Integrated Graphics Solutions for Graphics-Intensive Applications

Bradley Sanford

ADVANCED MICRO DEVICES, INC.
One AMD Place
Sunnyvale, CA 94088

Introduction

Over past few years the computer industry has seen the emergence of a new wave of integrated graphics-based desktop PC systems that incorporate the ability to display graphics without the need for a separate video card. Although integrated graphics solutions have shipped in production PC systems for quite some time, only recently have core logic solutions developers begun to release integrated graphics solutions designed for graphics-intensive applications that previously required the use of a separate video card.

There can, however, be quite a variance in the relative performance of these solutions. End users are finding they are well advised to research the various features available in each product prior to making a purchase decision. Some products have shortcomings, which can result in a failure to be able to run several current and future mainstream entertainment applications, and result in a very disappointing end-user experience with their new PC. Of the features available in integrated graphics-based desktop PC solutions, the capability to do 3D Transform and Lighting in graphics hardware has become a key differentiator in integrated graphics performance.

Establishment of Transform and Lighting in Graphics Hardware

There has been an overwhelming trend over the last decade for leading computer graphics companies to design and release solutions that deliver ever-increasing visual realism to the end user. This development progress has been arrived at through various means: by increasing the video processing power of the graphics device; by increasing the amount and bandwidth of memory available to the video processor; and by other means, such as offloading certain

graphic-intensive tasks that previous required additional processor-to-system bus bandwidth and utilization to the video processor. Leading microprocessor companies have also delivered solution to improve the graphics experience of the end-user by adding capabilities to the floating-point unit enabling more operations to be executed per clock cycle.

In 1999 and 2000, NVIDIA and ATI, respectively, released their first commercial products that featured the graphics hardware-based capability to handle Transform and Lighting (T&L), floating-point intense calculations required in any dynamic 3D PC usage environment. If the graphics hardware is not capable of handling these calculations in a system then they must be executed by the processor in software. This software mode can significantly tie up processor resources and inhibit them from being applied to other tasks that would otherwise contribute to the overall experience for the end-user.

From these initial releases to the present day, leading graphics companies such as NVIDIA and ATI have followed with subsequent products, incorporating hardware-based T&L. Through their releases of numerous hardware-based T&L capable graphics products targeting both mainstream and high-end desktop PCs, they established integrated hardware-based T&L capability as the industry standard for both mainstream and high-end computer graphics hardware.

Utilization of Hardware-Based Transform and Lighting in the Software Industry

Along the lines of similar past PC evolutionary trends, as the hardware capability became available, software followed that would leverage that capability. Over time software creators have begun

targeting their applications, particularly 3D entertainment software, at a user base utilizing hardware-based T&L in their systems. Many games are now written under the assumption that hardware-based T&L capability is present, resulting in software-based T&L execution so slow that they fail to run or result in an end-user experience that is so frustrating that they are considered unplayable. Because the processor resources are tied-up doing T&L calculations that were intended by software to be performed by the graphics hardware, the games can require more processor execution power and system bandwidth than is available, and performance suffers as a consequence.

The more powerful the floating-point execution ability of the processor, the less adverse results the user will experience in this circumstance. With the AMD Athlon™ XP processor, its particularly exceptional floating-point processing ability actually results in many value-targeted systems being generally capable of running most entertainment applications that don't specifically run a software check for the presence of hardware-based T&L. But ideally, a mainstream or high-end desktop PC contains both hardware-based T&L in the graphics hardware combined with an extremely powerful floating-point unit in the processor.

Without a particularly powerful floating-point unit in the processor or hardware-based T&L in the graphics hardware, the overall system may be incapable of running several of the latest 3D software titles acceptably. These problems are exhibited as extremely low frame rates and very slow, unacceptable game play response, assuming the program even runs at all.

Entertainment software is increasingly being designed to expect hardware-based T&L capability. Therefore, any system incorporating any type of "Extreme Graphics" for a performance PC entertainment solution would be expected to support hardware-based T&L.

Today the industry is seeing software that will not attempt to execute unless hardware-based T&L capability is detected.

Integrated Graphics with Hardware-Based Transform and Lighting

Although hardware-based T&L capability has existed in consumer desktop systems since 1999, it was always in the form of a video card implementation. Such an implementation is a physical video card plugged into a slot on the computer's motherboard. Integrated graphics is the alternative to this implementation. In this type of system, the computer's core logic can display graphics without the need for a separate video card. Integrated graphics solutions have become an increasingly large portion of the desktop PC market by reducing system component costs and simplifying system development. There never was, however, an integrated graphics implementation designed for and marketed as a performance graphics solution, capable of running the demanding 3D software applications of today and tomorrow until AMD and NVIDIA partnered to create such a solution. In 2001 NVIDIA released their nForce core logic solution featuring integrated NVIDIA GeForce2 graphics. When combined with an AMD Athlon XP processor, the result is an excellent performance consumer desktop PC graphics solution. Featuring hardware-based T&L along with exceptional floating-point capability in the processor, this system is capable of running the demanding 3D software applications of today and tomorrow, without the need for a separate video card.

In May of 2002, the Intel Corporation released their latest core logic integrated graphics solution. Described by Intel as being "for the latest 3D and digital entertainment applications" and featuring "Intel Extreme Graphics," the 845G chipset is marketed and sold as a

solution that can run the latest demanding 3D software applications of today and tomorrow.

There is, however, a major limitation to the "Intel Extreme Graphics" implementation; it does not support hardware-based T&L, as a user would find should they attempt to run the Spider-Man game (Intel® 82845G Graphics Controller – Spider-Man*: The Movie game does not run http://support.intel.com/support/graphics/intel845G/sb/1066254823742039-prd865.htm). As a result, today there are already several highly popular, current digital entertainment applications that either do not run acceptably and are unplayable or do not run at all on the Intel 845G-based platform. For all titles using dynamic 3D environments that are installed on a system using Intel Extreme Graphics, the Intel processor must devote cycles to executing software-based T&L. In those numerous cases previously mentioned, this reliance on the Intel processor for floating-point computation results in such degradation in graphics performance that the system cannot even run the application in an acceptable manner.

To overcome this inherent limitation in the system in order to run the failing PC entertainment titles, the end user must upgrade by overriding and disabling the "Intel Extreme Graphics". This involves additional cost to a brand new system and is done by buying and installing a separate hardware-based T&L-capable video card.

Conclusion

Hardware-based T&L has become an industry-standard feature in the modern 3D computer graphics world. Since its introduction to the consumer market in 1999, wide acceptance of this standard has followed in both the hardware and software communities. In their partnership, AMD and NVIDIA have partnered to deliver a complete

integrated graphics solution based on the AMD Athlon XP processor with the NVIDIA nForce core logic. Featuring hardware-based T&L along with exceptional floating-point capability in the processor, this solution delivers on the expectation of its ability to run 3D software applications created for today and tomorrow. The final result is an excellent end-user experience and satisfied end users.

The Intel integrated graphics solution "Intel Extreme Graphics" lacks hardware-based T&L capability. This results in end users unsuccessfully attempting to run several of today's much less tomorrow's mainstream 3D applications. The most apparent paths to end user resolution of this issue are for them to either return the system to their vendor or to upgrade their brand new system at an additional cost, which no doubt results in a frustrating end-user experience and unhappy end users.

The intentions of each of these two integrated graphics implementations are similar. Both are intended as simple, effective solutions to deliver an excellent mainstream 3D graphical solution without the need for a separate graphics card. However, only one of the two solutions delivers on the promise of extreme 3D graphics capability, and that is solution featuring the AMD Athlon XP combined with the NVIDIA nForce core logic. AMD works with its partners to ensure that end users have a performance consumer desktop PC graphics solution can handle the demanding 3D software applications of today and tomorrow.

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AMD Overview

AMD is a global supplier of integrated circuits for the personal and networked computer and communications markets with manufacturing facilities in the United States, Europe, and Asia. AMD produces microprocessors, Flash memory devices, and support circuitry for communications and networking applications. Founded in 1969 and based in Sunnyvale, California, AMD had revenues of $3.9 billion in 2001. (NYSE: AMD).