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B-Format for VR

How did we get here, why, what does the workflow look like today?

SENNHEISER



Cinematic VR Format Progression



- ▶ Nothing!/Stereo
- ▶ Quad Binaural
- ▶ Dolby ATMOS for VR
- ▶ Finally settled standard, Ambisonics b-format



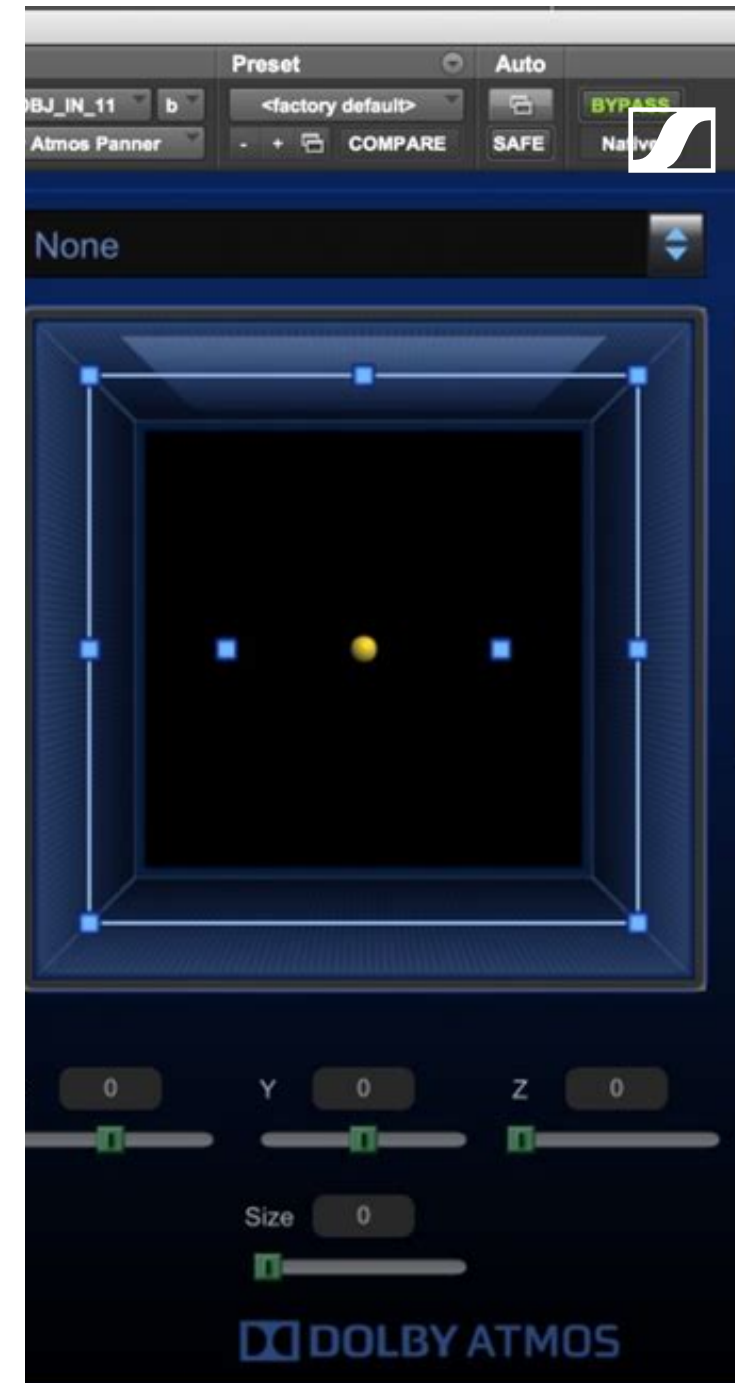
Static Binaural/Quad Binaural

- ▶ Before Binaural, most VR video was distributed without any audio at all or stereo. First major example of VR Video with immersive audio is Chris Milk's *Sound and Vision* project with Beck
- ▶ Showed the potential of immersive audio
- ▶ Easy playback (and interpolation) for VR video
- ▶ First format supported for distribution on a common platform
 - Milk VR, later called Samsung VR
- ▶ Problems:
 - Fixed HRTF, No height information, hard to add additional sound sources, limited specific orientations/no full sphere



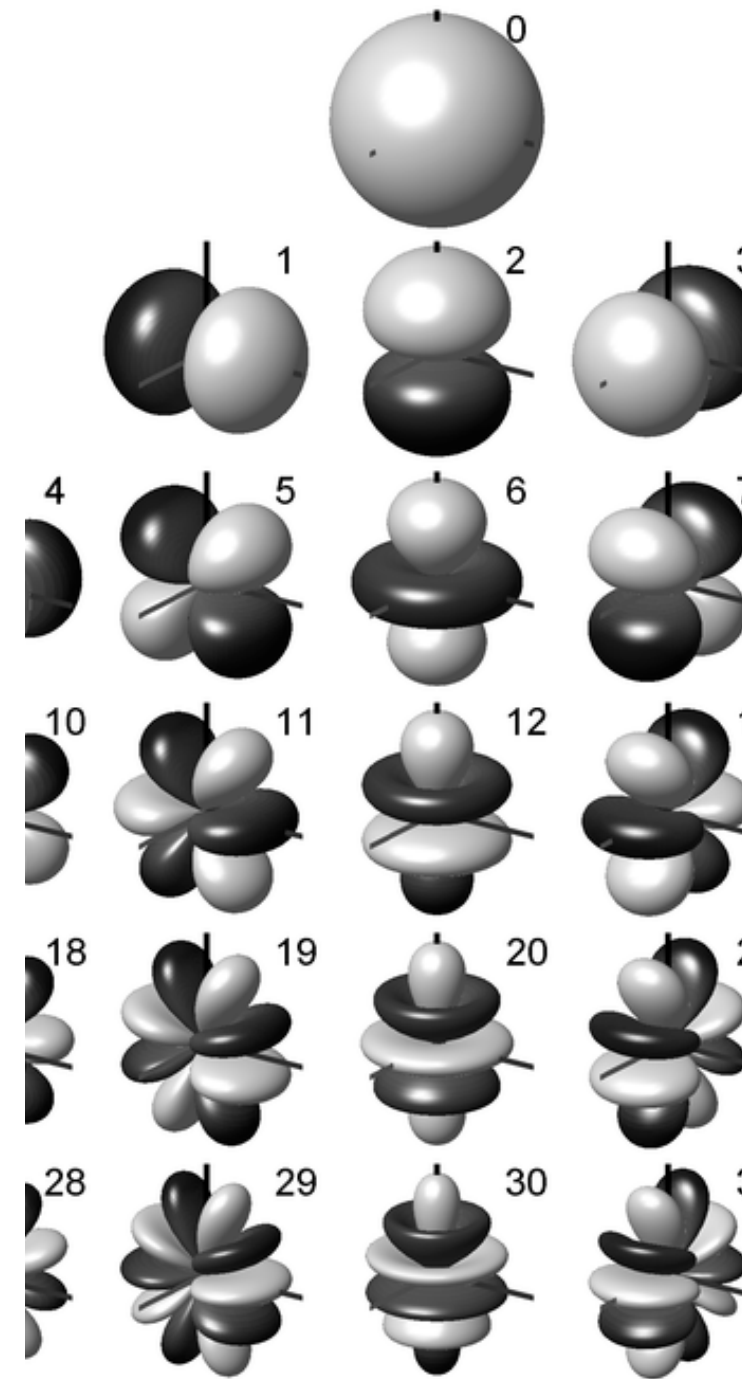
Dolby Atmos for VR

- ▶ Dolby attempted to establish Atmos as the standard for virtual reality content
- ▶ Allowed major content producers to reuse the tools they had purchased already for traditional cinema
- ▶ No relearning of new tools
- ▶ Hybrid bed and object format, allowed for specific high resolution rendering of objects
- ▶ Problems:
 - Front biased, relied on licensing model borrowed from traditional cinema, closed format/Dolby specific rendering, bed only supported channel based arrangements



B-format

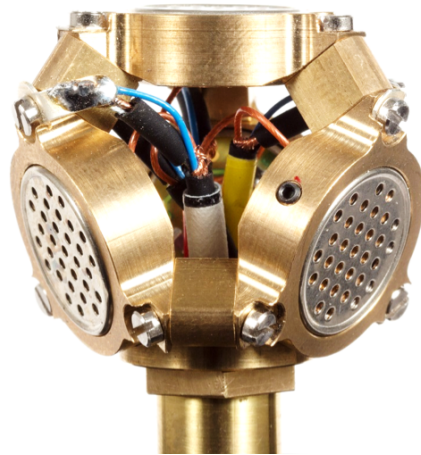
- ▶ Patent free, open and portable format
 - No licensing!
- ▶ Full sphere description, easy and flexible rendering
- ▶ Easy ability to add additional sound sources with panners
- ▶ Legacy of work around the format from the 70s on...
- ▶ Scalable resolution/data rate with order
- ▶ Full and widespread workflow support and wide spread distribution platform support
- ▶ Problems:
 - Resolution not as precise as object/hybrid format



B-format Standard Establishment Timeline 2015-Present

- ▶ Legacy microphones and software tools from the 70s+
- ▶ **2014:** VR really begins to start getting attention
- ▶ **Fall 2015:** Sennheiser begins producing prototypes of A-format microphones in late 2015 after year of studying the burgeoning VR Market
- ▶ **Spring 2016:** Google announces YouTube FOA B-format support in early 2016, full support not introduced until later that year
- ▶ **Summer 2016:** Two Big Ears acquired by Facebook, Facebook releases Spatial Workstation toolset for free
- ▶ **Summer 2016:** Facebook implements mixed-order B-format in Summer 2016
- ▶ **Fall 2016:** Sennheiser releases AMBEO VR Mic
- ▶ **2017:** Facebook announces full support for 2nd order playback 2017



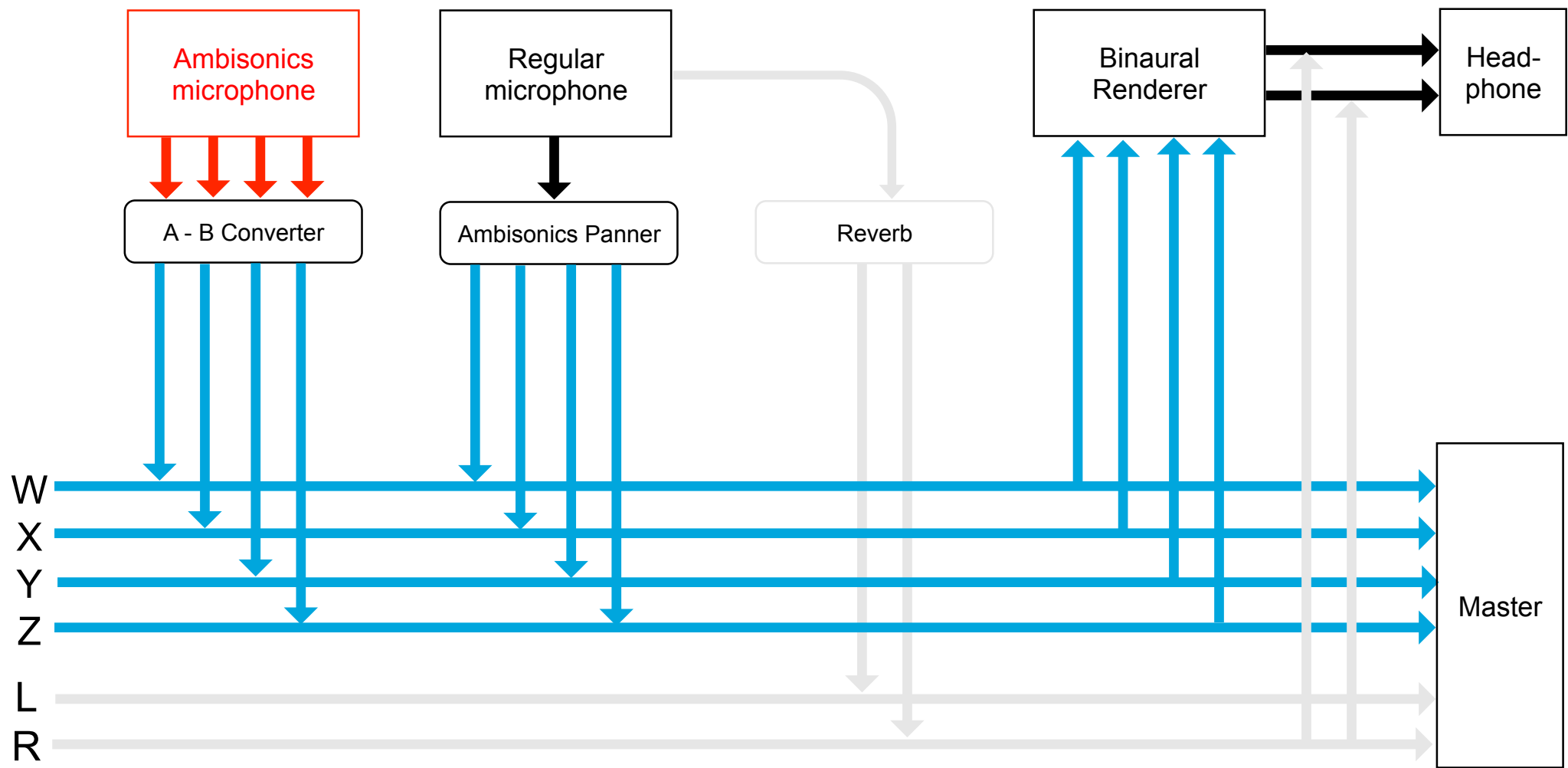




Panned Spot and
Sample Sounds

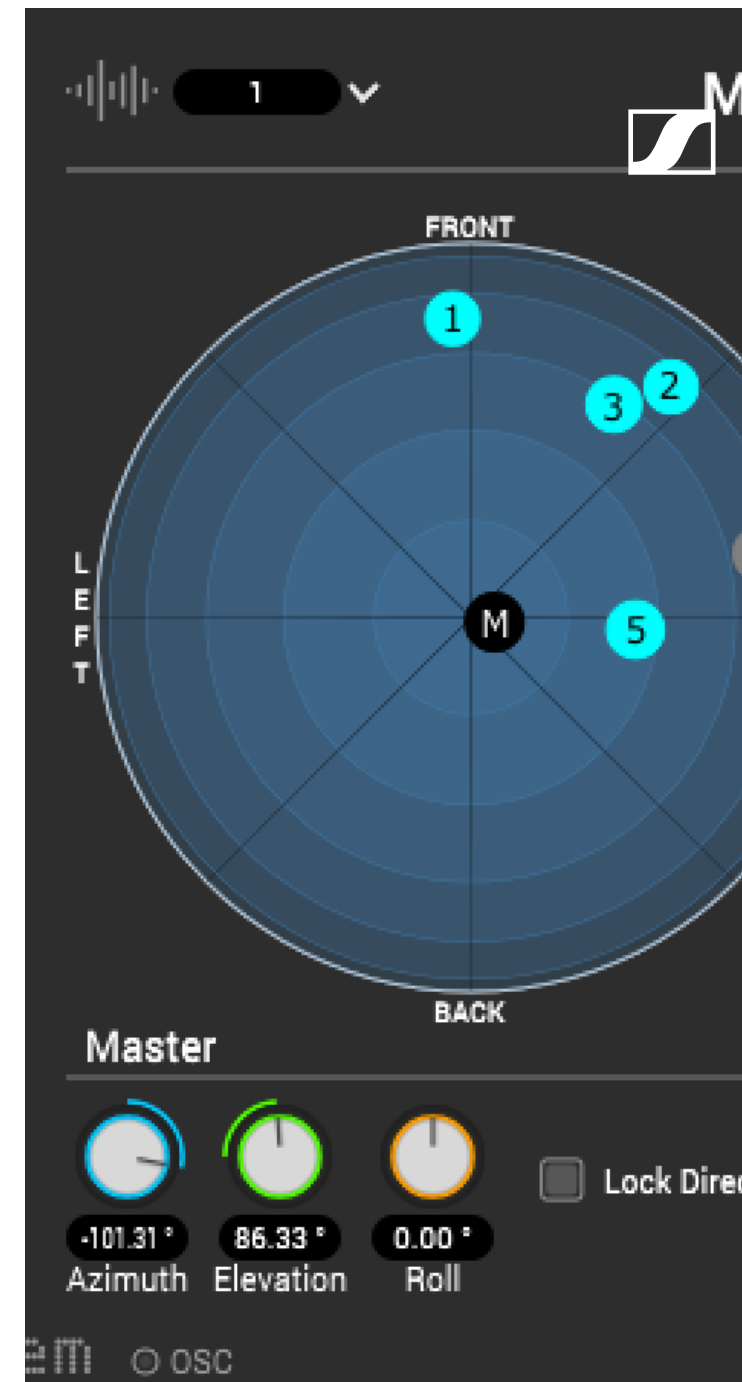
Ambisonics Mic
Recorded Bed

Standard workflow diagram for DAWs (First Order Example)



Spatialisers / Ambisonic Panners

- ▶ This is the main tool in the generation of synthetic Ambisonic signals
- ▶ Ambisonic panners take mono, stereo, and 5.1 sources and encodes them into an Ambisonics signal
 - Output of these plugins are first, second, third etc Ambisonics signals
- ▶ Operation is (relatively) simple, just specify where in space the sound should come from.
 - It becomes more complex when you are trying to track specific visual cues and do automation, though more advanced tools that allow you to mix in VR can assist with this.
- ▶ Some more advanced panners add additional features such as common room modeling reverbs and other effects that can be baked into the encoded signal



Binaural Renderers

- ▶ **As Ambisonics is a speaker independent format, you need to decode it in order to monitor while you are working**
- ▶ **Binaural rendering works by processing the Ambisonics signal through an HRTF or Head Related Transfer Function**
- ▶ **It is always best practice to use the renderer that you will be deploying to, as renderers can vary significantly in their effect and coloration**
 - As Ambisonics is an open and non-proprietary format it is easy to swap out other binaural renderers on your 3D master bus depending on which plugin you plan to use in your integration into your game engine
 - Supported for: BlueRipple, Sennheiser White Label, Google Resonance



Advanced Tools

► Virtual Reality Mixing

- Helps the spatialization process by allowing for sounds to be encoded in context. Available from DearReality and Blue Ripple.

► Object audio audition tools

- Possible with plugin from the Oculus Audio SDK, Google Resonance
- Allows you to hear what objects would sound like in combination your Ambisonic mix, particularly helpful to understand interplay with essential objects

► Ambisonics manipulation

- Allows for the manipulation of Ambisonics signals in a „spatially aware“ way
- EQ, Compressors, „Focus“/Attenuators, etc





Reccomended Free and Paid Toolchains for Ambisonics Production

► Free Basic Workflow

- Facebook 360 Spatial Workstation

► Paid Basic Workflows

- Audioease 360pan Suite
- Noisemakers Ambi

► Free Advanced Workflows

- IEM Ambisonics Plugins (Ambisonics manipulation)
- Kronlacher ambiX Plugin Suite (Ambisonics manipulation)

► Paid Full Advanced Workflows

- Blue Ripple Sound Third Order Ambisonics (Ambisonics manipulation, VR mixing)