A Revolutionary Virtual Surround Headphone Technology

Stephen Smyth On Smyth Virtual Surround™

Gary Reber

Five years ago, in Issue 88, September 2004, *Widescreen Review* published an On Screen interview with Stephen Smyth on the revolutionary Smyth Virtual Surround™ (SVS™) headphone technology. This technology is now a real product available for order at www.smyth-research.com. I passionately believe in this product and recommend that all *WSR* readers experience for themselves the incredible spatial performance produced over headphones processed with the SVS.

The prototype SVS headphone system was a professional eight-channel model, the HPM-208A. The unit was capable of accompanying two separate headphone listeners and virtualizations of up to eight separate channels, while running fully independent Smyth Personalized Head-Tracking™ (SPHT™) processes per user. The unit provided two separate headphone outputs, and the user could connect to either RCA stereo line outputs or to headphone amplifier output stages. Next to the headphone output jacks were the head-tracker inputs. These were connected via the control cables, to the head-tracker unit attached to each headphone. The HPM-208A multichannel inputs and outputs used RCA unbalanced interfaces but with screwdriver-adjustable input and output gains.

The shipping product is the Smyth Realiser A8 model, a (for now) single, eight-channel headphone processor, otherwise essentially equipped with the same operational features as the model HPM-208A.

For the wider market, the core Smyth Virtual Surround technology is available for licensing by manufacturers of home A/V, portable media, computer, and game equipment.

The Smyth Realiser package includes a pair of ultra small microphones that are inserted like ear buds into the users ear. The personalization process begins with a remote controlled calibration setup in which the microphones not only gather informatioin about the system/room character but also much more specific information about head movement and how your head and ear structure affects the incoming test signals sweeping through the loudspeaker system. The last stage of the process has the user don headphones (a pair of STAX SR-202 Basic electrostatic open-back earspeaker with SRM-252II solid-state driver are included in the package) over the earbud microphones and measurements are made that analyze the relationship of the headphone's interior "soundstage" and the user's outer ear or pinna. Two memory files are created—one for the room/system and another specific to the headphone/user interface. The final results are completely personalized for that listener.

I thought that I would re-publish my original opening remarks to the previous On Screen interview with Stephen Smyth as a preface to the latest interview, which follows. This is a very long piece, but I believe so strongly in the product that I believe it is crucial that the technology receive proper recognition. I hope you enjoy and marvel at the potentials that this spatial performance product delivers. The article is a perfect complement to my previous article entitled "7.1 Surround: Time To Get It Right," which was published in the September 2009 Issue 142.

"The subject of this On Screen conversation is a revolutionary new technology, which uses state-of-the-art signal processing to exactly replicate the sound of loudspeakers over headphones. Yes, HEADPHONES! This is such a revolutionary technology that I lost a lot of sleep thinking about its ramifications for the future of surround sound—in particular, holosonic® spherical surround™ sound. [As a footnote I should note that the Realiser system precisely emulates an entire in-room listening experience comprised of the sum of loudspeakers, electronics, cables, and the room itself including its acoustical signature (the entire electro-acoustical system). A multichannel (or stereo) recording sounds indistinguishably the same through quality headphones as it does through a loudspeaker array comprising up to eight-channel surround sound in a real room. The Realiser system permits natural head movements while retaining precise localization of each loudspeaker in the system.]

"This technology defines a whole new world for headphone listening, and I have been so emotionally moved by this technology that I have decided to be an advocate for its universal application. As long-time *Widescreen Review* readers know, I tend to take stands with respect to technologies that can advance the home theatre and surround music experience. Back in the 1990s I concluded through controlled A/B performance testing using original movie soundtrack print masters that DTS® Digital Surround™ was sonically and spatially better than Dolby® Digital, and I support DTS technology to this day as the best scalable lossy codec technology on the market. And while the differences between the DTS Coherent Acoustics® and Dolby AC-3® compression/decompression codecs are considered by some as subtle, true audiophiles desiring "the best that it can be" in sound quality have fully appreciated the differences. Stephen Smyth is the inventor of the DTS Coherent Acoustics codec, though he now is no longer associated with DTS. Stephen has now invented new revolutionary virtual surround technology. The technology has nothing to do with codec design or DTS but with the spatial experience of imaging-specific sound, a topic that I have devoted a great amount of space to in *Widescreen Review*. Virtual surround is an entirely different technology that replicates the experience of loudspeakers over headphones, without limiting the delivery of discrete channels of program content.

"I've used the word 'revolutionary' several times now in this introduction, because it is the best word I can think of to describe the remarkable transformation this technology will bring to headphone listening. Another technology that I have described as revolutionary is the D-BOX Odyssee Motion Simulation System [now referred to as D-Box Motion Code™], which has brought the dimension of motion to experiencing movies and soon, surround music. I guarantee that these two technologies combined will make for one of the most incredible sensual experiences one can have.

"Stephen Smyth and his brother, Mike Smyth, are the principals in a new company that is at the early stages of licensing the Smyth Virtual Surround (SVS) technology. Due to its unprecedented accuracy, SVS technology will find immediate application as a viable headphone listening alternative in high-end home theatre and music entertainment systems, in situations where loudspeaker playback is undesirable.

"According to the Smyths, I was the first to experience SVS technology outside their own laboratory experiments. I must admit that when Mike Smyth e-mailed me to request a demonstration I thought to myself, 'headphones, who cares, really?' I wasn't enamored with the Lake Technology Dolby Laboratories-licensed 'Dolby Headphone' technology with its 'fuzzy-wuzzy' spatiality and mediocre fidelity, yet I hadn't heard any other headphone technology that did a better job at simulating a surround sound experience. So, reluctantly, I agreed to a demonstration of this new technology, which promised to exactly duplicate the sound of loudspeakers over headphones.

"Well, as it turned out, after a conversation explaining the science that enables this all to work, I agreed to interface the Smyth Virtual Surround 'black box' electronics into our Reference Holosonic Spherical Surround Home Theatre Laboratory system. Stephen did a "personalization" measurement, followed by placing a set of STAX SR-202 Basic electrostatic earspeakers (the term used by STAX to denote headphones) over my head and ears, to complete the final stage of the 'personalization' calibration. These are STAX's entry-level stereo earspeakers, which are capable of extremely smooth and high-resolution sound quality, based on the renowned accuracy of electrostatic condenser design. These earspeakers are more than capable of resolving the full spectrum of sound. That was the first day.

"On the second day of the demonstration, Tats Yamanashi of Yama's Enterprises, Inc., the U.S. Distributor of STAX Electrostatic Audio Products, brought over two of STAX's top-of-the-line SR-007 earspeakers and SRM-007t vacuum tube output driver units to experiment with. The sound of these earspeakers was even more impressive, with bass extension that was deeper and an overall smoothness that was more linear and more dynamic.

"'Personalization' is the process of measuring the individual auditory response in the presence of loudspeakers and the upstream system electronics. You see, as with all human beings we are all unique genetically and just as with being fitted with prescription glasses, we tend to require slightly different prescriptions to see optimally, even if only the slightest differences in the correction parameters distinguish our sight. And while many of us without perfect vision will be able to see effectively enough when looking out through someone else's prescription glasses, an exact match will be the optimum seeing experience. So goes the 'personalization' auditory response measurement, which is stored in an electronic file within the 'circuitry' inside the SVS 'black box.' Now, when sound is heard by me through the headphone used during the measurement connected to my "personalized" circuit, the virtual surround experience will be optimized for me, personally.

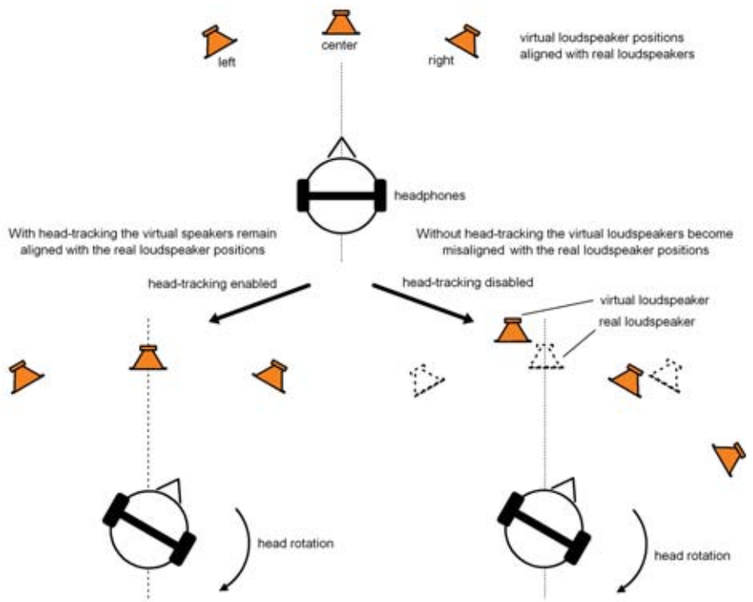
"SVS technology also uses a powerful signal-processing engine that implements the proprietary Smyth Personalized Head-Tracking (SPHT) methodology. Head tracking is a process that is used to de-rotate the virtual sound stage in response to the listeners' head movement. The head-tracking technique, combined with the 'personalization' tailoring of the system, is essential for maintaining all the complex sonic cues necessary to project the illusion of precisely placed loudspeakers relative to the listener's position in the room.

"It is envisaged that after-market SPHT-compliant head-trackers will initially be available for users to retrofit existing headphones, and that headphones with built-in head-trackers will also quickly become available.

"These proprietary techniques make Smyth Virtual Surround the only headphone technology that is sufficiently accurate to compete with the realism of loudspeakers.

"The technology will work with all program content, whether it is mono, stereo, or multichannel program content. The current implementation is limited to eight individual loudspeakers, but greater numbers of loudspeakers will be possible in the future. [The present model A8 can be used in pairs for up to sixteen simultaneous virtualized loudspeakers.] SVS is designed to directly reproduce those loudspeakers that would normally have been active in the 'real' playback system. An audio CD, for example, would normally be played over two loudspeakers, and SVS technology would create two virtual loudspeakers for this material. Similarly a 5.1- or 6.1-channel [7.1-channel] movie soundtrack, or matrix-encoded material, would be reproduced over 5.1 or 6.1[7.1] virtual loudspeakers. As a result, SVS enhances the playback of any program material over headphones, from 6.1-channel DVDs and 5.1-channel satellite programming to 5.1 DVD-Audio/SA-CDs and stereo music CDs.

ON SCREEN



"Product development is virtually unlimited. SVS technology can be included right now in a wide variety of audio related products, including DVD players, A/V receivers, TV sets, PCs, game consoles, portable media players, and home theatre systems, to provide a true-to-life 5.1/6.1 surround sound experience over headphones. The key to such implementation is incorporating into these products the set of proprietary algorithms that make up the Smyth Virtual Surround technology. The company is now starting to license their technology. The first implementation will be in external processor units, accepting the analog or digital PCM outputs of a DVD player, preamplifier/controller, or A/V receiver.

"The WSR Holosonic Spherical Surround Reference System is regarded throughout the industry as an absolute state-of-the-art audio (and video) system that is capable of revealing the most subtle nuances in sound (and video) reproduction and delivering the full dynamic range of recorded sound with bass extension to below 16 Hz. With the SVS system calibrated to my personal auditory hearing process, I put on the STAX earspeakers and played the title track from the DVD-Audio release of Steely Dan's *Two Against Nature*, which was recorded and mixed by Elliot Scheiner.

"My very first response was 'are the loudspeakers on?' The reply, 'No!' My immediate reaction was 'this is impossible! The fidelity and spatial dimension sounds exactly as if I was listening without headphones.' Stephen rigged a tilt sensor in the small head-tracking device mounted on the top of the STAX earspeakers, which enabled me to immediately A/B the experience. When I put the STAX earspeakers in their vertical position, as they would be on my head, the signal to the loudspeakers would be muted. When I took them off my head and pointed the head band toward the front, the room system would be unmuted. This enabled me to directly compare the two listening experiences at matched levels, which turned out to be identical! Amazing! Revolutionary!

"Since the prototype professional SVS system that Stephen brought supported two 'personalization' circuits and thus, two independent headphone stereo outputs, Associate Editor Jeffrey Kern (at the time) was able to have his own unique "personalization" experience. Jeff also immediately became transfixed to the virtual surround experience. Both of us continued to listen to stereo music, surround music, and movie soundtracks during the two days we were able to live with the system. With both surround music and especially movie soundtracks, the imaging was phenomenal, with dialogue perfectly locked to the center of the screen in front of us and the other channels spatially positioned appropriately, staying that way no matter how we turned our heads.

"I am convinced that this revolutionary technology will significantly transform headphone listening into a holosonic spherical surround experience, limited only by the fidelity and spatial realism obtainable with real in-room home theatre and surround music systems.

"Smyth Virtual Surround is the only headphone technology that I have ever experienced that is sufficiently accurate to compete with the realism of loudspeakers. Other headphone technologies lack the personalized head-tracking sophistication necessary to accurately simulate real loudspeakers, and therefore, are not directly comparable to loudspeakers."

What follows is the latest On Screen conversation with Stephen Smyth explaining the Smyth Virtual Surround technology and providing insights into the impact this technology will have on audio dimensionality.

Gary Reber, *Widescreen Review*: Stephen, for those who have not read our earlier interview and don't know about your product, can you briefly describe the Realiser?

Stephen Smyth, Smyth SVS: Yes. It's an eight-channel surround sound headphone processor. It measures the way the user's own ears hear a real loudspeaker system in a real room. That measurement is stored and used to re-create the experience very accurately in headphones. Up to eight loudspeakers, in any locations, can be replicated. There is no limit to the number of rooms, loudspeakers, and headphones that can be captured and stored. The Realiser also provides head tracking, so that the sound image in the headphones does not move as the listener turns his or her head. Personalization and head-tracking together provide an experience which listeners say is indistinguishable from the real room.

The general term for surround sound in headphones is virtualization, but this box produces such a superior effect that it's in a different category, so I named it the Realiser—the level of realism can be astonishing.

***WSR* Reber:** I believe it has been five years since I first explored your revolutionary headphone technology?

Smyth: Yes. You heard a demonstration unit. Since then we've made a lot of refinements—for example, the head-tracker. For your demo in 2004, we used a magnetic head tracker. That worked, but most headphones are dynamic, and thus magnetic, and it's not easy to use a magnetic tracker in the presence of a magnetic field. So we built a gyro tracker, and finally an optical tracker. Optical can be expensive and has its own issues, but the version we settled on is affordable, the range is quite good enough for a living room or a studio, and it's very stable and very accurate. Another thing that has been changing is the DSP platform. The one we used in 2004 was fairly expensive, probably overkill in many ways. We had to figure out how to make our process run on a cost-effective platform. What we have today is a superior system on a much cheaper platform. And, of course, we benefit from five years of ongoing development in the DSP world—chips are now faster and cheaper. The purpose for the early demos was to show that Dolby Headphone and other systems are fine, but don't judge the field by those systems because, clearly, what we were showing was something much different and much superior.

***WSR* Reber:** Are you saying that the whole entire Realiser System is on a DSP chip now?

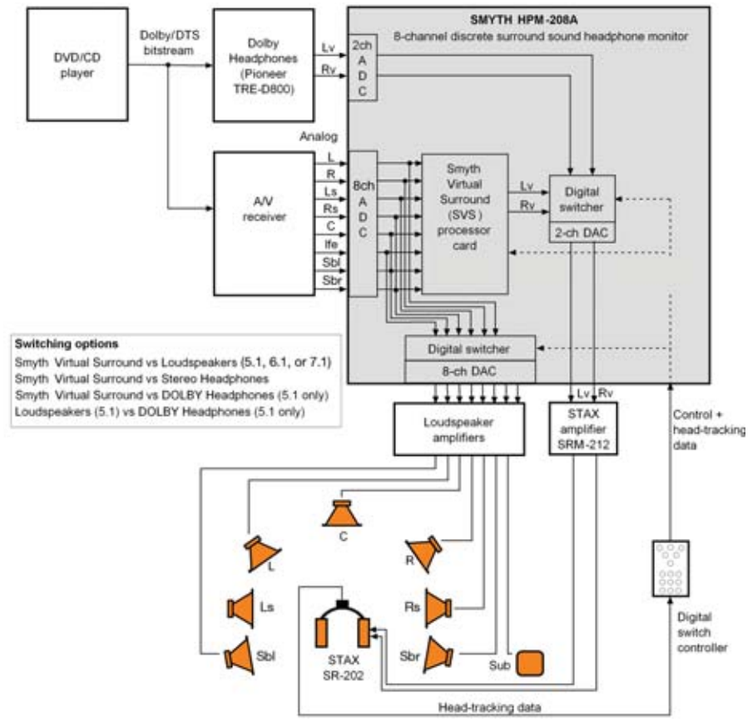
Smyth: Yes, a standard DSP. The evolution is not unlike it was with the audio coding that I've done in the past. You start off using the whole chip. And then as time goes on and chips get faster, you start to share the chip with other processes. Right now we have an eight-channel virtualizer; it allows you to capture reverberation times up to 850 milliseconds (.85 seconds), and it's a professional-level product. We didn't restrict it in any way. So what if you only needed a living room product, where living room reverb is never more than about 200 milliseconds? It could be done for less. But when you're launching a product, you're not interested in compromising it prematurely. Best to seek the best performance, and go with that. And if somebody pressures you later and tells you that if you can get it down to half that, we can sell a million of them, well, then, you've got some reason to look at how to cost-reduce it further.

***WSR* Reber:** You refer to living room size, but that also applies to a typical home theatre or a recording studio, a control room or post-production room, or whatever.

Smyth: Yes. As multichannel became prevalent, there was less need to have the room supply the acoustic. The reverb time tended to drop in studios because there are more and more channels available to generate the acoustic that you desire.
Theoretically, you should drop your reverb to zero, and you should re-create everything through the loudspeakers. Of course, the problem is that nobody's living room is zero. Most control rooms, even large dubbing stages I have measured, are generally around .2 to .3 seconds (200 to 300 milliseconds). They have the same reverb as an average living room.

***WSR* Reber:** That's good to know. Now, the Realiser system, what's the entire package?

Smyth: In our first product, we wanted to include everything. We allow you to make measurements, have a head-tracker, all the things that we demonstrated five years ago. We knew right up front that is the way we had to launch the product. So the system is a full-blown eight-channel completely



discrete full-bandwidth analog RCA in RCA out system, which allows you to connect to your A/V receiver, processor, or amplifiers driving your loudspeakers. You get a head-tracker system, which is based on the optical technology that we developed, and you get a set of in-ear microphones that again, we had to develop. And before I forget, the entry-level STAX SR-202 earspeaker is included with the system, because we wanted a base-line quality that people hear initially. The Realiser will attempt to correct for and linearize any headphone, but for now we thought, "Look, early adopters of this will be very critical, they're spending a lot of money, they're expecting big things, we had better ensure that that's what they hear." And so we included the STAX, and a clip for the head tracker to fit on the STAX, and the system is complete. You do not need anything else in order to make your first measurement and go. It's all there.

***WSR* Reber:** What about using magnetic headphones?

Smyth: We have tested many dynamic headphones. But they are often not what we would call transparent. Ordinarily, when you listen to headphones, you don't have any reference, no comparison, all you're hearing is a highly focused soundstage between your two ears, and if you hear bass or you hear treble, well, compared to what? We don't know whether a headphone has more bass or less bass or its trebles are high or it has a boost. You can compare different headphones, and we sure know that when we do that, we hear differences. But when you actually do a virtualization measurement, when you're taking our system and connecting it into a real system with loudspeakers, you have for the first time ever the opportunity to compare the virtualized room and loudspeaker directly to the real room and loudspeaker. Then you realize, "Ah, this headphone has the bass boost, this one is bass light, this one has a boost of two colors, this one does not." So, the only reason we went for the STAX is that it provides the most neutral presentation for the price. Period. So it doesn't stop people from, if they like a boom box approach, then they can get other headphones, and there's no problem. I'm not saying that they're all that way, they're not, but often, if it's not the driver itself that has some sort of resonance, often it's the cup of the headphone that has a resonance. Or they're too tight, or they're too uncomfortable, or they're too hot, or they're whatever. There are a few headphones on the market that are as comfortable as STAX headphones. One of the big applications of our product is to watch a movie, and the headphones will be

on the head for two hours, and the STAX are good for that. They're not the only headphone, we know that there are others, and we know that there are new ones coming out. We've heard the new Senheiser HD 800s, I've worn them, they're very comfortable, they sound good, but they're expensive. As I've said, I've tried quite a few, and there are some that work fine, but there are none that work better than the STAX, starting with this SR-202 model that's about $750 at retail.

***WSR* Reber:** I haven't experienced your virtualization system for five years now, and in its production form I'm still as blown away as ever, and I just can't get over it. And just to let our audience know, we actually calibrated today the Smyth Realiser System with my day-to-day reference system I use to review Blu-ray Discs™, and I'm looking at about 35 to 40 Blu-ray Discs a month, evaluating picture and sound quality. So I'm real familiar with this system, and it's just amazing that the Smyth Realiser system perfectly duplicates what I'm hearing with real loudspeakers in my room. In fact, since I've had the system, over the last three days, I actually reviewed three movie soundtracks just using the headphones alone. And my wife, Marlene, she's totally blown away because she feels that these headphones are so comfortable and she actually sat through two full movies without any complaints and actually prefers the STAX earspeakers to the loudspeaker system, which is surprising! So it really works. I have three pairs of STAX SR-404 Signature earspeakers powered with a STAX Class A SRM-007tII vacuum tube driver and a Class A SRM-727II solid-state driver. Each amplifier powers two STAX pro earspeakers.

How does the Realiser connect?

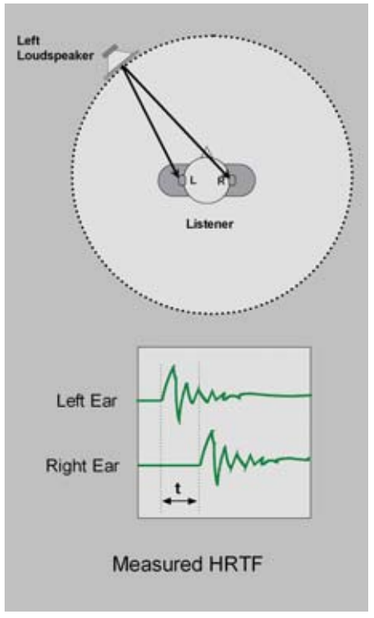
Smyth: The box is an analog system. We went for analog because that's the universal interface. With digital, you are faced with the question of what type of interface to use. HDMI is relatively recent in the development cycle of this product, and so on. And also, because it is a measurement system, we have to send signals out to your loudspeakers, and loudspeakers ultimately are analog, so we decided that we would go analog. So for digital signals there are converters; the converters we use are quite good.

***WSR* Reber:** The quality of the sound that we experience through the headphone system is limited by what factors?

Smyth: Well, one factor is one you can control, namely the amount of time that you spend on the measurement. When you make a measurement, you have microphones in your ears. These are small microphones, so they themselves have a relatively high noise floor, and they go in your ears and you sit there and you acquire an impulse response from each loudspeaker, one at a time. You can run slower sweeps and repeat sweeps to average down the noise. But for almost every demo, we use the very briefest measurement, three seconds per sweep, with no repetitions, with excellent results.

***WSR* Reber:** So, your recommended frequency for the microphone cycling is how many times?

Smyth: Well, the highest-quality sweep that we use is a twelve-second logarithmic sweep. You do that for each channel and



each look angle. There are three look angles: you make a measurement looking center (straight ahead), and then you make a measurement looking left, and then you make a measurement looking right, and we use those three measurements as a means of generating head-tracking. You can repeat these sweeps for all look angles, but of course, while watching a movie, you're generally looking center, so if you wish to optimize only one of those look angles, it would definitely be looking center. So often we increase the cycle time and repetitions for the looking center measurement, and then we measure looking left and right rather quickly because we know that that's really only for tracking stabilization. So that gets it down to a 30-minute measurement. In the lab I've sat for an hour. These are things a critical engineer or enthusiast might want to try. But again, the typical measurement cycle takes only three to five minutes total, for an excellent result.

***WSR* Reber:** Does performance improve significantly with the longer, repeated sweeps?

Smyth: Not much. I think with the brief measurement you get 95 percent of the effect.

***WSR* Reber:** How does the fidelity of the headphones themselves impact performance? In other words, you're going to get a different sound character from using just inexpensive headphones versus the STAX headphones.

Smyth: That's right. When I first developed the Realiser, I was using electrostatic loudspeakers. And it always struck me that here you are capturing this very, very fast system, and how are you going to reproduce it? You'd better make sure that what's playing out is equally fast. So you have to have a fairly transparent headphone if you really want to hear the characteristic of your loudspeaker. It isn't as if you clearly hear the coloration of the headphone in the emulated loudspeaker, it's not as simple as that. The emulated loudspeaker and room dominate, there's no question about that. The coloration that the headphone adds is a lot less, but it is still there. And so our approach has always been: if you want to be able to judge the room and judge the loudspeakers, then make sure the headphones are good. And of course we have tried the top-of-the-line STAX headphones, and they're better still. But are they that much better than the entry-level STAX? Maybe five or ten percent. What we supply is a very, very good system, but it doesn't stop people from improving the headphones. You can improve to whatever level you want.

***WSR* Reber:** Then the basic fidelity is going to come from your actual in-room loudspeaker system?

Smyth: Yes, because the room and the loudspeaker system is dominant. Of course, if the loudspeaker were in an anechoic chamber, you would hear only the loudspeaker. In that case, there would be a much closer divide between the fidelity of the loudspeaker and the fidelity of the headphone. But generally speaking, the room dominates, and so that is what produces the sound characteristic, not the headphone.

***WSR* Reber:** Now, when you calibrate, you calibrate for a person. What happens to your significant other or someone else who wants to experience the movie through another like pair of headphones, whether it be STAX or whatever? What happens to their experience? Is it the same or is it different? If it's different, how much different?

Smyth: Well, this deals with the issue of non-personalization against personalization. Say you made a measurement in this room, and you hear your loudspeakers in this room, and you put the headphones on and you're sitting in the same seat, and acoustically everything's correct, and visually everything's correct, the loudspeakers are in the same positions, you see everything, and so the effect that you get is 100 percent. So you get up off the chair and your wife sits down and puts those headphones on, does nothing else but just puts the headphones on. Well, she's still sitting in the same point that you made the measurement, and she's still sitting in the same room, so that's good. There's still a very strong visual alignment there, the loudspeakers are in the same place, the screen's in the same place. But the problem is, essentially, your head-related transfer function, which convolves the signal as it enters your ear canal, is different; everyone's is different. It's like a fingerprint, it's unique to you.

***WSR* Reber:** Did you say convolves?

Smyth: It convolves. In other words, it filters. A signal coming from your left as it hits your left ear, will bounce off the pinna, the outer part of your ear, it will bounce off the various surfaces of your ear and will sum together and begin to travel down your ear canal. If you take a white noise sound source and move it around your head, you'll notice that it seems to change its level and color and balance. That's your ear doing that, and that's what we use to determine direction. So when somebody else listens to your system, if the setup is similar and the position is similar, it won't be too bad, but it will be different. How different depends on how different the other person's ear shape is to your ear shape. In a demo, after measuring a new person, I'll put the headphones on and I'll listen to that person's virtualization, just momentarily, until I set the levels. It gives me an opportunity to hear, just briefly, what that person's measurement is like. I'm exposed to that hundreds of times, I've done hundreds of measurements, and there are some people whose measurements sound like they were made with my head; it's very close. And there are other people whose measurements sound really bad to me, so bad that I ask myself, did something go wrong with this measurement? Did the microphones fall out or something? Because it is hard to believe that anyone hears that way. Yet that person puts on the headphones and says "Hoo hah" and can't hear any difference between the headphones and the room. And finding someone whose measurements are similar to yours has nothing to do with height, build, male or female, or anything else.

***WSR* Reber:** Can the Realiser accommodate two separate independent measurements so that two individuals can be calibrated and listen at the same time to a movie's soundtrack?

Smyth: First of all, let me explain the operation of the unit. It's initially set up for one person. You put the microphones in your ears, the Realiser makes the measurements with your ears of a room and loudspeaker system, it captures up to eight loudspeakers in that system, and it generates a file onto which you put your name and a description of the system, and you save that. Internally there are 32 memory locations where you can save these files. So you could make 32 measurements and store them all internally, and they're there to be loaded in for listening anytime you wish. Then there is the second step, which is to measure the headphone on your ears, for which there are also 32 memory locations. Or you can plug an SD card into the unit and onto any SD card you can save up to 100 room files and 100 headphone files, so there is no limit to the number of cards in your library.

***WSR* Reber:** Which means that I could have, let's say that I had three home theatre systems in my home, each one in a different room, so that's three memories for those different rooms. Or I could go to someone else's home, or I could go to a professional dubbing stage, or I could go to a mix-down studio, or whatever, and those are additional memories I would have for their room signatures, right?

Smyth: Right.

***WSR* Reber:** Then I can choose my headphone. I can have STAX headphones for

one, I could have the Sennheiser 800 for another, right? I could have earpods for another, etc.

Smyth: Yes. Making the headphone measurement is quite simple, because there's no room involved. That's just you putting microphones in your ears and putting the headphones on your head, and you can do that at another time and place. If two years later you get new headphones, you put the microphones back in your ears and you put the new headphones on and you make another measurement. You don't have to go back to the room.

***WSR* Reber:** But you can combine them?

Smyth: Of course. In the Realiser we have four presets. A preset is something that you load the two files into.

***WSR* Reber:** The room file and the headphone file.

Smyth: To combine them, because you're now preparing the unit in order to listen to that room over those headphones. And the presets, once they're loaded, are held in RAM internally, so when you push those buttons you can switch between the four presets almost instantaneously. So you have your four home theatres, all right, and you've loaded them all into the presets. Say, you load in the same headphone for each. Now you can listen at will to four different home theatre systems at the push of a button, without leaving your chair. Unheard of, never, ever has anyone been able to do that. Normally you have to go to the room; the room has never come to you, and now it does. And so if you want to listen to four different loudspeaker systems, if someone's trying to flog you a good loudspeaker system, you say, well, I don't know, when I listened to them in your shop they sounded okay, but that's maybe because your room's different. Well, just bring them into your room, take a measurement, move them out, put them away again, put your old system back in, make a measurement, load both measurements into presets, and switch between the presets. What does that tell you? It tells you immediately what those loudspeakers sound like compared to the other loudspeakers, instantly. You could not do that any other way. Even putting the same loudspeakers in the same room with some kind of screen in front, and people do that, well, we all know that often one loudspeaker drives the passive loudspeaker sitting beside it that's been turned off, that's why people like to get rid of them. The loudspeakers that are not playing color the sound, they start to be driven by the driving pair. And some people will put three or four sets... if you go into Best Buy, there must be a hundred sets in one room. I can't see how you can ever figure out what's going on there, but they do it. So this is a great way, not only to compare rooms, but to compare loudspeakers and other things. If somebody's trying to sell you an acoustic panel and you're not sure, well, put it in, make a measurement, take it out again, listen to it, because it doesn't matter what the salesman says, that's what it's doing. And so it's a great system for comparing, it's essentially a snapshot. It's like an acoustic camera, it takes a picture of an acoustic and lets you recall it for as long as you like.

***WSR* Reber:** But now what about the two-people scenario? Can we deal with that or not?

Smyth: Yes. When we were last with you in 2004, our prototype box did two people. We put that aside to accelerate the development of the box you see now. However, we

did look at the calculations, and we looked at the processing power that would be required, and we realized that in fact the present box will do two users if the proper software's run in it. The box is internally ready to do two people, and we will release that software in the future. The head-tracking system is already geared up for two users. You can have two people sitting together with a head-tracker on each headphone, communicating with the same reference unit that's in front of the screen here, and both of those head-tracking signals go down that wire and to the Realiser. That's already working.

***WSR* Reber:** It's interesting because in my experience with Marlene with the Realiser, she just loves it. But I don't really know how close her ears are to mine because I can't hear what she's hearing. You know what I'm saying?

Smyth: You would need to listen to her measurement. And if you think hers is too bright, then she'll think yours is too dull. In the past couple of years, we have often gone into shows where we don't have the opportunity to personalize. And normally I will use my head's settings for the demo. We'll do a whole two-day demo where everyone is just listening to my settings, and not too many people seem to worry about it, they seem to be happy enough, they don't complain about it. And yet, when I listen to other people's, I complain bitterly because I always think it's too much this, too much that. And if you have a dull performance, people actually accept that more easily than a bright one. So the duller you are, in terms of frequency response, actually, the easier it is to be used as a generic.

***WSR* Reber:** I see. So the main difference then seems to be the brightness versus the dullness. Is that most of what the differences are? Or are the differences spatial as well?

Smyth: It is spatial as well, because we use the tonal information to determine direction, so if you upset the frequency balance, you will upset your natural ability to perceive direction. Now could you get used to that if that was the only thing that you were exposed to for the rest of your life? Yes, your brain would adapt to it. But we are exposed to our natural hearing continuously. Once you take those headphones off, you're re-immersed in your natural field. So that's why, when you put those headphones on with your own measurement, it sounds so good—because it is just the same, it's so natural, it feels that there are no headphones there. Whereas, when Marlene hears your measurement, she perceives there's something different. She can clearly see the screen, she can see the movie running, she can hear the soundtrack, she can correlate what she hears and what she sees, so she has all of the cues to allow her to pull the sound out of her head, and she's sitting in the same room and same seat where you made the measurement, so all of these things go well. But does she hear that complete naturalness that you hear? No.

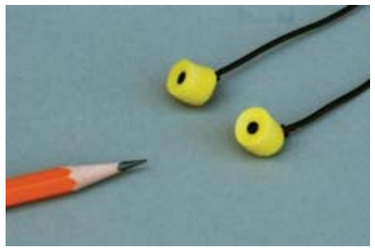
With personalization, as you know, some people will put the headphones on and swear that it's the loudspeakers they are hearing.

***WSR* Reber:** Well, that's what happened to me in 2004 and today.

Smyth: I've been in demos where some people have actually become irate about it.

***WSR* Reber:** They think you're teasing them, you're fooling them, you're doing a trick on them. It's amazing; it's just amazing, yeah!

Smyth: Even I've done it in the lab, I've had the headphones on, and you plug things in and out of your equipment and you forget that when you plug in and out of the Realiser, you're plugging in and out of your virtual



loudspeakers. And you plug out the last loudspeaker, and sure enough, the last loudspeaker over there gives a thump. And then you realize that you've got the headphones on. That's how good it is.

***WSR* Reber:** So it reveals to you how your brain works.

Smyth: We also use our eyes a lot in sound localization. Say you're listening to your headphones and virtual loudspeakers—if you see real loudspeakers in front of you, it's easier for the sound to localize there. If you take the real loudspeakers away, then it's a little harder. But now, turn out the lights, and all of a sudden the sounds from the headphones jump out of your head again, because there's nothing visually to deter them, to stop you from believing the loudspeakers are there. Outside is the weirdest situation. You record the output of the Realiser onto your iPod, you walk outside and you say, well, acoustically this is identical to what I just heard inside, and when it was inside, everything was correct. And yet, since everything looks different, all of a sudden it sounds different, because the brain is fighting back and saying, no, I don't believe this, there are clearly no loudspeakers here, why are you hearing loudspeakers? But with a little time listening, it even works outside.

***WSR* Reber:** Now, another neat feature of the Realiser System, which I appreciate because I rely on this technique in evaluating soundtracks, is that you can isolate any channel, you can combine any two channels or three channels, or four, or all eight, so you can actually have a tool to analyze where things were mixed, how they were mixed, and levels, and that's really neat that the box does that. And it visually shows it on the box as well, with lights, for the eight channels.

Smyth: When I was developing the Realiser, I would isolate channels and I would listen to them, because when you put up a full loudspeaker soundstage, it becomes a continuum. And your tweeter can drop off, or one of your loudspeakers can shut down, and it can be filled in by the next loudspeaker beside it, so you can be running for weeks sometimes, not realizing that one of your loudspeakers is dead. But more importantly, if you want to demonstrate what the process is doing...

***WSR* Reber:** You need to isolate the loudspeakers.

Smyth: Listen solely to the left loudspeaker, and there is the left virtual loudspeaker playing outside your head, where the real loudspeaker is. It is a vivid demonstration. You can solo each virtual loudspeaker one by one. When you put on a headphone, you expect the sound to come from inside your head. That's the way it's always been, but not with this.

***WSR* Reber:** Could people use such a feature for other purposes?

Smyth: Absolutely. People like yourself are listening to soundtracks, and often you hear something that's not quite right, so you rewind it and then you solo the loudspeaker and say, well, I'm right, that loudspeaker's actually dead. What happened to the completely dropped-out track on that loudspeaker? We have people who right now are using our product for QA for DVD and Blu-ray Disc work. As you know, there are plenty of places in Hollywood where people sit and watch and listen to DVD and Blu-ray picture and soundtracks. They check whether this track's there or whether this is in phase, out of phase, and so forth. With the Realiser, they can QA these multichannel soundtracks reliably. And further, we developed a meter bridge that works with the Realiser, and its job is to show the eight channel levels and also interchannel phase. If you play a CD through it, normally stereo music, heavily correlated, the in-phase is very, very, very, very strong. And so the phase meters go green—green for in phase and red for out of phase. It's a standard technique, but most metering systems are designed to give you the phase of only two channels—left and right. We had to build our own because there's no product out there that allows you to see phase on all of the zones—sidewall, front, left, right, rear, etc.

Now, would a generalized product, such as Dolby Headphone, have wanted to solo channels? I don't think so, because it would highlight, first of all, that the front loudspeakers do not virtualize well at all. I'm not knocking anyone, I'm simply saying that if you are personalizing, hearing individual channels is one great way to show off the performance. When you isolate each loudspeaker, it's just fantastic, it's just hard to believe. It localizes exactly the same as each real loudspeaker, and people just fall out of their seat.

***WSR* Reber:** Well, this is incomparable to anything out there. There's no headphone system that performs like this; this is real three-dimensional, real virtualization, it's incredible.

Smyth: Well, I suppose with the other products, they're looking at the much bigger market. It doesn't matter whether it's not perfect, it matters whether they can sell the product, and that's what they're interested in doing. I think the other companies have said to themselves, you can't have it complicated, nobody's ever going to use it, and that's true. If you want ten-million people or a hundred-million people to use it, yes, these are the simplifications. The problem is that the whole market gets polluted by that level of performance, and anyone coming in afterwards trying to sell a product that does work really well will be fighting against low assumptions. When we have this very different level of performance that comes with personalization it's a big problem. Personalization is a feature that actually requires you to engage with it and not just select the background color you've got on your menu screen.

***WSR* Reber:** But it's not really that complicated, Stephen, I agree that you have to stay still...there is a procedure, but it's not that complicated.

Smyth: When you compare it to what you would do to set up your mobile phone when you receive it, I mean, that's far more complicated.

***WSR* Reber:** And for the performance rewards, it's unbelievable.

Smyth: It is.

***WSR* Reber:** We talked five years ago about the idea that we could actually bring people into our place to get measured in our Holosonic Spherical Surround Home Theatre Laboratory, which would give them an experience that they normally would never get in their typical home theatre in their living room, sitting room, or family room, or down in the basement in which they built a theatre room. And then they could walk away with our signature space and listen to all their movies and programs through our signature space. It was so fantastic an idea, you know. So now you have the opportunity to continue to do that and to also now, possibly with people like Brant Biles and Robert Margouleff at Mi Casa Multimedia, who are doing a lot of 7.1 mixes for movie soundtracks, to go to their facility and get measured.

Smyth: Strange that you say that....

***WSR* Reber:** And what an opportunity that is.

Smyth: It is, and in fact purchasers of the Realiser are already going to Mi Casa for personal measurements. Mi Casa have quite

a big list of DVDs and Blu-ray Discs that they have mastered. And so we're talking about the ability to go into a shop and buy a movie and actually play it in the acoustic space where it was mastered. That's hard to beat.

***WSR* Reber:** Exactly. And the Realiser would be able to handle your own home theatre, and as well enable you to personalize other home theatres or mastering rooms that you went to.

Smyth: Absolutely. Another example is AIX Records, which had an offer at the CanJam headphone show for people to get a measurement in their studio. And the quality of AIX content is superb. We use their discs all the time for demos.

***WSR* Reber:** The recording quality is excellent, right, everything Mark does.

Smyth: What really struck the people coming to our booth was the idea that, if you were measured at AIX and listen to an AIX disc, you're hearing in exactly the same room, sitting in front of exactly the same mixing desk where this stuff was mixed. I mean, this is even better, mastering is one thing, this is where it was both mixed and mastered. Particularly in Hollywood, in Los Angeles, you have this industry of studios that handle commercial product. Now those studios not only have the opportunity of handling the product, they also have an opportunity of handling people through measurements, and why not? I listen to Mark Waldrep's AIX discs, and I often have questions about the way they were mixed, listening to my measurement of my own room. But when you take the measurement of his room and listen to those discs, you realize, ah, everything makes sense. Normally my center loudspeaker is below the display screen, and so I have this sort of triangular front, which does not work optimally with those particular mixes. Mark often mixes with the center channel down because he wants a certain portion of phantom to build into the front stage, so you want the center loudspeaker on the same level as the left/right loudspeakers. You really do see the power of the mixes when you're hearing them in the same environment.

***WSR* Reber:** Well, that's another thing that you could do in your home theatre system if you're limited to putting your center loudspeaker below or above, you could temporarily bring in another identical loudspeaker to your left and right front and put it right in front of the screen, right there, and take the measurement, and you would always have that perspective.

Smyth: That's right. At CanJam there were people who were coming into our demo who said to us, "I'd like to get on the waiting list for the Realiser, but my home system is not so good." There at the show, we have our 5.1 or 7.1 setup, we've got a Trinnov room EQ system installed to flatten the room, it sounds quite good. Immediately they realize, here's the first opportunity for taking a measurement, and not only that, we can show them how to do the measurement. So anytime anyone said to us, "I want to use this as my first measurement, can you load this measurement into my box when you ship it?" We would do it. And the first thing they get when they power up, is not a factory default, it's their personalized file. We would also say, "Look, you see the center channel? We're going to set it up in front of the screen with appropriate delay, may look a bit weird, but hold on, we're going to make the measurement that way." Sure enough, when you listen to the measurement, the dialogue's coming right smack out of the screen. What other way can you do that in real life?

***WSR* Reber:** No, you can't, at least not for most people. It's phenomenal, all right. Now I'm thinking that we never did have a copy of the original Holosonic Spherical Surround Home Theatre that we had in Temecula. If we had the personalization file, I could be listening to that theatre right now in this room.

Smyth: You could, and you wouldn't need to build a new one. We were at a meeting in Cambridge last year and we spoke to the BBC. We were explaining what we were doing, and they were saying, "Boy, we demolished about ten studio sound rooms. The sad thing is we wish we could have had your system to have recorded them all, so that we could compare them with anything

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we built later on. Just to be able to say, look, this new room's crap compared to the old one. Well, listen to it, let me see if that's true."

***WSR* Reber:** That's great, that's another application. One of the other benefits is, so many people live in apartment buildings, they live in condominium complexes, they live in close proximity of other people, and as I've stated many, many times, when you go to a movie theatre there's no volume control. Movies are mixed at a certain reference level, and to hear them properly with all the intended dynamics and subtleties and nuances, you need to play them in your environment at that level. If you reduce it, you're going to lose something. So this system allows you to maintain that reference level in your head while being in an apartment or close proximity, or whatever, so you could listen to your multichannel music, your movies, whatever else you can think of.

Smyth: We would see it as, you would go to a high-end dealer, he would have a room already set up with the Smyth Realiser installed. You may live in an apartment, or you may just not have a great sound system, but you still want to buy the Realiser. You will go to the dealer, and part of his service will be for him to measure you with his room and system. Or he may have an association with a studio nearby where you can get your measurement. We ourselves have arrangements for this in Los Angeles.

Also we're always hearing that many people have great home theatres but also watch movies in bed, they've got this setup sitting downstairs that's cost them hundreds of thousands of dollars and they're sitting in bed watching movies. So their downstairs theatre is now portable.

***WSR* Reber:** What component would be necessary to listen in bed in your bedroom to this system? You'd have to take this unit...

Smyth: You would take the unit and the head-tracker. And even the head-tracker is not necessarily a requirement because being in bed, you're pretty immobile. So really, if you had your feet up, if you were in bed, you really just need the headphone output. Do you need the Realiser box to be in your bedroom? Maybe not. Why not just pipe the headphone output to the bedroom? It depends how your house is wired up. I could imagine for a very sophisticated wired house you could send the picture to the room, and then you could also send the Realiser sound, which is just two-channel.

***WSR* Reber:** But if you didn't have that, if you have one box and it's in your home room, you'd have to bring the box up to your bedroom or wherever room you want to listen in.

Smyth: You'd have to have a DVD or Blu-ray player with multichannel outputs, and connect those eight outs into the eight ins and put on your headphones. You're done. There's only a requirement for a Realiser, a television, and the source player, that's it.

***WSR* Reber:** Could a unit be made that would have less features in it and would just serve that purpose? It could be an outboard box for that purpose.

Smyth: What we would call a play box. It would be sold by dealers who have an excellent room that they personalize you in. The dealer would have a Realiser like the one here, which allows measurement. He says to the customer, "I'll measure you and install your personalization file in the play box. You take only the play box home because, clearly, if you live in an apartment you're never going to have your own loudspeakers to personalize." And that's a great business for the dealer because when he changes his loudspeakers or he changes his room, he just phones you up and says, "I've got a new really good system, you should come and listen to it." And you listen to it and you say, "Ah, that's really good." "Well, do you want to measure it?" "Yeah, okay, that's $100 or $200," or whatever it is.

***WSR* Reber:** I think it's a fantastic application. Now, do you have this play box?

Smyth: No, it's something we're considering.

***WSR* Reber:** Well, I think you've got to first make available, as you are, the complete Smyth Realiser System, because that has to be for the people who have the performance systems, who...

Smyth: The current Realiser gives you fantastic flexibility, the ability to capture your own measurements. There's no end to that. You can take it anywhere you want. You've got a friend who's got a good system, you've got a friend in a studio who lets you in, and so on. But, yes, if we want to sell 10,000 of these boxes a month, it's not going to be this box.

***WSR* Reber:** And you could publicize locations where you can go and for a fee get measured and take those sound rooms with you. It will be fantastic.

Smyth: There are other ways of doing what we're doing. There's a system that Beyerdynamic markets, which is called Headzone. Headzone is essentially a 5.1 headphone. It's like Dolby Headphone except that it includes head-tracking. Its head-tracker is an acoustic head-tracker developed by a company in Switzerland. I think it suffers from a few problems, as you can imagine, using acoustics as opposed to light; there might be some delay issues. Anyway, Headzone says: I will give you a room or you will dial in a room. Just say: Where do you want your loudspeakers to be? What size room would you like? They have a program that runs on your laptop that you connect this box to, and you decide what type of room you want, and where you want your loudspeakers, which is not bad. And then you hit a "go" button and it calculates everything for that and downloads it. Now they will tell you that's your perfect room. And then you'll say, well, okay, who's in the perfect room? Well, it's a generalized head that's in the perfect room. All right, so I myself am not in the perfect room? And then you think, oh, how do I know that the room sounds good? Compared to what?

The beauty of the Realiser is you can go into a real room and make a measurement and compare it with the room while you are there. You put the headphones on and take them off, comparing the virtual and real rooms, and you're not going to leave until you're happy that they are the same. When you walk out of the room, you are confident that the measurement has captured the room. And you're done.

Is it a perfect room? In fact, you don't really care. If you go into the Chinese Theatre to get a measurement, is it a perfect theatre? No, it's a real theatre. The power of our system is choice. You make a measurement in a dealer's room and later say, "Dealer, your room sucks. I've listened to it and I'm not happy. I'm going to the other dealer down the road, he's got a better room." And you load that in and listen and say, "This is better." And then you listen to the first dealer's room again and say, "Well, this week I like your room after all." That's the way it goes. The person who bought our first unit got measured in Mark Waldrep's AIX Records studio, and he got measured in our office in Camarillo, and his immediate reaction was that AIX is superb. He meant that our room sounded like crap compared to Mark's room, and that was fine. And then a day later this person says, "Well, actually, I've listened to the Smyth Research room, and you know, it has its merits for a certain type of material. I realized, actually, it's quite good for

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certain things." This is the whole idea. This is the product working.

***WSR* Reber:** Yeah, I think that your system provides an incredible opportunity for experimentation. Now tell us about an iPod application because so many people have iPods.

Smyth: I've experimented with the iPod for over a year. The iPod records the two-channel output of the Realiser. The only thing that's different is that there is no head-tracking. With head-tracking, when you turn your head left and right, the virtual loudspeakers are stable, just like real loudspeakers. That gives you a very realistic rendition of the virtual soundstage. The iPod doesn't have any ability to use a head-tracker. What you're hearing is the same as if you were looking at the center of your screen. If you look center, keep your head fixed, that is what you will hear on the iPod, in 5.1 or 7.1. If you turn your head with your earbuds, the soundstage will rotate with your head. Often the out-of-head soundfield will then collapse because the moving soundstage is unnatural. When you turn your head away from a sound in real life, the sound stays where it is. In fact, we use that phenomenon to determine direction for low frequencies. So for the soundstage to rotate with the head is confusing. You learn to reject that over time.

But yes, the five or seven or two virtual loudspeakers, whatever format your music is in, are fully personalized on the iPod. Again, if you think about the sound of Dolby Headphone and similar products, the sound image is close around your head; it never gets away. There are two reasons for that: no head-tracker, and it's not personalized. If you personalize, the sound image immediately jumps out of your head and goes to the loudspeakers. If you turn your head without a head-tracker, it can fall back from that position. If you fix your head and wait, the image will go back out again. If you listen to surround on your iPod over time, the image always stays out of head. It doesn't matter how you turn your head, it will not collapse, because your brain has learned to cancel that effect.

***WSR* Reber:** Your system would work perfectly with a portable DVD or Blu-ray Disc player. What are the outputs to support various devices?

Smyth: We have an analog headphone output, and parallel to that we have an S/P-DIF output. So the 24-bit, 48 kHz signal that normally drives the DAC also comes out there. You can connect your optical cable into that output, then connect that to some type of recording device, or your computer. From there, associate it with your iTunes, in the case of an iPod. And that's all I do. I record it as a .WAV file. And then you import it. And then you go open your iTunes, go to your music library, click on that and go to Add File to library. When you add a file it will ask you what file to add. Go to the .WAV file you've just recorded and click on that and that brings it into your iTunes library. And then associate that with a play list and then sync your iPod. And there it is, it's on your iPod. Now if you need to compress it, there's an option to do that as well. But generally I just keep it as PCM. And when you play that, now you've got this home theatre or music system playing on your iPod.

***WSR* Reber:** Do you have to personalize your headphones for the iPod at that point?

Smyth: It depends what type of headphone you're using. If what you're connecting to the iPod is a normal pair of dynamic headphones, then of course, you would want to have your ears equalized for those headphones using the Realiser headphone measurement. If it's a pair of earbuds, right now we're in the process of generating factory files for different earbuds. These files will be available on our Web site, you'll just download them and put them into the system. Basically, the problem with earbuds is that there is usually quite a strong resonance associated with them. And so what happens is, with earbuds, it's often way too bright. It depends on the type of earbud. If it's an open earbud, if it's one that just sits in your ear, they don't have that type of resonance, but they have a low-frequency problem. Often it's difficult to get the bass up, but they would probably be okay the way they are. So in the Realiser you load the room file, but you just don't load a headphone file. You then record that and put that onto your iPod. That's what I have done, that's what I did for you today, except that I used a headphone EQ that I have generated for the earbuds. And when you do it properly, you can compare with the loudspeakers, you can plug in the earphones and somebody can stand with the switcher, it's identical.

Nate Fowler, *Widescreen Review*: You talked about how it's coming out 24/48 in the S/P-DIF; when it's doing the internal processing, when you're doing the A to D for your DSP, what are you keeping it in? Is it 24/96?

Smyth: The box works in 48 kHz, 24 bit. It doesn't matter, of course, to the user; that's invisible. If you sweep the box, it will fall off at 24 kHz, and then you'll immediately know that your sampling frequency was 48 kHz. Again, we understand some people will say, well 96 kHz is a great format. Some people will say 192 kHz is a great format, 384 kHz an even better format. In my experience, bit resolution is a much bigger contributing factor.

***WSR* Fowler:** The only reason I mention it is because Blu-rays™ are 24/96.

Smyth: Yes, because they have the space.

***WSR* Reber:** There's another kind of portable application, which is the back of the seat in a car or SUV, for the kids to be entertained while they're being driven somewhere. How does that work?

Smyth: That's one of the big applications. I suppose what follows on from that is any type of portable DVD or Blu-ray Disc player, they're very popular....

***WSR* Reber:** Yes. The new Panasonic Blu-ray Disc player hit the streets at a $750 price point. It is a full-functioning Panasonic Blu-ray, it has every feature that a standalone Blu-ray Disc player has. And, being portable, it's got an incredible screen on it, and it's a perfect application for this.

Smyth: This is very similar to a laptop. If you have a Blu-ray Disc in your laptop drive...

***WSR* Reber:** Or DVD.

Smyth: ...a portable player plus flip-up display, our system is great for that. Now the question would be for in-car, to what degree do you hear everything because of the road noise, there's probably a bit of noise cancellation application required there.

***WSR* Reber:** Gaming is another excellent application for your system. It's very exciting hearing things buzzing around, panning, so it can work for gaming as well.

Smyth: Absolutely. When we go to trade shows we very often take a PS3, a 42-inch plasma, and we have an HDMI audio breakout box, which breaks out the eight channels to analog and that connects into the back of our Realiser. So it's a very neat setup, and we also take the tactile outputs of the Realiser and we drive these through a Crowson amplifier into a motion platform, a one-yard square slab of wood with four transducers underneath. You set that on the ground and you put the chair on top of it.

***WSR* Reber:** So you have a tactile output on the unit?

Smyth: Yes. It's a separate output that acts sort of like a bass-management system, except it doesn't go to a subwoofer, it goes to a shaker. So we have that and we have our head-tracker, and we set it up there and you play your game, and it is unbelievable. It is absolutely unbelievable.

***WSR* Reber:** We have our PS3 in our system, so we could actually just play the games right through the Realiser System.

Smyth: That's right, and it's really, really good. We did the Tokyo Game Show about two years ago, and people just couldn't believe it. And, of course, for games you always turn the shakers up so you're nearly jumping out of your seat. The explosions, these shoot-up games, are hard to beat.

***WSR* Reber:** The other application we just barely touched on is for example, Mark Waldrep's AIX Records, where he needs to sell his multichannel mixes through the

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Internet, and he wants to give his customers the opportunity to sample a bit of what the tracks would sound like, but he can only do it in two-channel. So here's an opportunity for that, right?

Smyth: That is correct. Mark, of course, mixes stereo for the people who require it, but his main claim to fame is 5.1, and 7.1, as he is moving over to the Blu-ray Disc format.

***WSR* Reber:** That would be true of Chesky Records or Telarc or any of those companies who still specialize in multichannel surround music.

Smyth: That's right. What Mark's product is about is high-quality surround sound. And so how do you judge the value of that over the Internet, when everything is stereo? We have talked to Mark about this, and I think that we're going to try and do something about that. There's the issue of personalization. Imagine somebody gets personalized in Mark's studio; theoretically, he can send that measurement file up to the server and the server can process the multichannel to two-channel virtualized. And so not only is the user playing the track personalized, he's also playing it in the same studio where it was created, as a preview. You'd probably want to download the PCM discrete, you probably don't want to download a virtualized track. Although you could do that, and possibly, he could charge less for that. But that's a nice thing about a personalized track, the separate channels are not there, so in terms of piracy, the chances of that review track being streamed or sold is a lot less likely because the track is personalized for one user only. In contrast, once one person has got the PCM, then you're completely relying on his honesty.

***WSR* Reber:** You're exactly right.

Smyth: So a virtualized system, an SVS track, would be one way of dealing with piracy. It's also another way of reviewing 5.1 or 7.1 multichannel. And, of course, it's also another way of getting multi-track onto your iPod, as we have discussed.

***WSR* Reber:** That is fantastic. So Stephen, what are all the professional audio applications you've been thinking about?

Smyth: Well, some of them we've been thinking about and some of them have been knocking on our door. There are quite a few, actually. The common thread is the inability to get into the desired real control room or real studio. Everyone needs the ability to re-create that room somewhere else.

***WSR* Reber:** What are the different pro audio applications you've had requests for?

Smyth: There are situations where people need to re-create a studio, a control room, whatever it is. These are not people who are not familiar with the room, they usually have, in fact, used the room often. But they're now in situations temporarily where they can't have access to that room. So, for example, an outside broadcast truck or van, where you're going to go to a sports event and it's going to be transmitted in 5.1 live, who does that mixing? Well, it's a truck, usually parked in the car park outside the arena, and they get all the feeds in and they have to do a mix there, and then they send that to the studio or possibly directly to the transmitter. But the point is they are forced to sit in that small truck and make it function like a control studio. And they try to put loudspeakers on the walls, and of course, this truck has a generator on it, and whatever else, and of course, it's not ideal. So those people struggle to know whether the mixing they're doing there is acceptable before it goes out. With the Realiser, they can put on a pair of headphones, and not only do they hear 5.1 or 7.1, they actually hear the same studio that they normally work in. That's the key: they are familiar with the acoustic. You can use closed headphones or, sometime in the future, noise canceling, closed earphones, which will really push the noise down. So there are a lot of possibilities there. In France there's a big company that specializes purely in providing trucks for broadcasters. These people are keen to look into the possibility of adding the Realiser as an option for these trucks. It makes a lot of sense. We've sold product for this particular application, location recording. When you go to a location and set up your microphones, especially 5.1, how do you know what you're going to get? Normally you know after the fact. But these people are positioning their microphones and hearing the sound image on-site. No need to guess. And of course, mixing, would you ever do mixing on location? With our box you could, and you don't have to go back to the studio before you realize what's good or bad.

***WSR* Reber:** I've been on many recording sessions with Telarc Records, with the Cincinnati Pops Orchestra, with the Boston Pops, and at Carnegie Hall sessions. I've been right there on stage and backstage in their control room off to the side. This is a perfect application for such live recordings. I've also produced and recorded live music video concerts in which the Realiser would have been a perfect tool to monitor the mix.

Smyth: We're saying that you can actually hear the control room that you're used to. Any of these Telarc guys can hear their own Telarc sound rooms, that's the key thing. And there are four presets, you could have four different people, or you could have four different studios. You can check the mix to hear that it works in multichannel or you can have a room that just has stereo, as compared to a 5.1 room. You can switch between them and say, well, this is how a stereo mix would sound, this is how a 5.1 would sound. Anyway, the point is that this allows you to listen with the monitoring acoustic you're used to. How many mixers are invited to do something in another studio, another setup that they're not familiar with? Lots of them. What would it be like whenever you're done with your mix just to check quickly what it sounds like in your room back home? Well, now you can do that. So checking mixes with alternative rooms and loudspeakers...as you know, nearly all control rooms have 5.1 and then they have the two little monitor loudspeakers sitting on the console. Why? Because they want to hear what it sounds like on a lesser system. With the Realiser, you can load any combination of loudspeaker systems you want, and you can compare them all. Another application is for home or semi-pro mixing. All those people that bought Pro Tools systems, well, we know that the vast majority of them are garage musicians. And they are faced with the prospect of mixing over headphones, mixing in their closet, mixing in their garage. These people could go to a reasonable sound room, make a Realiser measurement, bring it back, and then they can do mixing in a proper environment over headphones. That's the way the recording market has gone, why the big SSL consoles are all gone away, because everything is being broken down by the power of the computer, the fact that everyone wants to do it at home. So there is the problem: everyone wants to do it at home, but how can you do it at home if you don't have the sound to go with it? It fills that gap nicely.

Another application is pre-mixing for movies and TV. When you go into a movie studio or you go up to Skywalker Sound, you'll notice that although there are big dubbing stages where the films are finally mixed and the director gets involved, there's an awful lot of groundwork done prior to that, which we call premixes.

***WSR* Reber:** All the premixes are done in isolated sound cubicles.

Smyth: Little cubicles, and the same with television. Those people often have to share a room, maybe two or three people in the same room, and they all do it over headphones. And yes, sometimes they'll try and fire their 5.1 system up, maybe using some small Genelecs or other powered monitor loudspeakers. But the point is, ultimately, it's the producer or the director who hears the premix in the dubbing stage. So I don't know how they do that, obviously they must be well experienced because they have to predict how that's going to sound on the big stage. But with the Realiser, these pre-mixers all go into the dubbing stage, they all get measured, and they all bring the stage back to their workstations. When they put on the headphones, they're on the dubbing stage. And so you would think that that should radically improve the process, or at least there wouldn't be a question that they're doing anything wrong, it would speed it up, it would give them a level of confidence. There's been a lot of interest for that.

Again, sometimes people get confused about what it is we do, are we trying to put them out of a job, are we trying to replicate the dubbing stage? No, we're not, that's not the purpose. We're simply trying to make it uniform. I remember talking to someone from Universal who said that they had spent a lot of effort and time trying to make each room sound the same. Why? Because you can spread out the work for the job and everyone's working from the same base. Our box is great for that, everyone can go to the same room, get measured, and everyone is listening to exactly the same thing. Another problem our system solves is that often the mixer has to contend with an influx of people coming through the studio and has to tell everyone to keep quiet, or shut the door. We have been told that it would be very nice if he or she could just put on a pair of headphones and continue. As you can imagine, when you're doing mixes, a studio is like a magnet. The second thing we were told is that nearly everyone has at least one or two assistants. And also on the dubbing stage, you'll see assistants. So we have the premixers, and then we have everything being brought in on the dubbing stage and put together, and even then there will be two or three assistants sitting in the wings, who are dealing with whatever sound effects or whatever it is they're doing, I'm not exactly sure. But what I do know is they're all wearing headphones, and they have to work. Clearly, they're not listening over the theatre loudspeaker system. They're listening over headphones. Or even with loudspeakers, those people are not in the sweet spot, they are back off somewhere behind the mixer, behind the desk. How is their work being compromised? We're told that's another brilliant application for the Realiser. Of course, again, going back to movies, how many directors come into the dubbing stage to hear the soundtracks? And how many don't? How many are already on another set? They are FedExed a recording. How do they listen to it? They can put it up in their home theatre, but there again, if they had visited that dubbing stage at some point, they could have measured it, they could own a Realiser, and when they receive the recording, they connect it all up and now they're on the dubbing stage. So when they make a critical appraisal of that soundtrack, they're hearing it on the dubbing stage.

***WSR* Reber:** That's a fantastic application.

Smyth: They could be anywhere in the world when they're doing that. And I think that is a big application. One of the problems we've been told is getting the director into the dubbing stage. Often, for these big movies, the director never comes anywhere near the place, and never has, and never will. So the stage is now available remotely. You have your director, you have your mixer, you have your producer, and with a record label you've got other people, I think, as well, who decide on the commercial viability of the recordings.

***WSR* Reber:** There are many people involved, including the artists.

Smyth: There are a lot of people who need to hear it, and the Realiser allows that. It allows those people to be involved and hear it for what it really is and to not worry that they're listening to it over their iPod and wondering, how they are making the adjustment on this. They know that if they do take it home and listen to it, then they're hearing the real thing.

Quality assessment is another thing, probably one of the most immediate applications of this technology, and we touched on it because you were describing your own issue when you're reviewing soundtracks. That's a big, big business. When we did it at DTS in the early days, we all did it. We all had to sit down and watch those stupid movies because you have to check if the encoder might have collapsed, something might have happened.

***WSR* Reber:** When you were developing the DTS codec?

Smyth: Yes, when we were working on the early LaserDiscs. We all had to alternate sitting in the sweet spot and run the channel switcher and watch those meters. I'm very familiar with soundtrack quality monitoring. There are some big companies that do this for everything, Blu-ray Discs, DVDs, broadcast television, satellite television, cable, in-flight entertainment. They spend a lot of their time with people in little booths with headphones or small loudspeakers, watching for whether the picture collapses or whether the channel collapses or whether a pop occurs somewhere. And of course the Realiser is very, very good for that. Very, very good because not only do we emulate a good room and multichannel monitoring system, but we also have the ability to cut the room out.

***WSR* Reber:** Take the room out?

Smyth: Take the room right out. You still have the five or seven directions, but those directions are an anechoic representation, they have no reverberation.

***WSR* Reber:** Which is excellent for spotting...

Smyth: ...clicks and pops, all that sort of stuff. This box is very, very good for that. How would you have an anechoic chamber with five or seven loudspeakers in it? Well, nobody does that, yet you can do that on the Realiser.

We can go on to another thing, which is very interesting also, education.

***WSR* Reber:** You mean audio professional education?

Smyth: Yes, classes on how to mix or otherwise produce audio. They do it primarily for 5.1 these days, not stereo. And we have been told by a couple of institutions that the big struggle is that they have a small number of very good rooms, but how do you share them? You've got thirty or forty students, maybe more. Maybe a hundred, maybe 120 students who are all tasked with a similar job, but how do they do it? Well, people who know our Realiser see immediately that it is a solution. Each student goes into the same sound room, they all get measured, and they all go back to their desks, and they all put headphones on. Now, what's also nice is that everyone is mixing with the same sound room. There is no bias. It doesn't matter how good or bad their sound room is, that's not the point. The point is that everyone has exactly the same opportunity to demonstrate his or her skill at doing the mix. And I think that's a very, very good application. Otherwise if you want twenty rooms, you've got to build twenty rooms. This way you can have one real room and it is replicated nineteen times or more on the headphones.

***WSR* Reber:** Exactly, it's a perfect application.

Smyth: Equipment reviews, I think I've touched on that. We read the papers that Harman produced. Harman has their binaural-room-sampling system, a system that was developed three or four years before I even thought about doing our Realiser. In fact, it was their work that really spurred me on to do what we did. They were sampling a room using a dummy head, and they showed very clearly that head-tracking made sense. They had a dummy head in the control room with microphones, and it had a motor attached, controlled by the head-tracker on your head, in another room. So the dummy head is sitting in 5.1, you're in a completely different room listening to the headphone output off those two microphones, but controlling the dummy head with your head, so as you turned your head, the dummy head moved. You were then asked where this sound was coming from. And they would log all the results down. They showed that by putting head-tracking in, it made the perception of direction dramatically more reliable, even though they used the microphone ears on a dummy head.

Harman have recently been talking about using the system for assessment of equipment.

In other words, can you use a system, which is flawed, which they admit does not replicate the 3-D image accurately, but the inaccuracy is consistent for whatever is being evaluated. If today, what you hear is a bit bright or a bit wrong in direction, the point is that error is there for the two sets of loudspeakers, so the question is, can you then tell which is better between those two loudspeakers, or what's different between them, accepting that what you're hearing it through is slightly flawed. They've written a lot about this, and their conclusion is yes, you can do that. But I would scratch my head and say, "Why would you even bother? Why not just have a system that actually sounds exactly the same as the physical loudspeaker, because if you're going to all that bother about comparing equipment, surely you could just sit down and measure it with your own ears." So, clearly, if Harman is talking about using this system for how to perceive differences between sets of equipment, then obviously that will work with ours too, and this comes back to the snapshot camera, audio camera concept that I always talk about, the fact that essentially you can take a picture or you can take a capture, a sonic signature of that setup, and you can replay it later on and compare. Put in one set of loudspeakers, capture it, and bring in another set of loudspeakers, capture it, and then switch between the two sets of virtual loudspeakers. That allows you to make an A-B comparison between two sets of loudspeakers. Otherwise the two sets of loudspeakers interfere with each other, which is what normally happens when you leave the loudspeakers in the same room when A-B comparing. Or if you have to take the loudspeakers out in order to bring new loudspeakers in, then there is a five- or a ten-minute gap in which you've then forgotten what the other loudspeakers sound like.

***WSR* Reber:** Exactly, it's hard to make an accurate comparative assessment.

Smyth: You can do it. If you live with loudspeakers for a year, you can instantly tell the difference when you bring a new pair of loudspeakers in. But the question is, with short exposures, can you accurately assess differences?

***WSR* Reber:** I've experienced that. It is a real challenge.

Smyth: People can hear the difference in equipment, that's for sure. And you can hear the difference in cables, and you can hear the difference between this and that. But here is the first time you can actually do an immediate A-B for anything, and say, "This is the real difference."

Sound room design is another interesting application. Your company's main claim to fame is it designs good sound rooms, and you've done a lot of jobs over the years. And, of course, it's that experience that allows you to design good sound rooms often. There is a science to it, of course, but often it's experience.

***WSR* Reber:** Often it is experience.

Smyth: But there's still an issue for these people to remember exactly how a room sounded. You do the fifth build, you end up with a really good room and everyone's really happy. And the sixth and the seventh and the eighth and the tenth and the twentieth, and you come to the thirtieth one and you think, this is good. The question is, are you doing better or are you going backwards? You have no idea because you can't remember precisely.

***WSR* Reber:** This is why we needed to record the sound signature of the Holosonic Spherical Surround Reference room that I had. It is now only a memory.

Smyth: We know of a company here in California that does this and that's what they want—to document their rooms for their own records. Even though these people are seriously experienced, they would still like to be able to recall precisely what each room sounded like. The other issue is, wouldn't it be great to be able to give your client a whole lot of rooms to choose from?

***WSR* Reber:** Yes, you want it built this way...

Smyth: Yes, this is what this sounds like. Of course, the client was not in those rooms to be personalized, and he's not going to hear it quite the same way. But I think it comes back to that Harman argument that even though it may be flawed, you may still be able to perceive the differences quite well. And so these people are saying that's what they want to do. For their own sanity, they want to know how their rooms sounded, because as you know, after a couple of months you've completely forgotten, unless you go back to that room. But often the opportunity's not there to do that. So every time they build a room, they take a measurement, and they archive it.

***WSR* Reber:** Well, I wish we could have done that with our room, because we're building that room again, and we're doing a few things differently. I would have liked to have been able to compare the results.

Smyth: The other thing that you can do when you're building rooms, is how many times would people like to roll in a couple of screens with some material on them, but rather than permanently install them, get a feel for how they change the sound? An expert can hear the difference reasonably well, as long as it's done quickly enough, but more importantly, what about the client, would he like to know? So you could have a panel over here, you could have a bass trap over there, but before we decide, we can wheel them up and try. The client will say, "Yeah, well, that sounds good but what was it like before that?" Well, hold on, roll back, you can't remember, you just can't remember. So even as an education, it's almost like saying, "Well, look, what about a course for people who design sound rooms?" There's another brilliant application where students are deliberately forced to capture the building of the sound room as it proceeds, to show the effect of each thing that they do. Equally for a client, you could say, "Well, I don't know whether you like this material or not, or whether you think this is useful or not." Because you know the way it is, whenever you're paying a couple of hundred thousand, you've no idea, are they just spending your money or are they actually doing anything real? Well, this will prove it, and whether you've gone too far, or it's too dull, or whatever. And so this is really like your "extreme green" home being built. You've got your time-lapse camera, it's exactly the same idea. You're doing that to show people how it comes together, but likewise, you can capture a room being built to show how it's sounding at different stages.

***WSR* Reber:** I could do that in our project now under construction and determine how these different things change it. That's a great idea, I think I'll do that. Well, you know, you've talked about all these different applications and I'm thinking in my head, what was the impetus? What made you want to develop this technology? Where did the idea come from?

Smyth: Well, at DTS we had 5.1, it was a stereo world, as you know. You personally were heavily pushing 5.1, and supporting the work to establish the digital formats. But the point was that there were all of these plans about 5.1 as a consumer release format, and the question was, who exactly is going to listen to it? Where do they get all these loudspeakers from? They were struggling to get two loudspeakers into a living room. Often you just use your television loudspeaker. Looking back now it seems that many people were willing to put home theatre into their rooms, although, I have to wonder how many of those home-theatre-in-a-box systems have been sold, probably too many for my liking. In those days the thought always was, what could you do to play 5.1? Is there another way of doing it? Headphones? This was to try and facilitate the proliferation of 5.1. That was where it came from, and that's where Lake Technology came from. That was why Dolby got interested in Lake, that's why we have Dolby Headphone. It's another way of providing a soundstage, which replicates something, which we believe might be difficult for the average person to re-create.

***WSR* Reber:** A soundfield.

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Smyth: A soundfield. So that was really how I got into it, and we went through all the demonstrations that Lake gave, and it was good, it was interesting. I wasn't very much into it, but I was aware of it from the demos. At the time we were still heavily embroiled in our own coding. I think at that time we were looking at 6.1 and then we were looking at 96 kHz/24-bit sampling, so we were all up to our heads. We didn't have a lot of time to look at headphone technology, but that was where my interest came from. The Lake demo was a good demo. It didn't end up as good in the Dolby Headphone implementation, but they had the right idea.

When I left DTS I wasn't so much interested in the headphone stuff. What Mike [Smyth] and I were looking at was trying to re-create a classroom effect, mainly for foreign language learning. The idea of distance-learning language is that you have two classrooms of opposing languages, and you hook up with another person on the other side and you talk, and eventually you talk native, and then you talk on the phone, and that actually is the only way you can learn a foreign language—to be forced to talk to somebody in that language, believe it or not.

***WSR* Reber:** I know, I lived in Sweden during part of my university years and found that to be the case.

Smyth: But the point is that distance learning suffers from this concentrated soundfield effect, the fact that everything comes through a single pipe, and so it's just a voice down a wire, there's no space to it, it's not like a real classroom. So the idea was, could you use virtualization to spread out the classroom members, so that you would be able to associate by space, if not by name, but certainly associate by space.

***WSR* Reber:** Right, he's over here, he's over there.

Smyth: You're always over there, I know your voice. So that was where we were, and immediately I started looking at some really simple binaural virtualizing stuff, and that was really where it started. And I went a wee bit further than I had intended to do. I started to do some experiments, and I was really interested to see just how good it could be. What are the limitations? And of course, you realize very quickly that unless you put the microphone in your own ear, and unless you measure the impulse response, it is not that good, it's not reliable, it's inconsistent. Any experiments I did, you just put that microphone in your ear, you measure the impulse response, you play it back, and you just, well, it sounds exactly right.

***WSR* Reber:** The impulse response is a very fast transient that represents all frequencies. John Dunlavy, the designer of our reference loudspeaker systems used at *Widescreen Review*, was insistent that his loudspeakers' impulse response measured well in an anechoic chamber.

Smyth: Yes, the idea of an impulse is that for that infinitely short time the signal represents all frequencies. It's broadband DC to infinity, that's the idea. You could say, then, "Is that not like a spark coming out of your loudspeaker?" You have a microphone that records the resultant wave that comes from that. That's what an impulse response means, absolutely. For loudspeaker design, you need an anechoic chamber because you don't want the walls to reinforce the sound, you don't want a superposition of constructive and destructive interference, you want to get rid of all that. You actually want to watch what the driver is doing and how it interacts with its own cabinet, certainly not how it interacts with surrounding things.

In actual practice, you don't use an impulse, because an impulse is very low energy. In other words, for me to get a sufficiently energetic impulse, I'd blow your loudspeakers up. So what you do is you spread it out in time. And when you spread an impulse out in time, what does it become? It becomes a frequency sweep. So a frequency sweep is like an impulse spread out. If you take a frequency sweep and crush it all together, it becomes an impulse. And so what happens is you can have this quite powerful soundwave swept over a very long time, which when compressed together produces a bomb-like impulse, literally, so we use sweeps. If you actually compacted them up to an impulse, they would literally blow your loudspeakers apart. So sometimes people wonder, "Where is the impulse response?" You're putting out sweeps, but they are the same thing. It's just a different way of looking at it.

***WSR* Reber:** The speed impulse can be depicted in a graph.

Smyth: An impulse is a step function. It's a step, which is supposed to be infinitely tall and infinitely short, so that it has no characteristic of its own, it's flat. Anything that deviates from an infinitely short, infinitely tall impulse has a shape to its frequency balance. Of course, you never achieve a perfect impulse in real life. But the sweep is good, it's not a bad way of doing it and is very practical and easier on the ears.

***WSR* Reber:** So that's how you got into experimenting with virtualization, and the more you got into it you saw these applications for this and...

Smyth: Well, we were still looking at distance learning, but I was spending more and more time trying to figure out what else was needed to make it work well, because the measurement of the impulse in a stationary situation is fine. So then it came down to confusion because of head turning. If you turn your head and the image turns, that's a problem, even if it's personalized. And in those early days that's what I found—you measure this thing, and you stay still, and you listen to it, and it's fine. If you move your head, you may lose that whole image. And so what I wanted to find out next was, how do you do head-tracking? Normally when you do head-tracking, you measure the impulse response for a number of positions, for maybe every couple of degrees. And the only system that had done it before used a dummy head and a turntable.

***WSR* Reber:** It's not a real person having to sit there and do it.

Smyth: Exactly. How does a real person do it? How does he know what five degrees is? So I thought, perhaps we should align what we need to do roughly with the loudspeaker arrangement that we would likely be using or would likely encounter with any application that might use this headphone system. And that's why it ended up that we used this idea of looking center and looking left and looking right, or you might look at the left loudspeaker or might look at the center loudspeaker and you might look at the right loudspeaker. You don't have to do that, but the point was, could it work with something like that? I mean, that's not five-degree increments, it's thirty degrees; would it work? Well, if you do it correctly, it ends up that it does work, and it works quite well. There are things that you do to make it work. And then the whole head-tracker system had to be developed. So those are the things you have to do, Gary. This is possibly why we haven't seen this type of thing. This development was not a standard job using off-the-shelf software. Neither was it a standard hardware job. Otherwise, the guys who build amplifiers would have done it by now. It's an integration, you have to understand both sides of it and how they work together. Why would all of these great industry-leading companies that talk a lot about audio and talk a lot about binaural, why is it that they're so badly behind? Why is it that someone like me would do this? I mean, I don't know anything about anything. But our result has just been so good, and everything else is just so bad comparatively.

***WSR* Reber:** I agree, your Realiser system dramatically outperforms all other headphone systems!

Smyth: And I don't attempt to explain that. I do think that it relates to the interaction between head-tracking and personalization and a method of doing it. I think that is where the big disconnect has come, and it's also caused by what Mike may call "death by a thousand cuts." You can start off with a perfect system and somebody will say to

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you, “Well, what happens when you turn the head-tracking off? What happens when I don’t listen to my measurements but listen to somebody else’s?” They’re each a step down. “And what happens if I don’t use 200 milliseconds reverb, what happens if I use 50? What happens if I join the reverbs to make it into a mush reverb,” which they do and there’s nothing wrong with it, but the point is, these are all steps downwards. So if you look at a Dolby Headphone or similar rendition and you look at ours, it’s not just night and day, it’s just a totally different concept, a totally different experience. And yet, both are trying to do the same thing, funny enough. But what the other people didn’t understand was every time they cut that wee corner and they turned that wee thing off and they tried to squeeze it in here and squeeze it in there, it’s a drop down. They would have needed our system to measure at each stage. But we all have to be careful about cutting corners.

People say to me, “I don’t move my head when I watch a movie. Why do I need head-tracking?” “Well, if you can get into your seat with your neck frozen and you can sit in that chair and you watch your movie to the end without moving your head, then I agree with you, it’ll be okay. The question is, how did you get into the seat, and do you move your head at any time? Because when you do, the effect is gone.”

***WSR* Reber:** With the Realiser, you can just move your head naturally with the headphones on, and it maintains the spatial relationships.

Smyth: With head-tracking, when you move your head, the sound image is perceived to stand still; but if you think about it, it’s actually rotating with respect to the headphone. So some have asked, what if you keep your head still and we rotate the image of the loudspeakers. That must be equivalent; would that not also produce an out-of-head experience? Well, it doesn’t, so that must prove that head tracking doesn’t work or isn’t necessary. But what they don’t understand is that your brain is connected to the muscles in your neck. And when it fires those muscles and your head moves, it expects the soundstage to be perceived as stationary. That is the connection, the feedback. It has nothing to do with the source. And that’s, of course, nothing to do with what those people are trying to experiment with. So as soon as you fire the muscles in your neck, your brain says, “Soundstage, don’t move.” If the soundstage moves, you’re not a real soundstage, you are a headphone presentation. So you stay stationary, don’t move your head, that’s fine. Move your head. You’re a goner if that sound moves because your brain will say, ah, I recognize that one. That was a headphone. And then it puts the image inside the head.

***WSR* Reber:** So the slightest movement would put the sound back into your head?

Smyth: Could do it. The bigger the movement, the worse, but it’s very, very powerful. When I first got my head-tracker going, I had never experienced head-tracking, knew nothing of what to expect. When you put it on, it just locks in. Sometimes I’d put the headphones on and walk over to the sofa to sit down, and the image is all over the place. And then the head-tracker comes into range, and it just sucks the sound right out of your head.

WSR Reber: Out of your head and puts it out into space.

Smyth: That’s what it’s like, it’s like it sucked it out of your head.

WSR Reber: Wow. That precisely is what the experience is!

Smyth: It is unbelievable.

WSR Reber: Is there any aspect of your Realiser that is patented?

Smyth: The whole system is patented. There are various aspects that are patented too. Virtualization itself is not something you can patent; people have been doing that for years. What we were protecting was the way that you make the measurement, the way that you do your look angles. What I was trying to figure out at the time was how to get a person to be the measurement. In other words, going back to the Harman thing, it’s every five degrees on a turntable. How do we get around that? Well, it has to be simple, and it has to be effective. The patent is pretty much built around that idea and what you need to do to process that information, to make it what you hear. The patent is not about virtualization, it’s not about listening to 5.1 over headphones. That’s not something you can do because it was patented probably in the 1970s. There are a lot of different variations that people have tried. So the concept of presenting a virtual loudspeaker on a headphone is old hat, been around for forty years now. The patents relate specifically to the way we make the measurement, how we process the information, and how we present it.

***WSR* Reber:** Well, this has been a long conversation. Have we covered everything?

Smyth: I think so. The idea is that if you’ve got a home theatre system, you can use that to measure yourself. If you’ve got a high-end dealer, the measurement could be part of the sale.

***WSR* Reber:** Exactly, you could go there.

Smyth: So you go there, and what’s good for the dealer is—although it might seem a bit strange that he’s selling a virtual room when he wants you to buy loudspeakers—the point is that he can sell his loudspeakers many, many, many times over, through measurements.

***WSR* Reber:** Well, you’re not going to want to have the headphones on all the time, you’re always going to want to have the real loudspeakers...

Smyth: Our system doesn’t replace loudspeakers, it complements loudspeakers.

***WSR* Reber:** Exactly.

Smyth: But what’s interesting about dealers is, as Mike often says, they bring in a new set of loudspeakers, they bring in the latest thing. And the dealer will phone his customer up and say, “I’ve got the latest in.” The customer will want to measure it, and he’ll be back again.

***WSR* Reber:** Exactly.

Smyth: There’s a lot of potential repeat business there, for measurements. And, as I say, if we go to a studio like Robert Margouleff and Brant Biles’ Mi Casa Multimedia, or Mark Waldrep’s AIX, those are classic cases of studios where there’s either movies or music being mastered, and you can actually buy that content and you can play it in the same place, virtually. We’re looking at the possibility of getting some movie theatres involved, where we would actually measure people during off hours. I can’t say who we’re looking at, but there are one or two movie theatres that we might be able to coax into allowing measurements.

***WSR* Reber:** That would be interesting and exciting.

Smyth: Obviously, capturing a movie theatre in your headphone, does that stop you from going to movies? No, people go to movies because they’re going with their mates. But tonight I want to watch a movie on this headphone, and I want to experience a good movie theatre. I think it’s all complementary.

Here’s another aspect of perception that’s interesting. If you look at the shape of your ear, you’ll notice that your pinna shape is facing forward. The shape of your ear is designed to process frontal information, frontal waves coming towards you. What that means is that if you look at how specific your shape is as you move away from the center point, you’ll notice that it becomes less and less specific. In other words, looking from the back, my ear shape is just as bland as your ear’s. So what this means is that loudspeakers that are behind us, we all perceive pretty much the same. In other words, that notchiness that’s associated with the particular shape of your ear is much less as you move behind, it’s much flatter. My frequency response from behind me would be much closer to your frequency response from behind you. So my virtual surround loudspeakers would sound better for your ears than my front loudspeakers. They’d sound more natural.

***WSR* Reber:** Yeah, I see. But we still have full directionality perception behind us, and one can pinpoint stuff behind them and around them.

Smyth: We do, but that’s not what I’m talking about. I’m talking about the very, very powerful focusing that occurs directly in front of you. If you were to do a polar chart of the amount that your pinna affects the signal entering your ear canal, it will peak at zero degrees right in front of you, which means that’s the direction that is most sensitive to personalization.

And of course, people have varying ear sensitivity to directionality, and there’s no question that if you move a source in front of you, one inch, Gary, in front of you, you can track that source very closely. But if you put the source above you and move it by one inch, then you’ll notice that you’re not so reliable. So there is a difference. It’s not that we can’t hear it where it is, we can hear perfectly that it is above us. But actually down to the last millimeter, you can hear that the front direction is definitely more sensitive than up or behind. And that, I believe, is to do with this pinna, basically this antenna, which is pointed frontways.

So that’s why in Dolby Headphone or any of these other things, the front loudspeakers are difficult, whereas the rear loudspeakers are easier. Even with a dummy head we feel better with rear imaging than we do with front. The dummy head does not have the individual pinna shape that we have.

When we demonstrate the Realiser, we like to point out how the virtual front center loudspeaker is fully out-of-head, the most difficult thing to do. But of course, the virtual rear loudspeakers localizing in their places are the crowd pleasers.

***WSR* Reber:** Well, Stephen, your Realiser is absolutely amazing and revolutionary. It is just wonderful. I have never experienced spatial performance from a headphone that precisely mirrors real in-room loudspeaker positions.

So, we covered everything?

Smyth: One last thing. We’ve said that some people have a good surround system of their own to measure, and some do not. What if you have a good loudspeaker system, but only stereo, two loudspeakers? The Realiser has a routine whereby you can use your two loudspeakers, or even only one loudspeaker, to generate as many virtual loudspeakers as you want. The Realiser will generate a virtual front center loudspeaker from your stereo pair, and you can turn your back to the stereo loudspeakers and measure them as surrounds. Or with one loudspeaker, you can sit in an office chair and rotate yourself to the angle required for each measurement.

Of course there is nothing wrong with listening to stereo with the Realiser; it sounds like stereo loudspeakers in a real room, outside of the head. Some of our customers are doing just that.

***WSR* Reber:** What a wonderful opportunity for the high-end audiophile to engage his or her stereo loudspeakers in a full spatial soundfield experience through the Realiser System.

Thank you Stephen so very much, this conversation has been really informative and educational.

Smyth: Thanks, Gary. If anyone wants more information or pictures, please go to our Web site at www.smyth-research.com. **WSR**