

# Radio Guide

Radio Technology for Engineers and Managers

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NAB 2004 Radio Show  
Exhibitor Preview

September 2004

Volume 12 Issue 9



## Injecting Excitement Back Into Radio!

### Distinct 5.1 Surround Audio

**Page 4** – We can actually inject life back into radio – make it fun and exciting again! We have a chance *now* to breathe new life into our medium. Finally, a killer app and a compelling reason for listeners to buy digital radio receivers – and a new reason to listen to radio again.

### NAB 2004 Radio Show – October 6-8, San Diego

**Pages 33-34** – On these pages, you will find a showcase of NAB Radio Show equipment exhibitors. From consoles to towers – and everything in between – equipment vendors are listed, along with their booth numbers, to make it easy for you to find what you need. **Radio Guide** will be at the show as well, roaming the floor checking out the latest gear. In the October issue of **Radio Guide** we will report on what we found.

change is sometimes a good thing

especially when it saves you money, lots of money



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# Distinct 5.1 Surround Audio

## A Life Saving Injection for FM Radio

by Frank Foti, Omnia Audio

[CLEVELAND, Ohio - September 2004] When was the last time you turned on the radio and heard something truly exciting? Think about it. Take a moment and *really* think about it. Hmm, not easy is it? For me, it was probably during the last of the heydays of CHR, about 20 years ago, when Z-100 (WHTZ) made its run in New York City.

Radio today is losing market share to its many alternatives: mobile CD listening, iPod, XM/Sirius, and netcasting. While none of those entities alone are beating radio, combined they are eroding the listener base.

Recently at the *Radio & Records* Convention in Los Angeles, I had the following dialog with a well-known PD who did not want to admit his station was losing audience: His claim was: "Hey, even with XM and Sirius around I still have a 4.3 share in Los Angeles." My reply: "Yeah, you do still have a 4.3 share – *but the pie is smaller*. Why is that?" He had no rebuttal.

### SLICES OF PIZZA

Most people can eat half of an 8-cut pizza easily. If the pizza is 12 inches round, that is a fairly large amount of pizza. However, suppose the pizza is only 10 inches round – although it is smaller, four slices is still a 50% share of the pizza. Think of radio ratings shares the same way; the radio "pizza" is getting smaller folks! If we do not do something soon, that same PD who once had a 4.3 share of a huge LA audience – and now has a 4.3 of a smaller audience – will soon have a 4.3 of next to no audience!

Fortunately, pessimism has never been my strong suit. I have heard the future of FM Radio, and it is truly exciting. The amazing thing about this new enthusiasm is that it is not a new format, super-duper air talent, or an amazing station giveaway. Surprisingly, it is technical. Now, for the first time since FM went stereo in 1961, we have technology that will blow your socks off. The ability to transmit distinct 5.1 multi-channel audio!

### THE KILLER APP

This multi-channel system invented by Fraunhofer Institute (FhG) and Agere Systems is superior in every way. It should be – it comes from people who know their stuff. The FhG folks created MP3 and MPEG AAC. They are also getting a lot attention for their new Iosono system that uses as many as 304 loudspeakers to create an amazingly enveloping soundspace for applications like high-end movie theaters. The Agere people are former Lucent and Bell Labs audio coding researchers.

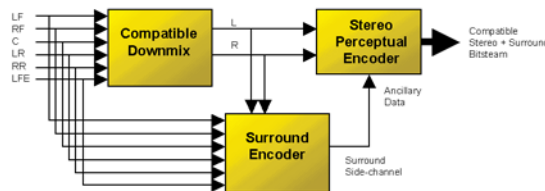
FhG has been busy pushing the frontiers of audio perceptual research. The latest result is a powerful spatial audio coding system, taking advantage of the most up-to-date knowledge in aural perception. I will spare you most of the techno-babble, but this is the *only* surround system providing distinct multi-channel listening experience to the FM radio audience. It is accomplished using a technique called *coded-discrete* which prepares the audio for transmission over iBiquity's HD Radio® system.

Psychoacoustics studies prove the *level difference*, *time difference*, and *coherence* between channels is what creates the perception of spatial image. The key to FhG's multi-channel system is representing these

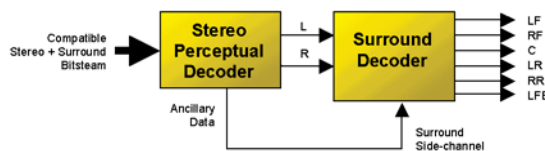
difference values with very compact coding, rather than transmitting all of the individual audio channels. The encoder estimates the values as a function of frequency (that is, within each sub-band) and transmits them to the decoder in an ancillary stream accompanying the main coded audio stream.

### PUTTING THE PIECES TOGETHER

A few block diagrams illustrate how an encoder/decoder pair would work within a broadcast channel such as HD Radio. The first step is to create the compatible stereo downmix from the multi-channel material. The resulting stereo signal is coded using any perceptual codec. Since there are no changes to the basic codec, this signal can be received by stereo radios. The spatial encoder extracts the various spatial cue parameters from the multi-channel input, which are transmitted in an ancillary data channel. The decoder, if present in the receiver, recreates the original multi-channel audio.



The Encoding (transmitter) Side



Decoding (receiver) Side

You can see that we need to have a downmix function to create the compatible stereo channels from the multi-channel source. The most obvious way to do this is with simple linear combiner (where a and b are constant scale factors, with the values usually ranging from .5 to .7), as follows:

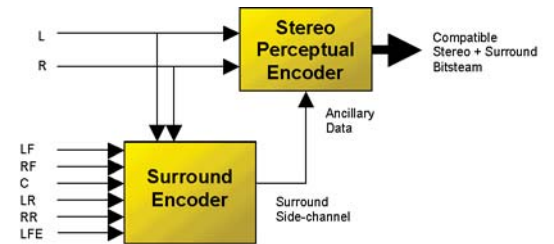
$$L = L_{\text{front}} + (a)L_{\text{rear}} + (b)\text{Center}$$
$$R = R_{\text{front}} + (a)R_{\text{rear}} + (b)\text{Center}$$

But this simple procedure is far from the best possible. When making an optimized downmix, a number of considerations come into play, from both psychoacoustic and production practices. Simply collapsing the front and back signals into a 2-channel representation may cause some confusion in the normal binaural cues and degrade traditional stereo listening. It almost certainly will sound different from what listeners are used to hearing.

### SOLVING THE DOWNMIX PROBLEM

The FhG system allows a producer to make a manual downmix, thus preserving maximum artistic freedom and allowing maximum flexibility to adapt to different kinds of audio material. Since almost all music released in surround format also has a stereo version on the same disk that could be used as input to the encoder, this stereo version is what would be heard by listeners with non-surround radios – with no modification or compromise of any kind.

Advanced automated downmixing is also an option when manual mixes are not available. A processor could dynamically modify the scaling values and relative phase during mixdown. Such a processor would use advanced algorithms that can take into consideration absolute source positioning, panning laws, the way sources were mixed into the multi-channel signals, and original inter-channel phase relationships, so it would have the potential to achieve a quality comparable to manual downmixes.



Encoder using external downmix process.

All well and good, I hear you asking, but will this work with HD Radio? The astonishing answer is: Yes. The FhG spatial encoding system is fully compatible with HD Radio's current codec for the stereo channels. (The side-channel for spatial information is less than 20 kbps, a rate possible in HD Radio's ancillary data channel.)

The ISO/MPEG audio group has noted these recent advances (and their market potential) and has started a new work item with the working title *Spatial Audio Coding*. FhG will submit their spatial approach to MPEG for consideration and testing, and chances are good it, or some variation, will eventually be approved as an international standard. Thus there will be the usual advantages of MPEG: an independent confirmation of performance, and assurance of fair and equal access to licensing.

### NOT YOUR DAD'S SURROUND

Again this coded-discrete system is the *only* system offering distinct surround sound. All of the other designed systems are matrix based and contain dual drawbacks that compromise and degrade the 5.1 multi-channel audio, as well as the existing stereo mix.

Consider the FM-Stereo system in place today. It offers discrete 2-channel audio with separation theoretically approaching 70 dB. I do not believe our industry would have accepted a broadcast system that passed off synthesized, fake 2-channel duophonic sound as FM-Stereo. Maybe you remember the quadraphonic systems from the 70's. They had the critical drawback that only fixed-scale downmixes are possible, so stereo compatibility suffers.

This is what the matrix proponents do: they fake the 5.1 audio channels by manipulating the original stereo mix to create the surround effect. In doing so, this technique also alters the original stereo mix so both the stereo and surround signals are in effect spatially distorted. Basically these other systems have yanked those old quad concepts from the 1970's out of the closet, and repackaged them as digital. This type of backwater tech is not the solution to boost radio listening.

For surround on radio to be respected and to successfully compete with other media, Radio needs the real thing: state-of-the-art performance – not synthesized, not matrixed, not compromised. The FhG method is innovative, totally preserving spatiality of *both* the stereo and 5.1 audio mixes.

### THE TROUBLE WITH MATRIX

The critical flaw in matrix systems is the spatial distortion of the audio. (Note: distortion is being used in a different context than we normally associate with audio.) The area of concern is the loss of separation in the spatial-axial patterns between the Left-Front/Right-Rear and the Right-Front/Left-Rear channels.

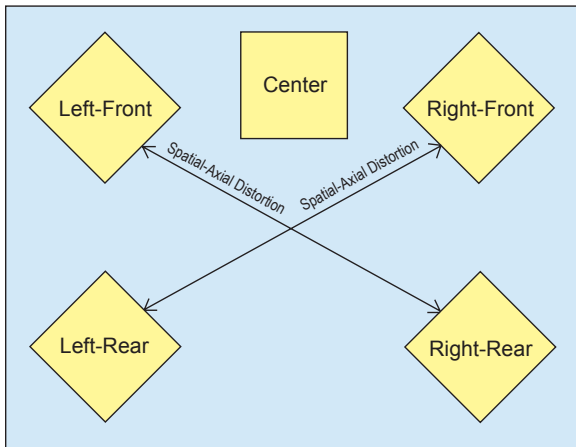
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# Distinct 5.1 Surround Audio

## A Life Saving Injection for FM Radio

Continued From Page 4

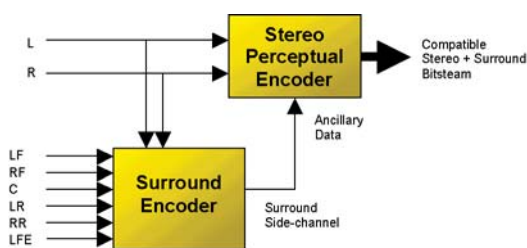
Audio signals along these two axes will tend to bleed into one another. This diagram illustrates:



The arrows correlate to the paths of perceived multi-channel artifacts. They are heard as false spatial cues and lost separation.

The alternative surround methods employing watermarking will not offer much additional benefit than matrix systems. The reason is a watermark function can not contain the needed data payload to properly manage all of the audio channels over the entire spectrum. There will be aural compromises, especially in separation and placement, sort of like lipstick being applied to the withered old lips of the failed 70's vinyl quad schemes.

This is one reason the 70's era matrix systems did not catch-on – they had a weird soft and indistinct quality in stereo. Clearly this is an important issue for broadcasters. With most people listening in stereo, we cannot afford to compromise our fundamental service. And that is why the FhG approach is so well suited to radio broadcast: the system does not depend upon any specific downmix procedure to work. Indeed, the downmixing process can be thought-of as a component outside of the basic spatial coding system.



Ask dad about this backwater tech!

Another problem with matrix schemes is poor surround separation. Matrix systems must mangle everything into a 2-channel signal, which is a crippling constraint on performance. They can have only a few dB separation between some of the channel pairs; even which channels get the separation is a design compromise. Because FhG's spatial encoding uses an independent digital side-channel and a modern perceptual approach to spatial cue encoding, it can always offer very high separation.

By the way, watch out for matrix demonstrations using material in one or two channels at a time. These are deceptive because a steering circuit detects this very directional condition and steers the strongest signal into the target channel, while reducing gain or providing some kind of cancellation in the other channels. (This approach is also a leftover from the 70's, having first been used in the Tate and Vario-

Matrix "logic" schemes.) In today's digital world, there is no reason we should bind ourselves to such limited approaches.

### EXCITING AND COMPELLING

Multi-channel 5.1 surround creates an impressive *theater of the mind* – something you must hear to truly appreciate. Imagine turning your Production Director loose with the power of additional audio channels on station liners, sweeps, and promos – even your commercials will sound exciting! Using surround channels offers endless creative possibilities that will stimulate live on-the-air bits, and morning show routines!

The 5.1 surround audio that accompanies DVD movies and videos has conditioned early adopters to a multi-channel world, and this is rapidly spreading to the mass audience. A common crawl on TV shows and movies is now: "This program is broadcast in 5.1 Surround Sound."

Are you aware it virtually is impossible to buy a 2-channel stereo receiver anymore? Audio stores tell me that 90% of their customers ask for multi-channel sound equipment by name. Most video and computer games now offer surround sound as well; remember we have a whole generation of young people who now consider multi-channel audio *standard*, just as this 1956 model-year writer considered stereo as a standard for so very long!

How about music? Have you heard any recent DVD-Audio or SACD discs? They will take your breath away. The re-release of many classic albums has brought new light, appreciation, and enjoyment by hearing them presented in an environment that actually draws you into the sonic experience. Getting this music on the air will make exciting radio.

Steely Dan's *Gauche*, Elton John's *Goodbye Yellow Brick Road*, The Who's *Tommy*, REM's *Automatic For The People*, Roxy Music's *Avalon*, and Fleetwood Mac's *Rumours* are a small sampling of discs that will leave you not only wanting for more, but making a trip to the local audio store to outfit your living room in 5.1. (Even the latest Britney Spears DVD-A/SACD is incredible in surround.)

### ROLLING ALONG AND ROCKIN'

Acura, Cadillac, Volvo, Mercedes, and Lincoln have already announced 5.1 surround with DVD-Audio/SACD players in their up-scale 2005 models. As happened with FM Stereo, soon this will work its way down to all models; the auto industry is moving this way because consumers want it.

Thus, radio broadcasters *must* migrate into the surround world, or they will get left behind. Remember: AM became a stepchild once FM stereo was universally accepted; all of terrestrial radio is now at risk due to the advancement of surround technology because the consumer has more exciting alternatives for their listening, and many involve surround sound.

Of course, to remain interesting to consumers program content needs to be compelling as well – that is a given. But now we have got a technical reason to get excited about radio again, and it will inspire new and compelling programming – just as FM stereo did when it was a fresh technology. This is what it will take to motivate the average consumer towards HD Radio, their vehicle to hearing exciting radio once again.

As an industry, we need to adopt the following mindset: Create enough of a "WOW!" factor in the mind of the consumer that it compels them to purchase a digital radio. The HDAM system offers that "wow" when comparing the HDAM signal to conventional AM audio; distinct 5.1 audio puts the "wow" factor into the HDFM system, creating the opportunity to win back lost listeners.

### WHAT'S NEXT?

If you are now convinced, you are probably wondering, "OK Foti, so what's next? When can I crank out this cool excitement you have pondered about?" For this to happen, only a few key people need to hear and act on this: the record labels, radio executives, iBiquity Digital Corporation, and the receiver manufacturers. Like I said, a few key people.

We need the record labels to provide the 5.1 content. This should not be hard; a lot of surround is already available, and with the incentive of radio's promotion capabilities, all new releases should be in surround format, as well as stereo. Just think about those vaults filled with multi-track master tapes of classic recordings that can be remixed into 5.1 and re-released again. The artists and record labels stand to make millions on the re-issues alone!

The record labels win, as they have a new revenue source from material they already have, similar to the introduction of CDs. This creates a general excitement involving a new music format drawing people back to record stores. DVD Audio and SACD multi-channel are ready for consumers now, but record labels need radio to help them promote these new disks. This is a no-brainer. As Nike would say, "Just Do It!"

(Late Note: At this was written, we have opened discussions with TM Century about creating 5.1 libraries comprising the top 1000 titles in each radio format. This would immediately help jump-start the ability to launch 5.1 programming, while the labels get online with new and re-releases.)

### BROADCASTERS' TO-DO LIST

Radio broadcasters need to perform two significant functions: Adopt this tech by installing it, and then promote the heck out of it! Remember how many station ID's used to say something like "101, WMMS, FM-STEREO!" That was how radio subliminally conditioned us to "stereo."

Now it is time to re-enact that discipline again: "100.7, WMMS, FM-SURROUND." Radio can easily tie in with audio stores to promote surround sound. Live remotes from audio outlets, radio give-aways, along with advertising will help tell the story so consumers will have a "top-of-mind desire" for digital surround radio.

Steve Davis, Senior VP of Technical & Capital Management with Clear Channel is an example of someone who "gets it." He recently said regarding 5.1 for radio: "The biggest breakthrough will be 5.1 surround sound using IBOC or similar digital technology. To compete with new methods of delivery, especially the ubiquitous DVD, I believe 5.1 will be key to radio remaining competitive, both in the home and in the car. Consumers have grown to expect this level of quality."

You may be wondering about the technical infrastructure. Yes, your facility will need to be upgraded to surround, but adding distinct 5.1 audio is not the challenge that FM faced when it rolled out stereo in 1961.

While it would be understandable if you were thinking this would require triple the audio channels around your facility with more cabling, switching, and routing, adding multi-channel audio actually is as easy as CAT5. Adding more channels to a network based router and cabling installation is done mostly by changing the software of the system, at very little incremental cost compared to stereo.

(Continued on Page 8)

# Distinct 5.1 Surround Audio

*A Life Saving Injection for FM Radio*

Continued From Page 6

The same is true for delivery systems. Modern consoles use the surface + engine configuration, so existing surfaces might well be connected to upgraded engines. For more information on an innovative networkable solution, check out: [www.axiaaudio.com](http://www.axiaaudio.com).

## SINGLE 5.1 METHOD PREFERABLE

iBiquity, the creator of the HD Radio system, needs to adopt a standardized surround transmission system. As I said earlier, only one surround technology is capable of faithfully reproducing the sound field without degrading both the surround effect and the conventional stereo signal: the coded-discrete system from FhG/Agere.

Contact iBiquity and lobby them to select one single system, as this will hasten the acceptance of this exciting tech. There are other proposed methods out there, but iBiquity has been reluctant to endorse a particular system out of risk of offending the others. Still, the fact is that *all* the others offer degrading performance to both the surround and stereo performance. So get iBiquity off the fence to get this going and make sure we launch surround on FM with the best tech possible.

The last group of people we need to convince are the receiver manufacturers. If the record labels and radio broadcasters are on-board, then the receiver folks will

follow. They stand to sell more speakers, amplifiers, and radios – a win all the way around for them.



The FhG/Agere system will appeal to the manufacturers because MPEG standardization means the tech will be universally available to all manufacturers at a reasonable cost. By contrast, the alternative methods are proprietary and thus worrisome for the manufacturers. One of the reasons MP3 has grown so fast is that it is an open standard, available to all.

## MAKING IT FUN AGAIN!

All this makes sense does it not? So, are you with me? Just think: we can actually inject life back into radio – make it fun and exciting again! I am hearing a line from that wonderful movie *Field of Dreams*: “If you build it, they will come.” We are losing listeners to many alternatives, a trend that will continue if we do not act.

We have a chance *now* to breathe new life into our medium. Finally, a killer app and a compelling reason for listeners to buy digital radio receivers, and a new reason to listen to radio again. Hopefully you are now jazzed with this excitement.

In closing, broadcasting needs to evolve with the changing world, instead of maintaining the status quo. As my buddy Scott Shannon used to say on the Z-100 Morning Zoo, “If it is too loud, you’re too old!” Well, we need to inject life back into radio. Adopting distinct 5.1 audio is just the right dosage of audio channels to excite the patient. If we follow this suggested path, it’s quite possible radio listeners will remember another great slogan from Z-100: “Lock It In, and Rip The Knob Off!”

*HD Radio is a registered trademark of iBiquity Digital Corporation.*

*Frank Foti is the driving force behind the Omnia Audio Processor, among other products. Learn more about distinct 5.1 multi-channel audio for HDFM, or share your views, by contacting Frank at Telos/Omnia/Axia: (216) 241-3343. Email: [frank@omniaaudio.com](mailto:frank@omniaaudio.com)*

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