Immersive Audio Series - Part 1

Essential Guide

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ESSENTIAL GUIDES

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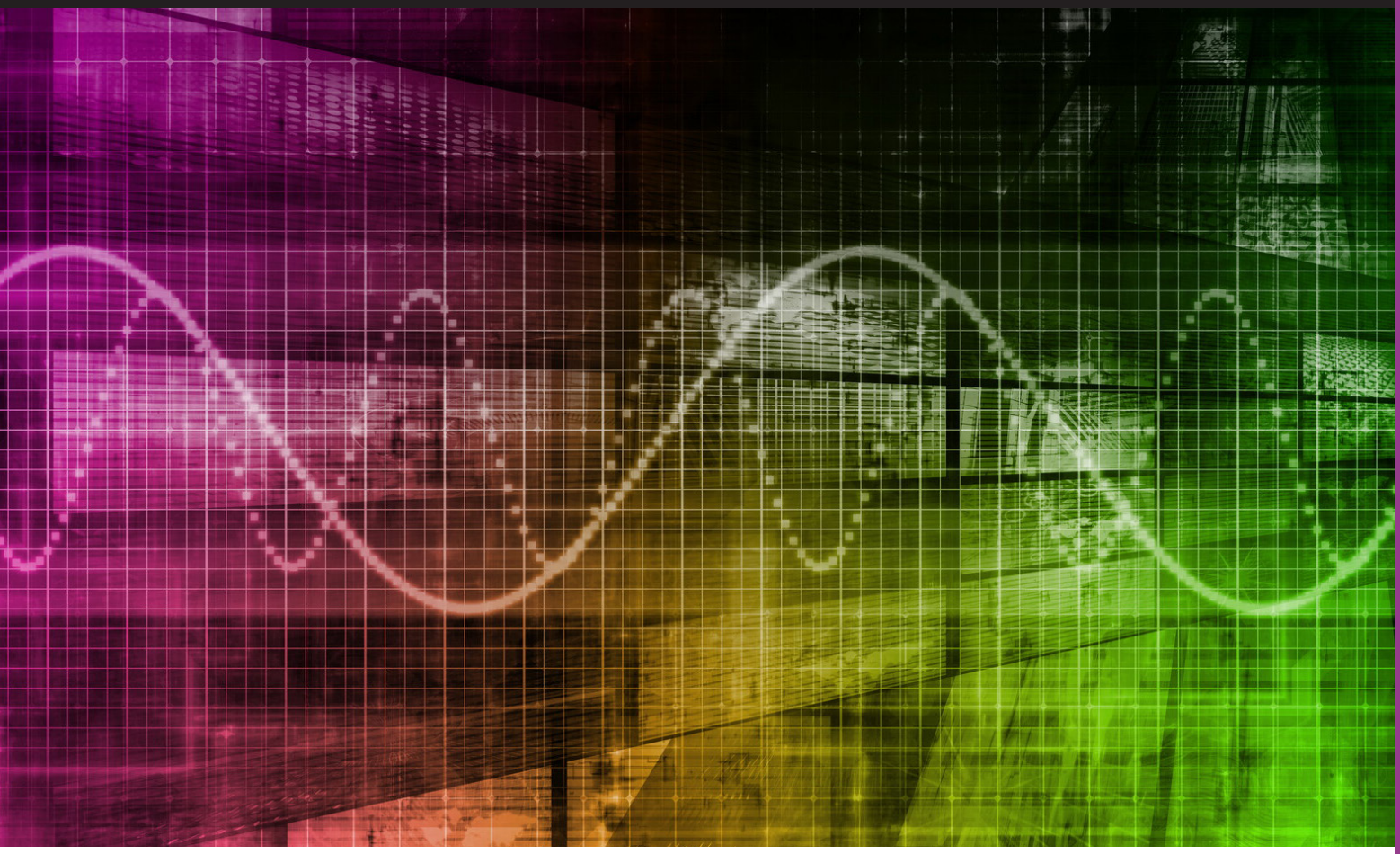
Immersive Audio Series



By Paul Mac – Writer, Professional Broadcast Audio

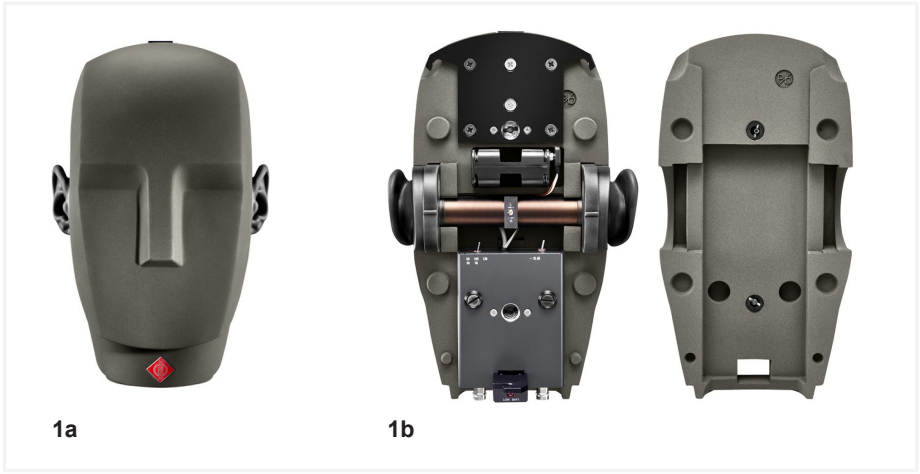
Part 1

Immersive audio has become a very wide term, though it should be simple: The listener is immersed in an aural environment, a natural soundscape, or even a space of ingenious audio design. However, this simple term and definition is only the above-water portion of a technology iceberg made up of a miscellany of acquisition, mixing, and playback technologies.

Even its close relationship with objects has become a catch-all object, even when they are not necessarily immersive. They might simply be additional and optional channels but use an immersive format for delivery.

In this first of a four part series we explain the various immersive audio formats for production and transmission.

To be pedantic, immersive audio probably starts with stereo. It's a format that makes a lot of sense - two ears, two speakers - and the word even has a Greek origin meaning 'solid' or having three dimensions. Certainly, the stereo headphone-based binaural technique is a very effective immersive experience.



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The Neuman KU-100 Dummy Head for consistent binaural recording.

The idea with binaural audio is that you record a source with microphones positioned in the ear canal of a real or artificial human head so that the natural localisation mechanism of the head (summed up with the term 'Head Related Transfer Function', or HRTF) is hard-coded into the recorded audio. To recreate the experience, the listener simply replays the audio over headphones, which by their nature skip the HRTF bit altogether.

There are several techniques that provide a more channel-hungry route from straight-forward or binaural stereo content, and the story of pioneering work in this arena is extensive, and readily available. However, we are probably best served by moving from binaural, directly to ambisonics - mainly because ambisonics plays an important role in the new immersive formats and is the immersive format of choice for one of the great influencers in today's broadcast market - YouTube.

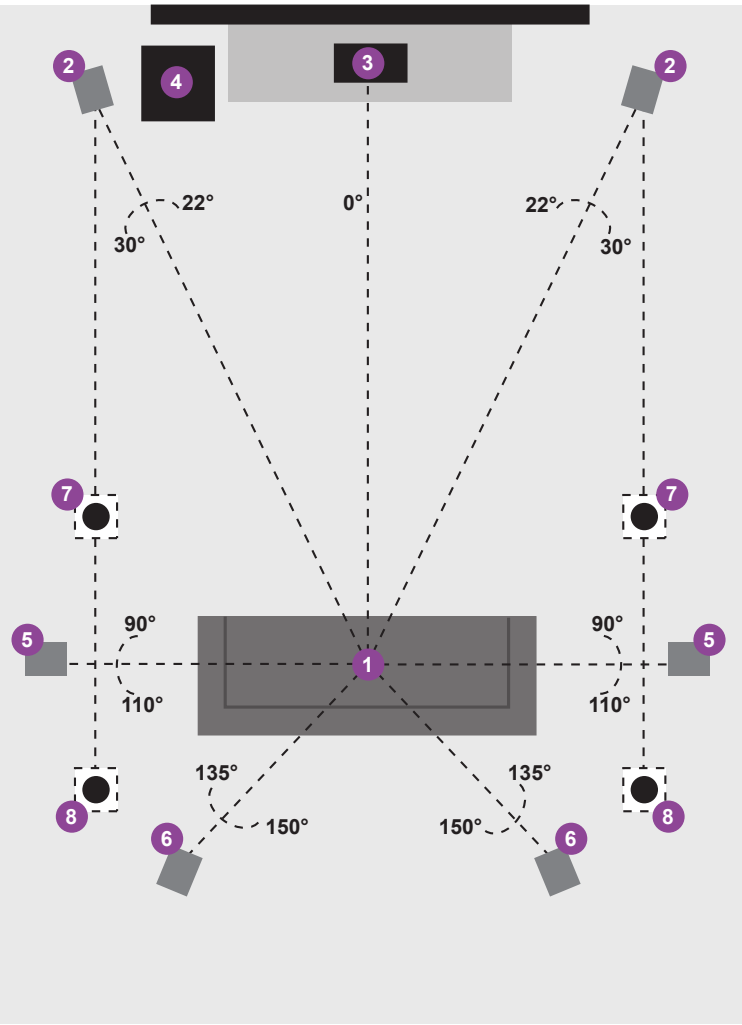
Ambisonics encodes a 360-degree sound field in a number of channels and is 'speaker agnostic' - a desirable trait that is now a core part of the way immersive audio is delivered in almost every standard or format. It is audio encoded or stored in such a way that it can be reproduced on and adapted for any number of speakers in any particular set-up. Aside from the audiophile considerations, one of the big advances is that the necessary delivery options are substantially reduced because it can be decoded for any system.

Ambisonic audio is further labelled according to its 'order' - equivalent to resolution (or adding more microphones into an array). As the order number goes up, so does the number of channels required to represent it. 1st order ambisonics is a four-channel format, also known as 'B-Format' though because of the issues around arranging microphones as a true coincident array, the most common microphone arrangement used to record it is a tetrahedral array which is then matrixed to B-Format – and others.

'Normal' surround-sound can be an immersive format, of course, and the latest height-inclusive formats such as 5.1.4 and 7.1.4 are simply extensions of 5.1 and 7.1 that introduce height speakers. However, it's important to note that if you 'print' 7.1.4 to 12 channels, you get a fixed-format 'bed' that directly corresponds to 12 speakers. Yes, downmixing, up-mixing, phantom positions etc can adapt it, but essentially it is not speaker agnostic. An ambisonic or object-based immersive format is more readily adapted because the channels and object positions do not correspond to actual speaker positions, but rather source positions in space.

Now we can differentiate between scene-based, object-based, and channel-based formats. Ambisonics represents complete sound field, though is still speaker agnostic, so that is Scene-based. A traditional surround format, where channels are locked to speakers, would be channel-based. Objects, on the other hand, are discrete audio items - channels that can have their own independent positions in a 360-degree space. However, those positions are not hard-coded to a speaker. Instead, the position of an object is described by metadata - three-dimensional coordinates that can be used to theoretically position that object exactly at the point of delivery, thus adapting to whatever the playback conditions are - whether that's a stereo TV, high-end sound bars, or a theatre with a multitude of discrete speakers.

Note though, that because objects are really just additional channels with accompanying panning information, a lot of talk in broadcast has been directed at using at least some object channels for added-value and accessibility options, such as audio description, alternative commentary, translations, and so on. As mentioned before, not all objects are immersive objects.

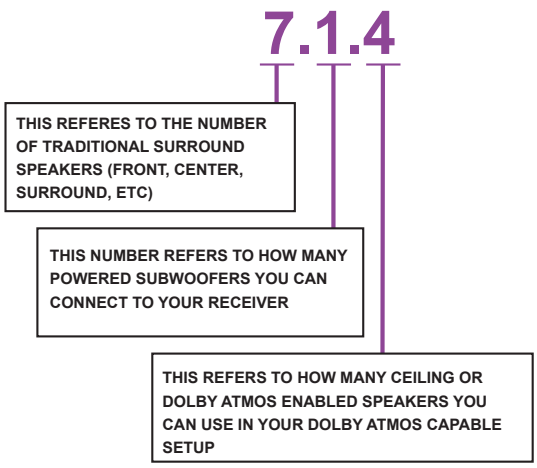


7.1.4 OVERHEAD SPEAKERS

1. SEATING POSITION
2. LEFT AND RIGHT SPEAKERS
3. CENTER SPEAKER
4. SUBWOOFER
5. LEFT AND RIGHT SURROUND SPEAKERS
6. LEFT AND RIGHT REAR SURROUND SPAKERS
7. LEFT AND RIGHT TOP FRONT CEILING SPEAKERS
8. LEFT AND RIGHT TOP REAR CEILING SPEAKERS

DOLBY ATMOS SPEAKER SETUPS:
WHAT DO THESE NUMBERS MEAN?

WHEN SHOPPING FOR DOLBY ATMOS HOME THEATER COMPONENTS, YOU'LL SEE A NEW WAY OF DESCRIBING SPEAKER CONFIGURATIONS.



A 7.1.4 layout for Dolby Atmos, home theatre.

In practical terms there can be provision for a combination of scene-based, object-based, and channel-based audio. Dolby Atmos, for example, has its surround 'beds' and object channels which give plenty of creative options for mixing and a versatile delivery mechanism that can adapt to pretty much any situation.

To make things a little more exciting, we can add spatial processing to the pot. For example, there are plug-ins and processes readily available for converting ambisonic to binaural via a mathematical HRTF. On the object-based side, manufacturers of PA for live sound systems are rolling out immersive systems that use spatial processing to enhance the experience without adding lots of loudspeakers and the corresponding complexity.

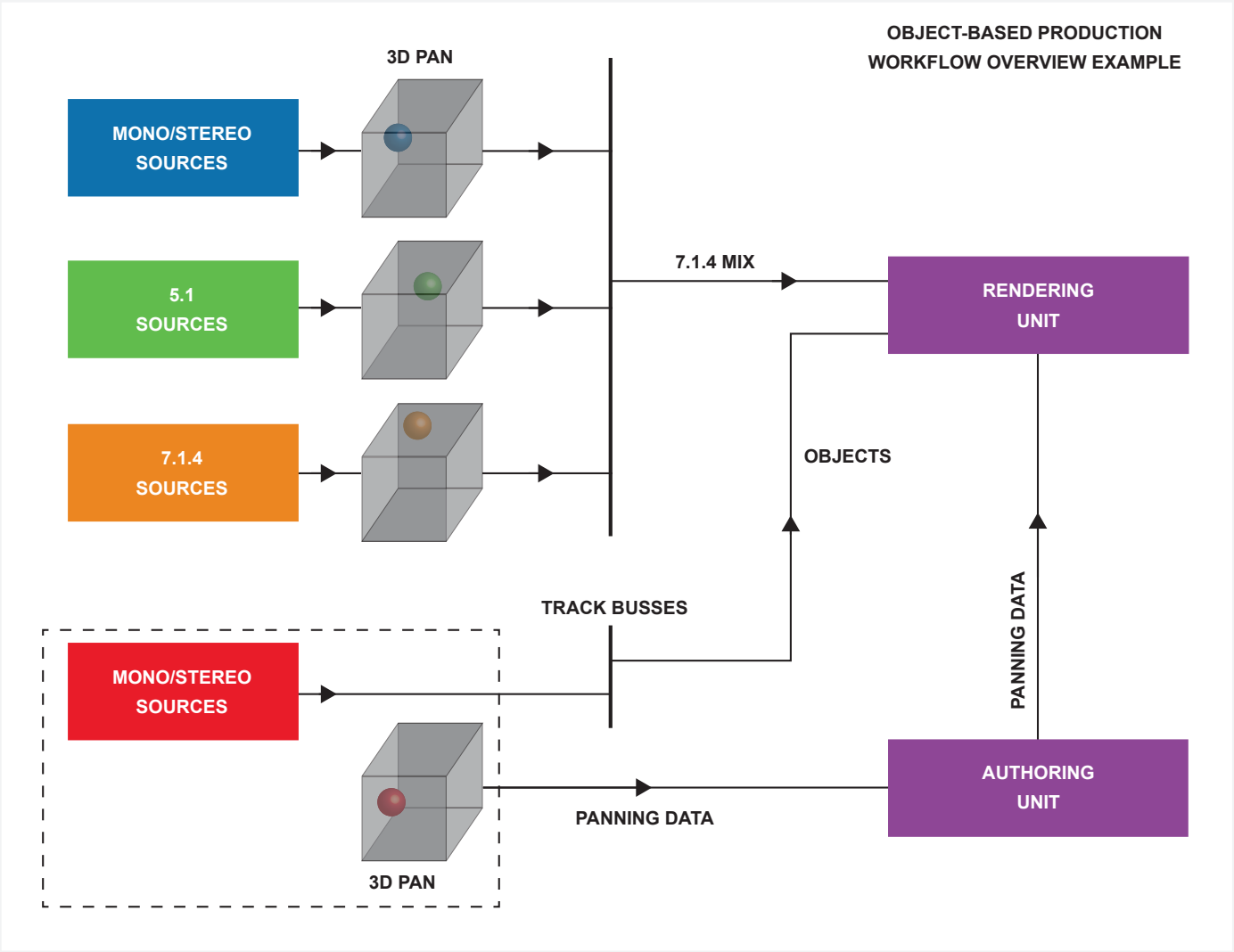
This range of immersive options necessarily asks a lot of questions of the infrastructure - from acquisition to transmission or transport, and on to domestic replay.

In broadcast there is the differentiation between what's possible or even desirable in live production versus the relatively limitless possibilities of post-production. Depending on the application you might want to deploy ambisonic microphone arrays and mix extra-wide scene-based channels, or you might need highly-focussed beam-forming technologies to make sure that your objects are not tainted by ambience. Again, most likely a combination of both, and more, will be required.

In that case, the production tools along the chain need to cope with the extra weight of wide-channels and be able to mix multiple scene channels of differing widths, as well as multiple objects, and pass them down the line. Then there is the question of where the panning / position is implemented and whether that can be left in the hands of the engineer. The rise of production automation in many broadcast disciplines lends itself to coping with this.

Panning objects in a console is a fantastic creative freedom, but it requires the panning metadata to be passed down the line, which requires standards and communications between products, whereas panning in a dedicated processor / encoder gets the job done without bothering the mixer but is unlikely to be a satisfactory hands-on option.

There has been work on moving metadata around in SDI infrastructure, but the real game-changer has to be the move to true-networked transport with Audio-over-IP. The SMPTE 2110 suite includes provision for synchronous ancillary data, which is a big deal when it comes to moving object-based content around, particularly when coupled with the vastly improved channel counts for AoIP.



A simplified immersive audio workflow showing a mixture of scene, channel, and object sources, including the sectioning of panning data as metadata.

On the transmission side, the latest ATSC, DVB, AVS, and ISDB specs include both Dolby AC-4 and MPEG-H provision. MPEG-H 3D Audio specifies channel, object, and higher-order ambisonic components with support for up to 64 loudspeaker channels and 128 codec channels, and also supports binaural rendering for headphone listeners. Dolby's AC-4 supports channel and object-based audio and can carry Dolby Atmos for broadcast.

There is a lot to consider in immersive audio, but there is a lot to gain as well. There are creative advantages in the new mediums, as well as the potential value of useful objects like alternative commentary depending of which team you support or language you speak. A number of broadcasters and streaming services are already pushing immersive audio to audiences and that is set to grow as the consumer becomes more and more accustomed to the experience. It is, after all, a lot less expensive or domestically cumbersome than immersive video options, and far less challenging in production.

Over this four-part series we will be looking at aspects of the subject areas covered here, but in greater detail. We'll be considering the essentials of human perception, the tools and techniques in ambisonic and object-based production, as well as the creative aspects. We'll be looking in greater detail at the standards, and the issues surrounding them, as well as the tricky business of broadcast infrastructure for immersive audio production. We'll also look at very practical issues such as considerations for the listening environment and use-cases aimed at informing the audio engineer.

SENNHEISER

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The Sponsors Perspective

Mixing Realities – Feeding The Immersive Markets

Will alternative immersive channels create an imperative for broadcasters? Veronique Larcher, Director of AMBEO Immersive Audio, Sennheiser, explores immersive content outside of the commercial broadcast space, including virtual, augmented, and mixed realities.

Creatives and platform developers have been actively investing in and moving forward with Virtual Reality (VR), Augmented Reality (AR), Mixed Reality (MR), and 360 Video technologies for some time now.

While there are differences between all of these, they all still bring an immersive experience to the viewer, and they mostly - depending on the use-case - require audio.

It is true that the domestic customer base for immersive media is still relatively low, though a good proportion of the population has experienced it in some way, and an increasingly wide range of applications and markets are starting to embrace its potential.

So, as the stock of content that provides a fully immersive audio and video experience increases, and the cost of that experience decreases, the production and creative norms of that content will become more and more familiar to the general population, and will drive expectation in all mediums, including broadcast. Content creators and their tools need to evolve or be re-imagined.

Which Reality Do You Require?

VR, or Virtual Reality, normally refers to an entirely artificial environment. For example, putting on a VR video game might put you inside a car with a view of the race track while you're sitting on your sofa. Or a VR tour of an architectural concept can put you inside a building that hasn't been built yet. Virtual reality is mostly experienced through dedicated headsets such as the Facebook Oculus products, the HTC Vive, or the Playstation VR headset.

Cinematic VR probably has the most content available, though much of it is short-form, due to the cost of production and the current speculative commercial nature of releasing a VR experience.

Documentaries are a fantastic VR medium, and one where its unique ability to short-cut to empathy can be used to great effect. VR can provide an ultra-real 1st-person experience that does all the heavy lifting when you want the viewer to put themselves into the shoes of a protagonist.

A view on mixed reality with the Magic Leap One.

VR games are impressive, but they are still relatively rare. The installed user-base of VR headsets has not grown as rapidly as many had first hoped, though maybe a new generation of lower-cost, standalone headsets such as Oculus Go and Quest will push the uptake on. The units put not just VR content but also 'normal' video and music streaming services on a much more convenient and affordable platform.

AR and MR

AR (Augmented Reality) and MR (Mixed Reality) do have separate definitions, but more recently the terms have been mixed up, with AR remaining the one most people know.

AR builds on what you can see around you by bringing in imagined or created elements that are not actually there but are superimposed on the real world. MR refers to interaction between reality and its augmented aspects. That is, if you put a virtual coffee cup down on a real table, you would want to hear it touch, from the correct point in space, and not see it go through the table.

AR and MR can be experienced through a 'magic window'-type app on a smart device or gaming console, or through dedicated headsets such as the Microsoft HoloLens or the Magic Leap One.

AR Made Real

Experiments in AR have been going on since the 90s, though early viable gaming implementations came along with products like the AR implementation in Nintendo's 3DS, or the cute Sony Eye-Pet for PlayStation 3. Pokemon Go and the forthcoming Harry Potter: Wizards Unite are more up-to-date examples that use the magic-window concept.

Some high-profile AR landmarks include events such as the opening ceremony of the 2018 League of Legends world championship. That event boasted more viewers than SuperBowl (it reportedly peaked at around 200 million combined concurrent viewers on outlets such as PandaTV, Huya, YouTube, Zhanqi and Egame), and featured the debut of the Augmented Reality K-Pop group K/DA, which combined imagined champions from the game joining with real-world artists live on stage for a performance of POP/STARS.

At the 2018 SXSW event the Sennheiser AMBEO team demonstrated an augmented live music performance where a live vocal performance by Noa (Playing Savage), was augmented by a full virtual backing band with immersive audio, via an iPad and the AMBEO Smart Headset. This demo evolved into the AMBEO Augmented Audio Lab developed for the Magic Leap glasses, and enabling participants to create a spatial soundscape in which they can wander.

More utilitarian uses of AR and MR might include being able to look around your kitchen and see or hear the status of your appliances and storage areas, or a surgeon might be able to have reference materials in their field-of-view, along with remote, live consultations. Developments such as the new Microsoft Dynamics 365 Guides for HoloLens looks like it has some serious potential in areas such as manufacturing and engineering.

The Magic Leap One mixed reality headset.

Microsoft HoloLens: Augmented reality can put reference materials exactly where they are needed.

Another very public use of immersive media is in the exhibition market. New media is a common subject matter for targeted pop-up exhibitions at museums, and the technology itself is a very attractive way to draw in the crowds. A recent Pink Floyd experience at the Victoria and Albert Museum in London got nearly 400,000 visitors in only a few months with an AMBEO 3D presentation of Pink Floyd: Their Mortal Remains, which put visitors in the audience for the live recording.

The Content Stockpile

The consumer needs a critical mass of content to be interested in investing in something - in gear, in the content, and in a medium. That's why creators need to be a focus point for the manufacturers and technology leaders: We need cool content and we need amazing apps that will then feed demand from consumers.

Magic Leap just closed off its first round of funding in its Independent Creator Program, and another round is promised for 2019. Sennheiser has its own AMBEO Developers Program, which includes free access to the AMBEO Augmented Audio SDK for iOS. You can apply here: **http://sennheiser-ambeo.com/developers-program/**

Some great leaps have been made in developer tools, such as the fantastic dearVR Spatial Connect workflow and plug-ins from Dear Reality, or the GUI leaps that many of the well-known console and DAW manufacturers are currently developing and launching. Include the rise of 360 video, ambisonic support on YouTube, and clever promotions such as Google Cardboard, the environment looks ripe for an immersive revolution.

When the content dam breaks, the consumer will be immersed - in all sorts of ways. That will increase awareness of the values and benefits of immersive audio, which will in turn become a benchmark. Broadcasters can only benefit from meeting that mark.

Genelec

The Sponsors Perspective

The Personal HRTF – An Aural Fingerprint

HRTF stands for Head Related Transfer Function and, simply put, is a catch-all term for the characteristics a human head imparts on sound before it enters the ear canal. Everything from level tonal changes caused by our head, shoulders, and pinna (external ear parts), to arrival-time differences (Interaural Time Difference, or ITD) between the two ears have an effect on our perception of the direction and distance of sources.

It's a concept that explains the necessity of headphones with binaural sound, for example. That is, if you record a source by sticking two microphones in your ears, that recording will incorporate your HRTF, both considering the direct sound and room reflections. If you then play that back through speakers, the HRTF effect becomes a disadvantage because of pronounced coloring and new room reflections clashing against the recording. The source would have to be replayed through headphones to avoid the HRTF effect being imparted a second time.

A Place of Your Own

Part of the issue with immersive audio reproduced through speakers in a space is the effective localization of sources within that space. With object-based reproduction or with wave field synthesis you can approximate actual source position, but in the end it all gets injected into your ear canal after processing by your own HRTF. Therefore, a binaural source over headphones should be capable of producing the ultimate immersive experience.

However, everyone has their own personal HRTF. Our aural perception filter is as personal as a fingerprint. A generic binaural signal such as might be recorded with a 'dummy head' microphone will be a good approximation, but to a certain extent it will always be like looking through someone else's spectacles.

What if you could easily measure and define your own HRTF? That could then be used by rendering engines to produce a personalized binaural feed from any source – including the most extreme object- and scene-based immersive formats. Set-top boxes, sound cards, games, mixing console monitoring sections, and DAWs could all incorporate rendering engines based on personalized HRTFs.

Enter SOFA

The SOFA file, or 'Spatially Oriented Format for Acoustics', is a general-purpose file format for storing spatial acoustic data, standardized by the AES as 'AES69'. The data does not only have to be a HRTF but could be applied to a specific listening position in a room or for modelling a full acoustic response of a concert hall at various positions, for example.

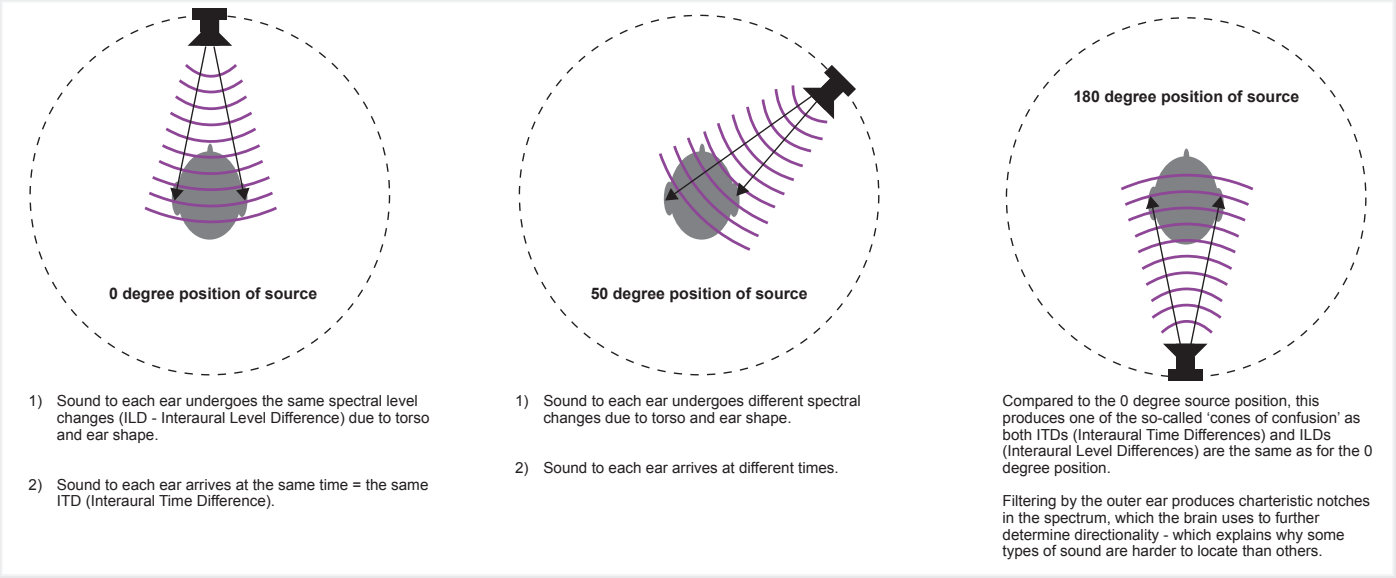
The data is made up of multiple impulse responses –a representation of how a given input is changed at an output. In the case of measuring HRTF, each impulse response represents a measurement for each ear, from a particular direction that is defined with elevation and azimuth. Therefore, to measure an HRTF with microphones you need to take enough responses to adequately represent the full source sphere around a test subject.

How many responses is enough? Well, this method of modelling and quantifying HRTFs is not new and the University of California, Davis' CPIC Interface Laboratory's HRTF Database has been in existence for some time with a compiled library of HRTFs where each one is made up of 1250 directional readings for each ear of the subject. However, numbers of readings in the 200 region are more common, such as for the Listen Library, which was a joint project between microphone and headphone manufacturer AKG, and IRCAM (Institute for Research and Coordination in Acoustics/Music).

Aural ID

Thankfully, an alternative to sitting in an anechoic chamber for several hours is here… Genelec recently announced its new Aural ID process for modelling an individual's HRTF and compiling that into a SOFA file that does not involve sticking microphones in your ears.

The idea is to create each model from a 360-degree video of the head and shoulders of each customer that can be acquired simply on a high-quality mobile phone.



Simplified HRTF: a couple of HRTF aspects that help determine source direction. HRTF is more complicated than this though, as it uses the entire upper torso and acts in three dimensions where both angle and azimuth are relevant.

That video is uploaded to the Genelec web-based calculation service, which builds a virtual 3D model, including especially detailed modelling of the pinna. This model is put into a full wave analysis of the HRTF using lots of virtual sources from many angles, which in turn generates the full HRTF data and the SOFA file.

Once you have your own personal HRTF data, a rendering engine can personalize any sound reproduction specifically for your headphones, bringing stereo and immersive content straight to your ear canals, and missing out those pesky monitors.

Of course, the monitors themselves, the room they are in, head movements, and other people listening with you have such a significant effect on a social listening experience that Aural ID is unlikely to spell the end of monitors just yet (something Genelec is no doubt pleased about), but this technology does have some significant practical applications and advantages in both consumer and professional worlds.

Immersive games should get a big reality boost for a start, and if mixing on headphones is necessary, it won't be such a hit-and-miss affair if your DAW or console headphone output can model stereo, surround, and immersive experiences comparable to loudspeaker reproduction at the touch of a button.

The Aural ID service should be available from Genelec very soon.

The SOFA file format is already in use in game development and is specified as the format of choice for Steam Audio from Valve Corporation, for example - a solution for developers that integrates environment and listener simulation.

Personalized HRTFs can be loaded into the Unity, FMOD, Unreal, and C environments, so expect to be able to load you Aural ID into your favorite VR game in the not-too-distant future...

A Head Related Future

In the creative space, you could argue that awareness of HRTF and its effects could inform mixers and engineers to an extent, particularly in narrative audio and effects for film and TV, for example. But because of the issues around headphones versus monitors, and the complications in generating content for every eventuality, history has generally settled for ignoring the HRTF principals, choosing to mix on monitors and leave everything else to take care of itself. Binaural productions have tended to be niche products because translation has been best assured using in-room monitoring.

Could personalized HRTFs be the next big step change for both the consumer and professional immersive headphone experience?

However, listening habits are changing and more people are putting on headsets and consuming content as a personal experience. Real time rendering of a binaural experience from immersive source material is already happening and will be completely relevant to how we approach broadcast audio production in the future.

Lawo

The Sponsors Perspective

Deep Dive Into Immersive Audio For All

The familiar “Faster, Higher, Stronger” motto is not just for Olympic athletes but also applies to the common man (and woman): The first black-and-white television sets were considered a sensation until color TV came along, opening a whole new dimension to the viewing audience. In parallel, cinema screens grew ever taller and wider. This went hand in hand with the switch from mono to stereo and a stunning series of dramatic boosts regarding picture quality. While 4K is still in the process of being implemented, more daring early adopters are already grooming their 8K offering.

Similar leaps and bounds occurred in the audio domain and were considered heaven-sent by the entertainment and broadcast sectors where operators were on the lookout for new, ever more spectacular ways of engaging with their audiences. Just think of quadrophony in the early 1970s or sports, concert and show telecasts in 5.1-Surround. What quickly became a standard in movie theaters eventually only made it into a disappointing number of home cinemas—the living room of most families firmly remained a “no-fly zone”, mainly for space and practical reasons. For a while, this seemed to put the great expectations and the ostensibly bright future of surround sound (5.1, 7.1, Dolby Surround, etc.) for the masses to rest.

The Irony Of Fate

True to the saying that hope is the last to die, countless public broadcasters and broadcast facilities kept investing in 5.1 audio and even took it to a point where they were no longer able to serve viewers with “only” two HiFi speakers a “proper stereo” sound. Down-conversions of their original multi-channel format were all they could muster.

Leading console manufacturers were only too willing to lend a helping hand and quickly came up with 5.1-bus desks. Still, as early as 2003, Lawo went one better by refusing to restrict its mc²-series consoles to a fixed number of multi-channels per bus. The engineers in Rastatt indeed realized that, for a convincing result 3D audio required a Z axis for vertical localization and hence more than six channels. Some call this approach “9.1”, others refer to it as “5.1.4”, “7.1.4”, etc.

For the London Olympics in 2012, the Japanese public broadcaster NHK devised its “Super Hi-Vision” project, which relied on 22.2 channels to match the revolutionary 8K picture quality with a genuinely immersive audio experience. Having been instrumental in bringing this project to fruition, Lawo leveraged its experience for the development of its Immersive Mixing Engine (LIME).

This seemed to mark the beginning of a bright future for immersive audio technologies—not least because there is currently an abundance of 3D solutions: Dolby Atmos, MPEG-H, AURO-3D, DTS:X, NHK 22.2, IMAX 6.0 and 12.0 as well as Sennheiser AMBEO 9.1 and later. The technology is available, and there are clear signs that new developments will be announced in 2019. The only snag is that general adoption of this immersive prowess has been so subdued that some broadcasters are seriously considering shutting down their 5.1 operations for reasons of unjustified cost. How come?

Practicability Comes Before Immersion

The main reason seems to be that consumers had to wait until 2019 before they could reasonably be expected to partake in these developments: as more than two speakers—preferably hidden in the TV set—are simply no option in most households, some manufacturers started developing soundbars and tools for binaural signal processing for headphones. These two listening solutions offer the advantage that they require next to no space while providing an immersive experience so convincing that no listener who has tried it will ever want to return to the two-dimensional stereo world.

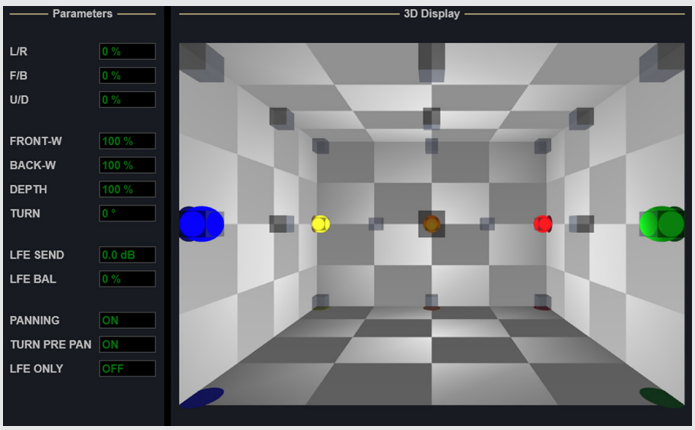
Providing a consumer-friendly infrastructure is thus paramount for the triumph of immersive audio technology and the success of any "new" playback format. Only now does it seem sensible for radio and TV channels to plan full speed ahead and match their superior picture quality with an equally rich audio rendition. The good news therefore is that all the pieces of the puzzle are slowly falling into place and will soon put a smile on the faces of both content providers and consumers.

And there is more: the object-based approach offers the additional benefit that consumers will soon be able to adjust the level balance to their own liking, i.e. to personalize their listening experience. This will come in handy for those wishing to improve the comprehensibility of dialogs without raising the overall playback level to an environment-hostile degree. Other options will include effectively muting commentaries for an unfiltered live experience. The audio information is indeed supplied as distinct channel groups, or stems, whose levels can be adjusted individually. It is left to the content providers' discretion how far they want to go with these additional options.

What Does This Mean for The Production Side?

Current trends seem to indicate that the immersive audio realm will eventually split into two territories—Asia and Rest of the World: In the US and Europe, Dolby Atmos is in the process of asserting itself, while Korea and China have set their ears on MPEG-H.

The immersive approach for objects, OTT content, binaural mixes, sound image personalization, etc., means more work for audio engineers. For instance, the fact that audio contents are consumed on a variety of platforms (telecasts, cable, internet streaming) and need to sound convincing on all of them requires substantially more monitoring than before. And we haven't even touched on errors likely to occur in stress situations when most processing parameters can only be tweaked on the outboard gear.



Close up on an immersive panning technology.

Features like Automix and Audio-follows-Video are generally considered a given. With its KICK software released in 2015, Lawo added automated control of mc² channels based on external tracking data. This system for a "crisp" and close-miked audio on soccer pitches is already mandatory in Germany's Bundesliga (first division) as highly complex mixing operations are carried out without the slightest artefact or phase glitch. KICK's reliability is such that the automation routines remain rock-solid all through extra time and the ensuing penalty shootout: all level balances remain consistent and reproducible, leaving sound engineers (AR1s) more time for other important tasks, like the overall mix.

Consistency is even more important in object-based offerings where an objective advantage for consumers needs to be achieved. Personalization will soon allow consumers to change the level balance. Yet this only makes sense if the provided audio objects are pro-grade. Crossfades, level jumps and crosstalk are artefacts content providers need to avoid at all cost for a satisfactory listening experience.

The Destination Is The Journey

The rising adoption of immersive audio can be felt everywhere—the number of new movie theaters with cutting-edge 3D audio technology keeps growing almost by the day.

Soundbars are taking over: The Yamaha MusicCast YSP-5600 sound bar uses sound beam technology and 44 speakers to produce a 7-channel surround image, including two height channels.

A new soundbar generation seems to have so much going for it that it will only be a matter of time before consumers give in to the undisputed advantages of immersive 3D sound reproduction. Immersive formats optimized for headphones will further stoke demand.

The attraction of interactive, object-based formats that broadcasters and broadcast facilities will offer soon cannot be overestimated. Its nicest side-effect is indeed that every consumer can shape their own listening experience by boosting some signals (and attenuating others), shortening contributions based on object metadata without losing important bits of information, or recreating the live atmosphere they remember from a stadium, arena, etc. In combination, these factors offer enormous potential for the market—and broadcasters will happily cater to these new expectations.

Lawo supports the adoption of immersive audio through the seamless integration of all relevant control features into its mc² consoles and will launch new solutions in the very near future. The next Olympic Games and other high-profile events are just around the corner. High time, then, that all parties concerned got cracking. From Lawo's point of view, the year 2019 will see widespread acceptance of immersive audio. Stay tuned for Lawo's product announcements later this year!

Immersive audio is bringing a whole new panning experience - 3D panning on a Lawo MC²66

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