

General

Zirene[®] is AM3D's post-processing solution and is capable of enhancing the audio (both speech and music) on devices such as mobile phones, TVs, portable music players and portable navigation devices or other kinds of devices where audio is essential for the user experience. The solution is purely software-based and is easily integrated into existing software systems.

The physical nature of mobile devices causes the listening conditions to differ greatly from what was expected by the authors of the media source. For example, stereo music and multi-channel audio are authored with specific loudspeaker arrangements in mind which are not directly achievable for the mobile user. Other limitations exist, caused by low acoustic output power and reduced frequency bandwidth.

To overcome the limitations of mobile phones and portable devices, AM3D is introducing Zirene[®], which offers world-leading audio enhancement technology based on AM3D's world patents.

Whether it is headphone or loudspeaker playback, Zirene[®] lifts the audio playback to a magnificent and powerful listening experience by adding high-quality audio effects such as expanding the size of the audio image, improving the low frequency sound perception and making it possible to experience the audio in various acoustical environments.

Zirene[®] offers the following features:

- Mono Widening
- Stereo Widening
- Virtual 5.1 Surround
- Reverb
- Sweet-spot Optimization
- Level Alignment
- Level Max
- Power Bass
- Treble Enhancement
- Transducer EQ
- Graphic EQ

Zirene[®] Mono Widening

In some cases where a monophonic audio signal is presented to a listener through stereo headphones, it is possible to improve the spatial properties of the sound image. Normally, the sound image will be perceived as being in the middle of the head. This unnatural listening situation can be burdensome, and can lead to fatigue after long periods of listening. Mono Widening moves the sound image to a position outside the head within a natural listening environment. This gives an enhanced feeling of comfort and relief during long-term use and brings the listener closer to a natural listening situation.

Zirene[®] Stereo Widening

In typical portable devices that have a set of stereo micro-speakers, the transducers are placed close together. When listening to music through these speakers, the stereo sound stage is very narrow. The intention was to play these signals back through loudspeakers placed at ± 30 degrees. The Stereo Widening algorithm creates virtual sound sources that are placed beyond the extent of the physical device. In this way, a much wider and more natural sound stage is perceived. See Figure 1.

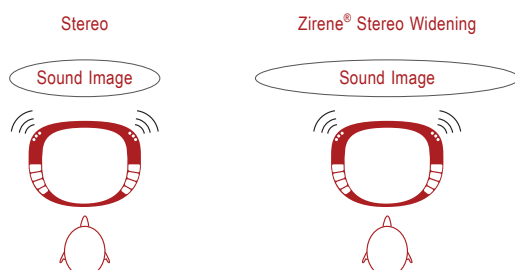


Figure 1: Stereo Widening effect.

The Stereo Widening algorithm also supports headphone playback. Normal headphone playback is often perceived as playing 'in the head'. This is an undesirable effect because the sound does not originate from two loudspeakers in a room in front of the listener. By using Stereo Widening for headphones, the user perceives the sound to be outside the head, which improves the overall listening experience.

Figure 2 illustrates how a user perceives the audio coming from two virtual speakers to give an 'out of head' listening experience.



Figure 2: 'Out of head' experience.

Zirene[®] Virtual 5.1 Surround

The introduction of video streaming in portable devices enforces the need for facilities which can play surround sound over headphones and closely spaced loudspeakers. Virtual 5.1 Surround makes it possible to experience a 5.1 Surround Sound set-up using headphones or narrow spaced stereo loudspeakers. To experience this, an illusion is created that the audio is actually coming from the five loudspeakers placed in a 5.1 set-up. See Figure 3. This illusion is created by the use of interactive binaural processing through worldwide patented Head-Related Transfer Functions (HRTFs).

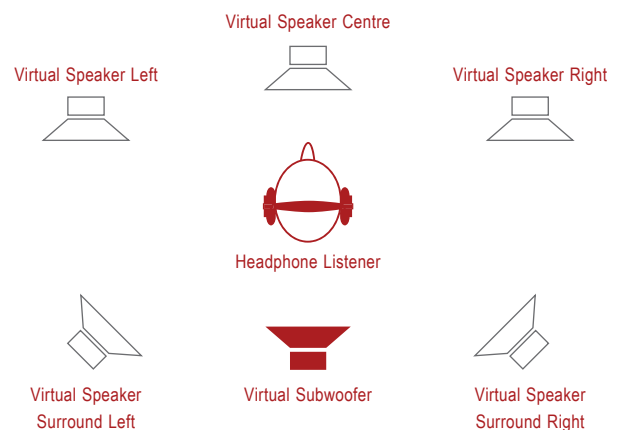


Figure 3: Virtual 5.1 Surround sound set-up.

Zirene[®] Reverb

Reverb is a sophisticated binaural room simulation algorithm for creating many different listening environments. The room simulation algorithm helps substantially to create the perception of distance. The focus in developing this algorithm was to create a high sound quality without using excessive processing resources. Furthermore, it is designed to allow for the creation of many different listening environments such as rooms, halls, an alley, an arena, a hangar, a cave, a plate etc. The user can select from a number of predefined listening environments and is then able to adjust the reverberation level and time.

Zirene[®] Sweet-spot Optimization

For devices that connect to car audio systems, Sweet-spot Optimization can be used to enhance the listening experience. When listening to music in stereo, it is desirable for the listener to be positioned symmetrically between the loudspeakers. However, this is typically not the situation in a car, and as a result the stereo image (sound stage) is distorted. Sweet-spot Optimization makes it possible to recover the correct stereo image as well as to ensure a clear centre image in front of the listener in the car.

Zirene® Level Alignment

The purpose of Level Alignment is to adjust the gain of different signals to compensate for the (potentially large) differences in sound level. This is useful when, for example, two consecutive pieces of music have very different loudness. This can be because songs (in MP3 format for example) have been recorded at different levels, because passages in a piece of classical music have very different volumes, or because the sound level of advertisements on the radio is much louder than the music being played. In such cases, Level Alignment effectively aligns the signals to minimize the difference, and softer pieces of music are much easier to hear as a result.

Zirene® Level Max

Level Max has the simple goal of boosting the level of the audio signal beyond what would be possible with a linear gain. In other words, the sound level is raised by means of non-linear processing. This is done without degrading the sound quality, the advantage being that small loudspeakers in a device can then deliver a much louder acoustic output.

Zirene® Power Bass

Power Bass is a bass enhancement algorithm that boosts the low frequency part of the signal and leaves the remaining part of the frequency range unchanged in terms of loudness and timbre. Through the application of our technology and drawing on our knowledge of how the human auditory system perceives low frequency tones, it is possible to create the perception of extreme bass enhancement without changing the amplifiers and loudspeakers already installed in the device. Power Bass maximizes the bass output depending on the amount of headroom available in the original signal. It is thus a non-linear bass enhancement process.

Zirene® Treble Enhancement

Since loudspeakers which reproduce sound in the low to mid frequency range are generally poor at reproducing high frequency sounds, a common approach in playback systems is to use a second loudspeaker for reproducing the high frequencies. Such a loudspeaker is often referred to as a tweeter. The Treble Enhancement algorithm developed by AM3D amplifies the high frequency content of an audio signal by means of non-linear processing, thus making it possible to manufacture playback systems without using tweeters. As a result, AM3D's Treble Enhancement provides a clear and crisp treble which emphasizes details that are usually lost in audio signals played on loudspeakers with poor high frequency playback capabilities.

Zirene® Transducer EQ

Often speakers especially in small devices do not have an ideal frequency response, e.g. some frequencies are reproduced louder than intended. The AM3D Transducer EQ compensates for this. The technology is based on an acoustical measurement combined with tuning by a sound engineer. By using Transducer EQ the overall listening experience will be improved considerably.

Zirene® Graphic EQ

Graphic EQ is a conventional ten-band graphic equalizer with attack frequencies from 31 Hz to 16 kHz with one octave of separation. The Graphic EQ's gain settings are converted internally to standard IIR filters to reduce the CPU load.

Graphic EQ also enables you to add a number of equalization settings for different kinds of music. This makes it possible to change the frequency characteristics of the playback system to suit a particular style of music. The following well-known music pre-sets are supported: classical, pop, jazz and rock.

Key features

- Works in any ANSI-C compliant platform
- No platform dependencies
- Input sample rate: 8-48kHz
- Input sample format: 8/16-bit, stereo/mono
- Output sample rate: 44100 Hz
- Output sample format: 16 bit, stereo

Integration of Zirene®

The Zirene® product is based on digital signal processing algorithms implemented in software and must be embedded into the software layer of the portable device. A conceptual block diagram of how Zirene® is integrated into a typical portable device is illustrated in Figure 4.

Whenever an audio signal is played back in e.g. a music player application, the audio signal must be routed through Zirene®, and the stereo output from Zirene® must then be routed to the codec and amplifier stage in the hardware layer.

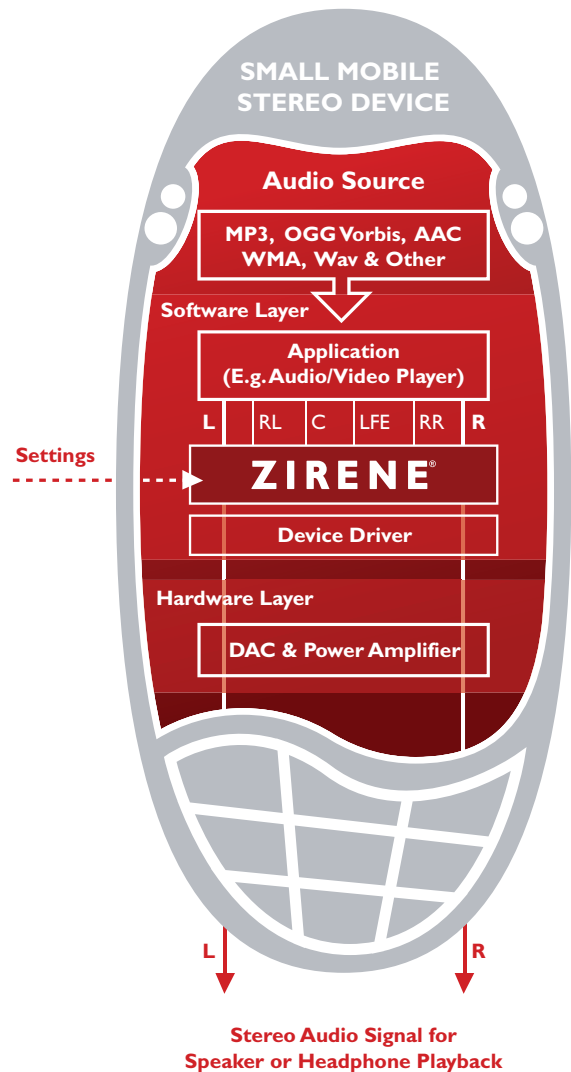


Figure 4: Integration of Zirene®.

Zirene® is easily implemented in existing software systems and is generic and module-based. The solution is not dependent on any external libraries, e.g. open source code, and is developed in ANSI C using assembly optimized code for the resource intense parts that are targeted at various platforms. An entirely ANSI C reference solution is available for fast prototyping on any customer device. Zirene® is already available for a number of platforms and can within a short space of time be ported to other dedicated platforms.

The Zirene® product can be customized to meet specific functionality, computation and memory requirements through the selection of individually requested processing elements.

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