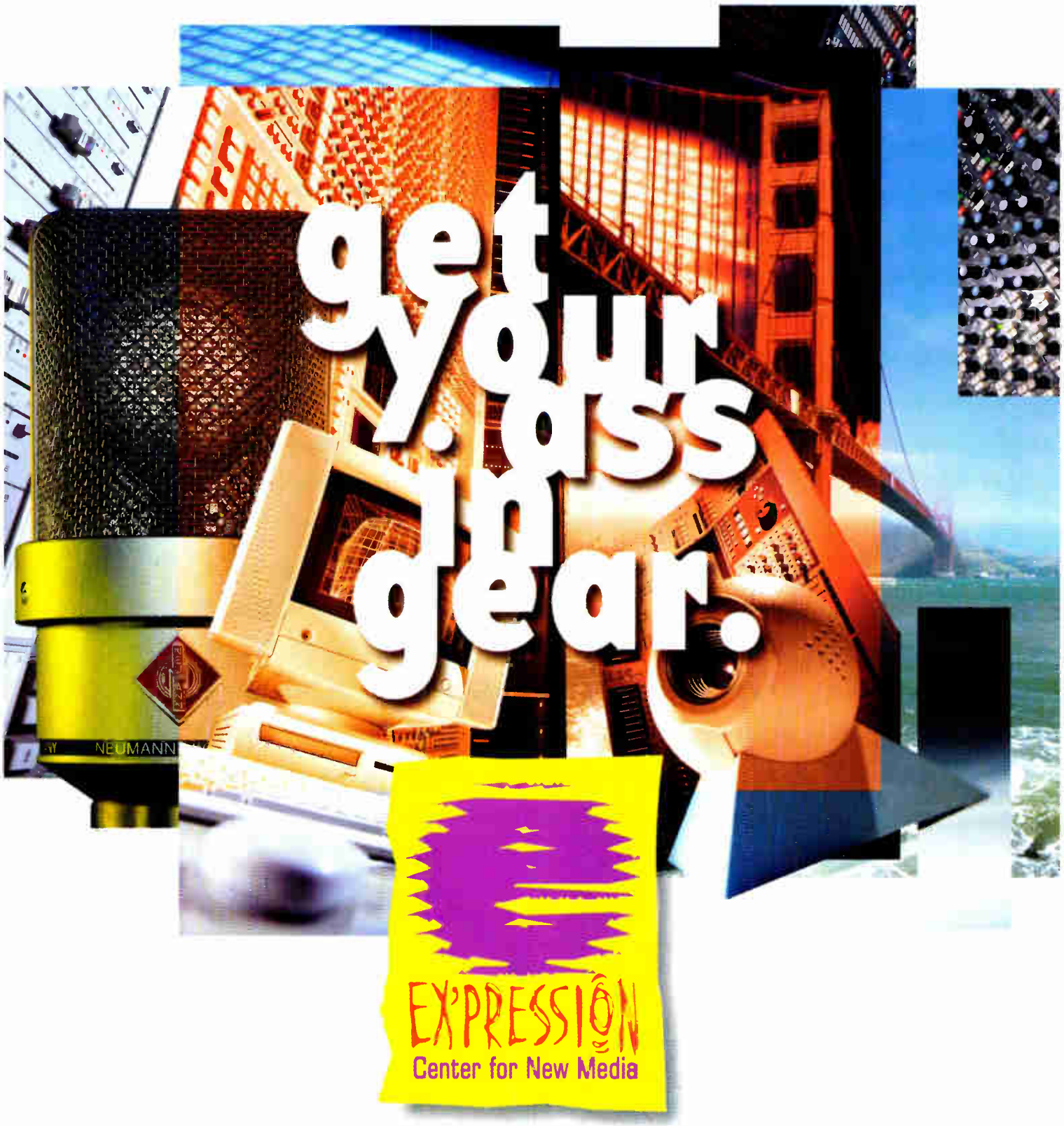

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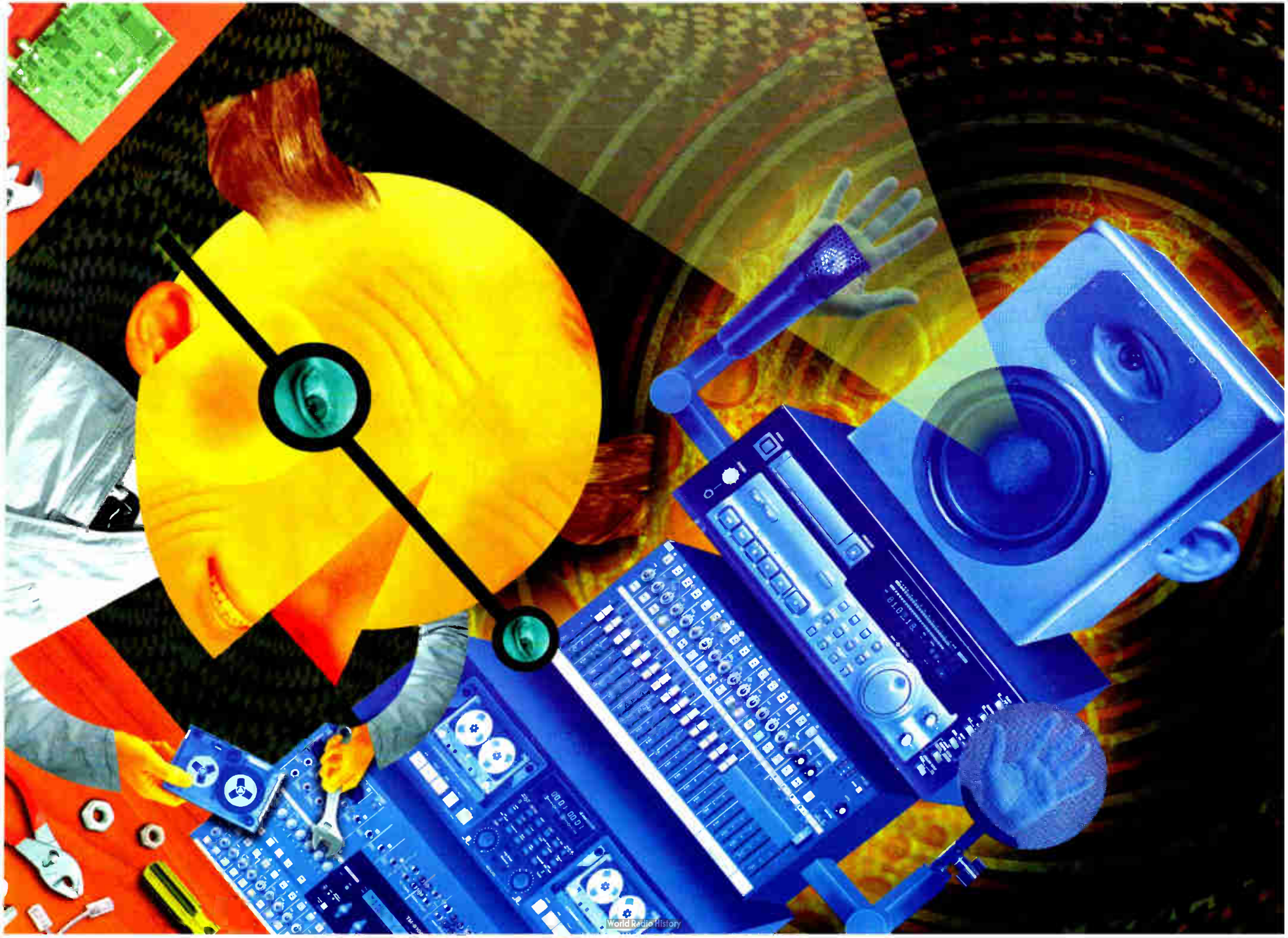
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IN THE YEAR

A Behind-the-Scenes Glimpse at Technologies for the New Millennium

BY GEORGE PETERSEN ILLUSTRATION BY GORDON STUDER

Predictions can be dangerous, farfetched, vague or merely silly.

When futurespeak turns to *audio* developments, the results typically are filled with crystal ball views of biocube storage, coin-sized terabyte datacarts, gigaHertz sampling rates, 400-channel pocket multitracks, antigravity handles for effortlessly stacking bass bins, and for good measure, a couple E-ticket passes to the private collection of holosuite programs stashed in the back of Quark's bar on Deep Space Nine. It's all fun and entertaining, but a sneak peak into what kinds of audio products we'll be seeing in the next few years—based on technologies emerging today—would ultimately be a lot more useful.

So with this goal in mind, we spoke to a number of leading technologists representing divergent fields of audio. The participants included: Yukiharu Akase of Yamaha, Keith Barr of Alesis, Mark Gander of JBL, John Meyer of Meyer Sound Labs, Andy Moorer of Sonic Solutions, Dr. Jörg Sennheiser of Sennheiser Electronics and Richard Zwiebel of Peak Audio. When you poll seven audio experts, chances are you'll get at least nine outlooks, and as expected, their responses were lively and informative. So, as the countdown to the 21st century begins, buckle your shoulder harness, disengage the gantry links, stow your tray table in its upright position and prepare for liftoff. Next stop: Audio 2000!

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Audio IN THE YEAR 2000

The Certainty of Change

Like death and taxes, this fact seems certain: Life in the technology lane is not going to get any simpler.

"Back in the days when we had 16 tracks on 2-inch tape, recording technology was all understandable," notes Alesis founder/chief designer Keith Barr, who, as the co-inventor of the Alesis ADAT, made a sizable impact in terms of making affordable digital recording technology available to nearly anyone. "With all the different kinds of computer recording hardware and human interfaces that can be attached to the computers, the world is going to become a lot more complicated," he says. "From a standpoint of somebody entering the field and trying to understand, recording is both extremely diverse and complicated. Kids who enter the music industry saying they love to play and want to record are surrounded by so many choices, with so much to learn in determining the best system for their situation. Will it be obsolete in two years? How fast is the computer? Does it do the processing or does some plug-in card do the processing? How do I back this thing up? Or do I wait a year for some new thing that's gonna back this thing up?"

And whether we're considering new production tools or release formats, the directions that audio is heading are not necessarily clear: "Technology is in a constant state of flux," Barr explains, "and all of a sudden, we're exchanging massive binary files: What we work with is adaptable for a medium that has not been defined and is constantly being upgraded. The industry is far from focused: It's diverse and complicated, and, as a manufacturer, that situation is difficult and it pains me. But inevitably, it's going to be that way, and I see no end to that. And no consolidating force on the horizon will simplify all of this for us."

BrystonVISION

I think the future of audio will partly involve multichannel sound, but not necessarily connected with video. I think that people will want to listen to music in the best, most accurate, most emotionally rewarding way, and that probably will involve more channels. The other thing I see happening—and I'm very pleased to see it happen—is greater accuracy in the storage media.

Implementation of DVD with higher sampling rates and true 20-bit digital will allow much better signal/noise ratios. Sixteen-bit digital gives us about 96 dB; 20-bit gives us another 20 to 24dB S/N ratio, up to 120 dB. That's what we actually produce in some of the products we build now. The 8B, for instance, in the 2-channel mode, is a 400W/ch amplifier with a S/N ratio in the range of 120 dB. So we look at 20-bit digital as the true test of what that amplifier can do.

—James Tanner, Bryston Ltd.

But regardless of the level of expertise the user has, "the challenge is seeking out new technology in order to create better sound reproduction than anyone has achieved before," notes Yamaha's Yukiharu Akase, responsible for the planning of products ranging from the PM4000 live sound console to digital products such as the SPX line of effects processors and the 02R, 03D and 01V mixers.

Akase adds that the quest for better sound requires "improving the creative music production environment in the areas of both hardware and software, as well as improving the products themselves. Some examples of products with new technology are digital recorders with large storage capacity and digital consoles that feature user-friendly open architecture and learning functions based on next-generation DSP technology," Akase explains. "However, more importantly, greater sounds are born when users can freely and fully express their imagination, ideas and sensibilities in their music—without limitations. We are now in an era where networking these devices flexibly will enable us to realize digital solutions beyond the continuum of time and space. In the near future, more people will use these new-generation devices and networking systems to create their original masterpieces anytime, anywhere."

On the other side of the coin, as soon as additional capabilities come to us, we tend to use them up immediately, whether DSP, RAM, disk space, modem transfer capacity, or console or recording channels. And today, it's ironic that many of us work on computers that require nearly as much RAM in their bloated operating systems as we used to have in total hard disk space just a dozen years ago.

"Our needs always sort of outpace the storage device," comments Sonic Solutions co-founder/chief designer Andy Moorer. No stranger to cutting-edge developments, Moorer also led the design team on the Lucasfilm SoundDroid workstation some 15 years ago—a timeframe that now seems like eons ago in a world where obsolescence is often measured in weeks rather than years.

Is 192 kHz Enough?

"Just when everybody had gotten comfortable with 16-bit/48kHz digital recording," Moorer states, "suddenly we're requiring 20 and 24 bits, 88 to 96 kHz—possibly 192 kHz." Taking the notion one step further, he adds: "I'll make a flat-out prediction that within two years virtually all professional recording will be done at higher sampling rates, 96 or 88.2 kHz or something like that, simply because there are so many advantages to doing so. Of course, there's the next question: 'Where does it end?' And is there any point in going higher?

"We're not trying to make music for dogs and bats," Moorer continues. "As far as perception goes, there are some fairly good reasons why 192 kHz is probably high enough, and these have to do with spatial imaging. The point is, people's differential time response—the binaural time response between the ears—is

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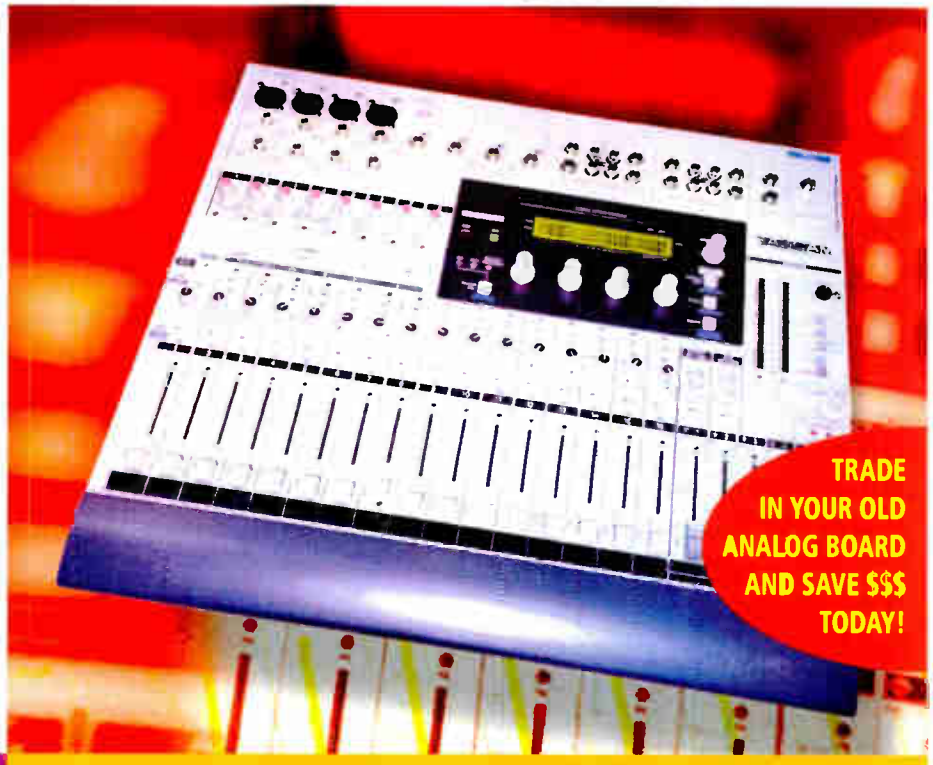

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Emagic believes the integrated "front end" application will play a dominant role in the coming millennium. Existing production tools will evolve into programs that can blend all media formats—such as digital audio, DSP, MIDI, scoring, synthesis, sampling, digital video, graphics, interactive multimedia authoring and mastering—into single affordable and easy-to-use applications for various skill and price levels.

Standardization will become paramount. These emerging standards will have to be user-friendly to guarantee the seamless integration of all the different media formats. Modular, reusable code structures will also be instrumental in providing more efficient production solutions in a shorter time span.

The inevitable accelerated increase of CPU performance and storage media capacity, coupled with standardization and affordability, will enable all media developers to create integrated applications. Naturally, the Internet, especially when equipped with much broader bandwidth, will play a vital role in exchanging media of all types and working on projects from many places in the world simultaneously. It will also serve as a stage where artists will find a new audience. Basically, the distribution cost for multimedia content will decrease significantly and offer access to more. In this respect, the entire world is an emerging market.

—Sven Kindel, President and CEO of Emagic

enormously more acute than what you would expect knowing the ear's frequency response. I think everyone can agree that nobody hears higher than 26 kHz, which is the highest recorded and confirmed pitch that somebody somewhere has been able to hear," which more likely refers to the aural acuity of a young girl living in the Peruvian Andes than it does to a working musician in Manhattan.

"So the question," Moorer says," is what good does it do us to have audio response out to 40 or 80 kHz? In terms of steady-state tones, it doesn't do us any good at all. But it does help preserve the time accuracy.

"Try the following experiment: Put a very short pulse—a microsecond-long pulse—into each ear. If you vary the delay between the left ear and the right ear of this pulse, anyone off the street can hear a 15-microsecond difference. I mean anybody. And that's already shorter than the time between two samples at 48 kHz. And some people can hear down to a five-microsecond difference between the two ears, and that's shorter than the distance between two samples at 96 kHz. And this five microseconds corresponds roughly to the distance between two samples at 192 kHz. So there's some fairly good reasons that suggest that 192 kHz is probably enough."

5.1...Done?

As DVD-Audio discs/and or Sony Super CD 5.1 releases begin rolling onto retailers' shelves in the months to come, 1999 may mark the year of the surround bonanza. Of course, if consumers don't embrace this new technology, then surround audio-only releases may merely be relegated to sit next to the Quad decoders, Elcasets and 8-track tape players in our attics. But either way, the debate continues, ultimately to be settled by the consumers who use their wallets, pocketbooks and Platinum Visa cards to cast their votes to accept or decline this new format.

"Going from stereo to surround in home listening is probably as great as the revolution when we went from mono to stereo," foretells Moorer. "There is some precedent in that the five-speaker system, LCRSS, happens to be used by the film industry. So people will have home theater systems with five speakers in them, possibly with a subwoofer enhancement. So at least initially, music will have to take advantage of that. That is, it would be a relatively difficult sell to convince consumers to go to five speakers just on the grounds of more interesting music. But the difference between a five-speaker presentation and two-speaker is absolutely breathtaking. It's not subtle. It's in your face. This is going to be a time of great creativity."

But are five channels enough? What's the next step? "We're doing some work with the University of California with 8-channel sound," explains John Meyer, from Meyer Sound Labs, a pioneer who brought electronic control into the milieu of sound reinforcement speakers; refined the concept of active, powered studio monitors; and, more recently, has pressed the development of powered enclosures for P.A. applications. "And using full-range discrete sound makes it pretty easy to do new things, such as room simulations to make a room bigger or other kinds of stuff. We found 5.1 hard to pan, although 5.1 is commercially viable, but video is the most important aspect of that. In an 8-channel system, you put one channel in the ceiling so you have LRC, then two on the sides and two on the back and one on the top, like the SDDS idea of it. The DVD could hold that much information—it might take both sides of the DVD to do this, or two layers. Maybe that'll come in the future, but that would be kind of interesting."

According to Moorer, multichannel sound could be taken even further: "As far as I'm concerned, the next stop after 5.1 should be twenties—you know, 20, 30, or more speakers. Anything in between doesn't make a whole lot of sense. As we cross into the next century, one of the things that we will probably see in our lifetime is sound-field reconstruction. Although we can make a fairly good case for there being a limit to the sampling rate and a limit to the number of bits required, it's harder to make a case for the number of speakers. And to reconstruct a waveform that had come from, let's say, a string quartet on a certain stage requires a holographic approach, which would be thousands and thousands of speakers.

"But talking about hundreds or thousands or tens of thousands of transducers or speakers, is really more a question of when we can expect this, rather than if it's going to come. I think it'll be more like

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wallpaper, you know, and embedded in the wallpaper will be zillions and zillions of speakers that as soon as you put the wallpaper up, will figure out where they are and they'll communicate with each other and tell your hi-fi set where they are."

Of course, more channels means increased storage requirements, but the answer to such requirements may go back to Moorer's comments about the needs always outpacing the storage requirements: "Now, if you think for one second about what that implies as to the amount of bandwidth and the amount of data that's going to be transmitted on our DVD format," Moorer says, "we've gone up in capacity by a factor of anywhere between four and ten, depending on how you look at it. The CD came out in '84, about 14 or 15 years ago. So, in the next 15 years, there'll be another factor of two-to-ten increase in the capacity of storage media, which will be manifested as more channels and higher sampling rates."

Moorer feels that all of this technology could lead to some pretty interesting, highly interactive times. "Music traditionally has been stage up-front. That is, there's no interactivity in a symphony concert, except that listeners can stand up and walk out if they feel like it. But the music just happens. Even in a jazz concert, there may be interactivity among

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From a recording industry perspective, there is tremendous opportunity for virtually anyone to achieve a high-quality recording today at a very affordable price, set it up in their bedroom and go for it. I think over the next five to ten years the tools we use and how we use them will continue to evolve both sonically and economically.

However, large, well-equipped studios will still offer an abundance of solutions, as well as a service-oriented, controlled environment for the artist. Because of this, they will continue to thrive and actually be more profitable as their equipment investments cost less.

From a retail perspective, I think there is going to be a tremendous backlash to the current MI "superstore" mentality of the large chain retailers. The smaller retailer will make a comeback in a big way, bringing back value-added, service and knowledge-based salesmanship, developing a true relationship with customers.

—Phil Celia, Director of Sales, Fostex Corporation of America

the musicians, and there's some amount of synergy with the audience, but it's not direct. I don't think we'll see a lot of interactivity as far as what notes are performed, but I do think we'll see interactivity in spatialization. If you want to hear that oboe part up close, you might want to walk right into the middle of the symphony and listen to it. Or, with a jazz musician, if you wanted to really hear what the trumpet was playing, you might want to walk over there. Or you might want to pan it around so that the drums are coming from the back right now."

But beyond deciding where to sit within the multichannel (or *very*-multichannel) listening environment, could the consumer have creative choices in how they experience the project? "Absolutely," Moorer feels. "Rather than the engineer deciding where to pan it, I think we're going to see more and more of these decisions deferred to the listening environment. So the idea would be, you may only have five or six or 12 speakers, but there might still be a point in sending 30 channels of audio and panning them in the home, or in the home theater, right then and there, simply because that allows you the ability to walk through it or change the spatialization."

Additionally, the producer could supply several preset mixes on the disk, stored as some sort of level/panning audio EDLs, perhaps giving consumers presets, in effect saying, "Here are six suggested presets, now there's 10,000 more of your own you could make." Or, "Do you want to sit in the middle of the band, in front of the band or behind the band." Moorer adds that another possibility is that with the producer's preset supplied on the disk—sort of in the form of the director's cut in film—users could call up the producer's preset to study how the mix was done.

Such a process could make a fundamental and revolutionary change in the way we mix, Moorer says: "One of the interesting results might be that we might start mixing things dry or mixing things more dry. In this case, the eight channels that are allowed on the DVD-Audio spec, might not just be speaker feeds; they might be unmatrixed feeds that would then be matrixed and processed in a set-top box via instructions that are sent along with the disk that could be changed or modified on-the-fly. This gets a little bit closer to what we were talking about, like being able to walk into the orchestra, although we're limited now by the number of channels and the bandwidth. There may be some amount of experimentation in releasing completely dry mixes this way, and allowing the set-top units to do the processing."

Meanwhile, stark changes are in store for the home listening environment, where consumers often spend tens of thousands dollars on playback systems, yet completely ignore even the most basic tenets of acoustics or loudspeaker placement.

"We're going to see more processing available in the home environment," Moorer notes. "Some of the problems in the home, of course, have to do with speaker mismatches and difficult listening environments, where speaker placement is often limited by the shape of the room, the location of the furniture—this kind of thing. Simply because the processing power is becoming so inexpensive, we're going to start to see self-calibrating and self-optimizing stereo systems in the home. There have been some past attempts to do this in the home with mixed results. But with five speakers, it's enormously easier to do, and you have some tremendous advantages by using more and more speakers to help get rid of room coloration. Or, certainly, if you wanted to change the acoustical nature of your room and make it sound like you're sitting in a concert hall, being able to assign delays to the different speakers. As far as the consumer goes, this is one area that hasn't been explored fully, yet we're going to see more experimentation."

Microphones: The Chain Begins

Yet not all breakthoughs require new technologies. For example, for some years, the industry has had access to quality analog microphones with dynamic range performance that exceeds 125 dB. Perhaps here, the analog side of the signal chain is merely waiting for digital to catch up.

"There are limitations at every step along the chain," Moorer says. "Microphone preamps get better and better, but in some ways, the microphone preamp is the limiting factor. We know that by running A-to-D converters faster and faster—that is, with higher and higher oversampling—there's relatively little theoretical limitation to how much signal-to-noise ratio you can get. So we're limited by the input stage to the A-to-D

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converter and also by the microphone preamp. This is going to sound odd, but to go to the next step both may require cryogenic amplifiers. We may very well have to cool them with liquid nitrogen to reduce thermal noise, which is really in some ways the final barrier toward getting under the 140/160dB signal-to-noise ratio that we might like."

Yet microphones continue to improve. "In traditional microphones, the trend of moving toward smaller solutions without compromising quality will continue," foresees Dr. Jörg Sennheiser, owner of both Sennheiser Electronic and the Georg Neumann company, and professor of acoustics at the University of Hannover, Germany. "Using these small, cost-effective transducers, we can pack many of them together to form lines or two-dimensional arrays. If we do them, for instance, with condenser microphones in silicon, we can add some intelligence to it, to steer the beam or whatever.

"Rather than inventing new things in most cases, we're back to the basics—reading old papers or patents—and seeing what technology makes things possible today," Sennheiser continues. "We did this in the past using the RF principle for condenser microphones, which

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—Doug Perkins, mSoft

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MytekVISION

Whatever happens to computers is going to happen to music. A DAW is not a piece of gear anymore; it's becoming The Studio, and if you are skeptical about it, listen to the latest Lenny Kravitz album. Tape and a large console are no longer preconditions for musical creativity. As digital becomes disposable, there will be more emphasis on computer hardware rather than specialized DSP, more emphasis on software functionality and higher resolution of the digital signal path. We'll witness closing of the gap between high-end and low-end DAWs. Take today's Cubase or Samplitude: Their 24-bit/96kHz capabilities are almost equal to Sonic or SADiE, and they have the unquestionable advantage of price point and disposability. No need to fear Bill Gates either; you'll see greater choice of operating systems tailored for handling high-bandwidth media. The BeOS for processing and Linux for networking are the early forerunners that promise to move us a step further.

As for software, the current model of a "DAW platform" as the central piece and "plug-ins" as the outboard gear seems to be neatly replacing the real analog studio with its virtual counterpart. The next big thing that's about to happen is total networking, where the concept of tape is gone in favor of sending music down the wire to the next studio where you are going to work.

—Michal Jurewicz, designer, Mytek

was a real oldie from the 1920s, I think. Now we have done the same thing with optical microphones, which was described many years ago. There is also the possibility of building a microphone without using any metal. There are some applications where metal is critical, for instance in a CAT scan, where metal distorts the high magnetic field. Patients need to have some way of communicating from inside that washing machine [laughs], so there is a need for microphones without any metal."

However, Sennheiser also looks at such developments in terms of the day-to-day needs of the audio community: "The same principle holds true onstage. Having a microphone without any electricity in it—just light being bounced off a diaphragm—we can make it absolutely sweat-proof, which is a problem today in live theater, and there are many more applications of the optical principle." And these are not merely lofty predictions. At last year's AES convention in Amsterdam, Sennheiser demonstrated a working prototype of an optical microphone that used fiber-optic lines to transmit and receive light pulses reflected off the back surface of a microphone diaphragm. "There could also be a revival of planar dynamic microphones, or transducers, such as small loudspeakers," Sennheiser predicts, "because modern magnetic technology makes it possible to shape magnets—at least in the future—at our will. Then we can create structures where we can make use of printed coils on the diaphragm."

Materials and Methods

Audio technologists often need to look into other industries to provide new avenues, particularly in the availability of raw materials. "Piezo-electric foil renders so many possibilities, but the problem is in the material itself," says Sennheiser. "We are not from the chemical industry. We know what kind of foil to take and how to stretch it in what direction to make it piezo-electric. But this requires large investments, so we would like to see the chemical industry provide a material that's properly stretched with high piezo-electric constants, because then we can make transducers out of it. Almost 20 years ago, we built many transducers for telephone use using that approach. They have some remarkable properties, and this material could also be used as loudspeakers, just as a tapestry on the wall. Then you can have square meters of loudspeakers—even with low-frequency reproduction—so that's a possibility. We're just waiting for the material."

Alternate materials and the availability of new materials are a major concern to speaker designers, emphasizes Mark Gander, vice president of strategic development at JBL Professional. In terms of the future of transducers, "the two phrases that come to mind are 'material science' and 'digital electronics integration,'" Gander says, "and those two areas will accelerate their pace over the next few years and determine how loudspeakers or sound systems that employ loudspeakers will be different in the future. Material science is actually the area of greatest advances that loudspeakers have continued to see since their popular commercialization in the 1920s and '30s, when the compression driver was essentially invented.

"Since then, changes in materials that are available to make diaphragms, changes in the material to create the magnetic field, are the areas that have advanced and created the greatest improvements in loudspeakers—whether that's changing from aluminum to titanium or beryllium or some composites for the domes on tweeters and compression drivers, or going from plain paper to carbon fiber, Teflon, Fiberglas, Kevlar or mixtures of all those materials with paper to make speaker cones. We've also seen progress from original field coil magnet assemblies—which are essentially electromagnets—to alnico magnet material, to the lower-cost ferrite magnet material to the more modern samarium cobalt and neodymium magnet materials. Technology advances in materials allow speakers to play with more efficiency, or go deeper in bass, or of particular importance—to have lower distortion than the generations before them.

"Recently, we're also seeing the possibilities of material science leading to other ways to make speakers, rather than the traditional compression driver or moving-coil cone or dome diaphragm, like some of the flat-panel speaker technologies from NXT and other people, Gander explains. "Modern materials technology has allowed these speakers to start to work at an acceptable level, while the flat-panel things that were done out of Styrofoam and other more primitive

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World Radio History

CIRCLE #040 ON PRODUCT INFO CARD

PMCVISION

Over the last 15 years, PMC has focused on developing high-sensitivity, linear systems with excellent phase characteristics. This combined with the obvious benefits of transmission line loading has given us a range of detailed, well-integrated monitors for any application. The recent addition of surround and center-channel versions, plus the ability to deliver efficiently a large dynamic range with extended frequency response, means that we can easily meet the multichannel, 24-bit/96kHz challenge.

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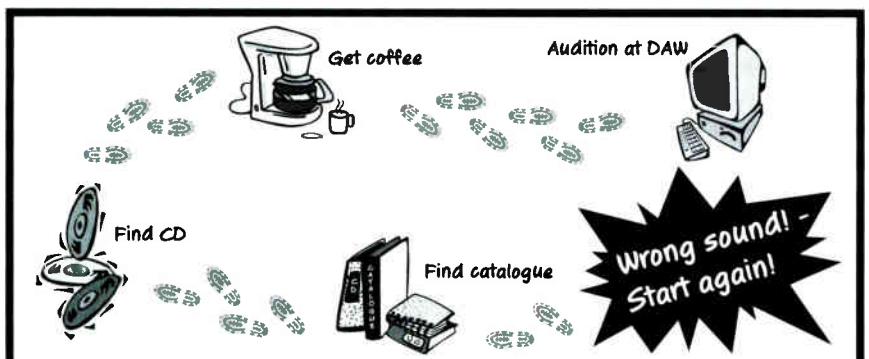
—John Wase, Professional Monitor Corporation

materials in the 1960s and '70s could barely produce speech-range intelligibility, much less high fidelity. Newer materials can actually allow these things to at least be intelligible, and are starting to border on relatively low distortion for high-fidelity applications—or at least medium-fidelity applications like laptop computer speakers and display-panel speakers for trade shows, retail establishments and educational institutions."

As a real-world example, Gander refers to a technology most of us are familiar with: "The perfection of the piezo-electric methodology for tweeters [in the mid-'70s] generated huge numbers of low-cost musician speakers," Gander says. "Now, we take piezo-electric tweeters for granted. They're considered at least inexpensive, if not cheap, and not particularly high-quality. But they are a very cost-effective way that a new material science technology allowed something to be commercialized and come into everyday use.

"More modern examples are the Mylar material that was developed for the space program and used in wire insulation. Mylar is now a common material for dome tweeters and for some of the flat-panel loudspeakers like the Infinity EMIT tweeter used in hi-fi. And there are some professional ribbon tweeters and ribbon devices using that material for the diaphragm. Once you have a material that can be both lightweight and still stiff, and handle a certain amount of mechanical and thermal stresses, you then have a capability of not only improving older designs, but creating new designs that weren't possible beforehand."

In spite of all the breakthroughs and advancements in technology, audio speakers are essentially still constructed around speaker cones, and voice coils. So



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Audio 2000 IN THE YEAR

why in 1999, are we still stuck with cones? "We're still stuck with cones because they work really well, and they're still very, very cost-effective," Gander explains. "The bottom line in acoustics is that you must move air—vibrate air molecules that are butted up against the diaphragm. There are some modern, exotic methodologies of directly vibrating the air. There are a number of research papers and one company that's trying to commercialize this distortion modulation of the air, where you actually put very high ultrasonic frequencies into the air at very high decibel levels.

"The harsh reality is, the air that we breathe and the air that we listen to sound in isn't particularly linear and doesn't accurately reproduce the vibrations that it gets. So over distance, you actually create distortion just from the fact that the air—which is nonlinear—is the propagation medium," states Gander. "And as you increase the sound pressure levels, you can generate quite high levels of distortion, just because of the air. Yet with that nonlinearity, there's actually a way to put in very high frequencies, say 50 kHz, and then also put in 51 kHz at 140, 150 or maybe 160 decibels. And that 51 and 50 kHz beat together and give you a difference frequency of 1 kHz, and you can actually perceive that as a 1kHz tone. The problem is you get all the beat frequencies and harmonics that build up above and below that 1kHz tone, and dealing with those is a limitation of that technology now."

Networking and All That

There's no question that digital has made a major impact on the recording community. In live sound, it's been brewing in the background, ready to take center stage. "These days, the 'digitalization' of products is accelerating at warp speed," states Yamaha's Akase. "Examples, such as DVD, digital broadcasting and the Internet, are trends that are having a tremendous influence and will continue to bring changes to the pro audio industry. Their influence is already apparent in the significant digitalization of music production, studios and sites. The need for digital P.A. systems and acoustic systems for concert halls is emerging."

Obviously, a key part of that digital future is networking, and Yamaha has been intensively involved in developing its mLan spec, which will provide the capability to send sample-accurate AES digital audio, MIDI and other control

StorykVISION

Equipment in the rooms will grow continually smaller as hardware, consoles, tape machines, etc. is replaced with virtual (software) components. The importance of acoustics, environment (room) comfort, lighting, ergonomics, etc. will increase substantially. (I loved a recent article by a well-known producer who said his favorite piece of equipment was his chair!) The economy of surface-applied acoustic treatments will continue. Prices should continue to drop. This will fuel the affordability of studio construction.

Digital sound has just about arrived (finally) to the point where consumer delivery systems are equal to or better than the best analog. This is fantastic. Millions of people will be demanding better environments in which to enjoy multimedia.

Surround sound will continue to drive the mastering and audio production community and be an enormous influence on how production environments are designed and constructed. We hope one thing will not change: Music will continue to be the reason for paying attention to all these changes!

—John Storyk, Walters-Storyk Design Group

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StuderVISION

In the 50 years Studer has been a supplier to pro audio and broadcast, there have been times when the future of products was obvious to the manufacturers, which allowed us to precisely anticipate the tools our customers would need in the future. Today this is no longer true as the various forces change the face of consumer and professional audio, but there are trends and technologies we are confident will be a part of the future audio landscape.

As consumers we will be listening to audio with higher resolution than 44.1/16. It will be multichannel and integrated with pictures and graphics. Audio will be streaming to us from multiple sources including the Web, direct satellite and cable systems. We will have physical copies on optical discs, hard disks and even good old 12-inch platters of analog vinyl (remember them?). We will be listening on playback appliances, computer systems, home theater systems, multichannel auto systems, virtual surround systems (more point sources than speakers) and multichannel headphones.

We at Studer can foresee that we will be producing high-resolution, digital, multichannel audio tools that integrate sound with picture in an efficient, reliable and cost-effective manner.

—John Carey, President, Studer North America

information over IEEE 1394 (Firewire). "The new generation of networking technology should be developed to connect digital products in a flexible manner, able to handle any audio and control signals in an efficient system operation," adds Akase.

A major player in networked audio is Richard Zwiebel of Peak Audio (Boulder, Colo.), which has developed products such as Peavey's breakthrough Media Matrix system, as well as created the Cobranet protocol adopted by numerous manufacturers. From a technology standpoint, the future for networking is bright, according to Zwiebel. "With 100-megabit Ethernet hubs, there was a finite bandwidth. But now we're working on the next generation of things using switched Ethernet. What we're doing is gigabit Ethernet between the switch, and from the switches out, using 100-megabit. Basically, once you get to that place, there's no limitation on the size of the network.

"Gigabit Ethernet allows us to put thousands of channels of audio around a place such as a theme park," he continues. "The technology that we base our technologies on comes from the computer industry—we could never afford to do that in our little old audio industry. The fact that Ethernet computer networks are going to switched, and the cost

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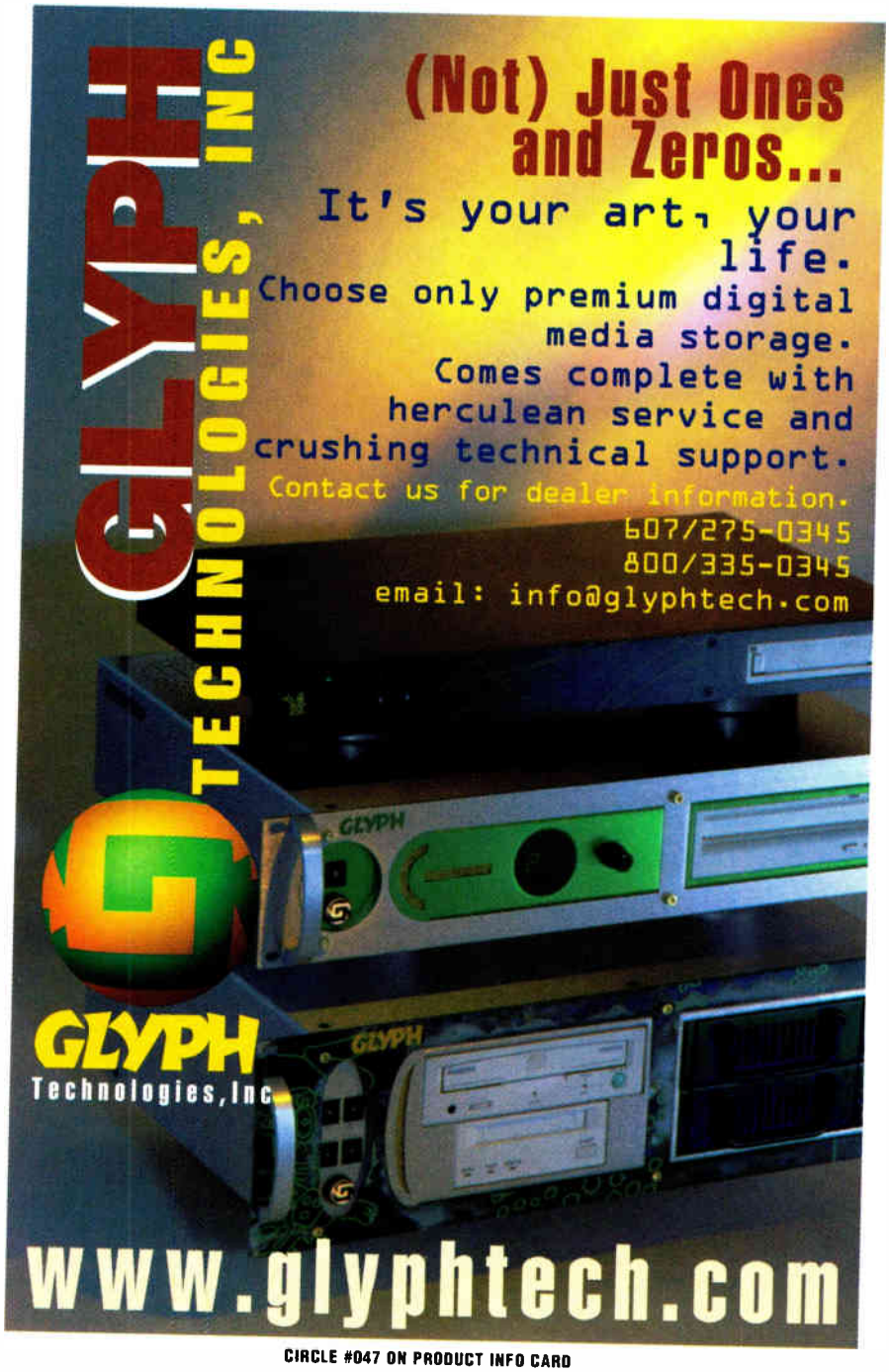
of the switches are now dropping to where they'll be like hubs pretty soon, means we can do a lot of things that a year ago were just impossible.

"Right now, I'm a consultant on a huge project for the U.S. Congress," Zwiebel continues."It's the House of Representatives chamber, and also upwards of 100 hearing rooms, and every one of those has its own audio system. We're developing a big network to tie the whole place together, so from one centralized location, a computer will be constantly polling every system, whether it's in use or not. We're using Media Matrix and amps that have control systems. But, regardless of whose product you use, you'll be able to centrally monitor all the pieces, see if there's anything going bad or any fault or anything, all the way out to actually measuring the impedance as such on the speaker lines to see if there's any speaker failures. Then it would alert somebody who's centrally located, monitoring systems over an area of miles. And using an audio network, if there is a problem, you'll be able to take control of it and actually listen to what's going on in the room, without leaving the central location. We'll also have one spare system there online, with all the presets for every room loaded into it. So if something should go bad, you can just automatically substitute the one you have right there centrally for any other system in the whole facility. That's the direction where technology's going."

At the same time, we need to be aware of the dangers of becoming overtechnologized, where we begin spec'ing systems based on their coolness, rather than for practical considera-



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XwireVISION

In the future we see local and remote production facilities of all sizes using wireless audio transmission for a host of applications, including the distribution of multiple channels of audio for production applications. A digital wireless snake is something engineers dream of today, and we see it becoming a reality in the near future. Some day, consultants will have the option to spec digital wireless in situations that formerly required cable, materials and labor, thus cutting costs and time for themselves and their clients. There's going to be some incredible digital wireless products in the future, especially with components and power sources becoming smaller and more powerful.

—Jamie Scott, VP of marketing and sales, Xwire

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Top: Renowned producers at StudioPro98 (L-R): Ed Cherney, George Massenburg, moderator David Schwartz, Nile Rodgers, Tommy LiPuma, Barry Beckett. Above: Mel Lambert introduces the panel on modular digital multitracks, moderated by *Mix* editor George Petersen.

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Audio IN THE YEAR 2000

EuphonixVISION

In predicting the future, "What is technologically possible?" is usually less meaningful than "What tools are needed to push the sonic envelope of music, film, television, computers and the Internet?". Artists with creative drive and consumer appetites for newer/bigger/better sound guarantee another decade of innovation. Just read through a Mix back issue from 1989 for a perspective on how fast it's evolving.

Our customers cry out for more channels, more tracks, more bits, more samples, more integration between picture and audio, and more integration between recording, editing and mixing. They want this to come in a form that is simple to understand and operate. Our future vision is focused on keeping the technology out of the way of the creative process. Too often, we've seen great technologies that weren't adopted because they didn't help make the production process better.

Sound is purest in its analog form, but digital audio lets you do things that analog can't. However, the path from microphone to recorder will be optimum in the analog domain for many more years. The tools that provide great sound with the minimum effort will be the ones we find on the pages of Mix in 2009.

—Scott Silvfast, President, Euphonix

tions. Does a typical elementary school auditorium really need a network-switched, modem-controlled system with 40 channels of wireless mics and six delay towers, when two hard-wired mics, a P.A. head and a couple two-way speakers would do?

This trend is definitely of concern to John Meyer: "In the last 20 years, the industry has gained some professionality in the audio trade," Meyer warns, "and this is one of the things I really worry about. When I started in the 1970s, there was about a 50 percent chance of finishing the show with problems and things blowing up, and everybody was used to that. We are more respected now. We put on more consistent, better shows. Networking and DSPs can bring us back to when we first got involved with transistor amplifiers, when shows didn't finish and we were making excuses. No one in the audience is going to forgive us if we say we didn't understand how complicated networking was. What is our goal? We're not trying to put an Ethernet together, we're here to put on shows."

One of the problems with networked audio control is the learning curve involved in using products from different manufacturers. Under the auspices of simpler-is-better, Zwiebel has begun developing a solution that would appeal to all audio users. "We're working now with a number of companies in developing a Web-based interface to all these various products," Zwiebel says. "They'll all be using a standard protocol like SNMP or something, so if you're familiar with using a Web browser, you'll be able to just go look at a link and click on 'I need to go to QSC control, or a Peavey this, or a Crown that,' or whatever. It'll open up just like a Web page, but you'll be able to have the controls and stuff inside that page. So if you know how to use a Web browser, you'll be able to get around your system. It's a whole new trend in technology we're going to see."

DSP Integration

But no matter what system, from a simple car-trunk P.A. for a wedding band to a huge, megabuck touring system, the integration of DSP into the sound reinforcement chain offers numerous advantages, but so far we've only touched on the possibilities.

"Now that we have tremendous electronics processing capability with DSP, and with more reliable electronic circuitry that can handle the abuses of portable applications and harsh environments, we have the chance to integrate much more fully what's going on with the transducers," says JBL's Gander. "This includes fully developing the capabilities of modern materials, whether it's carbon-fiber enclosures, exotic diaphragm materials, or new types of flat panel or ribbon transducers. And through the digital control and digital modification, we can extract the maximum performance from those devices—and actually overcome even more fundamental limitations than materials limitations, such as the fundamental nonlinearity of air."

Such developments would certainly have to go far beyond the delay and filtering capabilities typically associated with DSP use today, so are we really just on the cusp of intensive DSP control in loudspeaker systems? "Absolutely," Gander says. "In fact, most of the digital products on the market right now in terms of electronics products are really just simulating the previous analog models in terms of duplicating the classic Butterworth or Linkwitz-Riley crossover slopes, and just doing the delay. The real future is to change over into FIR [Finite Impulse Response] filtering. The classic IIR [Infinite Impulse Response] filtering is part of the mathematics of how we do digital filtering, digital crossovers and implement digital circuitry. But FIR filtering allows you to manipulate the amplitude completely separate from the phase, so we could have infinite slope crossovers that have no phase distortion, for instance. So we're just now at the point where the digital processing is cheap enough to be able to implement those type of filters, which require more processing power.

"Even with systems that right now seem very sophisticated, like the Peavey Media Matrix or the BSS Sound Web," Gander predicts, "the next generation will be able to compensate for distortions and reduce distortions not necessarily that are left over in the speakers—though they can be reduced as well—but will handle problems like combinations of many sources coming to an individual listener or air nonlinearity. Then the next step is beam steering and control of the directivity from multi-

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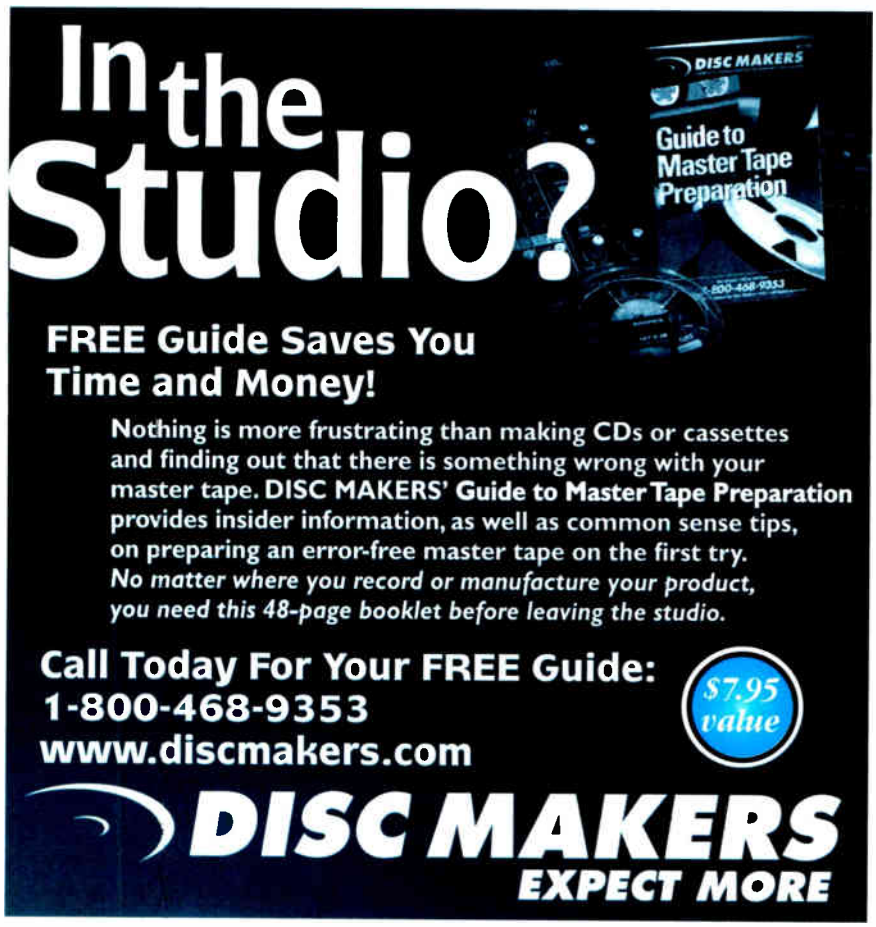

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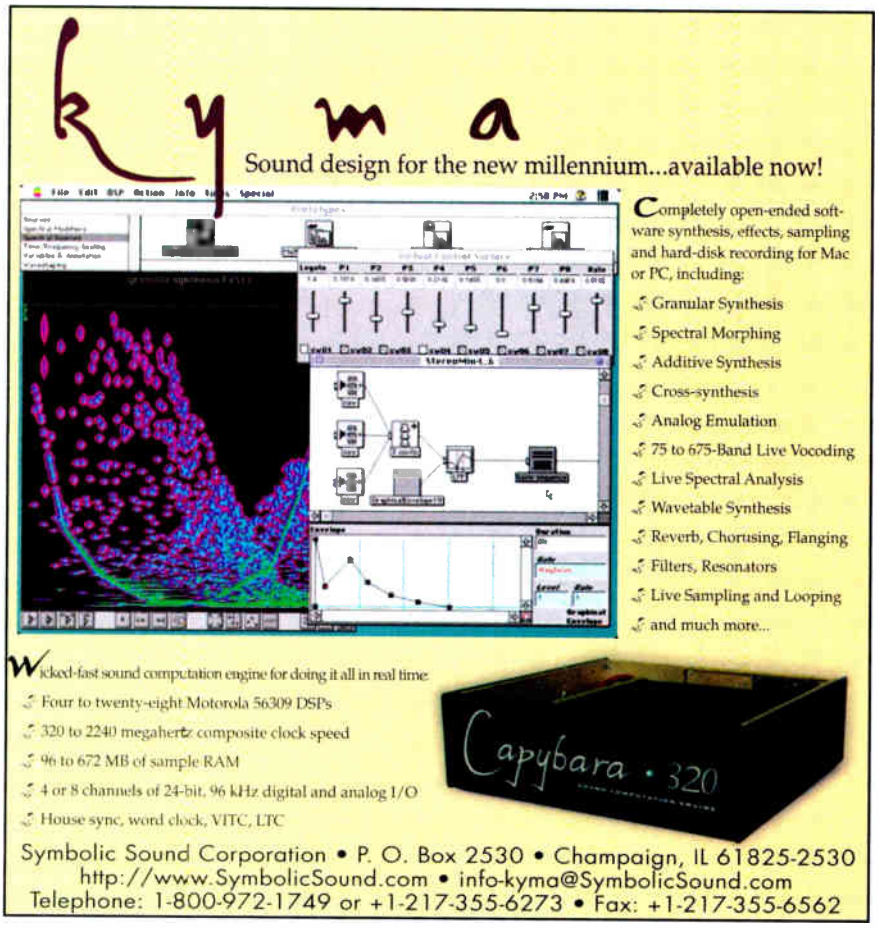

CIRCLE #051 ON PRODUCT INFO CARD

Audio IN THE YEAR 2000

ple loudspeaker sources. It could send the sound only to where the people are sitting—not up to the ceiling or bouncing around the room and causing time-delay problems and difficulties in intelligibility and quality."

On the other hand, providing too much control—especially of previously hidden DSP parameters, can have an adverse effect. "I look at the whole DSP thing like a car, where you have the controls that run the car, and then you have all the stuff that's inside the engine, the carburetor, etc.," Meyer says. "The audio world, seeing DSP coming along, suddenly thinks all these controls that were once hidden should be on the dashboard. Now, an FOH engineer doesn't generally need to know how to disassemble a console, and someone who drives a car doesn't need to be involved with all the aspects of how the engine is run. Most of the time they can drive a car without knowing how the carburetor works or without knowing how the timing works. I think it's a mistake that just because we're going to DSP that suddenly all these parameters should just appear on your laptop along with everything else—crossovers, all this kind of stuff. You want to have operators operate the system and technical people to go inside to work on the system. It's two completely different functions.

"The whole audio trade is getting dazzled by the technology, and we forget our goal," Meyer laments. "Fiber optics and DSP are not the goal—just a method of trying to achieve the goal. We only have one thing to do and that's try to get a sound into the audience so it can be heard, clear as possible." ■

Mix editor George Petersen lives with his wife and an interactive rottweiler in a 114-year old Victorian house on an island in San Francisco Bay.

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CIRCLE #052 ON PRODUCT INFO CARD

2001

A LIVE SOUND ODYSSEY

by Mark Frink

I stood in line outside *Mix* editor George Petersen's inner sanctum to wait my turn to use the latest in prediction technology. Code-named Crystal Ball, the device leased from a private Redmond, Wash., consortium uses a small warp-field generator to create a time-flux around *Mix*'s editorial server, allowing us to look at future issues of the magazine before they are written. As I waited, I thought back on the development of our young sound reinforcement industry, homegrown from a patchwork of

World Radio History

Photograph by Steve Jennings

devices borrowed from movie theaters, radio stations and recording studios: The live entertainment industry we know was created by musicians, inventors and tinkerers who adapted the necessary technology from bordering disciplines.

With the end of the century upon us, it's time to gaze into that Crystal Ball to try to see how new technologies are going to change the tools we've developed for live sound. One thought immediately occurs to me: Although digital audio production has arrived in recording, cinema and broadcast facilities, it is not taking over live sound. Not yet, anyway. But I'm going to walk out on that tongue-in-cheek limb and say that digital is coming.

THE FUTURE IS DIGITAL.

World Radio History

A LIVE SOUND ODYSSEY

Actually, digital technology has been seeping into the industry for years by way of application-specific products. First came digital delays, then reverbs, speaker processors, snakes and small-format mixers. Each application area has seen digital products dominate, once they've proven themselves, by offering better functionality than comparable analog products. However, to justify the costs associated with changing over to all-digital systems, the gear will eventually have to pay for itself. A new product, in any industry, can establish itself only by demonstrating a clear price-performance advantage, and the use of technology for its own sake is something only a handful of projects can afford (and something most live engineers avoid like the plague because they know that low serial numbers carry extra risks). Most engineers choose equipment because it fits their needs, regardless of whether a unit is analog or digital.

So, there are issues and there are obstacles, but the all-digital system is coming bit by bit, and in *Audio 2000* we have a chance to guess what that system might look like.

CONSOLES AND CONTROL SURFACES

Cruising the floor of the 1998 AES convention, it was obvious that digital consoles are now established in non-live applications. In addition to offering the ability to instantly recall the configuration and settings of a particular project, the development of these boards acknowledges that the final product will be digital information, and by working in that domain, attempts to maintain the integrity of the music. Though they are not often used for live sound outside of remote recording and broadcast applications, there are many large-format digital consoles now available. With six-figure price tags, these must replace several other desks or an entire remote truck to pay for themselves (which they can do on very large projects). They must also be accepted by the engineers who operate them.

An engineer's expectations about sound system operation for live shows is based largely on experience, the tried-and-true. The layout of large-format sound reinforcement consoles did not suddenly appear, but evolved into the popular topologies currently in use, and so mixing with a mouse is neither intuitive nor familiar to many live sound professionals. Designers of new consoles must accept the built-in bias for intuitive control surface layouts that are comfortable and easy to use. We expect a one-for-one representation of a fader for each input, with dedicated knobs and switches above each for all possible functions. Typically, we only make adjustments one at a time, but the comfort we get from being able to put a hand on a particular control instantly because it is in a fixed location on the control surface is important, and one of the positives that analog consoles have in common.

Designers of new consoles must accept live sound engineers' built-in bias for control surface layouts that are intuitive and easy to use. Possible future digital consoles might have a flat-panel touch-screen (or a number of them tiled together), depicting familiar rows of faders and knobs.

Possible future digital consoles that are easy to imagine have a flat-panel touchscreen (or a number of them tiled together), depicting familiar rows of faders and knobs that are operated by simply touching them. We have already seen that the first step is a control surface with mechanical faders, knobs and switches behaving much as their analog counterparts. By re-mapping the controls of a short console, an almost unlimited number of channels can be accommodated on a relatively small control surface. Think vertically, in layers, rather than horizontally.

Now that the Nintendo generation has graduated from college, it won't be long before they'll be mixing on PC-based systems using hand appliances that resemble game controllers, discarding rows of physical controls in favor of graphic displays on monitors that can be customized for particular users and specific tasks. Designers of successful digital mixers for live sound might incorporate the same dual-control approach employed in other product categories for live sound, using a physical panel with familiar controls to put operators at ease, plus a PC-based controller for editing the entire range of parameters from a computer screen. A familiar control panel's row of faders and knobs becomes the bridge between an analog console's control surface and a software-based control interface.

A digital control surface offers the flexibility of paged or windowed instrumentation layouts, with handles and switches mapped to control parameters specific to various tasks. But object-oriented control is only the beginning.

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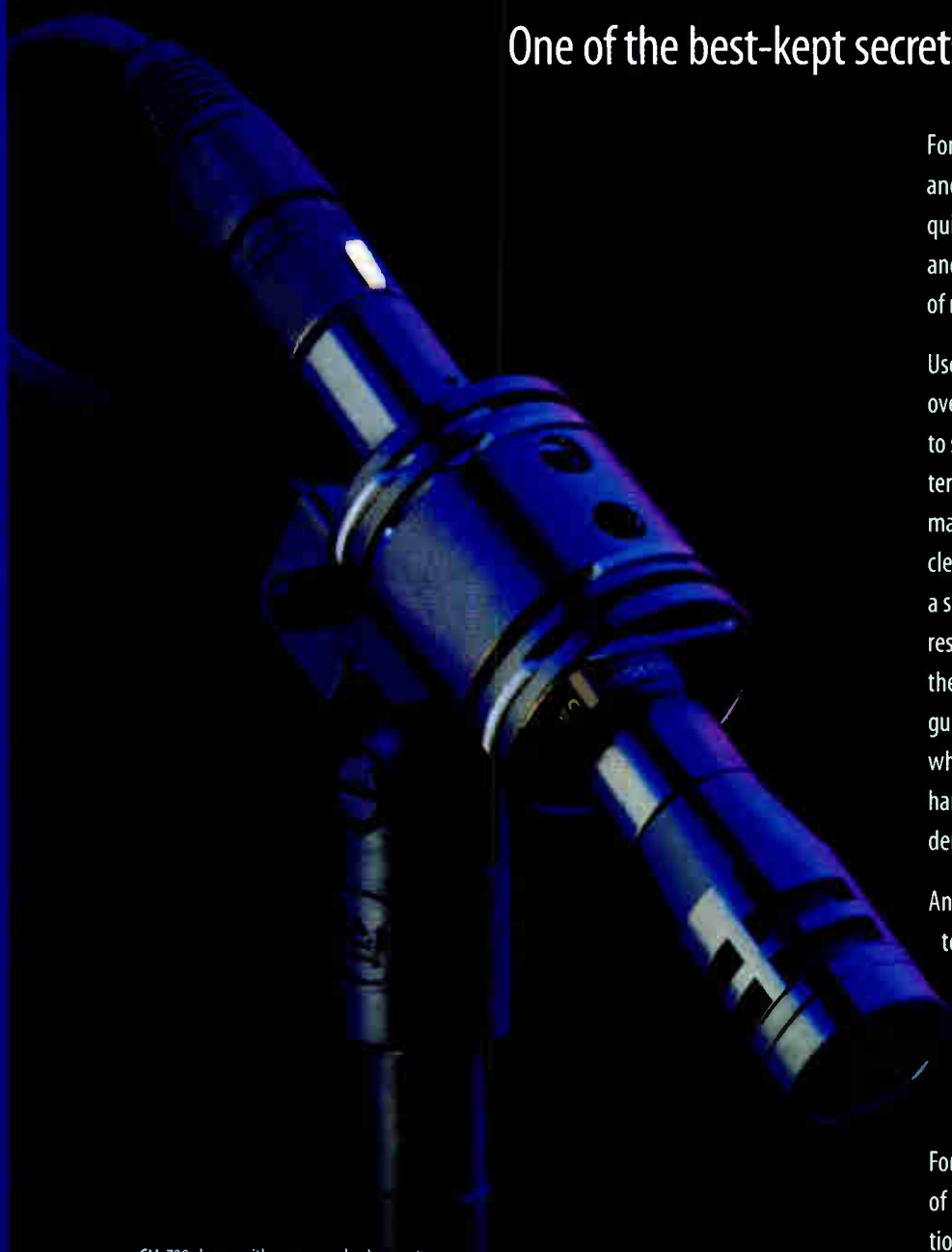

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The use of technology for its own sake is something only a handful of projects can afford, and something most live engineers avoid like the plague because they know that low serial numbers carry extra risks.

A LIVE SOUND ODYSSEY

Beyond this is the potential for digital consoles to incorporate expert systems that can take over the more mundane tasks of mixing, freeing us to listen to the music and watch the stage—all from a choice seat because the controls have been shrunken and fitted into a small cockpit that can be situated anywhere there's an open seat, after the large slab of faders and knobs is left behind.

THE DIGITAL INFRASTRUCTURE

But talking about digital consoles and control for FOH and monitor mixing is jumping the gun a bit. The first step in all-digital production for live sound is the obvious marriage of remote mic pre's and digital converters in multichannel formats. More benefits can be realized when signals are converted from analog as early as possible and then manipulated as a stream of ones and zeros all the way through to delivery at the speakers. There's a parallel in that we have seen a proliferation of mic preamps taking residence at the stage, as well as active splitter systems. This acknowledges the advantage of taking relatively weak input signals and raising their levels near the source before splitting and sending them over long snake lines.

Remote-control microphone preamps that can be monitored and adjusted from the mix position provide a front-end solution to systems with a digital backbone. Like MDMs and high-quality A-to-D converters (and everything else audio), these are available in 8-channel formats. The industry has already seen the marriage of preamps and digital converters in multichannel products that live in the head end of fiber-optic snakes. It's also easy to imagine A-to-D converters purpose-designed for amp racks to have presets to pick up and onboard-process groups of eight channels from the digital return snake.

But, once the signal is sent, there is a burning need for a format of multichannel transmission of digital signals from one manufacturer's box to another's. This digital cross-manufacturer interoperability is a Holy Grail that has seemingly eluded our corner of the industry. Though groups of manufacturers agree on recommended practices, there is no MIDI counterpart in the live sound world.

We are also in need of an inexpensive digital infrastructure—copper cable to use in place of fiber optics, along with a common multichannel format that can be shared by manufacturers to ship digital audio around. We have several candidates for each right now, using copper and high data speeds to accommodate more than 50 channels on one wire.

While fiber-optic technology has revolutionized large-scale distribution of digital audio, shorter distances can be managed using the inexpensive Category Five (cat5) cabling used in present-day computer networks. In layman's terms, cat5 wire is simply a 4-pair Unshielded Twisted Pair (UTP) cable, seen in modern offices cabled to each desk's computer. The terminations are RJ-45 connectors,

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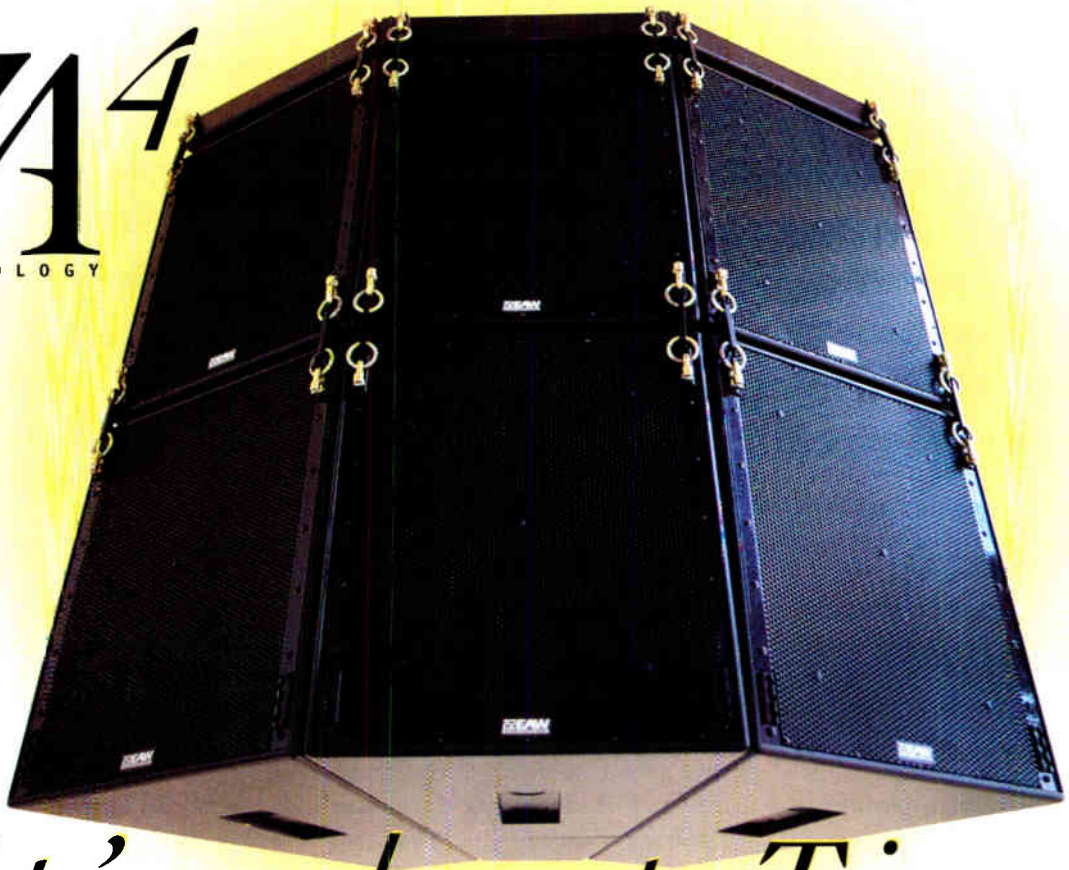

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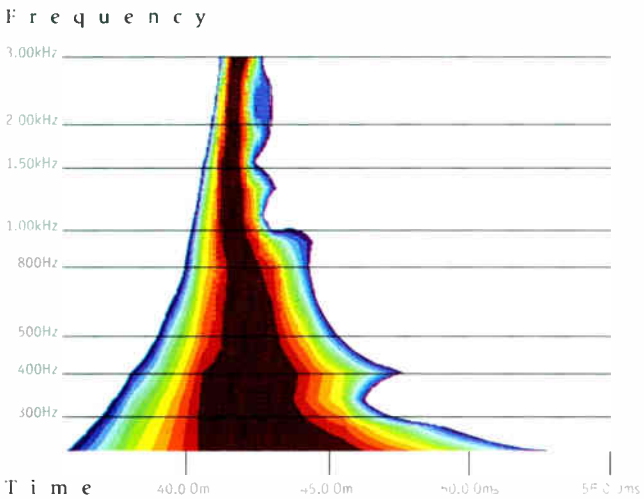

This wavelet image indicates amplitude in color (brown represents 0 dB, violet represents -12 dB) over time (horizontal axis) by frequency (vertical axis). The smooth, steep, tightly-packed slope through the upper midrange clearly shows the unified arrivals of critical vocal intelligibility information.

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similar to telephone jacks but with twice as many wires. The plastic connectors cost only pennies, and 1,000 feet of wire costs well under $100. Another type in use with large-format digital systems can ship 56 channels over 75-ohm coaxial cable for up to 100 meters. Independent of specific technology loyalties, it's easy to see how cabling a P.A. using relatively inexpensive computer network hardware and copper wire is attractive. Money saved could be used to pay for high-quality converters that are the on-ramps to the digital freeway.

The first step in all-digital production for live sound is the obvious marriage of remote mic pre's and digital converters in multichannel formats.

POSSIBILITIES—FROM MICS TO ARRAYS

What are the full benefits of a digital system? The potential for analyzing and processing signals—digital data—offers opportunities we can only begin to imagine. With the advent of inexpensive PC-based FFT analysis, powerful tools have been placed in the hands of live sound engineers who before had to rely on analog RTA tools. When all signals are digitized, we can further refine our ability to optimize the performance of the transducers at either end of the signal chain, "where the rubber meets the road."

For instance, individual microphones could be preprocessed to make them behave more like ideal input sources. All similar mics could be pre-EQ'd to target curves so that soundcheck would start by realizing the grand assumption that matching models of mics sound identical. The same mic might be used like a 57 one moment and like a 451 the next. Another example would be microphones that could double as inputs and analysis points, where a vocal mic could also be processed to identify frequencies that are about to feed back.

On the speaker side, individual components could be QC'd to an ideal spec. Arrays constructed from individual enclosures could be steered, tuned and tweaked driver by driver to provide optimal coverage. Distributed systems could be automatically synchronized once their distribution is digitally based.

And mixing itself will change radically, far beyond the simple pleasures of automation. How about delay-based as opposed to level-based panning? Inserts and outboard processing will become plug-ins and onboard DSP engines. You may even see the day when a mix engineer could telecommute and phone it in from home.

Where will this all lead? When word processors first began to replace typewriters, they were cumbersome, expensive and did little more than an IBM Selectric. PCs, however, offered really expanded functionality. Copying and pasting were some of the first time-savers. How often have you copied graphic or parametric EQ settings from one channel to another? How about the ability to open a copy of a previous gig with the same band, or a similar band in the same room? The point is, the range of operations in any digital environment exceeds what was previously possible with analog, as processing becomes more powerful and software develops.

Manual procedures that are repeated can be stored as automated routines or "macros." Eventually, processing power

What About the Sound?

While we're envisioning all the benefits to the user of an all-digital live sound system, we can't forget the sound. There's been much justified criticism of "CD-quality sound," that marketing catch-phrase that has invaded the consumer electronics industry. The dynamic range and frequency response of digital are widely considered inferior for live music (though many engineers probably haven't heard digital sound using high-quality converters).

Can we live with the limitations of digital sound? The fact is, in most larger systems we already do, in a processor between the mixer and the amps. Time-based processing requires A-to-D conversion, and most large live systems already have digital processors at some point in the signal chain, whether there's a simple alignment delay or more extensive DSP for further speaker control.

There are a lot of misconceptions about digital, too. One assumption is that digital equipment has inherent distortions that increase edginess and harshness. In fact, harsh digital sound can usually be traced to sharp filters, poor conversion, low resolution, truncated word-length, poor analog stages, jitter, improper dithering, clock leakage in analog stages and all manner of poor circuit design. And not all products sound the same, of course. Somewhere between the consumer's 16/44.1 and the mastering engineer's 24/96 is a compromise of word length and sampling rate that, when used with well-designed digital products, is good enough for live sound.

Even though we see continually improving speed and resolution, as well as falling prices, in digital technology, there are few shortcuts to quality. If the move to digital systems forces us to examine sound quality, we may wind up ahead. —*Mark Frink*

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can include intelligent agents that can automate mundane decisions based on information about the operator's preferences. It's hard to imagine the range of functionality of future digital consoles. Who'd ever have thought you'd be able to dictate to a word processor? We can similarly expect audio diagnostics to be incorporated into future generations of digital products for live sound.

SPECIALIZATION ENGINEERING— REINVENTING THE POT

Hey, it's not easy designing a flexible yet intuitive control surface for an emerging technology. Many current products were developed by teams of specialists. At one extreme, we have consoles that attempt digital approximations of analog desks, while at the other end there are creations that barely even make the analog analogy. Declining prices for flat-screen displays and other PC peripherals will offer designers of digital consoles new possibilities.

Pro audio equipment manufacturers have always borrowed technology from adjacent industries to provide affordable solutions to the relatively small live sound market. Now, there is a growing sense that all of us in audio will eventually be working in the computer industry.

Software engineers will no doubt determine the course, even the structure, of PC-based digital live sound systems. In the computer world, hardware quickly takes form after just a few sales, with scarce revisions, but new operating systems can be downloaded over a modem. The ability of design teams to refine software in subsequent versions means that input from end-users is incorporated into products in ways that weren't possible when audio instrumentation was all hardware-based. So, the physical look and feel of instrumentation will no longer be fixed in the first release of a console. The ability to customize controls and operation will also mean job security for software engineers, and the lessons learned by developers of PC-based mixing systems for other markets will translate into powerful new live sound products.

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2001 A LIVE SOUND ODYSSEY

All the little extras on our computers that we take for granted can eventually be incorporated into our digital audio work environment. Colors, fonts, icons, objects and windows will be adjustable, allowing us each to customize a portable work environment. Would we like pastel Star Trek touchscreen displays, or are we biased toward our old mechanical pots and faders? I'm guessing that early successes can be expected of digital consoles that replicate analog desks with fairly fully mapped controls and onboard converters; these are the products that will gain acceptance more easily from users and rental clients replacing analog desks in the first round. Further on, the separation of processing and control will create a slab of moving faders with a few virtual strips remotely located from a powerful digital audio computer. One future live sound mixer might be a processor rack that sits under the stage that is connected by a network to workstations onstage and in the audience; it would look like a notebook computer with a few appliances attached.

For now, no one's turning down analog large-format consoles, but you shouldn't let that keep you from getting to know your portable computer better. Once the conversion and processing start living in the amp rack and the stage-box, it won't be long before you find the new kids mixing on their laptops. Ready or not, you're likely to find yourself mixing on a digital live sound system sooner than you think.

We have already glimpsed the future and it looks like Star Trek. Think about it. The most coherent vision of a possible future is already in nightly syndication. It's no surprise that the control rooms of successful studios have begun to resemble the bridge of the Enterprise. Anyone who has seen the Star Trek Experience at the Las Vegas Hilton understands that a design bias for the control surfaces of future instrumentation already exists. "Engage!" ■

Mark Frink is Mix's *Sound Reinforcement editor.*

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— *Jim Miller, Electronic Musician*

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CIRCLE #063 ON PRODUCT INFO CARD

Wireless in the Age of Digital TV

By Ty Ford

Significant changes in the frequency spectrum available for wireless microphones have created a new playing field — one that's going to start developing cavernous potholes as the new DTV stations fire up in the United States. Starting in the largest markets, a number of UHF and VHF frequencies that have long been used for wireless microphone systems will no longer be available. Try some of those old familiar frequencies now and you'll be buried under a DTV transmission.

The writing is on the wall—and on the Web at http://www.fcc.gov/oet/dtv/start/dtv2-69.txt. Here you'll find page after page of soon-to-be DTV stations that will be inhabiting channels 2 to 69 (54 to 806 MHz) within the next five years. In the top 20 markets, the next on-air deadline is May 1999; the deadline for markets 21-30 is November 1999. And that's only the deadline—DTV broadcasters may fire up sooner. The long-range plan is for TV broadcasters to give up their current analog TV frequencies some time after the year 2006. If mass public acceptance doesn't happen by then, the date will be pushed out. When it does happen, the old frequencies will likely be auctioned.

Then there's the issue of UHF channels 60 to 69 (764 to 806 MHz), which have been redesignated for the Land Mobile Service (public safety agencies, including police and fire departments). Even though there were almost 2 million Land Mobile Service licenses in use several years ago, the FCC still gets 30,000 to 40,000 applications a month for the band, most of the applications being for two-way dispatch communications. Sources within the FCC admit that, due to the number of unlicensed systems in operation in this and other bands, they have no way of knowing how many are really out there. Effective patrolling of the bands is just not possible.

World Radio History

$25,000 FCC Fine

According to Bill Mayhew (www.mayhewco.com), who rents and sells wireless systems on the West Coast, "This is the biggest bandwidth change in history. In addition, 54 MHz has been assigned to Public Safety Radio service. It may come down to a $25,000 fine by the FCC for the local church if their sound system interferes with the local fire company."

For small operations, Mayhew points to Xwire. "It's not licensed, but it sounds wonderful, has 12ms throughput delay and has an output 1/2 of 1 mw. That's about 50 mv/m measured at 3 meters, but at 902 to 928 MHz, it's on the same frequencies as personal communications walkie-talkies and there are only five separate frequencies available."

Mayhew says that, while the loss of spectrum has caused a scurry to frequency-agile wireless gear, not all frequency-agile gear is the same. "Some manufacturers are making frequency-agile shortcuts. I'm calling the problem 'differential gain': It shows up as a nonlinearity in the wireless receiver. Tune the radio system to its lowest frequency and measure the frequency response and gain at the receiver. Then move to the top frequency and measure frequency response and gain. When I do it with some frequency-agile systems, I get a 12dB difference in output. It's due to nonlinear RF front ends. Most receivers are usually lower at the top, but some are set up in the middle so they slope at both ends. This probably won't be a problem if you're only using one or two mics, but with 20 to 40 mics, the noise and level differences will drive people nuts." Mayhew says the first systems he's seen that don't suffer from this problem are from Sennheiser.

Top 30 TV Broadcast Frequencies

According to Joe Ciaudelli at Sennheiser (www.sennheiserusa.com), preparation for global use of wireless mics has given them an advantage with the DTV spectrum issue. "We've just sent out a large poster to dealers and reps of the TV broadcast frequencies in the top 30 markets, indicating current channels, future DTV assignments, authorized Land Mobile Stations and Radio Astronomy frequencies. The poster also has the usable VHF and UHF frequencies for 30 countries." For more information on the impact of DTV, Sennheiser has established a toll-free number: 1-877-SENNHEISER, ext. 133.

Ciaudelli says Sennheiser started preparing for the changes five years ago with their latest generation of wireless mics. "They were originally designed to be tunable for use in different parts of the world where different spectrum rules apply. That's turned out to be especially important today in the U.S., with the number of frequencies that will be lost to DTV. DTV is going to make a lot of wireless systems obsolete. Our flexible RF circuit architecture allows the 24MHz frequency range to be moved."

The amount of frequency flexibility varies among the different Sennheiser models, ranging from 100 MHz up to 340 MHz. The RF circuit in Sennheiser's PLL Microport incorporates a "micro-range" within a "macro-range" design. Within its macro-range, the system is tuned to a micro-range covering a 24MHz bandwidth for UHF or 7MHz for VHF. A Programmable Read-Only Memory (PROM) chip is programmed within the bounds of the micro-range with 16 or 32 pre-coordinated user frequencies. The device can be retuned by sliding the micro-range anywhere within the bounds of the macro range, and installing a newly configured PROM, allowing users to move around the increasingly crowded spectrum.

Mic Makers Respond to Spectrum Changes

Our wireless systems were originally designed to be tunable for use in different parts of the world where different spectrum rules apply. That's turned out to be especially important today in the U.S., with the number of frequencies that will be lost to DTV. —*Joe Ciaudelli, Sennheiser*

Ciaudelli says micro-range shifting can be done by a trained Sennheiser RF technician for a nominal fee. Sennheiser has also mounted a competitive trade-in policy for a $100 to $500 rebate for any brand of single-frequency, crystal-controlled system, applicable against the purchase of a new Sennheiser frequency-agile PLL system.

At Nady Wireless, John Nady says the Nady 950 offers a band 20 MHz wide and few "differential gain" problems in its 490 to 950MHz range. "It's not a straight line, but it's only a 3dB to 4dB variation. In terms of receiver sensitivity, the better designed units don't have the problem."

FCC Sees No Force to Reckon With

John Nady responded to news about spectrum loss by sending a letter to the FCC opposing the loss of 760 to 806 MHz so that there would be room left for wireless mics. "Our letter wasn't considered, nor was Shure's, so the FCC is not considering leaving those frequencies open for us. It may be that there are more wireless mic users than the other kinds of users,

World Radio History

but because they haven't registered their mics, the FCC doesn't see them as a force to have to deal with. Also, unlike the other industries, there is no united lobbying front for the wireless mic industry."

Problems associated with unregistered wireless mics are greater with touring sound and production companies. Licenses need to be modified for every location. For many, that's just not practical. Users who stay in one geographical area know the drill: Fill out FCC form 600, check with a local frequency coordinator and wait for the FCC to grant your application.

Nady says what happens in the next five years will take place in an indeterminate rate, depending on variables that are not yet fully known. "The FCC has a very thorough Web page. If you're on the road, you can download the frequencies for the next city and plan ahead to deal with the issue. That means backup systems on other bands will be necessary to ensure uncompromised interference-free operation in all locales. Some of the spectrum around 800 MHz will be increasingly less usable. Shure, Samson and Nady among others are still supplying units around 800 MHz. Even our NADY 802, one of the lowest-cost units, has two frequencies available, in eight groups of two frequencies each between 794 and 806 MHz. Those units at 794 to 806 MHz may have five or six years of shelf life, but in certain locations, there will be problems, which is why we'll soon be introducing added frequencies in the 700 to 760MHz range. Even with the new frequencies taken by DTV, many of the channels between channels 50 and 60 [490MHz to 746MHz] will be available."

The complex greater San Francisco Bay Area, including San Jose and Santa Rosa, offers, possibly, a worst-case scenario. According to Nady, if each of San Francisco's 23 TV stations (eight VHF and 15 UHF) gets a DTV license, 46 stations will be on the air, leaving only 15 channels open between 174 and 746 MHz. However, Nady points out that the 950MHz band is still viable for analog UHF wireless. And, despite the widescale abandonment of the VHF band for UHF over the last few years, Nady says VHF wireless may not have been as bad as reported.

"Part of the switch to UHF was market-driven. There was nothing really wrong with VHF. The UHF spectrum was more open, but VHF wireless from most

DTV Table of Allotments for Ten Major U.S. Cities

CITY	NTSC	DTV	MHz
Atlanta	2	39	620-626
	5	27	548-554
	11	10	192-198
	17	20	506-512
	30	21	512-518
	36	25	536-542
	46	19	500-506
	57	38	614-620
	69	43	644-650
Boston	2	19	500-506
	4	30	566-572
	5	20	506-512
	7	42	638-644
	25	31	572-578
	38	39	620-626
	44	43	644-650
	68	32	578-584
Chicago	2	3	60-66
	5	29	560-566
	7	52	698-704
	9	19	500-506
	11	47	668-674
	20	21	512-518
	26	27	548-554
	32	31	572-578
	38	43	644-650
	44	45	656-662
Dallas	4	35	596-602
	8	9	186-192
	13	14	470-476
	27	36	602-608
	33	32	578-584
	39	40	626-632
	58	45	656-662
Detroit	2	58	734-740
	4	45	656-662
	7	41	632-638
	20	21	512-518
	50	14	470-476
	56	43	644-650
	62	44	650-656
Los Angeles	2	60	746-752
	4	36	602-608
	5	68	794-800
	7	8	180-186
	9	43	644-650
	11	65	776-782
	13	66	782-788
	22	42	638-644
	28	59	740-746
	34	35	596-602
	58	41	632-638
New York City	2	56	722-728
	4	28	554-560
	5	44	650-656
	7	45	656-662
	11	33	584-590
	25	24	530-536
	31	30	566-572
Philadelphia	3	26	542-548
	6	64	770-776
	10	67	788-794
	17	54	710-716
	26	42	638-644
	35	34	590-596
	57	32	578-584
San Francisco	4	57	728-734
	5	28	554-560
	7	24	530-536
	9	34	590-596
	14	29	560-566
	20	19	500-506
	26	27	548-554
	32	33	584-590
	38	39	620-626
	44	45	656-662
Washington	4	48	674-682
	5	6	82-88
	7	39	620-626
	9	34	590-596
	20	35	596-602
	26	27	548-554
	32	33	584-590
	50	51	692-698

A complete listing of NTSC and DTV frequency allotments for every U.S. city may be found in the FCC document 6th Report and Order on MM Docket No. 87-268; FCC 97-115, which is downloadable from the FCC Web page at www.fcc.gov/dtv. Note: all information is subject to change.

*Most wireless mic manufacturers have developed resources, charts or tables for dealing with their products in specific locations. Sennheiser USA (www.sennheiserusa.com) has created a comprehensive table of products and frequencies, searchable by city and by international destination. So, if your tour or production brings you to Dallas, for instance, you can head off potential problems by typing in "Dallas" and outputting the frequencies in use. *Mix* recommends that you call your mic manufacturer for specific details.

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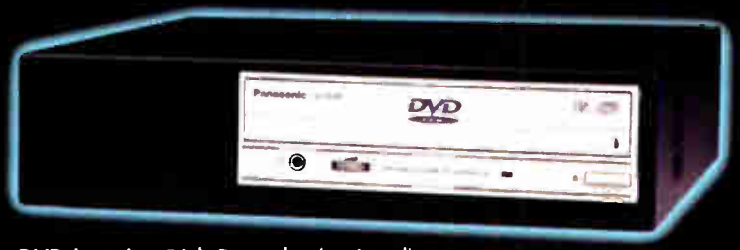

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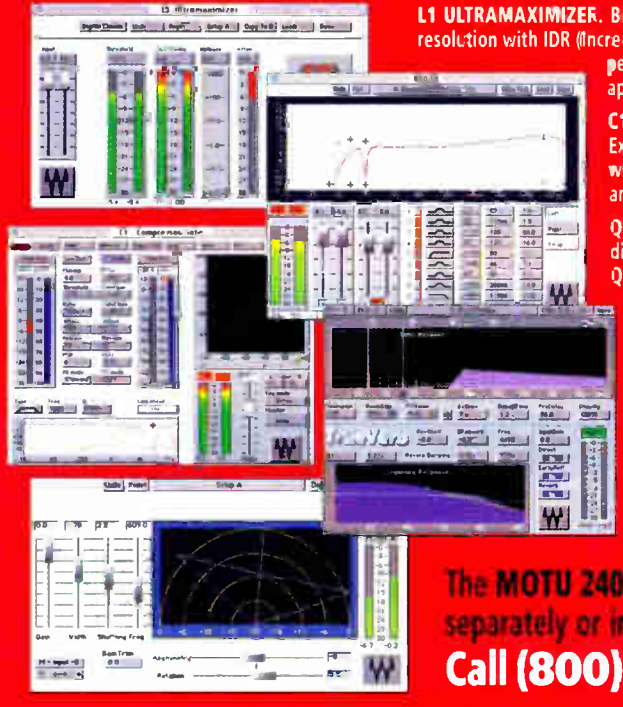

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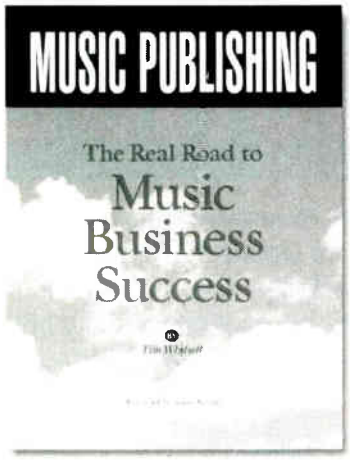
by Tim Whitsett



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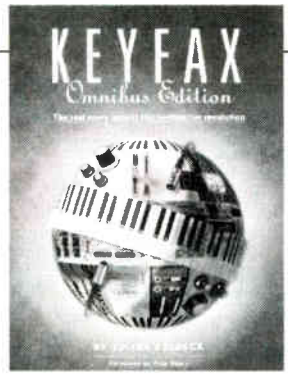

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Wireless

manufacturers is still superior to their UHF systems for signal to noise—maybe by as much as 10 to 15 dB. VHF also has less transmitter battery drain."

Short of coming together as an industry and pooling enough resources to win a bid in the upcoming spectrum auction, the only solution seems to be to do more with less and wait for more parts of the spectrum to be opened. Like many others, Nady is looking at solutions for the future. "We're working on a digital wireless in the 2.4GHz band. It's ISM (Industrial Scientific Medical); that means anybody can use it. 800MHz is available in Japan, so several competitors, including Samson, which is made in Japan, jumped into those first."

54 MHz has been assigned to Public Safety Radio service. It may come down to a $25,000 fine by the FCC for the local church if their sound system interferes with the local fire company.
—Bill Mayhew

With 20 TV stations already on the air in New York and L.A. (not counting any peripheral signals that get into those markets) and 20 DTV stations planned for each market, touring companies that have become reliant on a large number of wireless mics are going to have to ask themselves one question: "Do ya feel lucky? Well do ya, punk?" ■

Ty Ford's commercial and narration demos are available at http://www.jaguNET.com/~tford. He has also just uploaded an upgraded list of copyrighted mic/mic preamp reviews and a new list of production music and SFX libraries.

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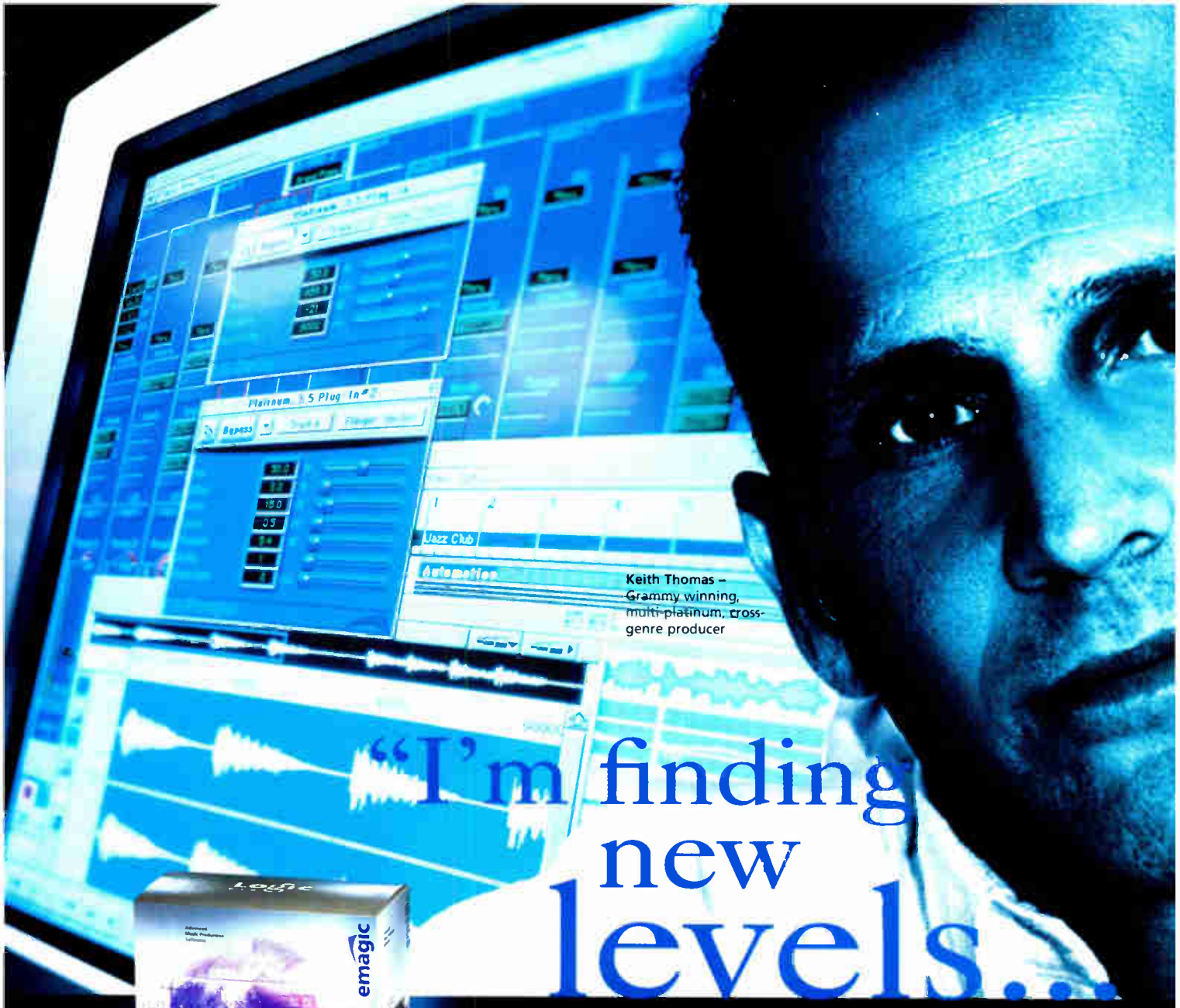

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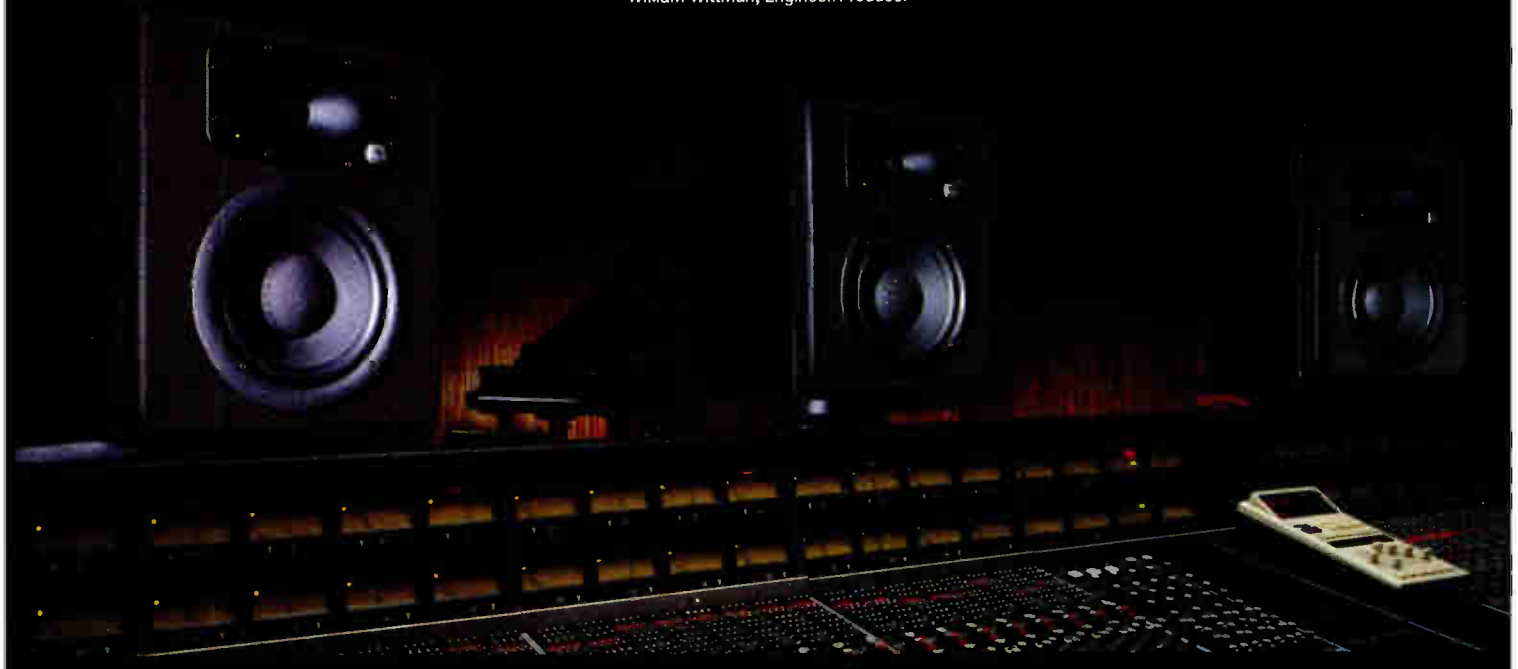

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The All-New JBL LSR Monitors are, quite literally, just that. Highlighted by a long list of performance-tailored components and customer-inspired features, they're like no other systems on the market today. The entire line, including the LSR32 3-way, 28P 2-way and 12P Subwoofer, is a technical triumph; resulting in new standards and performance levels for a rapidly emerging multi-channel recording industry.

Performance-Tailored Components

Revolutionary transducer designs, optimized network topologies and innovative materials are some of the reasons why the LSR line is being hailed as 'the world's most advanced monitor'. JBL's all-new ***Differential Drive®*** woofer permanently dispels the notion that better linearity, higher power handling and greater dynamic accuracy are somehow an unobtainable, evil triangle. ***Dynamic braking*** produces truly accurate bass at higher SPL's with maximum reliability. Composite materials, including ***Carbon Fiber*** in the woofer as well as ***Titanium*** and ***Kevlar®*** in the high and mid frequency components, insures performance that is always optimally maintained.

Not Just A Better Spec... A Better Monitoring System

While all companies boast about their specifications, JBL went one step further. To guarantee that every component of the LSR family worked together for optimal performance, LSR development employed JBL's unique 'system-engineered' design philosophy. Simply put: the entire line was researched and refined as one, with an overall performance goal in sight. What this means to you is a monitor and subwoofer that work together as a system; delivering stunningly uniform and accurate performance in both stereo and multi-channel applications.

LSR 32
12" 3-way mid-field monitor with rotatable Mid/High Elements.

LSR 28P
8" 2-way close field monitor with bi-amplification and active filtering.

LSR 12P
12" Active Subwoofer with Bass Management System.

JBL PROFESSIONAL

A Harman International Company

To find out more about the revolutionary LSR Monitors, visit JBL Professional at www.jblpro.com

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