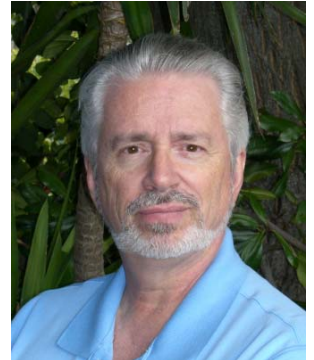


# *The evolution of 3D graphics hardware in the mainstream computer experience*

*by Geoff Walker*

Geoff Walker recently attended the Windows Hardware Engineering Conference (WinHEC) 2006 and reports on an interesting panel discussion about 3D Graphics in the computing environment



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The stated goal of this Microsoft-convened panel discussion was “to enable our audience to be able to advise and guide consumers and corporate decision-makers in their hardware purchasing decisions for Windows Vista, in relation to the relevance of graphics hardware in system configuration, experience and scalability”.

## **Panel members:**

Analyst: Jon Peddie, president, Jon Peddie Research

OEM: Joe Curley, director of marketing, Dell Dimension Desktops, Dell

Press: Eric Dahl, senior editor, PC World

Web Reviewer: Derek Wilson, senior CPU & graphics editor, Anandtech.com

Microsoft: Pablo Fernicola, group program manager, Windows Foundation Presentation Team

The panel was moderated by another Microsoft person. Although he did an excellent job of keeping the panel on track and staying out of the discussion himself, I failed to get his name.

## **Background:**

From a PC user's perspective, one of the most visible differences between Windows XP and Vista, the next major version of Windows, is the use of 3D in the user interface (UI). The Vista UI, called “Aero Glass” by Microsoft, changes the Windows desktop from a flat, 2D experience into something that uses 3D to increase productivity – as hard to believe as that sounds. For example, suppose you have eight windows open on your desktop: in XP, the windows overlay or overlap each other. To cycle through them you use the Alt-Tab keystroke; to select them individually you use the buttons on the taskbar. There's no way to see them all at once unless you tile them, which makes them much too small to be useful. In Vista Aero Glass, you can arrange the windows on a slant extending into the screen (in 3D) so that you can see them all at the same time. This is 3D in the sense of three fully usable dimensions, not 3D in the sense of monsters reaching out of the screen to rip off your face in stereo vision.

Another significant change in Windows Vista Aero Glass is that the final screen that's visible to the user is generated by an off-screen composition engine, rather than each application being responsible for updating its own section of a shared screen buffer as is the case in Windows XP. This completely eliminates the tearing, partial windows, slow screen updates, window trails and all the other weird on-screen Windows behavior to which we've all become accustomed.

Both of these changes in Vista (and many others) require substantial graphics processing horsepower to accomplish. For this reason, Vista Aero Glass hardware requirements include what is obscurely defined as a “DirectX9 graphics processing unit (GPU) with hardware Pixel Shader 2.0 support and at least 64 MB of graphics memory”. Translating this into English, it means that Vista Aero Glass requires a graphics card or controller

produced in the last year or so. What used to be required only for 3D shoot-em-up games is now required to run the operating system. (Vista can run in a mode that emulates the Windows XP 2D environment, with much lower hardware requirements, but that's just to achieve a reasonable degree of backwards compatibility, and isn't of much interest to readers of the *3rd Dimension*.)

To draw a very simple analogy, it's like when the PC switched from mono to color. Substantially upgraded hardware was required to support color, and the availability of color changed everything in the PC user interface and in the applications world. What this panel discussion is really about is exploring the significance of every PC including robust 3D graphics hardware. How will it affect mainstream PC applications? How will consumers become educated enough to make purchasing decisions? How can OEMs best design and differentiate systems while taking graphics into account? And so on...

**Panel discussion:**

What follows is a real-time, keyboarded transcription of the panel discussion in which I attempt to capture the essence of each panelist's comments. Each panelist is identified by their first name and their function. Keep in mind that the audience for the panel discussion was primarily hardware engineers, driver programmers and technical PC marketing people – not consumers!

**Opening statements:**

*Jon/Analyst:* Graphics is something that doesn't need to be discussed in the context of the mainstream user – it should just “be”. It's like discussing what's inside a TV set.

*Derek/Web:* We still need a longer-term view.

*Pablo/MS:* Mainstream users will need more guidance on how to select hardware.

*Eric/Press:* We need to get the message out about what an “acceptable” Vista Aero Glass PC is. Personally I'm surprised at how well some of the integrated graphics [low-end] systems run Aero Glass. We need to show more user benefit from adding graphics hardware, not just the ability to run the OS and games.

*Joe/OEM:* Today's mainstream graphics are yesterday's high end. It's a 24-month cycle. In the next 24 months we're faced with two Vista opportunities. The first is DirectX10 [the coming generation of graphics hardware], which provides a known level of rendering quality. The second opportunity is that Aero Glass users don't actually think of it as 3D. Within 18 months after Vista ships, most mainstream machines will meet both opportunities.

**Vista graphics hardware requirements:**

*Derek/Web:* We need higher requirements for the minimum hardware required to run Vista.

*Joe/OEM:* The message to PC buyers has been “low-end graphics can do everything you need” for a very long time; now we have to change that. We've added a page to our website that explains our take on Vista [see <http://www.dell.com/vista> and click on “Windows Vista Capable”].

*Joe/OEM:* It's surprising how low the bar really is for something that appears to run Aero Glass well. The real reason is to support the enterprise PC life-cycle. But consumers are confused because of the multiple levels of Vista, not only the five different versions of Vista, but also the several levels of hardware compatibility.

*Jon/Analyst:* Vista is the first proactive OS; all others have been reactive. Vista leads the industry. Microsoft has created a foundation for unimagined future applications. One element is DirectX10; when that spec is finalized, developers will go wild with great functionality that couldn't be done before. I know of three companies (and they're not game companies, either) who are chomping at the bit. In two years we will have a whole new level of stuff on the PC.

*Pablo/MS:* Getting to DirectX9 took five years and was non-trivial – it's not going to go as fast as you think.

*Jon/Analyst:* Graphics and mainstream is an oxymoron. The mainstream user shouldn't have to talk about graphics; he should just experience it.

*Joe/OEM:* How many of you in the audience have more than four windows open at once after working for one hour? [Everyone in the audience held up their hand.] Everyone knows the Alt-Tab keystroke because of this. Slanting the windows (solving a 2D problem using 3D) is a very good solution to this problem.

*Pablo/MS:* If you had an extra \$60-\$80 to spend on a system, what would you spend it on?

*Eric/Press:* Memory, then graphics. We haven't had enough time with Vista to really know where the limits will be yet. For example, we don't know yet if enterprise applications will be GPU-bound [i.e., if enterprise applications will need more graphics hardware in order to have good performance].

*Jon/Analyst:* Any question for me will be answered with "graphics". If all you have is a hammer, all problems look like nails. We spend all of our time looking at the screen, so we need to spend the money there.

*Joe/OEM:* Buy a great screen first. Then get a dual-core processor [e.g. an Intel Core Duo CPU], to get the background stuff [programs started automatically by the operating system] off your plate so that the machine becomes responsive. Then add more memory – both main memory and graphics memory. Then finally, get a good backup system. Actually you'll spend \$280, not \$80.

*Derek/Web:* Buy a big CRT monitor that can do very high resolution – it's much cheaper than the same size LCD.

*Joe/OEM:* A CRT is hard to beat when you have a high-end graphics requirement. However, in a few years they will be nearly impossible to dispose of!

*Jon/Analyst:* I have a 30-inch Dell display. I also have a 21-inch CRT monitor. There are some games that only play properly on a CRT. Photography and printing photos is still much better on a CRT. Eventually this problem will go away.

### **Drivers to increase the penetration of graphics hardware:**

*Jon/Analyst:* The consumer's sensitivity to DPI [dots or pixels per inch] is critical! Some people run low resolutions on big screens because they need to see the text on icons [which doesn't scale in Windows XP]. The font capability in Vista is extraordinary.

*Derek/Web:* Applications need to incorporate more graphics technology because applications are where you spend all your time. The desktop isn't that important.

*Pablo/MS:* There are three steps to the penetration process. First, the consumer sees the new user interface [Aero Glass] on PCs in the store and is attracted. Second, it's like when you first buy a new car - looks matter. Then over time you learn little hidden things that make the experience nicer. Finally, when applications such as the New York Times Reader [a cool new Vista and touch-optimized application demonstrated in Bill Gates' keynote speech] start using the 3D pipeline [graphics hardware capability] for everything they do, then everything will accelerate.

*Derek/Web:* OS-X looks great [on the Macintosh], but looks aren't enough.

*Joe/OEM:* If your job is to write software and you find that you need to include a legacy 8-bit piece of code, it's OK in Windows XP [because the OS allows it, which is not the case with Vista]. Now with Vista, we're dropping some of the backwards compatibility – which is great! We need to get people to expect more; we need to open up people's imagination. Also, getting rid of the scaling issues in current Windows will help because those oddities distract from the experience – they make it less immersive. [This is a reference to the fact that Windows XP is

resolution-dependent, which means that icons are fixed sizes and can't be scaled up. To compensate for this, some users increase the system font size, which causes a variety of unpleasant side effects ("oddities"). Given the audience, everyone automatically understood this reference.]

*Eric/Press:* Upgrades will be driven by enhancements in applications. It's taking the stuff that you couldn't have done before in Windows XP and translating it into performance that drives upgrades – but the consumer will need help!

**How long will it take?**

*Jon/Analyst:* Technology really grabs hold when it becomes invisible. When technology sticks out, it's just in the way of our lives. When those impediments go away, then we'll reach a new plateau.

*Derek/Web:* In gaming it still takes two years for high-end graphics hardware to move to the middle ground. It's going to take more time than we expect. Vista is a solution for 2008. It's a journey.

*Pablo/MS:* He's afraid that people will buy a high-dpi display but won't have the graphics hardware to drive it. Or that they'll try to run four applications simultaneously and Aero Glass will choke. We all need to educate our customers regarding what they need to buy.

*Eric/Press:* It's all about assumptions. When a product gets to a certain level, the better something looks, the more jarring the mistakes look. Two or three years from now it will start to get exciting, when everyone's graphics hardware is upgraded and applications are starting to use it.

*Joe/OEM:* The new integrated graphics controllers with Pixel Shader 2 [e.g. the Intel Graphics Media Accelerator (GMA) 950, found in most of the low-end Intel Duo Core chipsets] actually surpass most game requirements! If we don't push application developers to get the software to make more use of the graphics hardware, it will be slower than expected.

*Jon/Analyst:* Here's how to know if you got your money's worth when you bought a computer. Run a game, and if your fans are screaming so loud that you can't hear yourself think, then you got your money's worth.

**Audience questions:**

*Audience:* Are the Vista minimum hardware requirements really set too low?

*Eric/Press:* I can't tell where the minimum hardware requirements should be set yet. We don't have final Vista code. There are times when it's necessary to draw a line in the sand because evangelizing by itself just doesn't get the job done [i.e. get consumers to buy new graphics hardware en masse]. Drawing a line in the sand does get the job done.

*Derek/Web:* Microsoft offering the basic version of Vista without Aero Glass makes the "two years" even further away. It prevents users from seeing what could be. Unfortunately, application developers have to take that lowest level into account.

*Jon/Analyst:* My answer to every Vista question is "five". Buy a five [the highest Vista graphics performance rating reported by Vista's built-in hardware analysis program] because you'll have a need for it a year from now.

*Audience:* What is the future for non-graphical applications using the graphics hardware?

*Joe/OEM:* Some high-end, non-graphical applications already make use of specific graphics hardware. However, it's hard to write code for a "general" GPU [i.e. write applications that can successfully use all the different varieties of graphics processors that will appear in Vista PCs]. This means that non-graphical applications that use the graphics hardware will appear in niche categories first.

*Audience:* Do you predict that stereo viewing [visceral 3D] will make it to the mainstream?

*Jon/Analyst:* We've studied this question for several years. Technical issues are holding it back right now. Ergonomic issues also tend to limit the acceptance of 3D. The brain is really good at creating an illusion of 3D, though. I believe that stereo vision is primarily a gimmick. We will always be able to do better in our brain.

*Audience:* Graphics are everywhere – they're in our face all the time, especially cheesy graphics on TV. Won't the mainstream user "get" graphics more easily because of this?

*Jon/Analyst:* The consumer does get graphics in that sense. The cheesiness is on purpose as a motif.

*Audience:* What about graphics hardware in the mobile space? Isn't there an issue with power consumption versus performance?

*Joe/OEM:* Power management is important; we buy a lot of graphics chips and we don't want screaming fans. The power consumption of the CPU has decreased substantially in recent years; do the same thing in the graphics area [make the GPU more efficient]. PCI Express [the replacement for the existing internal PCI bus in PCs] was designed to support multiple power levels; we need to use the same concept in developing a DirectX10 [next-generation] integrated graphics controller!

*Pablo/MS:* Mobile is the greatest challenge.

*Audience:* Will the consumer ever be able to upgrade mobile graphics hardware?

*Joe/OEM:* Form-factor dependencies really come into play here. Mobile is all about mobility. Are you willing to buy a 17-inch bucket [a derogatory reference to the size and weight of desktop-replacement-class laptops, in which upgradeable graphics hardware is readily doable]? Mobile is tough to upgrade due to heat and tight design. We've done it [designed mobile computers with upgradeable graphics hardware], but only under a few narrow conditions.

*Audience:* How do you justify a \$500 graphics card?

*Derek/Web:* Application developers don't target that price point for the mainstream. It's only for specialized applications such as high-end games.

*Jon/Analyst:* That's an odd question coming from a company that writes graphics benchmark software [Jon recognized the questioner]. (Audience laughter). Questioner: Because we know the answer.

*Pablo/MS:* \$200 is justifiable for graphics hardware to support multiple monitors.

*Joe/OEM:* When you spend more money on graphics hardware, the quality of the individual pixels gets better. The best benefit of quad-graphics solutions [multiple interfaces between the PC and the monitor] is that you can do stuff at much higher resolution, which makes the display look gorgeous! The graphics effects in high-end games today are amazing. Quality is the key result. This justifies the \$500 cost for enthusiasts.

*Audience:* Can we use 3D technology to make the use of multiple monitors more effective?

*Jon/Analyst:* Yes. An extreme example is SGI's visualization center [see <http://www.sgi.com/products/visualization>]. To get the real benefit of multiple monitors in a 3D environment, you have to deal with the borders between the screens, which is difficult. Flight simulation is a good use of multiple monitors because you can see straight ahead in the center monitor, and out the airplane's side windows on the left and right monitors. If you put your monitors close enough together, your brain will actually screen out the gap. Your peripheral vision really helps you do this. Monitors have become so cheap that it comes down to whether you have enough room on your desk for multiple monitors!