



SINGAPORE HARDWARE Zone

Videocards - 3D cards - Soundcards - CD-ROM - Network cards - SCSI Adapters - Motherboards - Printers - Modems - Game Controllers - Scanners - PC Speakers

SINGAPORE's PREMIER SOUND CARDS ROUND UP

- 1) **DIAMOND MonsterSound MX300 PCI Sound Card (Vortrex+ 2 : A3D 2.0)**
- 2) **CREATIVE Sound Blaster LIVE! PCI Sound Card (EMU10K1 : EAX)**
- 3) **CREATIVE Sound Blaster LIVE! Value PCI Sound Card (EMU10K1 : EAX)**
- 4) **AZTECH PCI 338-A3D PCI Sound Card (Vortrex 1 : A3D 1.0)**
- 5) **YAMAHA WaveForce 192XG PCI Sound Card (XG : Direct Sound/3D & A3D 1.0 compliant)**

- Reviewed by Matthew Fam Kai Liang (27/09/98) -

EXPLORE : Technologies Behind

Each product has it's own unique advanced technology behind. The outstanding EAX or A3D 2.0 Wavetracing technologies are just an example of the many unique technologies you should know. In the next section, we will brief you on the meaning, construction and architecture behind the very design of the technologies of

- 1) 'Environmental Audio Extension' by CREATIVE (E-mu Lab)
- 2) 'A3D 2.0 Wavetracing Technology' by AUREAL Lab
- 3) 'A3D 1.0 Positional Surround Technology' by AUREAL Lab
- 4) 'Sondius physical instrument modelling algorithms' by CRL Sensaura

Only by understanding the technology behind will you be able to understand the special feature of each card. It also expands your knowledge and at the meantime help you appreciate the value of the particular card you intend to purchase.

So now just scroll down for the wave of the Wavetracing technology or the Environment feedback on you by the Awesome EAX technology. Bear in mind this page might be VERY VERY LONG WINDING.....

< [EAX](#) > < [A3D 2.0](#) > < [A3D 1.0](#) >
< [Sensaura](#) > < [So What ?](#) >

CREATIVE's *Environmental Audio™ Extensions* (EAX)



Microsoft has incorporated functionality into DirectX that allows game designers to incorporate 3D positional audio into their games. But the current DirectSound 3D API does not provide enough information to move beyond the existing 3D audio technology. Specifically, there is no method of specifying any sonic environment. Thus no reverberation can be applied. Distance is simulated only by loudness, and the sound designer for a game has a choice of recording the sounds of objects including reverberation (which won't localize well), having a "dry" sounding game, or foregoing use of 3D audio. Neither of these choices is appealing.

Fortunately, DirectSound 3D allows enhancement of the API by the use of Property Sets, and

Creative, working with Microsoft and other industry leaders, has finalizing a property set which will allow the addition of reverberation to the DirectSound 3D API. This property set is called the Environmental Audio Extensions (EAX). The property set is non-proprietary; indeed Creative is working with Microsoft to incorporate the Environmental Audio Extensions into a future revision of DirectSound 3D.

The operation of a DirectSound 3D property set is shown schematically in figure 5. For the standard DirectSound methods, when DirectSound is invoked, the sound card driver is queried by the operating system, and acceleration of the standard methods is arranged if supported; if not software emulation is performed. Then if the application is prepared to take advantage of the additional capabilities implemented in a property set, it queries DirectSound as to whether the property set is supported, and this query is passed on to the sound card driver. If the property set is supported, the query succeeds and the additional methods in support of the capabilities become available to the application. Note that the features in the property set need not be accelerated in hardware. While the Sound Blaster Live! Card will support EAX with hardware acceleration, the property set can be made available via software emulation as well.

The Environmental Audio Extension property set controls a number of properties which control the reverberation and audio reflections. The basic properties are enumerated in table 1.

DSPROPSETID_EAX_ReverbProperties
 DSPROPERTY_EAX_VOLUME
 DSPROPERTY_EAX_REV_DECAY_TIME
 DSPROPERTY_EAX_REV_DAMPING
 DSPROPERTY_EAX_ENVIRONMENT

Table 1 - Primary EAX Property Set

These primary reverb properties allow the game designer to specify the relative loudness or volume of reverberation in the environment, how long the reverberant decay of the space is, and the general damping properties of the walls of the space. We'll see what the "environment" property does a bit further below. Table 2 shows some additional "custom" properties which provide further control over the environment. DSPROPERTY_EAX_SIZE
 DSPROPERTY_EAX_LF_DECAY DSPROPERTY_EAX_DIFFUSION Table 2 - Custom EAX Property Set These custom properties control several more nitty-gritty details of the reverb, including the room size, the low frequency decay (which relates to the humidity) and the diffusion of the chamber (which relates to the coarse texture and geometry of the walls). Additional custom properties will be released in the future. All this is likely beyond the level of detail the typical game designer is interested in dealing with when under pressure to ship the title. While all the parameters are necessary, they are specified in terms an audio engineer, not a dungeonmaster, would understand. So to help out, included in the EAX SDK is a set of presets which specify named environments, some examples of which are presented in table 3. These presets can either be used as supplied, or as points of departure for experimenting with new environments. When the property DSPROPERTY_EAX_ENVIRONMENT is set to one of these presets, the other properties acquire default values and an "instant" environment is created.

EAX_ENVIRONMENT_SMALLROOM
 EAX_ENVIRONMENT_LARGERROOM
 EAX_ENVIRONMENT_PADDEDCELL
 EAX_ENVIRONMENT_BATHROOM
 EAX_ENVIRONMENT_CAVE
 EAX_ENVIRONMENT_CANYON
 EAX_ENVIRONMENT_STONECORRIDOR
 EAX_ENVIRONMENT_UNDERWATER

Table 3 - Typical Reverb Presets

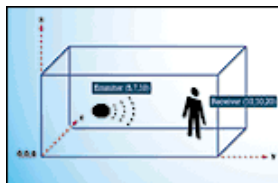
By adding reverberation as a simple "preset" which is specified using the property sets associated with EAX, the game programmer now has a method to get live, reverberant sound as well as 3D audio.

One final thought I'd like to present before we leave the topic of reverberation: for many years we've heard claims from lots of advertisers that they have ways of enhancing the music and sound we hear. One often wonders why the producers of professional audio recordings - all the movies, TV, and music we hear, don't make use of these supposedly marvelous "stereo enhancement" technologies when the recordings are produced. The answer is that recording

studios have their own method of "enhancement," and that is the professional reverb! Simply stated, reverb is the best "ear candy" any amount of money can buy!

Environmental Audio is the next audio platform by Creative. Its revolutionary technology recreates real-world multi-dimensional audio on your PC. It immerses you in sound so vivid, you experience games, music, and other existing audio applications rather than just hear them.

By nature, the human ear is intolerant of audio imperfections. The Environmental Audio Platform addresses this problem by introducing a system comprised of several key components.



E-mu Environmental Modeling

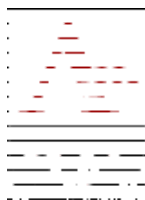
Environmental Audio Software Technologies created by E-mu Systems♦, Inc., a subsidiary of Creative, that provides high-end audio equipment to Hollywood studios, will change the way you perceive audio forever. They include: E-mu Environmental Modeling™, which accurately positions audio objects in a 3D space by rendering audio reflections and; Creative Multi Speaker Surround™, which allows real-time panning and mixing of multiple sound sources using two or more speakers. These technologies will greatly enhance audio content from the past, the present, and the future.



Environmental Audio Speaker System is a new line of multi-channel speaker systems from Creative that will deliver the full potential of Environmental Audio. The PCWorks™ FourPointSurround™ speaker system is the best companion for your Sound Blaster Live!. It offers four compact satellite speakers and a powered subwoofer. The Desktop Theater™ 5.1, a great companion for your PC-DVD system, is a five-satellite plus powered subwoofer speaker system with an amplifier and a built-in Dolby♦ Digital decoder.

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AUREAL's A3D 2.0 Wavetracing Technology



A3D 2.0 Overview Building on the breakthrough success of A3D, Aureal is introducing A3D 2.0 as the next generation of its positional 3D audio standard. Designed to take full advantage of Aureal's upcoming Vortex 2 chip, A3D 2.0 is fully backwards compatible with A3D while introducing the following advances:

Vortex 2 support: more 3D sources, higher sample rate, bigger HRTF filters

Aureal Wavetracing™: real-time acoustic reflection, reverb and occlusion rendering
 A2D: host CPU based A3D emulation mode for non-accelerated PCs
 A3D API: all-in-one interface to support A2D, A3D, A3D 2.0 and DirectSound3D
 Advanced resource management features
 A3D authentication protection

More 3D sources

Current A3D systems can render 8 concurrent sound sources in 3D space at any given time. While sufficient for today's games, the next generation of 3D applications is pushing this number to 16 sources, as provided by Aureal's Vortex 2 chip for a richer listening experience. Additionally, Vortex 2 provides up to 64 3D reflection sources, used by Aureal's Wavetracing technology to render sound reflections off of walls and additional objects in the 3D environment.

Higher sample rate and bigger HRTFs

Current A3D systems render audio at 22kHz sample rate. Vortex 2 significantly improves 3D audio positioning accuracy and overall quality by raising the rendering rate to 48kHz. At the same time, the length of HRTF filters (Head Related Transfer Function: the set of audio filters that form the core of positional 3D audio processing) has been doubled to apply 3D processing to the full 48kHz frequency spectrum of a sound source. The result is a new standard of quality for positional 3D audio (before anyone else has come close to reaching the current standard set by A3D).

Aureal Wavetracing technology

Developed over many years in conjunction with clients such as NASA, Matsushita and Disney, this new technology is a key advancement for A3D 2.0. Aureal Wavetracing parses the 3D geometry description of a space to trace sound waves in real-time as they are reflected and occluded by passive acoustic objects in the 3D environment. This means that sounds cannot only be heard as emanating from a sound source in 3D space (as in A3D), but also as they reflect off of walls, leak through doors from the next room, get occluded as they disappear around a corner, or suddenly appear overhead as you step into the open from a room. Reflections are rendered as individually imaged early reflections and as reverb late field reflections. Acoustic space geometries and wall surface materials are specified via the new A3D 2.0 API. The result is another quantum leap in audio rendering realism similar to the one experienced by listeners when switching from stereo audio to current generation A3D rendering.

Figures 1-3 illustrate Aureal Wavetracing in action in different 3D space geometries:



Figure 1: no geometry, only a listener and a sound source, resulting in standard A3D direct path rendering (red line)

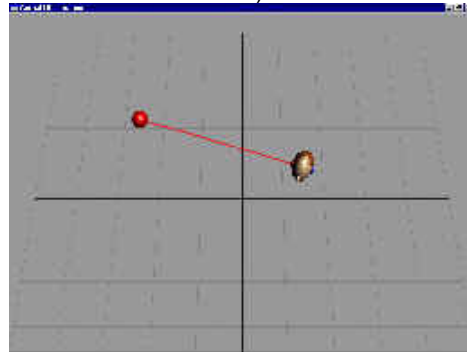
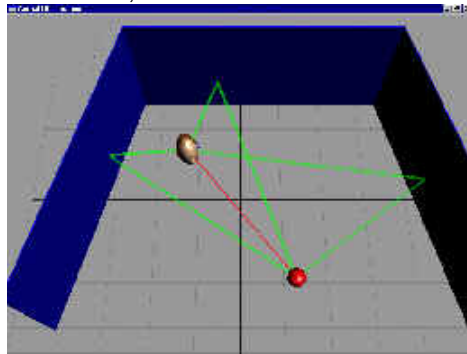
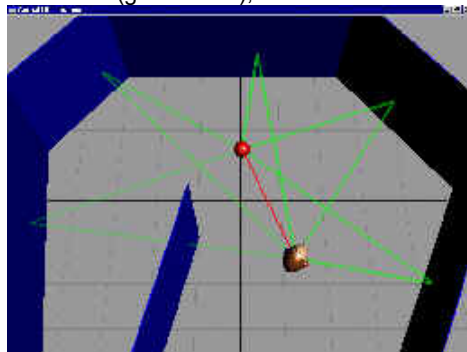


Figure 2: simple reflection case: listener, sound source and 3 walls that reflect the sound (green lines)**Figure 3:** more complex reflection/occlusion case: listener, sound source, direct path (red line), and 6 walls that are reflecting the sound (green lines), with one reflection being occluded

A3D API

The A3D 2.0 SDK features a greatly expanded A3D API (Application Programming Interface). It combines support for baseline audio playback and 3D positioning features with new resource management, 3D geometry and 3D scene management functions. Designed for simplicity, efficiency, and to mirror known paradigms from 3D graphics APIs, the A3D API represents the leading edge of interactive audio functionality. It also delivers 3D audio device independence without frame rate performance penalties: an application coded to the A3D API will run on any Windows PC with any audio sub-system. A3D drivers will automatically ensure that A3D 2.0, A3D, DirectSound3D hardware will be engaged to the fullest possible extent.

Advanced resource management

Current A3D systems feature an intelligent resource manager that automatically maps complex acoustic spaces as defined by applications to the limited audio hardware resources available in a system. In other words, the application can play as many sounds as it wants without having to worry about what kind of audio sub-system it is playing on. The real-time resource manager efficiently picks out the most important sounds to play on available audio resources. A3D 2.0 further enhances this feature by adding new capabilities such as: support for looping sounds, sound source priorities, audibility culling, reflection management and room geometry culling.

A2D

A2D is an A3D software fallback engine, used to emulate A3D on systems that have no 3D audio hardware support. A2D can also be used to "backfill" software rendering buffers if an application runs out of A3D hardware resources. A2D is based on a heavily speed optimized, feature reduced version of A3D and runs stand-alone on any host CPU. As a result, A2D extends A3D 2.0 to offer developers a true all-in-one audio solution and a single API to code to.

Written in tightly optimized x86 assembly code, A2D significantly outperforms any other host based software fall-back solution with higher speed (lower CPU usage) and higher quality (better mixing, sample rate conversion and positioning algorithms).

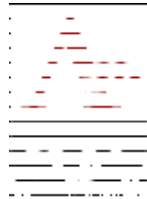
Finally, A3D 2.0 drivers will also automatically support generic DirectSound3D hardware accelerators to ensure that A3D 2.0 applications will span the entire range of audio platform (in descending order of number of A3D 2.0 features):

1. Vortex 2

2. Vortex 1 and other existing A3D platforms such as the original Diamond Monster Sound
3. Generic DS3D hardware accelerator
4. Generic stereo legacy hardware (ISA)

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AUREAL's A3D 1.0 Positional Surround Technology



A3D 1.0 Overview Aureal A3D is a breakthrough new audio technology that enables a real-life audio experience by surrounding the listener with sounds in all three dimensions using only a single pair of ordinary speakers or headphones. Aureal 3D is based on recreating all the hearing cues that allow us to perceive sounds in everyday life. The key to A3D lies in the following fact: since we can hear sounds three dimensionally in the real world with only two ears, it must be possible to create sounds from two speakers that have the same effect.

A3D technology forms the basis for two groups of applications:



- **Aureal A3D Surround**

Produces Dolby(r) certifiable playback of surround sound encoded soundtracks over a single pair of speakers or headphones.

Aureal A3D Surround is based on Aureal A3D audio technology that allows exact placement of sound sources in the 3D space surrounding a listener using just two ordinary speakers or a pair of headphones. The key to A3D Surround is to combine Aureal A3D technology with a surround sound decoding technology such as Dolby(r) ProLogic(r) or Dolby(r) Digital AC-3(r). The surround sound decoder produces five audio streams that have been pre-mixed in a recording studio to create a sound field that surrounds the listener. Instead of playing those five streams back on five physical speakers, they are passed through the A3D Surround process that projects 5 "virtual speakers" into space. The result is a Dolby certifiable surround sound experience from just two speakers!



A3D Interactive

Enables interactive 3D audio - a highly immersive and realistic 3D listening experience - for video games, 3D Internet sites

and other interactive software applications. What is interactive 3D audio? Interactive applications are based on the idea of creating a virtual environment that can be navigated by a user while a story line unfolds in unpredictable ways based on the user's actions and inputs. The most fun and engaging environments are the very realistic ones that put the participant in the middle of a three-dimensional world with action happening all around: racing games, 3D Internet sites, flight simulators or first person video games to name a few. 3D environments are wildly popular and have actively pushed the envelope of 3D graphics systems in recent years. But what about audio? For audio to be interactive, it needs to be created "on-the-fly", just like the visuals. And to make the audio as realistic as the visuals, it needs to unfold all around the listener. If a monster enters a scene from behind you, its roar has to sound like it's coming from behind, so you can swirl around and face it.

Today's audio systems are not capable of such effects: stereo can only put a sound left or right. Extended stereo (a.k.a. 3D stereo) can put it a little further left or right, but still not above, below or behind. Surround sound can do behind, but won't work for interactive applications because the soundtrack needs to be pre-encoded. What is needed is a new technology that is interactive and allows for realistic, fully three-dimensional placement of sounds - Aureal A3D Interactive is that technology.

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CLR's Sensaura 3D Positional Audio Technology



Sensaura 3D Positional Audio Overview The key elements in a 3D-sound technology are the audio filters (which are used to spatially-position the sounds in three-dimensions), the transaural crosstalk cancellation (TCC) technology used to reproduce the 3D-effects via loudspeakers, and the efficiency with which these two blocks of audio processing can be carried out.

CRL has ported the Sensaura algorithm to a range of fixed- and floating-point signal processors. CRL has also developed the necessary interface software (HAL) for the DirectSound 3D*1 standard.

Transaural Crosstalk-Cancellation Technology

Transaural Crosstalk-Cancellation (TCC) technology is used to deliver the 3D-sound effects which are created by the HRTFs, when replayed over loudspeakers. Sensaura TCC has been developed in the most critical audio market of all: the music business. The Sensaura technology has evolved through many recording sessions at the famous Abbey Road studios in London, and Capitol studios in L.A., and it has been approved by "golden ear" producers and studio engineers. Poor TCC results in a narrow sound-image and uncomfortable listening effects. In particular, as the listener moves his head, some sounds will appear and disappear. Sensaura TCC has been developed to provide a completely natural listening experience, with no such artefacts. Evidence of this is provided by its successful application in the demanding area of classical music recording.

Efficiency

The length and accuracy of the HRTF filters are primarily determined by the accuracy of the original response measurements on the artificial (or real) head system. The Sensaura filters are efficiently implemented as FIR or IIR filters on a range of fixed and floating point DSPs. Sensaura technology also uses a highly efficient TCC algorithm. For PC applications, this provides the option of having minimal memory requirement for filter library storage, OR a greater number of positional filters (thus having smaller gaps) for smoother, 3D-sound panning. Inefficient audio-processing technologies result in a smaller number of available channels and also significantly greater chip cost. And, in addition, the HRTF library storage requirement is proportionately greater.

At a recent game developer seminar conducted by Psygnosis, the leading European game developer, all major 3D positional audio technologies were compared. The comparison report stated,

"[Sensaura's] sound was superior to the other systems, both in terms of overall quality and the 3D placement. This system also convincingly located sources off the horizontal plane as well as giving a good sense of distance and front-back placement. It also gives a larger than average sweet spot."

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So What ?

After reading all the technical specification, or maybe you have skipped them, you should have some idea of the architecture behind the different chipsets.

So let's just gear up for the all important review coming up. Before this, we bring you behind the scene of the equipment used for this MEGA review. And they are not lax in terms of quality, as said, you must compete with the best to bring the best out of the sound cards.

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Technical Specification Chart

Summary:

Card Name/Model	MonsterSound MX300	SoundBlaster LIVE	SB LIVE Value	PCI 338-A3D	WF 192XG
Manufacturer	DIAMOND	CREATIVE Lab	CREATIVE Lab	AZTECH Lab	YAMAHA
Chipset (Maker)	Vortex+ 2.0 (AUREAL - AU8830)	EMU10K1 (CREATIVE)	EMU10K1 (CREATIVE)	Vortex 1.0 (AUREAL - AU8820)	YMF724(XG)
Processing power	600+ MIPS	1,000+ MIPS	1,000+ MIPS	300 MIPS	1250 MIPS*
3D engine	16 channel Hardware-based A3D engine	32 DirectSound 3D streams @ 16 bit, 48 kHz	32 DirectSound 3D streams @ 16 bit, 48 kHz	16 bit, 48 kHz DAC	73 DirectSound 3D streams 16 bit, 48 kHz DAC
32-Bit Digital Audio Engine	26-point convolution interpolation	8-point interpolation 32-bit, 48 kHz	8-point interpolation 32-bit, 48 kHz	32-bit 48KHz	24MHz processor speed 32bit bus width
Wavetable engine	320 Voice (total) 64 (hardware)	512 Voice (total) 64 (hardware)	512 Voice (total) 64 (hardware)	64 Voice (total) 32 (hardware)	192 midi XG voice (64 hardware voice)
DMA Channels	96 DMA channels: 80 DS3D streams. 16 A3D streams	40 DirectSound streams 16 EAX ch	40 DS streams 16 EAX ch.	48 (16+32)	73 DirectSound streams
Speaker discrete Audio Output	HRTF for 2 out Front/Rear Out	HRTF for 2 out Front/Rear Out	HRTF for 2 out Front/Rear Out	HRTF for 2 speakers.	HRTF for 2 speakers.
Sound effect modelling	A3D 2.0 Wavetracing engine	EAX accelerator E-mu Environmental Modeling	EAX accelerator E-mu Environmental Modeling	Aureal 1.0	CRL Sensaura engine
Wavetable sample	4MB onboard (DLS capable)	2/4/8MB system Memory Maximum 32MB	2/4/8MB system Memory Maximum 32MB	1-4MB system Memory	2MB onboard + 2MB s/w
DOLBY DIGITAL (AC-3) support	YES (now)	Not Available (Under-Planning)	Not Available (Under-Planning)	NO	NO
Soft-DVD support	YES	NIL	NIL	NIL	NIL
Digital I/O	YES (S/PDIF)	YES. Digital I/O card supplied	Capable. Digital I/O connector	NO	NO
Soft-DVD support	YES	NIL	NIL	NIL	NIL
Signal / Noise Ratio	96dB	96dB/100dB(full)	96dB/100dB(full)	>93dB	>95dB
THD+N	0.002%	0.002%	0.002%	0.003%	

<https://assets.hardwarezone.com/2009/reviews/sound/roundup/sound2.htm>

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