

# On Screen With Wilfried Van Baelen

## Auro Technologies

Gary Reber

This On Screen interview took place during CinemaCon at Caesars Palace in Las Vegas this past April.

**Gary Reber, *Widescreen Review*:**

Wilfried, please introduce yourself and share your background.

**Wilfried Van Baelen, Auro**

**Technologies:** I am CEO of two companies—Galaxy Studios and Auro Technologies. Galaxy Studios is located in Mol, Belgium. We also co-produce films—about 10 films every year—through our sister company Mollywood, which I have been CEO of up until last year. Ever since then, my brother Guy took over the CEO function at Mollywood because putting a new audio format to market and as well as having to deal with all the related services and activities needed, Auro Technologies is requiring so much of my attention.

I started my career as a professional musician. I started to play music since the age of eight, beginning with trumpet, and then at 12 I started to play organ and synthesizer. I was doing studio recordings and giving many concerts by the time I was 16 years old. I then went to the Conservatorium, where I won five first prizes including the one for classical pipe organ.

When I was 16 years old I had a request from Philips to record an album; the following year I started to build a studio in my father's empty chicken coop; and at 18 I completed this studio, which was an eight-track analog facility.

I recorded the first albums there, and they sold fantastically worldwide with more than 100,000 albums sold. In the meantime I was also writing the books for organ players. It was mixing between pop and synthesizer on the one side and giving concerts and doing classical work on the other side, always engaged in both activities.

My endeavors as an organist led me to become involved in a German company called Wersi, which specialized in self-built organs. All my organs (seven in total) were built by my brother Guy, who is three years younger, and he used the soldering machine I bought him for his birthday. During this period I was playing on those great sound-

ing organs, which felt like super synthesizers, and was touring mainly in Europe. At that moment I received many requests to produce for other people, whilst it was never my intention to produce soundtracks for others. However, people loved my studio and the sound creation I did as an engineer so much that suddenly after two or three years my work became popular amongst the main producers in Belgium, and the number one hits were just coming one after the other. I started to learn to make arrangements and write scores for orchestral productions. I produced/engineered in total more than 20 platinum awarded albums with international artists.

I eventually went to London to record in the big studios but was surprised to see that there were issues with regards to acoustics, crosstalk, and compatibility—I remember being surprised to see that in London, the Mecca of the industry. And more and more I began to develop an idea of how an ideal complex should be like. And the idea merged that I would need five to seven different acoustical rooms and three to four different technical rooms, but that they should always be in conjunction with one another, depending on the needs, on every single moment in a production.

At one point in a certain pop production you might need to overdub one session with the orchestra, and thanks to the interactive

studios, I could use the Galaxy Hall for just that one session needing overdub whilst everything in the mixing room stays intact. Needing the Hall only for a short moment, the next moment it was ready for the next session if needed.

So it's completely flexible and interactive, both technically and visually.

Having this fantastic plan in mind, I went to the best designers on the planet and they all said the same, namely "this is not possible." They claimed people could never develop such a concept since there's no technology, no building construction that would allow you to look through the window but without hearing anything that is happening on the other side—meaning without such a concept, you are always going to disturb the other productions. So I wanted this 330-square-meters recording room that is 8 meters high, being just one of those isolated rooms, and I wanted to have that in such a way, as well as the ability to record a very quiet instrument, such as a harp, in there whilst on the other side of the window being able to have a rock band playing in a completely different production. So it has to be used simultaneously on different productions without any audible or visual disturbance between one of those 11 rooms.

At that moment, being the year 1991, specialized studio designers simply said to





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## ON SCREEN

me “you can never isolate to such extent between rooms with a visual connection.” So I asked if they could not invent something like this, but the answer was that there are a lot of innovative things to come up with, but changing the laws of physics is not that evident. As this is all about physics, they thought I might not understand, since isolating that low-end energy would be almost impossible through windows. So as I bluntly suggested putting in more windows, they replied that I just did not know enough about physics because the more glasses you would put in between the walls the worse it would be for low frequencies. It would be better for the mid and high frequencies, but even worse for the lower, because if you halve that gap between two glasses, then the air in between (air behaves like a spring) is cut in half and is as such giving less low-frequency isolation.

I eventually came in contact with Eric Desart, Technical Director of the Gerber Group, and Professor Gerrit Vermeir from the University of Leuven. These were the people who really helped me to realize my dream. They told me they believed it to be a very interesting project for them for many reasons, so if we could work out a way to work together, they would support me with all the knowledge they could. As they came back to me three months later, I told them we needed about 11 inventions to realize—one of them being to produce the biggest glass panels ever in the world, 11-centimeter glass. One glass panel would have the weight of more than one ton, and realizing that the whole glass industry at that time was limited to 700-kilogram glass with 8 centimeters thickness, this was the thickest ever produced in Europe.

But I was so lucky that at the end of the '80s there were so many bank holdups that those bank holdups required thicker and thicker and thicker glass panels. And I remember at the time we made the request that there was only one factory in Germany who could produce these glass panels. People from the board of directors from that company asked us “it's about 11-centimeters glass, for which weapon is that?”

You have to understand the construction; there are 11 bunkers and each bunker is, in fact, a concrete bunker standing on metal springs. And the resonant frequency from each bunker is less than 3 Hz. So those bunkers rest only on these metal springs. They do, in fact, measure 2.8 Hz. Due to that whole construction and everything surrounding it, I needed the most silent air conditioning as well. Thus, Galaxy Studios has the quietest recording environment in the world, which was designed by Eric Desart.

We constructed Galaxy Studios in three phases. It took seven years, 16 people, and about 318,000 man-hours to finalize the whole project. It was an amazing project to be part of; it's the most advanced studio complex that you found in the world.

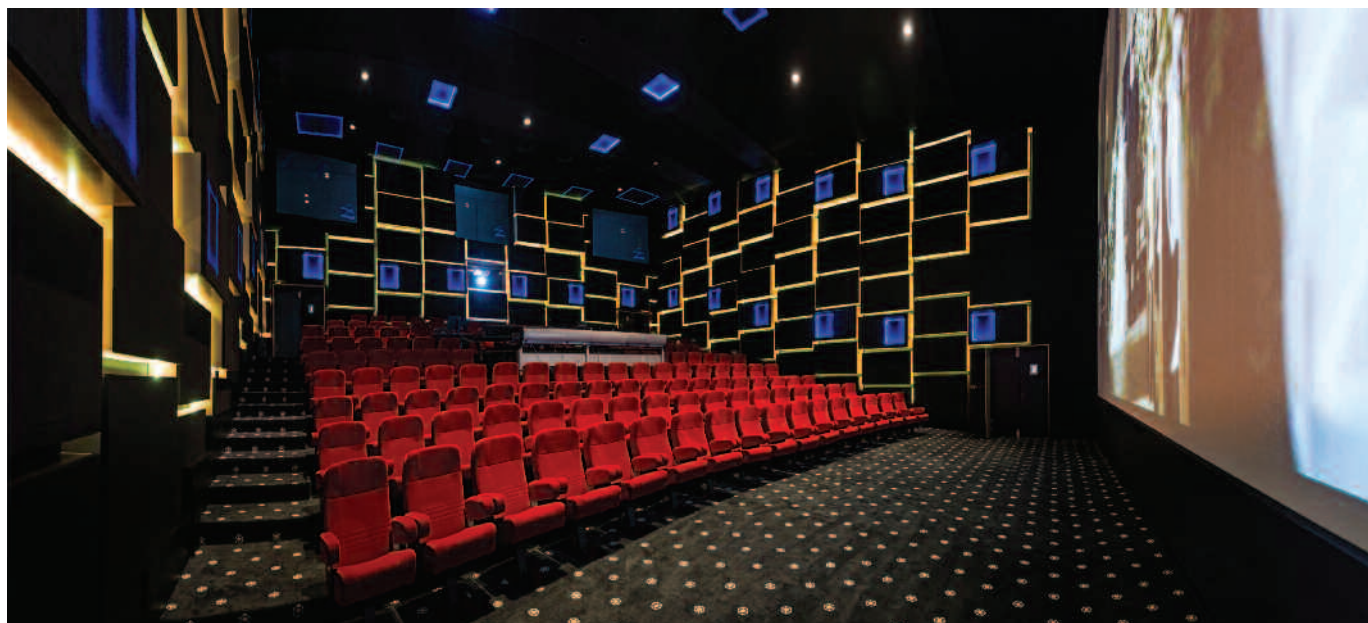
**WSR Reber:** Is this the environment that you used to develop Auro-3D® sound?


**Van Baelen:** Yes, and I'm coming later to that. Acoustics are the most flat linear reproduction that you've ever measured and ideal to analyze the reproduction of each sound system. The isolation between the rooms is more than 100 dB on the full scale. And even the equipment, we aim to have the best equipment available. I was always trying to push the boundaries of the industry to the next level. When the Studios opened in 1995,

I was already thinking ahead and wondered what would be next, maybe Surround sound 5.1 in music?

When I was 18 years old, I heard quadraphonic sound for the first time in my life, and immediately was amazed and thought that this would have to come into the world as soon as possible. And I was hoping after CD was launched that soon after a quadraphonic CD was coming to the market as well, as they did with phonographic vinyl in quad too. But no, it was not coming, until in 1994 I finally heard about a new format coming that was having 5.1 capability, being the DVD. I figured that this would be the moment; I could now put my surround recordings on DVD. So in 1996 we built the first music studio ever in the world for dedicated 5.1 music productions. I required SSL, the company who manufactures Solid State Logic mixing consoles, to build the first 5.1 Surround console for music for us. They said 5.1 is a format for film, not for music, but I was determined to make 5.1 productions for the music industry.

And thus we had the first SSL9000 console built for Surround at Galaxy Studios, installed in 1997. On top of that, there was another technology we built together with SPL. It was a 7.1 music-mastering console that became a reference mastering console worldwide. All sound is going to 120-volt parts, giving headroom of about 40 dB. So we could play back CDs so much louder with that console without having so much extra distortion compared to other mastering techniques. Darcy Proper came over to Galaxy Studios specifically for that console, and she was nominated nine times for a Grammy award, winning twice.





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Whilst working with 5.1 and stereo all the time, I kept trying to find compatibility, but that seemed to be an issue. If you had a 5.1 mix and a stereo mix, it was so hard to make it compatible. I found there were two parameters that were very important to make it compatible: gain and panning. These were the two things that were always used to change between mixings in each of those formats. So I asked Ams-Neve, market leader in digital consoles, to design new software for our AMS Neve Capricorn console, which would allow a double routing while having control of volume and panning for each of those routed signals. A few weeks later, I got that software, which made a huge difference in my workflow: I could deliver the final stereo and 5.1 mix at the same time without any extra time needed and without any compromise to either of those formats. That was an amazing next step. But we couldn't do that on our SSL9000 analog console because we had too many things to re-patch, unfortunately.

So under the initiative of our Residential Mixer Ronald Prent, together with API, we developed the concept of a new module, an analog module. So we decided to give that console the name "Vision" because there is a clear vision behind that console, in order to produce 5.1 and stereo mixes simultaneously, without having any extra time needed, in comparison to if you would do it when only delivering one format. So since 2004, we have two console rooms with the same concept at Galaxy Studios, one with the AMS Neve new digital console 88D and the other one with API Vision, both capable to deliver 5.1 and stereo simultaneously to our client without any added cost.

That experience became an important aspect in my Auro-3D developments later on because I saw the importance of backwards compatibility. When we were at the end of the '90s with Super Audio CD, remixing many of albums in 5.1 at Galaxy Studios, there was a lot of budget from Sony and Philips, and they paid a lot of money to the studios to remix those songs in 5.1 sound. However, some of the clients were in fact bands—who were still existing—and they wanted the same thing for their next production: a stereo mix and a 5.1 mix. So I went to the record companies and proposed to have a budget to do the mix in 5.1 as well, but they said there was only one mix budget. They did not intend to pay me something extra because I would deliver a 5.1 track as well. You have to understand that we will not sell more because of having a 5.1 release as well. There was only one budget, one mix budget. And even the producers sometimes said they did not want to have any concession on the stereo mix. And all these things

made us develop that workflow in the analog and digital console, so we could deliver the 5.1 mix as an extra added value to all our clients. If you went to Galaxy Studios to produce your album, you would have it in stereo and in 5.1 for the same price.

**WSR Reber:** As a footnote, back in the quadrasonic days I was producing and recording music, and I was also a principal in Tate Audio. Have you ever heard of Tate Audio?

**Van Baelen:** Tate Audio?

**WSR Reber:** Tate developed the matrix decoding technology, which CBS Laboratories licensed to decode SQ. And then later on that same technology was licensed to Dolby® Laboratories, with a switch in the channel placements for Dolby Cinema, Dolby Stereo.

**Van Baelen:** So you understand perfectly what I'm talking about. That's always fantastic, because very often that's not the case.

So that mixing console development was a major experience in my life. While I was busy with promoting 5.1, I received a call in 2005 from Tom Hapke, a German producer, who asked if I was familiar with the 2+2+2 format. He was surprised to find that I hadn't heard about it. This triggered my senses and I found out that only one (classical) engineer in Germany, Werner Dabringhaus, made recordings in that format. He was interested in classical music in 5.1 but he said, "What can I do with the LFE and center channel in classical music?" So he started using the center channel and the LFE to put them up as two height channels above the left and right loudspeakers. My first question to him was what he was going to put up on those channels in classical music and he said, "Just two microphones above the orchestra played back with two loudspeakers. Listen to the difference—much more transparency, much more natural colors of the instruments, and much more depth." Tom Hapke experienced that effect of the addition of just those two front height channels, and he wanted me to produce the first pop production in that 2+2+2 format together with him, which we did beginning in May 2005.

**WSR Reber:** That brings to mind, Tom Jung's DMP Records. Tom always recorded with a height channel, overhead the sweet spot. Jung SA-CD recordings used six microphone/channels—three forward facing microphones, set up in a Quasi-Decca Tree arrangement representing left, center and right front. The other three microphones captured the ambient part of the performances—left surround, right surround, and overhead. The overhead channel is full range, unlike the LFE or .1 used in 5.1. The idea was to better re-create the spatial dimensionality of the acoustical space by placing a

loudspeaker over the listener's head, creating the dimension of height.

**Van Baelen:** Correct, but the overhead channel is not creating that effect. Most people think that the overhead channel can reproduce those reflections and spatial dimensionality, but with many tests and recordings I found it is the least important to have those overhead 3D reflections. Most of the reflections in nature are not coming from above but from the sides, and actually human beings are less sensitive for sounds coming from above. It is for that reason that the second layer, Auro-3D's unique height layer is key to the reproduction of this spatial information around the listener and not the top channel, as commonly believed.

**WSR Reber:** Telarc also produced several SA-CD recordings using the sixth channel as a height channel.

**Van Baelen:** And when did they do that?

**WSR Reber:** DMP released experimentally in the '80s and later SA-CD in the '90s, while Telarc began releasing in 2001.

**Van Baelen:** '80s already?! And how many, and they have, but they didn't put them together...

**WSR Reber:** I don't know...I've got several recordings from both companies in my surround music optical disc library. They're really great.

**Van Baelen:** Yeah, but that's the point. Let's say you put microphones to record an orchestra in a way that you always have this higher layer to capture those reflections to mix them together with the main microphones, but what you don't do is play those Height channels back via different Height loudspeakers. The point being, the moment when I heard these microphones play back by two different height loudspeakers, I was like, "Wow... what's that?" It sounds so much more natural, with so much more depth. I wondered why that was exactly, and I called a few professors and people in the audio industry and asked why you hear more harmonics if you record and play back, let's say, using a "vertical stereophonic field" in front of us. And everybody claimed it doesn't make sense and that you hear all the harmonics already if you use a stereo omni pair. I was convinced and persistent in the fact I heard absolutely more harmonics with the height channels, more natural spatiality. Afterwards I started to do tests with that because there was something very special that I found out fairly easily. With that pop production I wanted to do funny things and started using those height channels as well, but in an artificial way with sounds panning up and down. So I was panning sounds horizontally, and then I wanted to move them up, like we are used to do with panning in the horizontal stereo field, in which you can easily

pinpoint sources as a "phantom source" between two loudspeakers. But the funny thing was that when I was panning up I didn't hear it. But I saw my meters doing it, though, so I wondered why I could not hear it then. I couldn't position sounds in between those vertical two loudspeakers up until I tilted my head 90 degrees and then I was actually hearing the sounds going up.

**WSR Reber:** Really?

**Van Baelen:** Yes, how does this work? I myself was very intrigued about it because I thought; I didn't understand how we hear. So I read all kinds of books to learn about our hearing in 3D. And that was very interesting because I didn't find audio engineers or people who had answers on those questions. So I went to the neural specialists, people who are studying the neural part of our brains, as I wanted to understand how we hear, and that is how I came in contact with professors doing scientific research of our brains and understanding the audio/visual experience of human beings. This was extremely interesting. But before going further about the meaning of an immersive experience, I want to finish the way I came to develop Auro 9.1 system...

So this is what happened; the German producer said he wanted to have three formats in one: the 2+2+2 mix (from Dabringhaus), the 5.1 surround, and the stereo mix. So I had to deliver three mixes in one workflow. So I started to combine all loudspeaker layouts and came to a 7.1 layout, based on 5.1 standard plus two height loudspeakers in the front above left and right. This loudspeaker layout was allowing me to switch fast between all the three formats in order to mix them simultaneously.

But I felt that the total sound in 7.1, which included these two height channels, was sounding so much better than the 2+2+2 format or the 5.1 format, although I started to feel something very unnatural. There was a lot of 3D information in the front but there was almost nothing in the back. There were only two loudspeakers at the back, giving a very unnatural balance between the energy spread of the sound coming from the front compared to the sound from the back. And I thought of putting two extra loudspeakers, like 7.1 nowadays, on the bottom, and two up, which was the Dolby format that they were launching in 2009, four years later, but I didn't quite like it. I felt there was something amiss with this format and tried to find a solution to come to a better natural spread of sound. That is when I thought of the fact I was missing two height loudspeakers at the back like I heard in the front ... and when I tried that out ... that was again a magical moment in my life. For the first time, I was surrounded by sound like I had never before

experienced. It felt so natural all of a sudden. I had never been so immersed in sound, and I really felt a higher emotional experience to what I was hearing. It was much closer, and again I wondered why we hear a more emotional experience when you record things like that and when you play it back like that. And I heard it every time with all kinds of music. I was playing around with many things, not just music, but as well sound design for film, games, etc., and then it occurred to me to perhaps add even more loudspeakers to make it even more impressive. So then I started to do experiments with the channel above us.

**WSR Reber:** Right over the sweet spot.

**Van Baelen:** Yes. And that was a big disappointment, as I envisioned it to be the height of the immersive experience to have the channel above us as well. So I made recordings in places from which I thought there were many reflections coming from above, like in a church. The moment when I came back to the studio and did replay what I recorded, I had again a very strange experience. The moment I started to hear the channel from above I felt like the sound was falling on my head and it was not natural any more. This happened especially with acoustical recordings, when you hear that channel above you and it is not giving a higher emotional effect or more natural result but rather the opposite. I didn't understand that either. Why are we less sensitive to sounds coming from directly above us? And secondly, it felt like there are almost no reflections coming from directly above. So if that channel directly above us was only important for source sounds, then the use of it was much less powerful and less needed than I expected.

So I started to see that human beings are not equally sensitive from all angles for sound energy. I very often had a similar experience when I did mix my stereo and 5.1 simultaneously: when I was putting certain sounds in the surround channels from the stereo mix very often I felt the sounds became louder compared to when I experienced them in the stereo mix, and more in particular, sounds with more direct attack. And then I came to the conclusion that it seems to be we are more sensitive for sounds coming from the back. Later I found that scientific research came to the same conclusion: human beings are about 2 dB more sensitive from sounds coming on the non-visual field. And it has to do with survival because we don't have our eyes on our back...

**WSR Reber:** So we're more sensitive to sounds coming from behind?

**Van Baelen:** More sensitive because we cannot analyze the field as good as the one in front of us. In fact our subconscious brain

is always busy with scanning the environment around us, like radar, to inform our reptile brain that our environment is safe, but if there is something going on or approaching in the back, which can hit us or sounds like it could mean potential danger, our subconscious brain immediately informs our conscious brain to look for it ... because having the visual information allows us to react better in order to survive. The simple description of this process is the reason why, if you have objects coming close, it takes our immediate attention subconsciously. Our conscious brain is immediately informed about it because we are very sensitive to it. That's one of the reasons as well, if you hear certain things in Dolby Atmos or in object-based technology, the moment those sounds are produced in our non-visual surrounding field, it takes our attention more than normal to diffuse channel-based sounds and, therefore, those objects can cause more of a distraction from the storytelling on screen. So this means it is not always more immersive. On such moments, it feels more like a gimmick or an effect, and is as such, not always experienced as more immersive. This also has to do with the 3D reflections around those objects, which are not reproduced and thus do not sound as natural.

**WSR Reber:** Here's how I set up my reference systems; I always set up with a sweet spot right in the middle equidistant from a circle of identical loudspeakers.

**Van Baelen:** Yeah, but that's the perfect situation.

**WSR Reber:** In a couple of systems all the identical loudspeakers are full range.

**Van Baelen:** Good, wow.

**WSR Reber:** In fact, they're Dunlavy Signature SC5s, six of them in 60-degree slices. So the 60-degree is perfect phantom imaging between each bottom loudspeaker channel. So that's how I set it up, so the two sides are at 90 degrees. That's how I set my reference systems up right now. But what I've been disappointed with in motion picture sound is that with the 7.1 format, I argued that the extra two channels should be the side channels, but instead they positioned them at the back.

**Van Baelen:** You are so right, there is a difference between the ideal equal spread of sound in a horizontal plane around us compared to the 7.1 standard.

**WSR Reber:** But they didn't do that, and thus phantom imaging in the holosonic® dimension is compromised.

**Van Baelen:** I agree 100 percent.

**WSR Reber:** Instead they went with the rectangular movie theatres and all that architectural limitation and they put the extra two channels in the back, so now when you're playing a 5.1-channel recording on my system,



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the surrounds are naturally to the rear, but when I put on a 7.1 recording, the added two channels, instead of occupying the natural mid-side positions between the front and surround loudspeaker channels, they are positioned further back than the normal surrounds. I just wanted to know what your position was on that. I'm frustrated with that because every time I have to rewire the interconnect cables when I'm playing 7.1 soundtracks.

**Van Baelen:** I wrote a document about the whole Auro-3D concept in 2005 in which I described the listening formats from Auro 8.0 up to Auro 10.1. Later, in 2009, I added Auro 11.1 and Auro 13.1, due to maximum compatibility between all formats in professional cinema and home cinema. That was the moment when I defined the maximum compatibility between the Surround formats (5.1, 6.1, 7.1) and the Auro-3D listening formats. But one of the things that I've seen is; it would have been so much better for the industry when we could have started from a typical 6.1 (L,C,R, LS, CS, RS) instead of 7.1 because a 6.1 is very easily compatible with 5.1, while a 7.1 is not. With 6.1, you just can divide that mono channel minus 3 dB in the left and right surround if you want to have it. But with the 7.1 it's somewhat of a nightmare because the mono sounds in those surround channels will have to be treated differently compared to the stereo channels in the backwards compatibility with 5.1 surround. This means that engineers have to make two different masters. If the standard would have been chosen for 6.1 surround as next step after 5.1 surround, then it was a more backwards-compatible solution, which didn't require much effort in the workflow. So I hoped that 6.1 was still a good format to start from because the main thing about 7.1, what people like, is that at least they have that back wall as a separate channel. They could fly over certain things from the screen to the back wall without hitting the sidewalls. A 6.1 had that ability—three screen channels and every wall a separate channel. So when we would split up each wall in two different zones, like 7.1 is doing with the back wall, it would have made sense to do that with each sidewall and the backwall. That's what we do in our Auro 22.1 loudspeaker layout. The lower layer has three channels in the front—left, center, right—you have stereo on the sides and stereo in the back, so there are six surrounding zones in the theatre, then we mirror that because the mirror of the lower layer and the height layer is the key to getting a natural immersive sound. I will tell you later about that.

**WSR Reber:** So you're mirroring that with channels above that same channel?

**Van Baelen:** Yes, the same, exactly the

same. And on top of that, there is the third layer, called TOP Layer (sometimes called the Voice of God channel), which we split up in four zones. I'll tell you later more about it.

Going back now to immersive sound. My main question was, why does this height layer create a so-much-more-immersive impact? What about our hearing system? How fast does that work? And what about the fact that I couldn't experience vertical phantom sources? But why do we hear phantom sources when using triangle relationships between loudspeakers? With Auro 9.1, I felt I could place sounds even in the hemisphere and more precisely in the lower surround layer, although I could never do that in 5.1 surround without activating the height layer. It's not like a discrete channel but it feels like a zone, which is portrayed in a large sweet spot, even much larger than the 5.1 sweet spot. This all has ~~all~~ to do with the triangle relationships between the loudspeakers in the hemisphere that give the Auro-3D format the feel that many more channels are involved. If we do play the Auro 11.1 demo without telling experienced engineers what format we played, they believe to have heard about a 20-channel system. That's very typical for the Auro-3D format because the height layer is defined and thus able to create those extra zones.

Take for instance the demo recorded by Paolo Carrer in Auro 9.1, you hear a tractor coming from the back and it's passing by on the sides to the left front. If you cut the height channels, there is a poor imaging where exactly the tractor is, but adding the height channels not only gives so much more natural color on the sound of the tractor but as well it's precise position, even when moving between the back channels and the front left channel. And that is, in fact, a good example to understand how our brain is getting so much more information when the Auro-3D's unique height channel is engaged. This vertical information for our brain, all the reflections around those moving sources, the time delays etc., will help our brain to better translate the original natural experience. Head Related Transfer Functions (HRTF) is one of the key things related to the Auro-3D experience. It is one of the reasons why the market provides the feedback that Auro-3D has the most natural and, therefore, most immersive sound, but there are many things related to that result. The loudspeaker setup is just one part of it that I found out myself after many hundreds of tests in 2005. And if you have a lower layer and a height layer, what about the angle between both? Does it make a difference when having an angle of 20, 25, 30, 35, or 40 degrees in the vertical axis? Because in stereo, as you know, a stereo

field horizontally is optimally 60 degrees. If you do that vertically, you do not hear a coherent vertical stereo field. It feels like the objects are not related to each other. So, again, how does that work differently for our brain in the vertical axis?

**WSR Reber:** So you have to make it smaller.

**Van Baelen:** Much smaller. All those tests in small and larger rooms did give an almost similar result, that is typically an ideal coherent vertical field is around 30 degrees. This vertical Stereo field between Auro-3D's lower layer (the standard 5.1 layer) and the height layer allows both; a more precise location of the source sounds in the vertical axis plus all the reflections in 3D around those sources, which do not only increase the vertical precision of the location of those sounds but as well create more depth and natural harmonics, resulting in a more natural color. Also, having such a vertical stereo field in front and around the audience allows this much more. It creates that coherent relationship between what we see on screen and what is heard by the audience. If the lower layer is put too high, there are no ear-level experiences, and those are too important, as most of the sounds in nature are having their sources around ear level. To get an immersive experience, it is so important to reproduce the vertical ear-level positions, as we experience that in nature. "The closer to life-like sound, the more immersive the experience" (quote Wilfried Van Baelen, AES Paris and San Francisco 2006). So that's the reason why you need to have the ability to reproduce the ear-level experience. That's a very important thing—to get immersed. If you see a picture in front of you, Gary, and you see like a town, and you see like a bike passing or a car passing to the side, you should not only hear it horizontally but vertically as well, precisely where it should be. And that's my biggest comment on Dolby Atmos, they're putting the loudspeakers so high up that if it bypasses, everything flies over your head.

**WSR Reber:** We don't want that.

**Van Baelen:** It is very important, that ear-level experiences are reproduced as closely and correctly as possible, which is possible with the Auro-3D loudspeaker layout. Of course, in a professional theatre there are some industry safety rules, as well as spread of sound that has to be taken in account. But those were very well defined many years ago. Why should we change those, like Dolby Atmos is doing? But a comment I sometimes hear from people is that we are not lowering the existing loudspeakers. No we don't do that at all. If you read the 5.1 standard very carefully, it should be placed at around 15 degrees in an average theatre,



defined like that by THX® as well. In a very large theatre you have to raise it a little bit up in order to create an equal spread of the sound energy. But in smaller theatres, we are perfectly within the specs, even with a 12-degree elevation, which would allow a much better ear-level experience.

**WSR Reber:** So you're saying the height channel should be 15 degrees?

**Van Baelen:** No, around 30 degrees above the lower layer for the surround channels.

**WSR Reber:** You're measuring it from some location in the theatre as an ideal seat.

**Van Baelen:** Each seat in the middle of the theater is a kind of reference point, because we will divide the vertical axis in three layers with similar angles in order to make the same experience for the whole audience, wherever you are sitting in a stadium seating theatre. You see, the idea is to have a vertical spread—the ear-level (surround) layer, then the height layer, and then the top layer. The top layer can have more rows, depending on the size of the theatre. The goal is to give everybody in the theatre the same overhead experience. That can only be done when that top channel is mono. That can be different in a small home theatre, where we only need one loudspeaker and not two, like Dolby Atmos. But in standard professional cinema theatres with a

capacity between 100 and 800 seats, we typically split up the top layer in two rows. This way, everybody has the same overhead experience. If you make it stereo, then it can sound completely different to where you are sitting, which means a smaller sweet spot. That's the main and most common difference between Dolby Atmos and Auro-3D, Auro-3D is enlarging the 5.1 sweet spot, while Atmos is making the sweet spot smaller compared to the 5.1 Surround. On top of that, Atmos is not compatible with 5.1 standard loudspeaker layouts for theatres, as you may know.

**WSR Reber:** I didn't know that.

**Van Baelen:** If you see the 5.1 standard, Atmos is just not respecting that standard. The way they've positioned the surround loudspeakers is completely different from the standard. First of all, they've put the loudspeakers much closer to each other so there is much more clustering and comb filtering. Additionally, they direct all the loudspeakers to the center of the room, and they specifically have to do that for the reproduction of their object-based sounds. If you move an object from the front screen channels to the side channels, the first surround loudspeaker, which is normally directed to the middle of the room, will not sound okay for the people sitting towards the middle or back of the theatre. You probably won't hear it, so they

have to angle the loudspeaker. But can you imagine all the sounds, which are not objects, but coming from the channels (even in Atmos typically more than 80 percent of the sounds), are coming together to that one point, thus creating much more artifacts than what we had with standard arrays. That's the reason that it feels more distorted and less natural as well compared to the Auro-3D loudspeaker layout, which is based on the existing 5.1 standard. Those specs about these arrays were specifically designed to give the audience a similar quality experience. It's all about physics, and those laws have not been changed since those standards were designed a few decades ago.

More and more engineers are starting to check the 5.1 rendering coming out of the Atmos system by playing them back over the lower layer of the Auro-3D system because that lower layer is exactly following those standard specs. If you play back a 5.1 movie over an Atmos loudspeaker layout, it has not the same audio quality as we are used to hearing with a normal 5.1 surround setup. Of course, this is regardless of the quality of the loudspeakers used.

To be continued in Issue 189, September 2014. **WSR**

