Understanding OpenGL

This document provides an overview of the OpenGL implementation in Boris Red.

About OpenGL

OpenGL is a cross-platform standard for 3D acceleration. “GL” stands for “graphics library.” “Open” refers to the ongoing, industry-wide contributions to its evolution. OpenGL has been common in graphics workstations since 1992, and is built into both the Windows and Macintosh operating systems as well as a wide variety of display cards. However, OpenGL has only recently begun to make its way into video production. Boris Red was the first NLE to use OpenGL acceleration and continues to pave the way with this new technology.

The technology behind OpenGL grew out of the desire to display high-quality 3D images as quickly as possible. Specific instructions for drawing geometry, textures, lighting, and special effects have been coded into the chips powering many graphics applications, including game consoles, and many desktop computer display cards.

More details about OpenGL are available from http://www.opengl.org.

OpenGL and Boris Red

The bottom line is speed. Boris Red uses OpenGL to draw objects onscreen much more quickly than previous display technologies. In many cases, animations display even faster than real time. That’s because the images are displayed using software embedded in display hardware optimized especially for this task.

The Difference Between Video Processing and OpenGL

Because the needs of 3D content creators are different than the needs of nonlinear video editors, OpenGL and desktop video take very different approaches to displaying images. Video systems are optimized to display fixed-size video images at a fixed rate. While some specialized effects hardware can perform real-time operations on video, video editors have also relied on components built into their computers to perform additional processing for special effects, such as CPUs and RAM.

OpenGL processing, on the other hand, is performed entirely on the OpenGL card. CPU power, including multiple CPUs, RAM, as well as dedicated video processors, including real-time effects hardware, do no affect OpenGL performance. While some OpenGL hardware has the ability to share excess processing tasks to fast computer memory, it is critical for video editors to understand that the hardware in their systems may not be equipped for OpenGL processing.

This is especially true of the hardware driving desktop computer monitors. Many computer display cards are designed to support large workspaces, but do not allocate any resources to drawing 3D objects, textures, or shading using OpenGL acceleration.

As a result, even the most current, state-of-the-art video systems may be missing the single component necessary to take advantage of OpenGL processing: the right display card. Fortunately, a wide range of reasonably priced cards is available to support the OpenGL acceleration in Boris Red. They are the same cards supported by the handful of NLEs that support OpenGL, as well as other graphics and 3D applications.

What are the requirements for OpenGL acceleration in Boris Red?

When started for the first time after installation, Red performs a fast, automatic test to look for the specific items below. If your configuration passes this internal test, Red opens with OpenGL enabled. If your configuration does not pass, an error message appears with more specific information. In that case, Red will open with OpenGL off by default, but you may elect to enable it yourself. Please see the next section for more information on how to work with unqualified systems.

Clicking the **Test OpenGL Hardware button** in the Render tab of the Boris Red Preferences window also shows the results of the internal test. This is the recommended method for examining your system's configuration.

Available Texture Memory

Greater than 32 MB of texture memory must be available to Red. As is typically the case with processing power, there's no such thing as too much. More texture memory provides better performance, so if your budget allows a choice, go for the card with more texture memory.

The number we use in this context refers to the results of the OpenGL hardware test, rather than simply the amount of texture memory on your video card. For example, in some cases the Windows OS can make additional memory available, beyond what is installed on the card. In others cases, host applications reserve some texture memory. Because of this, different amounts of texture memory may be available in the plug-in and standalone components of Boris Red, resulting in different levels of performance.

Supported Hardware

For a complete list of supported cards and drivers, see the Boris FX web site:

http://www.borisfx.com/products/opengl_cards.php

Software Settings

Macintosh OpenGL drivers are supplied by the operating system. Generally speaking, the latest drivers for Windows-compatible hardware are recommended, but be sure to check the Boris FX website for details.

Important Note on OpenGL Support

Due to the fast rate at which GL card manufacturers release drivers, Red may disqualify your OpenGL hardware erroneously. If this happens, you should try to enable OpenGL to see if you benefit from GL acceleration. If you have troubles with slowness, or render inconsistencies, please disable GL. For information on enabling OpenGL, see How do I adjust the OpenGL settings?.

While OpenGL may work in the Red Engine, that does not necessarily mean it will work inside your host application. This is due to the fact that some hosts use Open GL memory, leaving it unavailable for Red when you work inside the host.

If your host crashes when trying to apply Red, and you cannot disable OpenGL in your host, please contact our technical support staff. They will send you a preferences file that will start Boris Red with Open GL disabled.

Boris FX will make every effort to continue to qualify OpenGL cards and driver versions. However, it is important to note that it is impossible to qualify all combinations of Open GL cards, operating system, drivers and host applications.

What if my card is not on the supported list?

Users with non-supported cards may still be able to get adequate performance, as long as those cards have more than 32 MB of available texture memory.

For cards with less than this, OpenGL accelerated previews may still be available, with fewer cached textures available for preview. You also have the option to use OpenGL acceleration without any texture caching, which most systems will support.

In the small handful of cases where OpenGL acceleration causes conflicts with your display hardware, OpenGL may be disabled.

What are the consequences of trying to use OpenGL on an unsupported configuration?

Perhaps none at all. You may well find the performance to be acceptable. The worst that typically happens is intermittent color flashes or distorted frames, none of which will be present in final renders. All these issues will go away when the resolution is set to High Quality or OpenGL is adjusted.

Can I have OpenGL available just when I need it and otherwise leave it off?

Absolutely! Simply work in High quality, at your chosen resolution. OpenGL accelerated previews will only engage when making adjustments, where redraw issues will be less distracting.

For those cases that require precision even when making adjustments, simply press the Alt (Windows) or Option key (Mac), and all interactions will display in High quality. This behavior is set in the Preferences, on the Render tab, and can be reversed, so that all interactions are High quality by default, and the modifier key engages OpenGL accelerated previews.

How do I adjust the OpenGL settings?

The amount of texture memory that Boris Red attempts to use may be adjusted in the Render tab of the Boris Red preferences. The **OGL Acceleration menu** offers the following options. Choose any option except Off to enter hardware OpenGL mode. You can also adjust this option by choosing Preview > OpenGL Mode and then choosing the appropriate option from the submenu.

- ***Off*** disables the OpenGL hardware acceleration. This provides the slowest performance. When you choose Off, your system only offers software OpenGL acceleration. You should only choose this option if your system does not include a supported OpenGL card. You can use the **Test OpenGL Hardware button** to determine if your system includes a supported card.
- ***On, no texture caching*** enables the OpenGL hardware acceleration but not the texture caching.
- ***On, some texture caching*** enables the OpenGL hardware acceleration and a limited amount of texture caching. Try this setting if the recommended setting generates garbage images.
- ***On, Max. texture caching*** provides the best performance and is the recommended setting. OpenGL is only used for previews and interaction. None of these modes affect the final output of your effect to disk, which is rendered at the highest possible quality.

How do I use OpenGL in Boris Red?

Simply open Red and begin working. While working in Draft Quality, everything displays to your monitor using OpenGL. Pressing the **Space bar** or the **Play button** provides OpenGL accelerated previews.

This is especially useful when building 3D animations, or even animating 2D objects such as video layers or still images. For example, you can animate the position and scale of a large image, and simply press the spacebar to see real-time playback of your pan and zoom animation.

What are the difference between OpenGL playback and Preview to RAM?

OpenGL playback is engaged when pressing the spacebar to play while in Draft Quality. Preview to RAM is obviously slower, but offers more accurate display and timing, as well as the ability to include audio with your previews. (OpenGL is a visual format and doesn't include audio at all). Be sure to switch back to High Quality for the RAM Preview.

Again note the fundamental difference between OpenGL processing and traditional CPU and RAM processing. OpenGL previews are handled entirely by the accelerated hardware on your display card; RAM previews go through the same path to your computer's CPU as the final renders to disk. This is why RAM previews are slower on one hand, but more accurate on the other. The two kinds of previews provide two types of different tools, for two different tasks: speed and precision.

One more minor difference relates to the behavior of the Timeline window during previews. During RAM previews, rendered frames are marked in gray along the top of the window, and the CTI (Current Time Indicator) position updates to show playback progress. During OpenGL previews, no frames are rendered by the CPU, but rather by the graphics card, so no rendered frames are cached. It simply isn't necessary, as OpenGL playback is faster than playback from frames cached in RAM.

For similar reasons, the CTI does not update during OpenGL previews. The CTI is connected to CPU renders, and is not aware of OpenGL renders. Even if it were, OpenGL can display frames more quickly than the CTI could update. Tying the two together would slow down the OpenGL preview. Again note the difference between the purpose of previews in RAM and OpenGL, one to provide the most accurate possible previews, and the other to provide the fastest possible previews.

How do I use the OpenGL interactors in the Composite window?

The default interactors are for Translate, indicated by handles with arrows at the end. Mousing over one of the handles turns yellow to indicate that you can drag to constrain the movement of the selected object in that direction (X, Y or Z). Clicking the object, but not directly on the interactor, allows free movement in any direction.

Press the E key on your keyboard to switch the interactors to Rotate mode, indicated by spheres at the end of the handles. Again, dragging a handle constrains rotation to that axis, and clicking on the object, but not on the interactors, enables free rotation.

The R key enables Scale, indicated by squares at the end of the handles.

W returns you to Translate mode, which is the default state of the interactors. G toggles the visibility of the interactors.

The W, E, R shortcuts for Translate, Rotate and Scale are standard in 3D modeling applications, but may also be changed using the customizable keyboard shortcuts feature in Boris Red, found in the Edit menu. The shortcuts for selecting these interactors are located in the Preview menu.

Which aspects of Boris Red are accelerated by OpenGL?

OpenGL was created for the acceleration of 3D. The most obvious place where users will see the advantages of OpenGL in Boris Red is therefore the creation and animation of 3D objects. This includes text, charts, vector shapes, and extruded Adobe Illustrator files.

It also includes a variety of 3D primitives available inside Red, such as spheres, cubes, page turns, cylinders, and planes, including still images and video layers. All of these are true 3D shapes, in fully three-dimensional effects environments. They can animate and play back in real time, or even faster on some cards. Additionally, static effects filters applied upstream in Boris Red are included in OpenGL accelerated previews.

Why do some elements of my compositions not display during accelerated previews?

Open GL was developed to optimize 3D. While no other compositing environment offers as many 3D creation options as Boris Red, Red offers much more than 3D. Red also offers advanced compositing, custom masking and image processing capabilities such as animated apply modes and Optical Flow, as well as motion tracking and 2D vector art. Software renderers still best handle all of these features.

Even within the world of 3D, Boris Red offers a number of features that OpenGL cannot currently display in real time with the quality that Red users have come to expect. These include bump maps, reflection maps, certain kinds of lights, and cast shadows. OpenGL can display materials created in Red, intersecting and combined objects in a scene, and some lights, shadows and textures, but not yet the full range of 3D options available in Red.

Red also offers a variety of ways to combine those 2D compositing features with 3D objects, for an exceptional range of effects options. Again, this combination of compositing styles may sometimes exceed the current reach of OpenGL.

That's true today, anyway. As the OpenGL standard evolves, look for a wider variety of effects to be accelerated. In the meantime, Boris Red combines the best of OpenGL speed for effects creation with exceptionally high-quality software rendering for the most flexible approach to compositing and effects on the market.

What are the benefits of OpenGL when working in High Quality?

When building animations with elements whose display is not supported in OpenGL, you need to see every detail. That's what High Quality is for, of course. However, you may not need to see every detail in your scene when moving specific objects. OpenGL is automatically engaged when you interact with those objects, such as when scaling or positioning them, whether using sliders in the Controls window, values set in the Timeline window, or using interactors in the Composite window to move or scale the objects directly.

During these interactions, masks, bump maps, reflection maps, and downstream filters may be turned off to allow OpenGL accelerated previews. The High Quality software renderer takes over when you release the mouse, and all composition elements are visible.

There are times when you'll need to see every detail while moving objects, of course. That's easy – simply press the Option key on Macintosh or the Alt key on Windows while moving elements, and the display updates with every element displayed at High Quality, in the resolution that you've set.

You may also choose to reverse this behavior, so that interaction leaves all elements visible by default and only hides them when holding the modifier key, in the Render tab of the Preferences.

How much faster is OpenGL processing?

This is virtually impossible to quantify in any consistent way, because of the wide range of hardware configurations and the wide range of effects it's possible to create with Boris Red.

As noted earlier, some advanced 2D compositing effects do not benefit at all from OpenGL's 3D acceleration. A single layer of 2D texture, including video, may be accelerated only moderately, as 2D interactions in Boris Red are already quite speedy.

To show 30 frames per second, an individual frame must be drawn every 33 milliseconds. Even minimally qualified systems are capable of speeds more like 20 milliseconds per frame, even on a multi-layer 3D animation with textures, lights and shadows that might take 15-20 seconds to render at highest quality, representing a performance boost of 1000% or more in some cases. Again, this will vary dramatically depending on all of the variables mentioned above. The bottom line is that OpenGL provides a truly dramatic performance boost.

Does OpenGL accelerate final renders?

Not at this time. However, Boris Red offers a wide variety of render optimizations in virtually every area of the product. The time savings will be more dramatic on complex effects, but can be seen in effects using 3D extrusions, procedural textures, large images or frame sizes,

a wide variety of filters, and composites that combine static and animated elements. Depending on the specific effect, renders may be improved by 30% or more. See the Boris FX website for details.

Troubleshooting

My card is on the supported list, but an error message indicates that my card isn't compatible.

This is almost certainly a driver issue. Be sure to check the Boris FX website for information on the latest supported drivers.

In many cases, you'll still be able to take advantage of OpenGL inside Boris Red, as discussed earlier in this document.

Why do I sometimes see different images in OpenGL previews than I do in High quality or in rendered output?

As discussed earlier, a number of advanced 3D elements such as bump maps, reflection maps and cast shadows cannot currently be displayed in Red's OpenGL. accelerated previews. It is important to remember that OpenGL is currently best used for previews and to accelerate the building of effects. Effects should always be viewed in High Quality before they can be considered finished.

Other elements that display quite easily in OpenGL require an additional step when working in High quality software renders. These include OpenGL's ability to show shapes such as cylinders and page turns as true 3D objects, as well as intersecting shapes.

To see the same thing in High Quality, you just need to place those objects inside a 3D Model container. In fact, objects inside 3D Model containers, including video layers, may now have the entire range of 3D attributes applied to them, including bump maps, reflection maps, intersections with cast shadows, and more. This is such an important feature that there is now a shortcut button on the timeline for nesting selected tracks into a 3D Model container.

Why do I see banding and reduced colors in the Composite window?

This is especially common on Windows systems that have less than 32-bit color set in the Displays Control Panel. Boris Red requires 32-bit color on both Windows and Macintosh.

Windows users with ATI boards need to right-click their computer desktop and select Display Properties, select the Settings tab then click the Advanced button. This opens the dialog box for your video card's configuration. Click the OpenGL tab and set the Texture Preference to

the maximum setting. If you do not have the option to set Texture preference to maximum, you need to update the ATI Control Panel. It can be found with the drivers (as a separate download) on the ATI web site.

In addition, ATI's latest driver (listed on their website as Version: 6.14.10.6368 and in our OpenGL hardware test as version 6.14.10.3842) has a bug and does not support 32-bit color for textures at all. ATI users should use the driver listed on ATI website as 6.14.10.6360 until a newer driver is released that addresses this limitation.

Why do I see white frames, purple frames, garbage frames and other distortions in the Composite window while trying to use OpenGL?

Your video card does not have enough texture memory to support the chosen level of OpenGL. Begin by reducing the amount of texture caching. If you still see problems, turn off texture caching, then turn off OpenGL if necessary, until you can upgrade your display card.

Why is my OpenGL performance slower on my second monitor?

Windows users with dual head display cards have two options for configuring their displays: Independent and Stretched. In Independent mode, each screen runs independently of the other. It allows only one screen to support OpenGL playback, typically the monitor with the OS menu bar. In Stretched mode, the monitors share one display and one resolution, allowing OpenGL playback from any part of the display.

Macintosh users with separate cards to drive each monitors will also need to leave the Composite window on the monitor where it was first opened. This is because of the way the operating system manages OpenGL resources. To change monitors for the Composite window, move it to the desired monitor, and exit Red. The Composite window will support OpenGL playback in the new location in the next session.

Why does the OGL Hardware test shows the wrong information for my Matrox G550 card?

The Matrox G550 driver will sometimes incorrectly tell us it is a G440 or G400. Regardless, we do not officially support any of those boards. The Parhelia is the only Matrox device supported for OpenGL in Red at this time.

Why do the CTI and RAM cache markers not update during OpenGL previews?

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Why do OpenGL previews move more slowly with the Info window open?

Among the features of the Info window is that it measures the time it takes for an individual frame to be rendered by the computer's CPU. OpenGL previews are not rendered by the CPU but by the graphics hardware. However, the Info window will force renders to the CPU in order to display that information, effectively bypassing the accelerated OpenGL preview in favor of the slower, but more accurate, CPU render.

One reason why the Info window is not currently an adequate measure of how quickly an individual frame is rendered is that OpenGL is frequently capable of displaying full resolution frames faster than 30 times per second, certainly faster than the calculation time can be displayed. In other words, showing the OpenGL processing time is much slower than the actual processing!