MDA MULTI-DIMENSIONAL AUDIO
## A 3D AUDIO SOLUTION FOR PROFESSIONAL APPLICATIONS

OVERVIEW

An open and extensible multichannel immersive audio format that uses audio objects accompanied by positional rendering metadata facilitates the creation, archiving and distribution of interactive 3D digital media content.

CHANNEL-BASED AUDIO

Currently, multichannel audio content creation and delivery relies on assumed speaker configurations. While effective mixes for standard 5.1- or 7.1-channel surround sound speaker configurations are achievable, more immersive sound fields require a larger number of speakers for which no standard number or configurations presently exist. Without knowing what the speaker layout will be at rendering time, content creators face a real challenge in producing appropriate channel-based mixes. In addition, adapting an original channel-based recorded soundtrack to multiple consumer playback configurations requires producing multiple versions of the original recording or applying spatial audio format conversion methods that often degrade the original audio quality.

In interactive audio applications, audio scene description parameters can only be estimated at playback time. If using *channel-based* formats, metadata that includes the dynamically varying positions of virtual sound sources is unavailable. The geometric description of the audio scene is instead implicitly and heuristically derived from the output signal channels, and only valid for a particular loudspeaker playback configuration. Thus, the creation of dynamically moving audio entities is compromised when the playback system parameters differ in number of speakers, speaker locations, etc. from what the content author worked with. In essence, channel-based audio may limit the ability to convey the intent of the content producer.
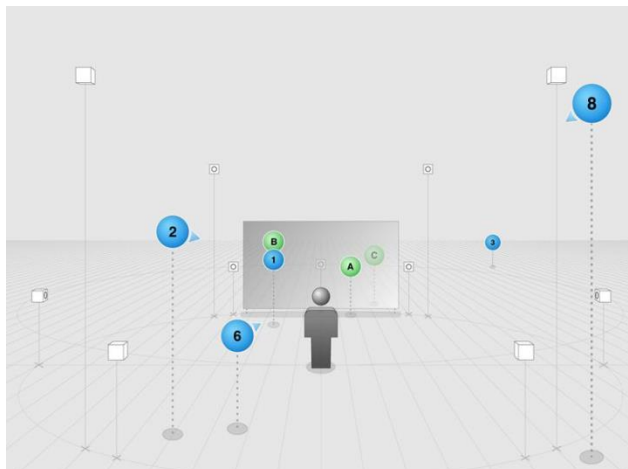
## A SOLUTION WITH NUMEROUS BENEFITS

Borrowing the concept of *object-based* audio from interactive audio applications such as computer music, virtual reality and gaming systems, avoids the constraints of channel-based audio and allows for immersive, three dimensional audio environments to be created. An object-based audio content

format allows content creators the ability to craft one program that can be played using any playback configuration, thus removing the burden of producing multiple output formats and replacing it with a streamlined process for creation, archiving and distribution of digital media content. The advantages of object-based audio include enabling the most faithful spatial audio reproduction possible on the target playback system configuration, and flexibility in the setup of multichannel sound systems.

For broadcast or video-on-demand service providers, an object-based audio format enables having a single inventory while catering for different delivery channels, languages, hearing or visually impaired consumers, and listening configurations including enhanced reproduction over headphones, in noisy environments, or at night time. When delivered to the home, consumer versions of object-based audio formats offer additional flexibility for personalization and interactivity.

MDA PROGRAMS

MDA stands for *Multi-Dimensional Audio* and is a new format for recording, transmitting and rendering three-dimensional audio. MDA differs from channel-based audio in that it does not explicitly assign audio waveforms to specific speakers. Instead, it describes a collection of dynamic audio objects positioned in space that jointly comprise a three-dimensional sound field. Each object is a point or extended sound source existing at a given spatial position for a specified interval in time. These objects are archived as uncompressed PCM data with a complete description of the audio and its position. An MDA renderer uses the geometrical layout of the available speakers at render time to compute specific waveforms for each speaker to optimally recreate the intended sound field as specified in an MDA bitstream. There is no practical limitation to the number of audio objects in an MDA program.
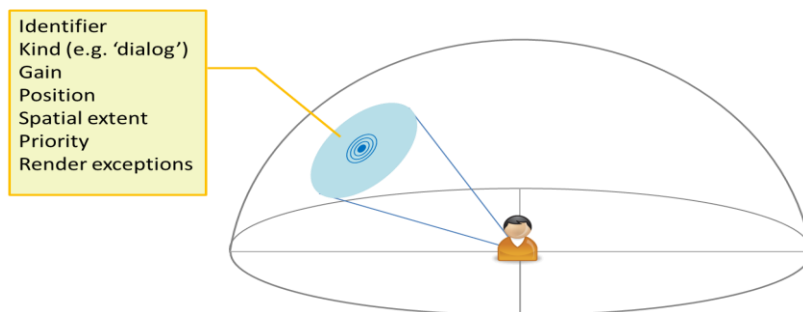
MDA separates the speaker layout at rendering time from the artistic intent at creation time. The audio contained in the program can be played back optimally in any speaker configuration, even those that deviate from standard recommended professional layouts. The same bitstream can be rendered on a simple 5.1 setup, a more advanced 7.1 setup, or all the way up to a 48-speaker configuration or more. The availability of the sound field as a description of objects in space allows modes of playback and interactions not available in channel-based audio.

Because the audio objects are rendered into the mix at playback time, the output can be highly personalized to the reproduction environment by providing a selection of multilingual, hearing impaired, or visually impaired objects that can be optionally included in the mix at the discretion of the user. Future MDA bitstreams will provide the ability to encode object-specific loudness and dynamic range control information. Use of that information along with context aware rendering can reduce the need for head-end pre-processing and can increase fidelity.

The MDA specification has three components: the MDA program specification, the MDA reference renderer specification, and the MDA bitstream specification. The MDA program specification stipulates the metadata in MDA, including metadata hierarchy and structure. The MDA program specification intentionally does not describe a file or bitstream format. The MDA reference renderer denotes the expected acoustical meaning of metadata and waveforms in an MDA program. Finally, the MDA bitstream specification provides a serialization of an MDA program. It describes a fragmented file format, with each frame in an MDA file playable independently of previous or future frames. MDA files have the extension `.mda`.
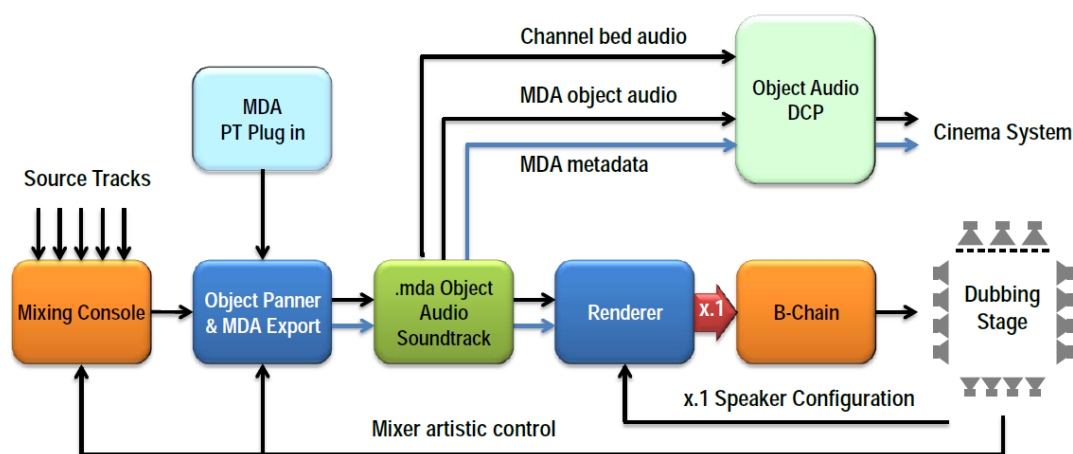

Figure 1: MDA Workflow.

The intended use of MDA is professional applications, primarily Digital Cinema and broadcast. It is not directly suited for consumer applications as the audio essence is stored as uncompressed PCM. However, MDA does allow for easy transformation to other formats (including object-based formats) suitable for home delivery.

EXTENSIBLE METADATA FOR FLEXIBLE RENDERING

All of the information regarding each particular audio object in an audio environment is stored in the MDA file. The archiving is done in such a way that audio delivery and playback may be performed by any number of different systems at any point in the future from the same archival source. This allows companies and individuals the ability to create brand differentiation while maintaining consistency of playback in all rooms. The extensible nature of MDA allows for possible future feature expansion.

AVAILABILITY

The MDA format (metadata and bitstream) as well as the MDA reference renderer are available as royalty free specifications for content creation and production in the professional space. The MDA format is supported by a royalty free SDK.

STANDARDIZATION

The MDA Program was developed in collaboration with a group of industry partners and incorporates feedback from audio engineers, mixers, and broadcasters to meet the requirements of the cinema and broadcast industries. The MDA specification has been submitted for inclusion in immersive sound standards with three international standards organizations: SMPTE for D-Cinema applications, and ETSI and the ITU for broadcast content creation. Standardization allows for further input from the appropriate industries and ensures a high quality of output in the programs.

THE MDA TOOLKIT

There are several tools that may be used to create, mix, and render MDA 3D audio programs to loudspeakers. Some of those tools are highlighted below along with a short description.

- **MDACreator** is a plug-in for use in Avid Pro Tools to position and mix together audio objects and create MDA files. MDA Creator enables the mixing engineer to control the position, movement, and related spatial aspects of each audio object. Monitoring of the audio is done in real time while mixing.

Figure 2. MDA Creator Instance in Pro Tools session.

- **MDAPlayer** is a stand-alone GUI application for MDA file playback.

CONCLUSION

With the development of upcoming Ultra High Definition TV standards and the emergence of Immersive Audio systems in movie theaters, next-generation multichannel audio technology for the cinema and broadcast industries must be easy to use, extensible, and affordable. The MDA format, with its tested functionality, performance and open nature, meets these requirements. MDA allows content creators to produce immersive 3D audio sound fields that can be reproduced in many environments.