



ON SCREEN

On Screen With Wilfried Van Baelen

Auro Technologies—Part II

Gary Reber

Part II of the On Screen interview, which took place during CinemaCon at Caesars Palace in Las Vegas this past April.

Gary Reber, *Widescreen Review*: How's that going to translate to the home?

Wilfried Van Baelen, Auro Technologies: That's a very good question. When it comes to Atmos, I do not see how you can properly translate it to your home. In fact, the Auro-3D format is designed as a one-cross market solution, which means that it will translate its experiences perfectly between professional cinema theatres, cars, games, headphones, and home theatre as well. The whole thing was envisioned back in 2005 to have maximum compatibility. I told you how my experience about compatibility between 5.1 and stereo was one of the main experiences to come to this whole concept.

If Dolby wants to come to home theatres, first of all, I wonder about which setup they will advise. Because it does not make sense to promote a technology if the difference between object-based and channel-based masters is not even experiential. So how many loudspeakers do you think you need to hear the difference between Auro 11.1 and object-based Atmos?

WSR Reber: I don't know, how many?

Van Baelen: You need at least 20 amplified loudspeakers to have an audible difference because with object based, you need enough amplified loudspeakers to do that. In fact, all object-based solutions end in a channel-based reproduction.

WSR Reber: No one's going to do that in the home (well, maybe a few).

Van Baelen: Yeah, that's the point. Who is going to put in at least that amount of loudspeakers? Additionally, if you would consider that fact, then the Auro 22.1 system, with its three vertical layers, will still produce a much more immersive experience compared to the two layers of Dolby Atmos. With the Datasat AP24 cinema processor, you can do it up to 24 channels. It's much easier and more future proof to follow the Auro-3D growth path than going to other immersive formats for many reasons—in compatibility, in setup, and everything. Plus we have an extra layer, an extra vertical layer, and that's the key. Anyway, we already announced that we would add the object-based functionality

in our format, but it has to be based on a common standard, and we will not change the concept of our loudspeaker layout being backwards compatible with the main 5.1 standard specs. The only thing we will have to add is a separate loudspeaker between the first surround loudspeaker and the side screen channels. Only that loudspeaker has to be directed to the center of the room.

A lot of people don't understand it, but if you are thoroughly understanding how the vertical stereo field works, human beings are most sensitive for sounds coming from the ear level up to about 40 degrees high. And why? Because in earlier times that is where your enemies were sitting. And we are very, very sensitive for those 3D reflections between those angles. The speed of our brain with respect to audio is enormous. The audio sense in our human body is the most developed sense we have—much more than the visual part.

To give you an idea about the speed of our aural system; when we hear a sound, the speed going from the left or right ear to our cortex, that's only about four to five microseconds, so that means only four to five millionth of a second. Five microseconds is the same wavelength as a 200 kHz sample and this explains why we hear spatial differences up to 200 kHz. That's the reason why we don't hear a difference in the sound of a 96 kHz or 192 kHz mono track as well. Although in stereo, when there is spatial information between both tracks, you immediately can experience the difference. Of course, there's no spatial information in a mono track for our brain to detect it. We are so sensitive about that information. And it's all horizontally located; we don't have an ear on the top of our head so we cannot hear the time differences vertically as we do so horizontally. Locating sounds happens mainly based on three items: volume (the air pressure comes louder from one side than the other), the time difference between left and right (for generations, we thought that's the most important thing) but recent research has shown all the head-related transfer functions are key for our brain as well in analyzing the surrounding sound field in a true 3D space around us. We don't need visual information; our two

ears alone are capable to locate sounds in the hemisphere. But even with a million loudspeakers around us, we will not be able to re-create natural sound. The art is doing so with the minimum amount of loudspeakers to get the maximum immersive and natural effect, and that's what the Auro-3D format is all about.

Because after a certain amount of channels, each channel extra is creating issues as well. So the key is to understand how to minimize without touching the key elements. That vertical stereo field, as defined in all the Auro-3D loudspeaker layouts, between the lower and height layer, allows us to re-create the most important reflections. This is what I miss in the competitive immersive formats using object-based technology because they should be able to re-create the earlier reflections around the sources for every object, but for which you need a vertical stereo field in front and on the sides (not with something above the audience that's working different and unnatural, since in nature there are almost no reflections coming from above).

The three-layer system that the Auro-3D cinematic formats have is, first of all, the minimum amount of vertical layers you need for a large room. In a small home cinema room, you can even do it with two layers, like defined by the Auro 9.1 setup. It's perfect for small home theatres, but the moment when you're going to a big home theatre, let's say more than one row of seats, then you need Auro 11.1 or Auro 13.1 (this last one is based on the 7.1 standard instead of the 5.1).

WSR Reber: Our readers need to have you help them with taking their 7.1 system and making it a 9.1 Auro.

Van Baelen: It's so easy.

WSR Reber: That's what they need to know. For example, I'm using all Magneplan planar magnetic loudspeakers in my main reference system.

Van Baelen: That's fantastic.

WSR Reber: That's the loudspeaker technology I prefer. It's very fast. They are totally phase coherent all the way through; it's just the best.



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Van Baelen: Well, if you have the height level, you will see...

WSR Reber: But they're all line source, they're six-and-a-half-foot-high tall, line source planar magnetics, and they go down to 25 Hz with ribbon tweeters.

Van Baelen: That's good, wow.

WSR Reber: There are two full-range loudspeakers and four near-full-range loudspeakers, plus a tri-center array—all Magneplans. But I haven't implemented any height channels yet.

Van Baelen: But you do not have to use the same technology for your height channels.

WSR Reber: I am planning to use BG Corporation planar magnetic drivers because they're flat and they're easily put into a ceiling, and are the same technology concept as the Magneplans.

Van Baelen: You can do that, yes.

WSR Reber: Do you know Stephen Smyth from Ireland

Van Baelen: Yes, of course.

WSR Reber: Stephen developed the DTS Codec. Stephen, after he left DTS developed an immersive...

Van Baelen: Virtual Headphone System. I have that.

WSR Reber: I love that system and I've been personalized in various dubbing stages. They will do 16 channels if you stack two boxes together.

Van Baelen: We already tested that three years ago, together with them, and we've developed in the meantime our own technology. We have both. You can do it with that system, combining both, but we have a new technology, but I think we do not have to go in that technical detail now.

WSR Reber: Another time.

Van Baelen: That's another three hours.

WSR Reber: Well, the reason I brought that up is I'm writing a feature article on 25 audiophile headphones that I'm listening to through the Realiser A8 Virtual Surround System, and other two-channel and surround music sources, with the Magneplan system as the reference.

Van Baelen: With the Virtual Surround System I started to understand how sensitive we are to sound. Our audio sense is the first sense we develop in life, happening even about four to five months before we are born. I started to understand more and more of the

power of our subconscious and particularly how our hearing system is probably the most developed sense that human beings have.

WSR Reber: I've always maintained that the audio experience of a movie is the most critical. That's what really connects you emotionally to the movie. I always say it's like 80 percent. We did research with Tate Audio in which Oxford University did a study, and what they determined was that around 80 percent was the audio part of the movie experience.

Van Baelen: George Lucas famously stated that sound was at least 50 percent of the movie experience.

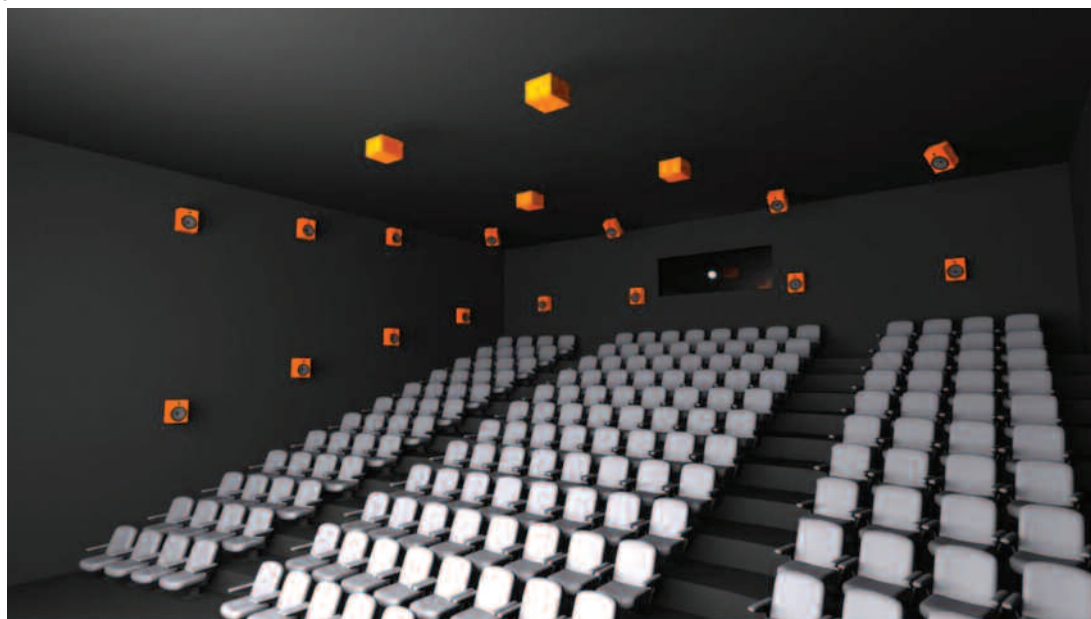
WSR Reber: But George Lucas hired Tomlinson Holman to create THX, and Holman was totally anti-aggressive surround. He said all the sound should be at the screen and that if you put anything back here, it's distracting. And I had arguments in the magazine dating way back, including a special edition I published on THX. I was always criticizing THX because that was their philosophy. I said, no, you want to create a three-dimensional holosonic and spherical surround experience so that the perception of the picture will be three-dimensional.

Van Baelen: A comment that I very often receive is "Auro-3D is what surround sound was meant to be."

WSR Reber: Exactly.

Van Baelen: Why did nobody think about adding the third dimension in the way that Auro-3D brought it to the market? I made the same mistake before, I was working in surround formats believing that was true 3D sound the entire time, because for more than 20 years,

surround sound formats were promoted as 3D sound formats, and of course that's what you believe if you don't know any better. I never thought that putting loudspeakers up there would make such a big difference in our audio experience. I didn't see that I was missing a dimension, and suddenly in 2005, only in 2005, my eyes opened and it was like, Wow, we are missing a dimension, and that was an amazing shock... I think that was the major thing I achieved; to realize that exact thing and then to come up with a concept to bring that extra dimension and its related experience into the market. I'm certainly not the first guy who was trying to put things up there. But coming with a total concept for all markets and a solution that is both efficient and possible, that's is what I saw as a next step for the audio industry and for which I designed the Auro-3D format. But I wanted to be careful as well because if you see the amount of channels added in history, for instance, from 1870 mono to the 1930's stereo; it took 60 years to add just one channel. Then from stereo to surround, which was an additional four channels—that took at least 40 years as well. Again, more than 20 years between 5.1 and 7.1—that's like one channel every 10 years. So when I came up with ideas like Auro 10.1, I thought that it



would take time to convince the world again to add those extra channels. But when people see that this is not just about adding a few loudspeakers in a two-dimensional setup, but adding a complete new dimension, that makes the difference. Some people think that adding more channels is better. That's not true. Even with a million loudspeakers around us, we will not be able to reproduce natural sound. The art is to do it with the least amount of channels as possible because every channel extra creates phase issues, creates workflow issues in the delivery format, and all sorts of things. And that's what a lot of people like about the Auro-3D format because it is the most efficient true 3D audio format. The moment when you're going to add channels above a certain amount, you are always going to have a lower sweet spot experience. You have to be very careful what you do with it. Even when using object based as well... That's the reason I think that our Auro 22.1 system is the ideal combination of both because it is using the object-based technol-

ogy while keeping the backwards compatibility within the existing main surround standards, and moreover, keeping the sweet spot very large. All this with more creative possibilities to locate sounds around the audience and without suffering from typical physical issues like the SPL drop, related to the distance, which we unfortunately experience with full object-based systems in large theatres.

I know a few engineers who already mixed Atmos films, and when they were not sitting in the sweet spot at a premiere, but for instance sitting somewhere more close to the walls, commented that they were surprised, as they almost didn't recognize their mix anymore. That's the problem, and it is something you never experience with Auro-3D because it enlarges the sweet spot.

Even if you work in a full object-based system combined with Auro-3D's unique three-layered system, the difference when comparing it to our dedicated Auro 11.1 system mix is mainly not that big.. Most of the sounds, which are moving from the screen

into the side walls, typically move with a speed into the theatre. And your brain doesn't catch so much detail if something passes by so fast. The moment when it goes too slow, it will make a bigger difference, but that can catch your attention again. However, typically filmmakers are very cautious with such sound effects because they are afraid to lose the audience's attention from the storytelling on the screen. Very often when things are coming from the screen with speed in it, you do not hear the difference between object based and channel based. And what about specific objects in one loudspeaker on the sides; for some people sitting in the theatre that sound will be behind them, whilst for other people sitting more to the back that sound is in front of them. So that creates a different experience, depending where you sit in the theatre. This is very often the thing that filmmakers don't want, because they hope to give people the same experience or try to do this as much as possible. Therefore, I believe that this zone approach that the Auro-3D format is using,





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which starts with our Auro 11.1, is the most efficient solution for immersive sound in cinema theatres.

WSR Reber: How does the DTS 11.1 system compare...

Van Baelen: In fact, it's the same. Their 11.1 is the 7.1 plus four. We have that format as well, because it is integrated in our Auro 13.1 format (7+5+1) but with an additional third layer.

WSR Reber: So the DTS 11.1 system is the Auro system?

Van Baelen: No, the Auro 11.1 has three vertical layers, while the DTS 11.1 has only two vertical layers. Even when the third layer cannot be installed, our Auro-Codec Decoder will distribute the sound of the top channel over the height layer, as defined in the metadata.

WSR Reber: Does that work good like that?

Van Baelen: Yes that works very well. We have, in fact, an option for both loudspeaker layouts, and in our Auro-Codec both are supported as well.

The key for immersive sound is having this vertical spread in the layers. That's much more important than the horizontal perfection of the placement, having that natural spread around is the main idea. That's what immersion is about. It's not related to channel-based or other object-based technology, it's related to the natural spread around us, both horizontally and vertically.

WSR Reber: Well that demo today at the South Point Casino was great. That was extraordinary.

Van Baelen: Thank you. I launched the Auro-3D format in 2006. You cannot believe how many people and companies were inspired by that concept. Many companies copied those ideas of easy backwards-compatible loudspeaker setups and started to build their own technology around it. The only guy who was not influenced by me was Kimio Hamasaki. His 22.2 system from NHK came to the market the same year as Auro-3D. I didn't know anything about the existence of their tests and format. In some ways, both formats have compatibilities, in certain ways not.

In 2006 I launched the Auro-3D format at the Audio Engineering Society Convention in both San Francisco and Paris, and the reaction from everybody was the same; "Wow, ten channels, how are you going to put this in the market?" or like, "Okay, what are you going to do now?" People are not going to install ten loudspeakers at home to listen to MP3-quality compressed, so it has to be lossless. Lossless compression, everything is limited to eight channels. HDMI and so many things to consider, so I thought, "How can I do that?"

WSR Reber: How can you do it?

Van Baelen: I developed a technology, a concept, but I didn't develop the code specifically because very specialized engineers did write the Auro-3D Codec. The patent under the name of Guido Van den Berghe and myself was granted in 2010. That technology allows you to mix the height channels into the lower channels, like you do a normal downmix, but the Auro-Codec Decoder can reveal out of that mixed signal all the original tracks. It is not just a matrix, because that doesn't work. To create an artistically controlled downmix, engineers have to offset some volumes here and there. If there is a lot of reflection above and you bring it in your down layer, your down layer will be too wet, or if you have a lot of dry sound, you have to make that creative process to down mix yourself. That's what our technology allows in order to create a perfect 5.1 master.

Typically that 5.1 is even balanced out better than a normal 5.1 mix, when you start from an Auro-3D mix. A lot of mixing engineers didn't believe that up till the moment they experienced that by themselves. That's typically better because engineers make slightly different decisions if they start in a full 3D audio environment (which typically works better for the 5.1 downmix as well). The moment when you're going down to a 2D-level, two-dimensional surround level, then you have to downmix that. Normally, if you mix PCM in PCM in lesser channels, you cannot go back to the original. The technology we developed allows us to go back to the original without any loss of audible quality.

WSR Reber: Wow, so you can restore...

Van Baelen: Exactly, yes. So what you heard today...

WSR Reber: But you still have to put the loudspeakers in and you still have to get the...

Robert McKinley, Datasat: The same delivery system.

WSR Reber: Yeah, that's an important key.

Van Baelen: So this technology allows you to even put an Auro 11.1 or Auro 13.1 master on a standard Blu-ray Disc™. People at home, they do not have to change their existing Blu-ray Disc player. Of course, they have to add the height channel loudspeakers and they need a device with the Auro-Codec Decoder—like Datasat's for instance—that can decode that signal. The Auro-encoded 5.1 stream is just a normal 5.1 PCM stream, which may be even lossless compressed. So if you play it back without having an Auro-3D device with the Auro-Codec Decoder, it sounds exactly the same as the normal 5.1 PCM. If you have the Auro-Codec Decoder inside one of the devices,

then the Auro-Codec Decoder immediately recognizes that audio stream and it reveals that 5.1 PCM stream out of the original Auro-3D master.

WSR Reber: All right, now, let's bring Datasat into this. Are you the first now to be licensed for cinemas? Please introduce yourself.

Ciarán Doran, Datasat: I'm the Chief Executive Officer at Datasat Group. Datasat Digital Entertainment is a partner with Auro Technologies and with Barco to help Auro and Barco bring—I think it's described as Auro 11.1 by Barco—to the professional cinema market. Barco, quite honestly, is the owner of the license.

And Datasat is a technology partner with Barco in order to help them bring a product to market, which decodes and upmixes the Auro technology. We worked with Barco to introduce the Datasat AP24 18 months ago.

McKinley: Correct, AP24-3D processor.

Doran: Do you want to talk a little more to that because you're more...

McKinley: Sure, my name is Robert McKinley. I'm the Chief Operating Officer for Datasat Digital Entertainment in the United States. Barco came to us about two years ago and wanted to develop a box that was capable of producing the channel count and feature set that was needed to accurately produce Auro 11.1 in the professional cinema market. We worked with them and developed certain software aspects of our unit, being a very full-featured box, to accommodate a circuit card that would be inside to do the upmix technology and also handled the decoding as well. The decoding was originally going live in the media blocks and it does—I'm assuming that's still correct—and we also needed to have a decoder inside our unit itself. Barco chose us to partner with in order to bring that audio processor to market, and we did that in a period of a little bit less than a year. We've got a little over 200 units in the field right now, with more units being put in every day.

Doran: And that's based on the AP20, which has been selling for what, the last four years?

McKinley: Four years, which is our own branded 16-channel digital cinema processor.

Van Baelen: The nice thing is, if they put the loudspeakers up, they at least need the cinema processor on all the channels to EQ and calibrate all, so that's the reason why already they need new technology. The reason why the decoder is in that device as well has to do with the fact, if alternative content is going to be produced in Auro, like operas and similar things like that, then they are not passing the media block. Then they are passing this technology and they are decod-

ing. But the moment when a film comes out, typically the decoding is done in the media block. The reason why is because of watermarking. The film industry wants to have watermarked content. You know about watermarking?

WSR Reber: Yeah, a copy protection technology.

Van Baelen: People don't always know this, but if you have an iPhone and you record one minute of audio in the theatre, they can find out in exactly which theatre you were sitting and which minute you recorded. It's just about copy protection.

What we do is first decode it in the media block and then watermark it. We are the only DCI-compliant solution in the market that has all sounds and channels watermarked. In object-based systems, the objects are typically not watermarked, only the channels are watermarked. The nice thing about having the Aero-Codex Decoder inside of the AP24 is if you want to play a Blu-ray or alternative content, then at least you have that solution as well. Plus there is something else we developed; a groundbreaking up-mixing technology called Aero-Matic®, which makes a 3D audio experience from each mono, stereo, or 5.1 recording. This is the most advanced and most natural up-mixing technology. What does it mean? You play back a stereo recording that you have at home and the up-mixer is bringing that 3D field around that stereo format. If you hear it, you will be utterly surprised because it does not change the artistic intentions made by the creative people. Being a producer myself, I'm very sensitive of technology that is changing my creative intentions. If I put a pop singer dry into the recording, I do not want up-mixing engines suddenly add reverb that wasn't in the recording originally. Or I do not want, like many other up-mixing engines do, the spectrum changed, which means the up-mixed version should not sound brighter or have other colors than the original version... If you hear Aero-Matic, it's a very natural translation of the original recording in true 3D. It is so good that most people don't believe it is achieved by only using our Aero-Matic algorithm. They usually think we remixed or remastered it. So we ask people to bring their own content with them so we can play it over the Aero-Matic to prove it is for real. Even going from Mono to 9.1, you won't believe your ears because it sounds so natural.

WSR Reber: I've got to hear that. Is that in your processor?

Van Baelen: Yes.

WSR Reber: For my two-channel music, I use the Fosgate Audionics FAP-V1 Surround processor-preamplifier designed and engineered by Jim Fosgate. This is a 100 percent tube, 7.1 processor using Fosgate's signature expression of Dolby Pro Logic II. I play all my two-channel music through the FAP-V1, and it's fantastic when heard in 7.1. I love it. But this sounds even more...

Van Baelen: I'll tell you; once you listen to your stereo music through our Aero-Matic, you are not going to want to put it back to the original anymore—but keep listening to

the up-mixed version because it creates that immersive feeling around you, which is giving you a higher emotional experience as well.

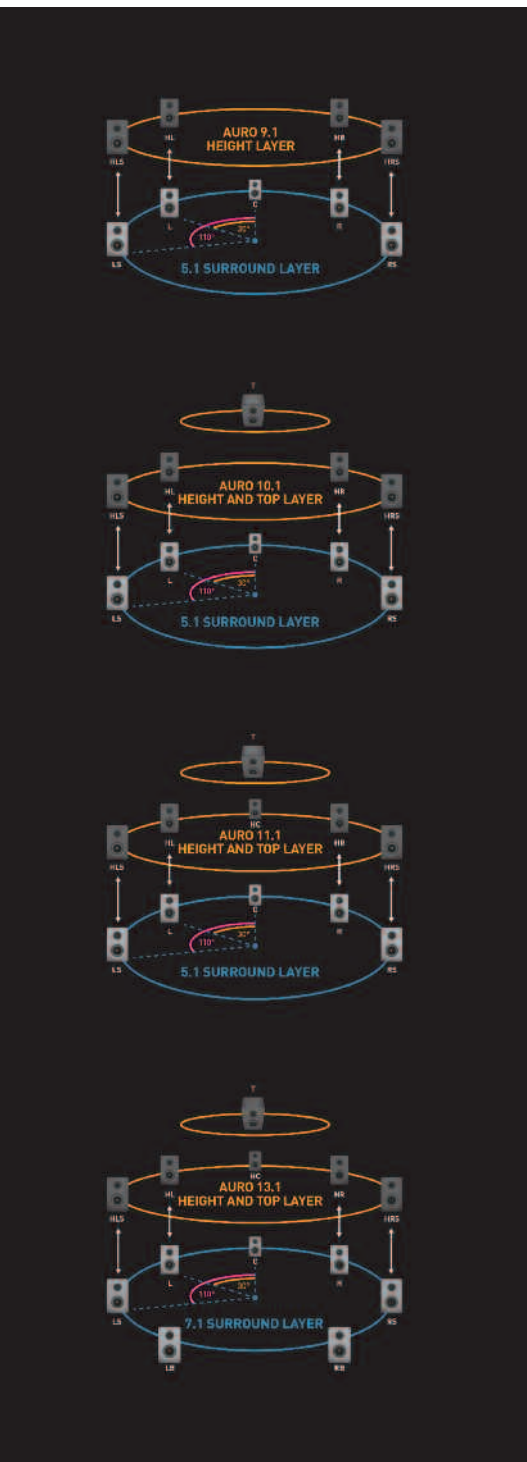
WSR Reber: The first time I heard about Aero-3D was through the company StormAudio™.

Van Baelen: We have an integrated 3D sound processor as well, which we developed together with StormAudio but exclusively distributed via Aero Technologies and its partners. It's called the Aero-3D Auriga™. We also developed two more devices together with Datasat; the Aero-3D Crux™ and Aero-3D Mensa™. The names of all the Aero-3D devices are inspired by star constellations. You know, with Galaxy Studios and all of the history, I feel a strong connection with "space" and "galaxy." The top model of the Aero-3D range of sound processors is the Aero-3D Mensa, whilst at the opposite of the range you have the Aero-3D Crux. The Aero-3D Auriga, as opposed to the Crux and the Mensa, has the amplification on board. It has 16 output channels in total, of which 13 channels are amplified, each 200 watts of top-quality amplification. This amount allows for a very good quality amplification of an Aero 13.1 setup, which is similar to the Aero 11.1 cinematic setup but based on 7.1 surround instead of 5.1 surround. This means that consumers can play back all their 5.1 and 7.1 content following the surround standard.

WSR Reber: When you say amplified inside, you mean the amplification for the loudspeakers?

Doran: They're Class D amplifiers. Let me go back to your question a moment ago. Is Datasat the only company doing this? Yes and no. We're not the only company licensed by Aero Technologies. We signed a license agreement...let me rewind before that. One of the reasons that we've been able to work closely with Barco is because Datasat's history is DTS Digital Cinema. We are DTS Digital Cinema; we're the cinema division of what was formerly DTS. We've got more than 20 years experience in the cinema surround sound market, with more than 30,000 units and cinemas around the world, so there's a good history and a good pedigree there with the company. So Aero-3D and immersive sound is probably the most exciting thing that's happened in the last 15 years in Surround sound for cinema, whether it's for home or commercial cinema.

It was fairly natural that Barco should start talking to us about how we can help them bring a product to market with the encoding, the decoding, and the up-mixing engines for Aero Technologies. I came aboard about 10 months ago and found that that product was on the market, there was a relationship there





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with Barco, there was also a relationship there with Wilfried and the team, and it struck me very sensibly that the home cinema market is looking for something exciting as well. It was only within a matter of months that we signed an agreement with Auro Technologies to license their technology for our already high-end, luxury home cinema processors, and we've got one on the market called RS20i [reviewed in Issue 183, January 2014]. It retails a little under the \$20,000 mark. And we've just introduced one last month called the Luxury Series LS10, which is at a different price point—a little bit lower down, it's got a different feature set. But all our processors now will include Auro-3D Engine, which includes decoding and the groundbreaking Auro-Matic up-mixing technology for the home market. We were at ISE in January and it was quite something.

WSR Reber: With respect to implementation in the home theatre market, one of the complications is that there's the Ti, or Texas Instruments, implementation, and then there's the Sharks. They represent different implementations. Many manufacturers have had problems over the years when they're trying to implement different surround technologies because some were using TI and they're stuck in that platform, and the others were using a different platform and they were stuck there, and one platform could do certain things and the other one couldn't because of that, so where is Auro-3D? Is the Auro-3D technology going to be on all of these different platforms?

Van Baelen: We have more than 50 people working with Auro Technologies at the moment, about 35 in the R&D Department, and a part of them are busy with the implementation on different platforms for different markets, like for instance, the automotive market. The first cars are coming out next year; German cars with Auro-3D inside having the height loudspeakers installed in the car, and it's amazing. You will not drive a car without this after you have experienced this.

Doran: Your car is an entertainment system.

Van Baelen: Yes, it's really a new driving experience, so much more relaxing as well, because the Auro-3D system has a relaxing effect on our brain, which is very helpful in these days of stressful traffic.

WSR Reber: So, then, this is really encouraging because I'm a super advocate for surround music, so that's where the technology will be extremely important.

Doran: In terms of music, yeah. Remember what I was talking about earlier about object-based sound for cinema versus an Auro-3D system, which is actually a recording format in true 3D, while object-based systems are not a recording format.

WSR Reber: Yes, Auro-3D can be a recording format for true 3D audio.

Doran: I was explaining to Gary about the difference between, object based is one thing for being able to position sounds in one place in case you have many amplified loudspeakers, but in terms of an immersive system, Auro-3D strikes me much more as a recording format also.

Van Baelen: You have to understand that a lot of people don't understand what it means when you say object based versus channel based. In fact, object based is only a new delivery system. It's in fact the wrong wording, and we have to be very careful. Auro-3D is supporting object-based technology as well. We already have object-based technology in our Creative Tool Suite to allow mixing in both concepts (channel and object based) simultaneously to simplify the workflow. But up to Auro 13.1, we do not use object-based as a delivery system. We keep it channel-based because up to an amount of 15 channels, Auro-3D has much more advantages compared to object-based systems, which only makes sense if you have at least 20 amplified channels. That amount is not realistic for home cinema application in my opinion. What you can achieve with the Auro-3D's unique three-layered system, with a setup between 10 to 14 channels, is much more immersive compared to object-based technology with only two channels and having up to 20 amplified channels. The way that the vertical spread of sound around the listener is like with Auro-3D's unique height layer is much more determining to get an immersive sound compared to the difference of using object- or channel-based technology.

WSR Reber: So immersive sound is not related to a technology like channel or object based but to the vertical spread of sound?

Van Baelen: Exactly. When we came in 2010 to the market with the name "Immersive Sound," it was because we wanted to have a new wording for a true three-dimensional sound reproduction based on a loudspeaker setup that is using the x,y,z axis, to create a hemisphere of sound around the listener.

That addition of the missing third dimension in sound is what immersive sound means. The different technologies used to achieve the distribution of that format have nothing to do with it. I know that companies like to sell their technology and claim that using object-based technology does make it more real or more natural, but that's not always the case, like I already explained before. Our vision is to first add the third dimension with channel-based solutions, and the step after that, let's say from more than 20 amplified channels, is that we will use object-based technology as well, but not in the same way as Dolby Atmos is doing because we don't want to

give up backwards compatibility and we don't want to have the same issues as they do with regards to having a smaller sweet spot. Anyway, at the end of the year, when the new delivery standard is coming out, as defined by the SMPTE standard, it will allow everybody to implement that standard into tools and hardware.

We have already implemented the MDA object-based technology in our Auro-3D creative tools and it's all software based. Unlike Dolby, they need hardware to do that. We can do everything in software. So this means I can run the whole object-based software from my laptop; I don't need any other hardware.

Our Auro-3D Creative Tool Suite is really fantastic and the most easy tool suite to create three-dimensional mixes, not only for film but for music productions as well.

The question is, does it make sense to use object-based technology in music productions? Lots of engineers start to understand now how big the impact is on the whole workflow with Dolby Atmos, even up until the distribution. There is something else as well; if you want to record native sound in 3D, you cannot do that with object-based technology.

Doran: That's what I was meaning by Auro is a recording format. Dolby Atmos is object based, it's not a recording format.

Van Baelen: That's correct. Object-based technology is an artificial way to re-create a three-dimensional sound since it can not reproduce the natural billions of reflections around the sources, which are key to achieve a natural reproduction.

WSR Reber: So for motion picture sound effects, for atmospherics and things like that, they could actually record it in Auro-3D but not in Dolby Atmos.

Van Baelen: Exactly, you cannot record in "object based." If you are going to put ten microphones in a city scene, you cannot say, "I want to have that car or that bus as a completely separate object with all the reflections revealed out of that scene." You cannot isolate that sound, including all the reflections around it in a 3D soundfield. That's what I miss in object-based systems too. Typically, they start from mono and stereo sounds and they put it around in the room. But the most important sounds to achieve a true reproduction of a natural experience are the reflections. If you record an airplane outside, for instance, with an Auro-3D microphone rig, which has 10 to maximum 12 channels, then you should try to listen to every channel separately, as well as each of the three layers separately. One of the most renowned sound designers on the planet is Richard King. He did recordings of airplanes flying over for the Dreamworks Animation movie

Turbo. He told me afterwards how surprised he was to hear so much information and reflections coming back from the tarmac that are important for our brain to better localize that airplane flying over. So if you would cut the lower layer and just listen to the height and top layers only, the definition or localization of where that airplane is much less because you are missing the ear-level reflections, which cannot be re-created. Object-based technology cannot re-create those reflections of the objects. So if you only have a stereo sound flying over in the top or overhead channels, of course you hear the fly-over, but you are not immersed at all. If you put the Auro-3D's unique height channels on, you would notice there's already much more space coming around you and that it starts to sound much more natural already. When you would finally put the lower channels on, suddenly it feels like you're standing there. All these reflections are so important for our brain. Those experiments also taught me that the overhead/top channels located in the ceiling above the listener are not the most important ones to achieve the reproduction of a natural soundfield. In 2005 I already did so many tests, and so many times I was surprised to hear the results and to find out that the vertical stereo field between ear-level and about up to a 40-degree elevation is key to getting that immersive effect, because most of the 3D reflections are located in that field and not above us. There is a paper from a German professor describing that there are reflections coming from above, not only outside but as well in rooms. Additionally, human beings are less sensitive for sounds coming from above. For that reason, the Auro-3D loudspeaker layout is first having a height layer around the audience before adding the final top layer. In music, I don't see the usage of that top layer at all, except for some special effects. It already sounds so much more natural and immersive by only adding Auro-3D's unique height layer.

WSR Reber: Wow, that's incredible. Music surround is something I've advocated for so many years. I was so disappointed when the music industry dropped surround recordings.

McKinley: Gary is very good friends with the founder and conductor of the Las Vegas Philharmonic Orchestra.

WSR Reber: Hal Weller is my grade school best friend for life, and he's the founder of the Philharmonic here in Las Vegas and the conductor. He just retired last year. Now he has the Foundation To Assist Young Musicians, especially disadvantaged young children, to teach them classical music instruments. It's great, I just contributed yesterday 200 classical CDs from

Telarc. I'm really good friends as well with Jack Renner and Michael Bishop, both previously at Telarc.

Van Baelen: They do really amazing recordings.

WSR Reber: I've been to various recording sessions with Jack and Michael, and their surround recordings are wonderful.

Van Baelen: I'll tell you something; the biggest classical event on the planet is the New Year's concert in Vienna. Have you heard of it? Fifty-million people watch that concert live every year on the 1st of January. That's been recorded in Auro-3D four years in a row already.

WSR Reber: Morris Kessler, the founder of Amplifier Technologies Incorporated (ATI), is a good friend. Theta Digital is upgrading my Cassablanca Music and Cinema Controller to the Cassablanca IV. He doesn't have Auro in that yet.

Van Baelen: No, because it's a TI platform. At this moment our library is not yet available on TI processors.

WSR Reber: When is that going to be implemented? I'm putting in his new Signature 6000 Series amplifiers, because I want to implement the height channels using BG Corp's R18i planar ribbon loudspeakers.

McKinley: We need a conversation then to get you Auro-3D somehow.

WSR Reber: We need to review Datasat with Auro-3D processing.

Doran: Well, you know that we've got the upgrade card for the processor that you reviewed. That's one step.

WSR Reber: Doug Blackburn, our technical reviewer, did a really good job.

Doran: The product that we launched in January, the Luxury Series Processor, which is having the Auro-3D Engine on board, you haven't even seen that yet. As soon as we get that off the production line, because it's now in production, that would be the one that we could review and you could play with that and see how it sounds in your home theatre.

McKinley: You should try that out, absolutely.

Van Baelen: We were at GDC—the Game Developers Conference is the biggest conference on gaming. We had a meeting suite there with a demo setup, an amazing success again. Audiokinetic, a leading company in audio engines for games, has chosen to implement our Auro-3D technology in their audio middleware solution Wwise® because it is the most efficient true 3D technology on the market. A game in Auro-3D would really be an awesome new gaming experience.

And then our technology becomes very powerful because what happens is you can experience that over headphones as well

using our Auro-HeadPhones algorithm. But if you have an Auro-3D sound processor, which has the Auro-Codec Decoder on board, what happens is the game in 3D sound is encoding to a surround format, like 5.1, and going through the HDMI interface and then decoding in the A/V Receiver. Our technology is developed in such a way that this process is so fast that no latency can be felt when playing such a game... In fact, theoretically, the Auro-Codec Decoder only needs two samples for two channels; it goes that fast.

WSR Reber: But how does it work with the different loudspeaker layouts you have in the Auro-3D format?

Van Baelen: The sound processor with our Auro-3D technology recognizes which loudspeaker layout is active (between Auro 8.0 up to Auro 13.1) and will automatically render the Auro-3D signal over the available loudspeaker layout. That's the power of the Auro-3D format; we are not only fully backwards compatible with the existing surround standard but between the different Auro-3D loudspeaker layouts as well. The reason why we have different layouts is related to the size and capabilities of each room.

Additionally, not only are our loudspeaker layouts backwards compatible but our Auro-Codec allows full compatibility with the existing carrier formats too, meaning that people don't have to buy a new Blu-ray Disc player. This will be again a difference when going to object-based formats, which will require a new Blu-ray Disc player.





ON SCREEN

WSR Reber: Wow. That is a lot of information that we should discuss at another time. I am kind of just stunned, it's incredible.

Van Baelen: To say where we are now in each industry, let me summarize. First of all, in the film industry we have worldwide now almost 500 professional cinema theatres already installed, or confirmed to install the Auro 11.1 by Barco at the end of this year.

WSR Reber: What about the actual production of motion pictures, what's going to happen there? Because you've got Dolby on one end, right, with Atmos. Are they all going to be in Auro-3D as well?

Van Baelen: Yes, of course, step by step there are more requests coming from the theatres now to have Auro-3D content.

WSR Reber: Now what about the studios releasing...

Van Baelen: Skywalker Sound was leading and installed their first Auro-3D Studio System two years ago. Recently they installed their second system. DubStage in Burbank was Hollywood's first independent studio going for the Auro-3D Studio System. Fox Studios has installed two Auro-3D Studio Systems as well. Warner Bros has one installed. Sony Studios' Holden Stage is installed. We are working on other studios as well, which will be announced soon. In total we will have more than 35 leading post-production studios worldwide with a certified Auro-3D Studio System by the end of this year.

In automotive, we already have a few main brands signed up. As you know, the big company Continental, known for its tires but a worldwide leading company in electronics for cars, have signed a contract with us to implement the Auro-3D system in cars.

WSR Reber: I see this is where surround music can come back because a lot of people listen to music in their cars. That's the only time they have, and I'm hoping this is going to revive the music industry again.

Van Baelen: Major labels are getting interested in remixing their music in the Auro-3D format. The Pure Audio Blu-ray format is the ideal format for Auro 9.1 releases. That's the most immersive format for music because Auro 10.1, with the channel in the ceiling, doesn't make so much sense for music. But the lower 5.1 surround layer combined with Auro-3D's unique height layer are key to this totally new music experience.

WSR Reber: Then we can record that in Auro-3D.

Van Baelen: Yes, but not only music is related to original Auro-3D recordings. It doesn't matter, we already did, for instance, dance music and other remixes as well without being recorded in the Auro-3D format. You cannot believe what you can do at the creative end, having these four extra height channels around the listener.

TC Electronics has already integrated Auro-3D in their newest upgrade of the TC 6000. There are a lot of software people busy with ideas around the Auro-3D format.

WSR Reber: Do you think the labels will actually go back and the groups will go back to recording in surround? Do you think that's going to happen?

Van Baelen: All; they all do. Once they heard it, they all do.

Many artists and engineers said to me after hearing the Auro 9.1 format, "That's the way music should sound. In fact, Auro-3D is what surround sound was meant to be like, but it was missing the final third dimension." Nobody could imagine that this was going to

make such a big difference.

Van Baelen: An interesting reason as well is, Gary, that if they remix their content in a format like Auro-3D, record companies can extend their IP rights on their repertoire with probably another 25 years.

Doran: All of those primary markets are movie, gaming, automotive, and what about broadcast?

Van Baelen: I believe that Auro 9.1 will be the next big thing to happen in audio for the broadcast market. I believe that the Auro 9.1 format is probably the next big standard after the 5.1 Surround formats because it is a very natural step and it creates that true 3D audio experience with a minimum amount of channels.

WSR Reber: That whole Barco experience today, I called it "Cinerama on Steroids," with that wrap-around screen. And once they get rid of those little black columns, which I'm sure they will eventually do, it will just be a seamless hemisphere of picture and then that Auro-3D sound. It will be incredible.

Doran: And they've got a hemisphere of image as well.

WSR Reber: It's a 180-degree image.

WSR Reber: It was really impressive. As a side note, like I said, I used to produce music video concert specials, which were released on HBO, PBS, and on video tape and optical disc. I'm a big jazz fan—big band jazz, jazz orchestras. Stan Kenton, etc. I produced and recorded Buddy Rich's last project, which was released on television, LaserDisc, DVD, CD, and vinyl. I've got this project I want to produce with Gordon Goodwin's Big Phat Band, which is a 19-piece jazz orchestra with 13 Grammy nominations and four Grammy Awards, they're all L.A. based. The greatest studio musicians in the world are in this band. This is the hottest band. All the kids love the Big Phat Band, and Alfred Publications produces all his music.

Van Baelen: Where do they record? Where do they make these recordings?

WSR Reber: They record in different studios in L.A. Tommy Vicari mixes. They were the first ones to actually do surround music in jazz. They did four DVD-Audio albums, all in surround 5.1. But now I want to do a live recording with them.

Van Baelen: When?

WSR Reber: Anytime I can get the rest of the money I need. I want to shoot it in 3D and in this incredible Auro-3D sound format. They're so dynamic, so powerful; this band is really hot. I was thinking of shooting in 4K and then converting it into 3D.

Van Baelen: If you can do it in 60 frames per second, you should do.

WSR Reber: That's what I'm thinking but



I... DTS said that they would be a sponsor. Monster will be a sponsor. I'm trying to get enough sponsors together to get the money to do it. If anyone out there has an interest, please contact me.

Van Baelen: You can mix it at our place. Let me see if I can help you with the layout and give you the microphones.

You know, Capitol Records, Al Schmitt's room?

WSR Reber: Al Schmitt's a friend. I know quite a few famous recording engineers, who are all my friends, and who I have written about in *Widescreen Review* as well, as they have participated on our Home Theater Cruises' Technology Conference At Sea™.

Van Baelen: His room is going to be converted in Auro-3D for an impressive event we will do soon. It will be the first time in history that we will do a "remote scoring" in Auro 9.1, which means that the director and composers are in the Capitol Records studio while the orchestra and the conductor are in Galaxy Studios. So six cameras and the Auro 9.1 sound are transmitted in real time. The latency is less than a second and allows interactive communication between the creative people located in Hollywood and the ones located in the heart of Europe at Galaxy Studios (Belgium). Talking about immersive or subconscious experiences; if you hear stereo or you hear surround or you hear Auro-3D, with Auro-3D you yourself would feel much more relaxed. So I was interested why this happened, and this can be measured on our brain. The same thing happens with picture. About ten years ago people started to research that by scanning our brain activity. Perhaps you don't know, but if you start to watch film with 24 frames per second, a few minutes later they can measure that your brain activity is going up, meaning this requires brain processing and is more exhausting compared to a natural audio/visual experience. So the question was, why does this happen only with the reproduction of image and not in daily life, when having our eyes and ears working throughout the whole day. It seems to be that our subconscious brain does not see the 24 frames as a fluid movement but as stereoscopic slices. Our subconscious is so much faster than our conscious. Our conscious brain can handle eight to 12 items per second. Our subconscious brain, however, typically handles about 12-million items per second. The point was; how many frames per second can we see to not experience a difference in our brain between what has been reproduced and what you see in real life. Many tests have shown that above 54 to 56 frames per second, this extra brain activity goes down again. So that's the reason why there is such a difference between

watching 48 frames per second (like with Peter Jackson's *Hobbit*) or if you would see the images by 60 frames per second... Just those 12 frames make a huge difference in our subconscious experience and is the key to get more immersive picture.

WSR Reber: Yeah, absolutely.

Van Baelen: So if you go to 60 frames per second, that's so much more relaxing, immersive. So that's the reason if you go for Auro-3D sound with 60 frames per second picture in 4K... That's the key for the future.

WSR Reber: That's what I'd like to do this project in. I remember Douglas Trumbull in the early days, when I went to see Showscan, it was in 60 frames per second, and I swear, it was like watching 3D. It was so real; it was unbelievable.

Van Baelen: I think 4K, 60 frames per second, is much more important than stereoscopic 3D. At least that's my belief. Of course, 60 frames per second per eye in stereoscopic 3D will create an immersive real-life visual experience but the job of the stereographer becomes even more critical to come as close as possible to the depth of a natural 3D image.

WSR Reber: I love 3D, though.

Do you have any closing thoughts you want to impart to our readers?

Van Baelen: Let me say, I think it's fantastic how we live in the momentum again. You see, what I just told you, going from mono to stereo it took us 60 years, namely from 1870 to 1930. It took another 40 years (that was in the '70s), when this was extended with the second dimension to create a plane around the listener, known as surround sound formats. And now finally after an evolution in audio reproduction of almost 150 years, Auro-3D is finally able to bring for the first time that third and missing dimension to the market with its concept and technology. Perhaps many people don't realize that but the addition of this height dimension is a final step in the evolution of adding dimensions into the sound reproduction. Because the fourth dimension, which is time, is already part of sound... So there is no 4D Audio. That doesn't mean that sound cannot be improved anymore in the way we record and reproduce but from an evolution of recording and reproducing natural sound, Auro-3D made a major leap and is a huge momentum in the history of audio.

WSR Reber: And technological development is so exponential, it is becoming faster and faster.

Van Baelen: People sometimes ask me; "Wilfried, you developed the Auro-3D format in 2005, why did it take so many years to be here now?"

I introduced the Auro-3D concept and listening formats in 2005, but in 2006 I started

with a team of engineers to develop a technology that can bring that new experience to all markets and that took us four years. Then I had to wait for the patents to be granted, which happened in August 2010. Then we decided to go to market and launched the Auro 11.1 format in the first spatial convention in Tokyo in October 2010. Barco became our exclusive partner for the cinema market and they launched Auro 11.1 at Cinemacon convention in 2011. The reactions were great, and Barco began to sell systems worldwide immediately. From the start, I felt a strong worldwide company, such as Barco, was necessary to create the trust that exhibitors needed. My company is too small to put an audio format on the market without partners. Then in May 2011, a major leap forward was when Skywalker Sound, the worldwide number-one post production facility for sound for film, decided to install the Auro-3D Studio System. I remember that it was the first of November 2011, a memorable moment, since George Lucas made a press release that his film *Red Tails* was going to be released in the Auro 11.1 format. It might not have been a big Hollywood film but it was the first Hollywood film, released in Auro 11.1.

Red Tails was the first movie ever with immersive sound using the Auro 11.1 format. I had already done a few parts of movies locally, to do some tests, but not a full big movie, like a Hollywood movie. And Skywalker Sound was the first to embrace the format in 2011. All these things together have caused a move about immersive sound worldwide, standardization groups started to create work groups and Dolby decided to quickly come with their answer to an immersive sound cinema system as well, which became Dolby Atmos, and thus tried to differentiate with what we do.

So, to conclude, I am happy with what I have contributed to the evolution of the reproduction of sound; that is bringing that final and missing dimension, height, to all markets where audio is involved. I'm very happy that I'm part of that whole thing, from its invention to putting it into those markets as well. Bringing this complete new audio experience to the world, knowing that it will bring so many people so much more joy and emotion in their audio/visual experience, gives me a very warm and satisfying feeling. I think it was and still is my mission.

WSR Reber: Thank you, Wilfried, for such an informative and engaging conversation. And thank you, Ciaran and Robert, for your informative contributions as well. This is a wonderful story. **WSR**