Rapture3D Game Edition User Guide

v2.7.4

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1 Introducing Rapture3D

Thanks for using Rapture3D! Rapture3D works with computer games to give a full 3D surround sound experience.

This is help for the edition of the software which ships with games that are tuned to work with the Rapture3D OpenAL driver. This is known as the "Game" edition. There are "User" and "Advanced" editions too, which also use OpenAL and additionally support 3D audio playback. The "Advanced" edition also supports professional studio use of the Rapture3D Higher Order Ambisonic decoder.

Please note that this OpenAL driver is not the same as the newer Rapture3D "Universal" audio engine. This interacts with games in a different way.

1.1 Getting Started

Generally, Rapture3D will just work with your sound card settings, so if sound is working on your PC then you're probably ready to go. Although you may want to check your Windows "Advanced" sound card settings because Rapture3D works best when it knows exactly what kind of speaker layout (or headphones) you are using.

Once your sound card is set up, Rapture3D will choose sensible settings for your PC. But you may wish to use the Rapture3D Speaker Layout tool to tune things further so the sound is just as you'd like it.

2 Sound Card Set Up

Your sound card was probably set up when you bought it, although the settings may have changed depending on what you've connected to it since. If your computer can play music or films with sound, make telephone calls or even just play the Windows "welcome" jingle then you're probably ready to go.

You need a DirectSound-compatible sound card for this edition of Rapture3D to work properly. This is the normal type for Windows, so if other sounds are working then Rapture3D probably will too. If not, then it's probably best if you talk to the shop where you bought your computer (or a friendly expert) before continuing here. To avoid embarrassment, you might want to check you've connected up your speakers or headphones correctly (the instructions probably came in the box with your PC).

Rapture3D works best if it knows exactly how your speakers are set up. If you're feeling brave, you can "Configure" your Windows sound card to choose the layout you want. This is particularly important if you're using headphones or a "surround sound" system with more than two speakers. On some systems (but not all) you can also check and change these through the Rapture3D Speaker Layout tool using the Layout tab.

2.1 What Is A Sound Card?

Once upon a time, a sound card used to be a computer expansion card (a circuit board) that was slotted into the back of a PC to produce sound. These days the electronics needed is often built into the main body of the PC or connected using USB, so there isn't really a "card" involved at all. But we often still call the electronics involved a "sound card" anyway.
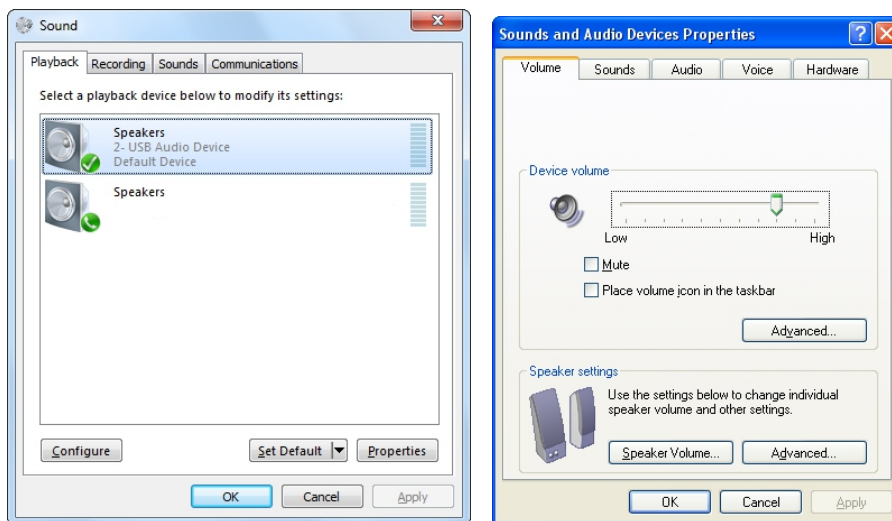
Sound cards typically have connectors to allow you to hook up speakers or headphones, although some work with internal speakers, particularly in laptops.

If your computer produces sounds at all, your sound card is probably ready to go, though if you want to use more than two speakers you should probably delve deeper...
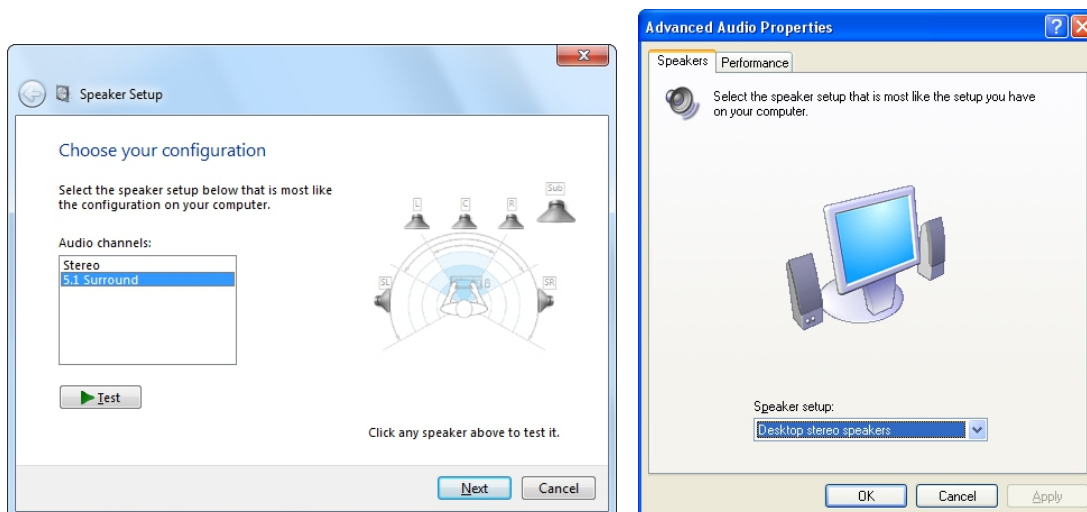
2.2 Advanced Sound Card Set Up

Windows "Control Panel" is normally available from your Windows "Start" menu. Within this, depending on how you have it set up and your operating system, you will see a section with a names like "Sound", "Sounds, Speech, and Audio Devices" "Sounds and Audio Devices" or "Hardware and Sound".

When this is selected, you should see something like one of these:

If you click through the tabs, you should see the audio settings you're using for other audio playback. If they don't look right, change them if you're sure you know what you're doing, or find an expert to help.

Once you're done, click on the "Configure..." button if it's enabled (or "Advanced..." on Windows XP). This should bring up another window as below. If it doesn't, or if the button isn't enabled, don't panic - it's probably just that your sound card is stereo only but doesn't understand that there are different types of stereo. You can configure this more precisely in the Rapture3D Speaker Layout tool by using a Stereo Compatibility ("Compat.") mode on the Layout tab. There is a similar compatibility mode for ITU 5.1, primarily for use on XP.

The important thing here is the "Audio channels" setting, or the "Speaker setup" choice on Windows XP. This should be set as close as possible to the actual layout of the speakers you're using. Again, if you don't have the right stereo options available you may want to use a Stereo Compatibility ("Compat.") mode on the Layout tab.

Click on "OK" when you've finished making changes, or "Cancel" if you want to leave things as they were.

3 Rapture3D Speaker Layout

Once you're happy that your sound card is set up correctly you might want to fine-tune the settings using the Rapture3D Speaker Layout tool. Normally this appears under "Blue Ripple Sound" on your Windows "Start" menu.

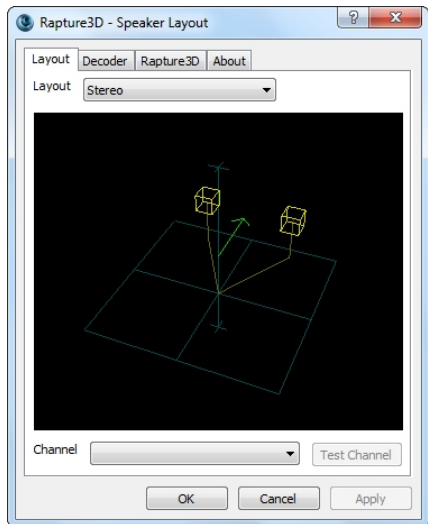Set up is done in stages, each with its own tab:

1. On the Layout tab, check your sound card has been set up correctly and that the speaker (or headphone) layout is correct.
2. The Decoder tab can be used to select the decoder that will be used for the layout chosen on the previous tab.
3. On the Rapture3D tab, you can choose the settings that will be used when a game is running.

Click on "Apply" or "OK" when you're happy with your changes, or "Cancel" if you want to leave things as they were. Note that if there is a game running when you do this, Rapture3D will attempt to restart itself, so make sure you save your place first as some games may not like this.

If your Windows sound card settings are correct then Rapture3D generally will choose sensible settings for your machine, so none of this is *necessary*. But we think the flexibility this program provides is useful and interesting!

Oh, there's an About tab too, with information about us (Blue Ripple Sound), the edition of the software you're using and other third-party software we've used, plus some legal stuff. Please read!

3.1 The Layout Tab

As you can see above, most of this page is taken up with a graphical representation of the speaker layout you're using. You can click and drag to rotate the graphical view (this doesn't affect the sound).

The speaker layout displayed should correspond to your Windows settings. If you change the layout on this page using the "Layout" drop-down at the top, you may also need to change your Windows settings. We'll try to change them for you automatically, but often this isn't possible, so you (or a friendly expert) might need to use Windows "Control Panel" to change some soundcard settings.

3.1.1 Layouts
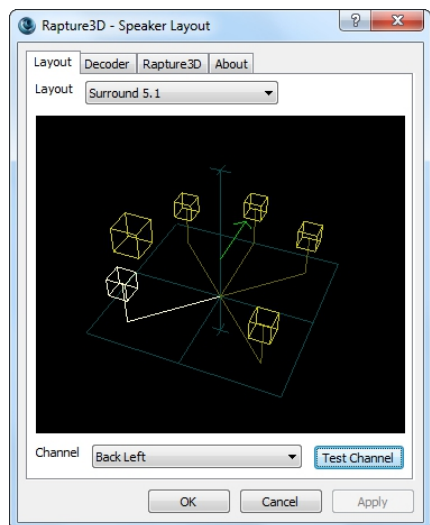
Rapture3D comes with support for the following layouts:

Stereo	This is a straightforward layout using two speakers that many people use.
Headphone Stereo	This is what should be selected if you're using a set of headphones. If you've connected headphones but Windows won't let you select this then take a look at the Compatibility Modes below.
Mono	Just one speaker is available. Obviously there's not much we can do in 3D here!
Quad	Four speakers at the corners of a square.
Surround 5.1	This is an arrangement with front left, right and centre speakers and two "surround" speakers at the side or back. There's a subwoofer too, which can go anywhere in the room. This layout assumes that the four corner speakers are set out roughly in a square, which is slightly different to the "standard" ITU layout below. We find that many gamers and sound positioning systems use this.
Surround 5.1 (ITU)	This is a version of the "Surround 5.1" layout that you may well have set up if you're following cinema conventions rather than gaming ones. This layout has larger gaps between speakers to the side and rear, as recommended by the ITU (International Telecommunication Union). Specifically, your front left and right speakers are expected to be 30 degrees from front centre and the "side" speakers at 110 degrees. Anyway, try changing the Layout drop-down between the options and see which one looks most like the actual layout you're using. Don't worry about the location of the large "subwoofer" in the picture - this can go anywhere in the room.
Surround 7.1	This adds two more speakers beyond Surround 5.1, so there are two side and two back speakers.
Surround 7.1 (Wide)	This is a widescreen speaker layout used in some cinemas, where placement of sounds across the screen for many viewers is prioritised over immersion and front/rear balance.

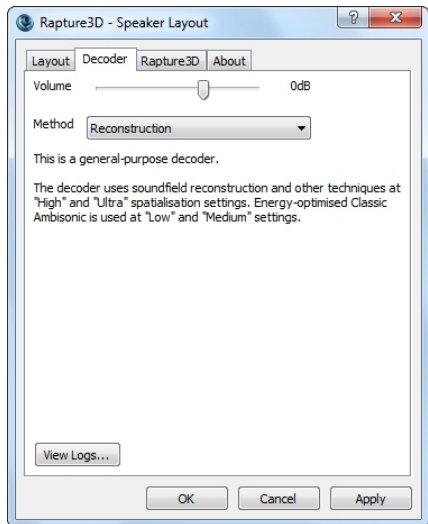|	
Surround 3D7.1	This is a new layout that takes a bit of effort to set up, but is well worth the effort as it allows sounds to be placed above and below! (It works fine for stereo and 5.1 films too.) For this to work, you need your computer set up to use 7.1 surround speakers, but you don't put the 7.1 speakers in their normal places. See here for more detail.
Surround Stereo	It's possible you have your computer set up using stereo (i.e. two channels) but you're feeding the audio to another box with a "surround decoder" which will do some clever stuff and then feed to more than two speakers. "Dolby Pro Logic" is an example of this. If you select this option in Rapture3D we'll try to generate a compatible signal (make sure you select the right "Method" on the "Decoder" tab though). These systems typically don't work as well as feeding the surround speakers directly, but they aren't bad.
Compatibility ("Compat.") Modes	Some Windows sound cards don't know the difference between different types of stereo (ordinary Stereo, Headphone Stereo and Surround Stereo). This is because the difference doesn't really matter to them - they just output two channels of audio and call this "Stereo". However, this matters to us. So if you've connected up headphones and your sound card lets you select "Stereo" but not "Headphone Stereo", select "Headphone Stereo (Compat.)" instead. This will tell your sound card that you're using Stereo, but Rapture3D will know the difference. There is a similar compatibility mode for ITU 5.1, primarily for use on XP.

3.1.2 Checking Things Out

Once you've selected the correct layout, it's worth checking to see if sounds are really coming out of the correct speakers. To do this, select the channel you want to test using the "Channel" drop-down (the relevant speaker will light up in the picture), check the volume levels on any external amplifiers or suchlike - and click on "Test Channel". You should hear a "bing" noise from the correct speaker. If it comes from the wrong one then I'm afraid you need to go check your wiring. Sorry...

Sounds should be roughly at the same level from all speakers, so if you have any external amplifiers you might want to tune them.

If everything looks okay on the Layout tab, you're probably good to go. But you might want to proceed to the Decoder tab for more control over how things sound...

3.2 The Decoder Tab

Things start to get a bit more technical here, but bear with us and it'll hopefully be worthwhile.

To start with, there's a volume slider at the top of this screen. This slider sets the overall level used by Rapture3D when it's started up. Note that this is an *additional* control - it's separate from the main Windows volume setting, any volume controls in the game you want to play and any settings on external amplifiers etc. In general, you should just leave this control alone (at 0dB) and use the other ones.

There's also a "View Logs..." button at the bottom of the screen. Don't worry about this unless you need to troubleshoot. (It provides technical details about things that happened when Rapture3D was last used.)

Then there's the "Method" drop-down. The exact list of items available here depends on what you selected on the Layout tab. For instance, the "Reconstruction" option in the picture above is available for multi speaker arrangements (e.g. Surround 5.1) but not for Stereo or Headphone Stereo, which have some thoroughly different options. Whichever option you select, the text below the drop-down describes how this method will work. Try flipping through the options to see what you're choosing from. Some of these options make quite noticeable differences to how things will sound when you actually start a game up that's using Rapture3D.

3.2.1 Decoder Methods

Since you can flip through anyway, we'll just describe some of the concepts here so they make a bit more sense. Decoder methods have a variety of pros and cons. Some of them use more or less CPU power, some of them are more or less sensitive to how accurately you've set your speakers up and some of them actually will work better for people with differently shaped heads! The best thing to do is to try some and listen...

3.2.1.1 Headphone Stereo Methods

Several of the headphone decoders use HRTFs. HRTFs tell us how sound travels past a human head and into the ear and provide a great way to provide a realistic sound image over headphones. However, human heads are not all the same shape! We provide six different HRTFs - you might like to try these out to find the one that works best for you. At best HRTFs can place sounds anywhere, including behind and above. However, if they don't really match your head shape you may find "confusion" occuring, with sounds that should be behind appearing to be above etc. If you find this happening, try a different HRTF.

HRTF	HRTF-based headphone decoders using psychoacoustic cues to present sounds in full 3D. Amber is often a good choice.
Simplified HRTF (Amber)	Version of the Amber HRTF, massively simplified so it is is not frequency-dependent. This places relatively light load on your CPU.
Panner	This splits sounds between the left and right ears using carefully optimised panning functions. This places relatively light load on your CPU.

The HRTFs provided are based on academic data sets available on the Internet - thanks to all involved! They've been processed for use with Rapture3D, so any problems are entirely our responsibility. We've given the data sets colour names like "HRTF (Red)" for simplicity, but you can see where the HRTF actually came from in the text shown on this tab.

If you don't want to use an HRTF data set you can just select "Panner". This will provide a perfectly serviceable plain stereo image. You can save a few CPU cycles this way too, although the simplified HRTF is no more expensive.

3.2.1.2 Stereo Speaker Methods

If you're just using a normal stereo system then "Panner" is probably what you want here.

Panner	This splits sounds between the left and right speakers using carefully optimised panning functions. This places relatively light load on your CPU.
HCTC Stereo	HRTF-based Cross-Talk Cancellation. Requires accurate speaker set up at an angle of 50 degrees.
HCTC Stereo (Narrow)	HRTF-based Cross-Talk Cancellation. Requires accurate speaker set up at an angle of 20 degrees. Amber only.

The HCTC Stereo options can work well if your speakers are set up very accurately and if you don't move your head much. They're not suited for use with multiple listeners. They're also dependent on you finding an HRTF data set that works okay for you (the same problems apply as described for HRTF headphone stereo above). But they're well worth a try, particularly if you're using desktop or laptop speakers.

But - why only two speakers? To get the best out of Rapture3D you could try using a sound card that lets you connect more...

3.2.1.3 Multi Speaker Methods

If you're using proper surround sound systems with four or more speakers (e.g. 5.1, 7.1 or 3D7.1) then these options are available:

Basic	This method produces a resilient decoding which should play well on a range of speaker systems including large venues. It should be used if your speakers are only roughly in the right places or if your CPU is struggling to keep up.
Reconstruction	This is the default setting. It produces a solid image and uses a sensible amount of CPU power. It relies on the speaker layout being set up accurately and is optimised for a domestic or studio listening environment.
Tinted Reconstruction	This is a more expensive option in CPU terms, but performs HRTF-based tinting on the audio stream to strengthen the spatial image. For some people, this can even give a sense of sounds being above and below when all speakers are all at the same height!

For layouts with a front centre speaker, there are variants of the methods above. This is because, for compatibility with speaker sets with a special dialogue front centre speaker, the front centre speaker is used usually for dialogue only.

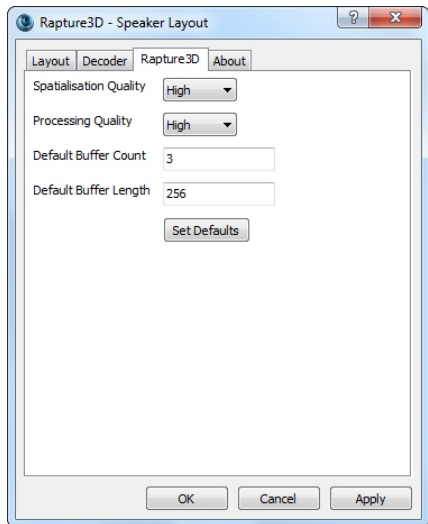|	
Basic (Front Pan) **Reconstruction (Front Pan)** **Tinted Reconstruction (Front Pan)**	As above, but use the front centre speaker for panning as well as dialogue. Use this if you are confident that your front centre speaker has the same response as the others.

3.2.1.4 Surround Stereo Methods

These are offered if you selected "Surround Stereo" or "Surround Stereo (Compat.)" options on the Layout tab. Just select the method that matches the surround decoder you are using. If none match, you probably want to switch your layout back to ordinary Stereo.

Dolby Pro Logic	This is compatible with Dolby Pro Logic decoders. Your decoder may be able to make use of a centre speaker and one or two surround speakers at the back of the room.
Dolby Pro Logic II	This is compatible with Dolby Pro Logic II decoders. Your decoder may be able to make use of a centre speaker and two surround speakers at the back of the room.
Dolby Stereo	This is compatible with Dolby Surround decoders. Your decoder may be able to make use of a centre speaker and one or two surround speakers at the back of the room.
Matrix QS	This is compatible with Matrix-QS decoders. These are fairly rare.
Matrix SQ	This is compatible with Matrix-SQ decoders. These are fairly rare.
UHJ Stereo	This is compatible with ambisonic UHJ Stereo decoders. These are fairly rare.

Note that the encoders used here aren't all "official" ones. They should be compatible though.

3.3 The Rapture3D Tab

Here's where gaming settings are selected. You can tune these to make the best use of the hardware you have available. If in doubt, just press the "Set Defaults" button to choose settings that make sense. If quality setting are too high, you may find that audio "skips" or other parts of the game such as the graphics engine struggle to keep up and become jumpy.

3.3.1 Spatialisation Quality

This determines the quality of spatial rendering (3D sound) used by Rapture3D. Note that this control works on conjunction with the actual decoder method chosen on the Decoder tab.

3.3.2 Processing Quality

This determines the quality of effects processing and sample rate conversion used by Rapture3D.

3.3.3 Buffer Configuration

The default buffer count and length can be set. A default buffer length of 256 is generally recommended, though you may find that a length of 512, 1024 or 2048 helps if you experience stuttering. Generally, lower buffer counts lower latency, but setting the count too low for your hardware can cause stuttering. If in doubt, just use the defaults!

If you're wondering what "latency" means, here this is essentially the time delay between initial audio processing and the sound being sent out of the back of your computer. We work hard to make this as quick as possible, but in the end latency is generally limited by the quality of your audio hardware and its driver. The "advanced" edition of Rapture3D supports ASIO-compatible studio kit which is often capable of extremely low latencies.

4 Technical Notes

4.1 3D7.1

3D7.1 is a variant of the 7.1 surround speaker arrangement. The original 7.1 surround speaker arrangement typically places three speakers at the front of the room, two at the sides and two at the back. Further, a subwoofer (the ".1" in the name) is placed somewhere in the room (it doesn't matter too much where). Quite a few computers come with 7.1 surround sound these days and there are packages for sale that allow it to be added if not. The arrangement of the main seven speakers here puts all speakers at the same height, which is a bit of a shame when using games where things are happening above and below!

The 3D7.1 speaker arrangement (invented by Simon N. Goodwin) is designed so that usually it can be used with existing 7.1 sound hardware. All you have to do is *change where you put your speakers*. It's also designed so that stereo material or 5.1 material will still play back well. The advantage is that games or other 3D audio software that can handle the new speaker arrangement (e.g. via Rapture3D) can produce sound in proper *full 3D*!
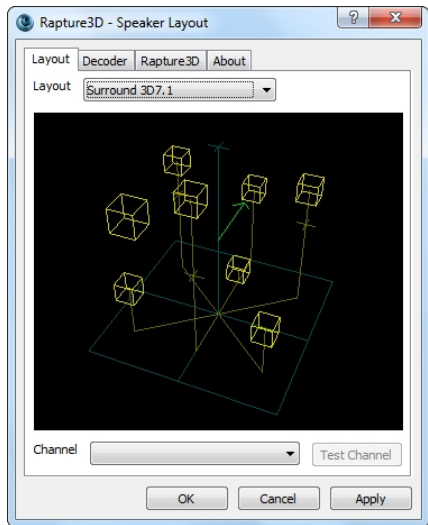
4.1.1 Speaker Locations

Speakers should be placed as follows:

Original 7.1 Speaker Location	New 3D7.1 Speaker Location
Front Left	Upper Front Left
Front Right	Upper Front Right
Front Centre	Front Centre
Subwoofer	Subwoofer
Back Left	Upper Back Centre
Back Right	Lower Front Centre
Side Left	Lower Back Left
Side Right	Lower Back Right

More mathematically, six of the speakers (ignoring the front centre and subwoofer) should form a regular octahedron aligned so front and back faces are vertical.

4.1.2 Configuration

Once you have your speakers set up correctly, select "Surround 3D7.1" in the Layout tab and check the speakers are wired up correctly. You may also need to set your Windows "Advanced" sound card settings to the "7.1 home theatre speakers" arrangement (don't use the "7.1 wide configuration speakers" setting here). You'll probably want to use the test tones to check the speakers are in the right order after all that work!

After this you can select a Decoder as usual.

4.2 OpenAL Developer Notes

Here are some technical notes for developers who might be interested in tuning their games to get the best out of Rapture3D.

The Rapture3D OpenAL driver is built in software and so consists primarily of a driver dynamic library and a configuration tool. It comes in a number of editions with different licensing schemes and features. The "Game" edition is restricted to work only with the games it ships with.

4.2.1 OpenAL Specification

Rapture3D meets the full OpenAL 1.1 specification, including full support for alSuspendContext() and alProcessContext() to give much better control over scene content than many drivers.

All filters support high-pass as well as low-pass options as documented in the specification.

4.2.2 Ambisonics

Rapture3D's heart is a studio-grade 3D rendering core based on Higher Order Ambisonics, running at up to fourth order. This allows great flexibility when the audio is "decoded" for an actual speaker arrangement, including headphones and arrangements like 3D7.1. The "advanced" edition of the software allows the use of custom speaker arrangements.

If you're not sure what ambisonics is and would like to find out, the Wikipedia article on it isn't a bad start.

4.2.3 OpenAL Extensions

Rapture3D supports the following OpenAL extensions:

- ALC_ENUMERATE_ALL_EXT
- ALC_ENUMERATION_EXT
- ALC_EXT_CAPTURE
- ALC_EXT_DEDICATED
- ALC_EXT_EFX
- ALC_EXT_STATIC_BUFFER
- AL_EXT_BFORMAT
- AL_EXT_EXPONENT_DISTANCE
- AL_EXT_FLOAT32
- AL_EXT_FOLDBACK
- AL_EXT_IMA4
- AL_EXT_LINEAR_DISTANCE
- AL_EXT_MCFORMATS
- AL_EXT_MULAW
- AL_EXT_MULAW_BFORMAT
- AL_EXT_MULAW_MCFORMATS
- AL_EXT_OFFSET
- AL_EXT_STEREO_ANGLES
- AL_EXT_SOURCE_RADIUS

ALC_EXT_CAPTURE is only supported in the sense that the extension is present as required by the OpenAL specification. No capture device is provided.

ALC_EXT_DEDICATED allows sounds to be sent directly to a dialogue speaker or subwoofer if one is present.

ALC_EXT_FOLDBACK is a new extension that allows the game to capture mono or stereo downmixes of the game output, e.g. for movie clip recording.

AL_EXT_BFORMAT allows ambisonic B-Format material (WXYZ or WXY) to be used directly as game audio assets. Such material can contain a complete pre-rendered "soundscape" that can rotate with the orientation of the listener.

AL_EXT_STEREO_ANGLES allows stereo assets to be panned horizontally.

AL_EXT_SOURCE_RADIUS allows mono sources to change size.

4.2.4 Scaleability and CPU Load

Rapture3D has configuration options to scale CPU load to meet the hardware available. Default settings choose sensible options if the user does not select them explicitly. The code has been tuned heavily for CPU load.

Rapture3D does not place any limits on how many sources, buffers, filters, effects or aux sends are used. The only limit is the CPU power available on the machine used.

4.2.5 Audio Quality

All internal processing is performed using 32bit floating point operations. Sample rate conversion options include linear and sinc interpolation. A lot of attention has gone into ensuring that control changes result in smooth audio flow.

4.2.6 Effects

Rapture3D supports the EFX interface for effects. The deprecated EAX interfaces are not supported. The following effects are available:

- AL_EFFECT_CHORUS
- AL_EFFECT_COMPRESSOR
- AL_EFFECT_DEDICATED_DIALOGUE
- AL_EFFECT_DEDICATED_LOW_FREQUENCY_EFFECT
- AL_EFFECT_DISTORTION
- AL_EFFECT_EAXREVERB
- AL_EFFECT_ECHO
- AL_EFFECT_EQUALIZER
- AL_EFFECT_FLANGER
- AL_EFFECT_REVERB
- AL_EFFECT_RING_MODULATOR

Note that the same reverb algorithm is used for AL_EFFECT_REVERB and AL_EFFECT_EAXREVERB although different parameters are exposed. All the available parameters are used, including the directional reverb controls. The algorithm is an optimised high-quality ambisonic reverb, producing B-Format output directly.