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WHITE PAPER

IBM Deep Computing Visualization

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IN THIS WHITE PAPER

In this white paper IDC analyzes the Deep Computing Visualization (DCV) offering from IBM. DCV is a visualization framework that uses middleware to connect IBM xSeries IntelliStation workstations in a scalable graphics configuration that uses commodity components. IBM is also offering the ability to perform remote visualization tasks, in which users can utilize DCV scalable graphics capabilities from a remote site.

IDC believes there is a productivity gap for both existing and potential users in the current workstation market. Although the traditional UNIX workstation market has been in decline for several years, IDC does not believe that the drop represents a decline in graphics application needs. As commodity hardware has become more powerful, the premium price for advanced graphics systems has become too high a hurdle for some potential customers. Alternatively, users of proprietary systems are not realizing the price/performance benefits of commodity components. Scalable graphics architectures that are based on Linux, OpenGL, and commodity graphics adapters have the potential to reinvigorate the high end of the workstation market.

IDC believes there is also a category of potential users that could benefit from scalable collaborative visualization, but these users have not invested in visualization technology previously because of either high costs or hesitancy to change their organizations' workflows to accommodate new technology.

IBM is targeting three types of potential customers with DCV:

- For users of traditional proprietary graphics systems, DCV aims to provide equivalent levels of performance at a lower cost on many applications.

- For users of personal workstations and PCs, DCV aims to provide a more scalable solution that is still based on commodity technologies.

- For users who wish to incorporate visualization into their workflows for the first time, IBM can deploy DCV in conjunction with its worldwide services organization and its external partners to enable collaborative visualization while easing potential pain points in the transition.

SITUATION OVERVIEW

State of the Market: Opportunity for DCV

Many sectors of computing are seeing increasing demands for visualization capabilities, largely because many organizations are facing massive and increasing amounts of data to interpret. Many companies turn to visualization as a tool for transforming the information represented by their data into a competitive advantage. This is particularly true in high-performance computing (HPC), but it also extends to any organization whose intellectual property exists in massive, growing data sets.

With visualization systems, organizations can represent large amounts of complex data in ways that engineers, scientists, or decision makers can understand easily. A visual model of an oil and gas reservoir, for example, can make it easier to decide on the extraction method that will yield the most usable oil. A visual model of a crash simulation can draw the designer's eye to structural elements that need to be reinforced. A visual model of the human circulatory system can show areas of improved or unchanged blood flow following a planned surgical procedure.

Today, most users of scalable visualization applications are in disciplines that are also associated with scalable HPC for scientific or engineering applications. However, IDC believes there is a growing need for visualization among nonscientific computing users. This is especially true for commercial computing applications that require a user to make decisions based on large amounts of data, such as financial analytics, fraud detection, or process management.

In contrast to these trends, the worldwide market for traditional UNIX workstations has been declining for several years, from $4.5 billion in worldwide revenue in 2000 to $1.3 billion in 2003 (see Figure 1). Several factors have contributed to this decline. The most significant factor has been the encroachment of low-end commodity systems that are able to address a portion of the application needs for many users.

Traditional UNIX workstations are based on proprietary operating systems and components (e.g., graphics adapters). Because they are specifically designed for technical applications, these workstations frequently have inherent performance advantages over PCs or personal workstations. However, the proprietary nature of the technology, combined with relatively low volumes in the workstation market compared with the PC market, has made traditional UNIX workstations significantly more expensive than PCs or personal workstations.

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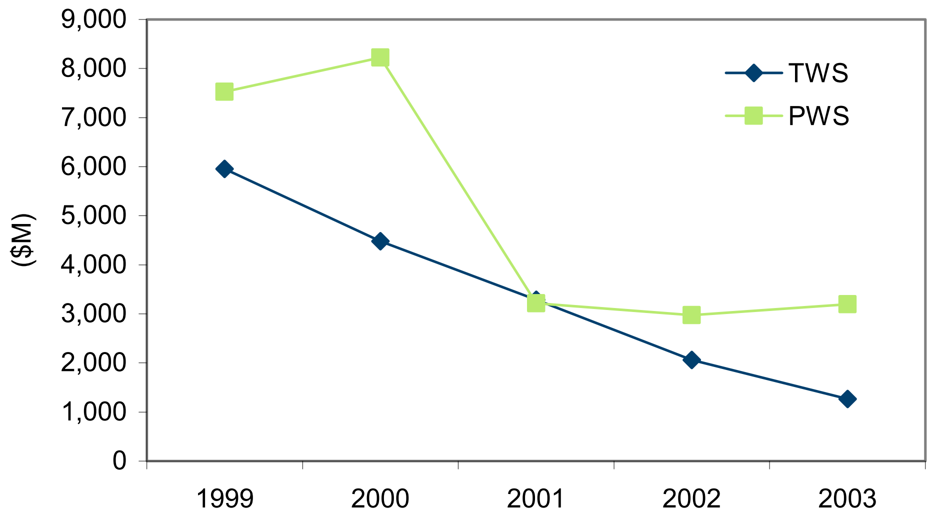
FIGURE 1

Worldwide Revenue of Traditional Workstation (TWS) and Personal Workstation (PWS) Markets, 1999–2003



Notes:

Traditional workstations are those based on 64-bit RISC processors running a version of the UNIX operating system.

Personal workstations are those based on x86 processors running Windows or Linux.

Source: IDC, 2005

As PCs and, specifically, commodity graphics adapters have become more powerful — driven primarily by the computer gaming industry — the difference in absolute performance between commodity-based systems and traditional UNIX workstations has declined. For many users, this has created a "good enough" scenario, in which a PC-based solution meets many (but not all) of an application's requirements at a fraction of the cost. Over the past several years, much of the traditional UNIX workstation market has been replaced by PCs or commodity graphics workstations based on Linux.

The downside for users in making this transition is that all of their technical application needs might not be met. Also, without a scalable architecture, they lose the ability to expand their problem sizes. However, users who do not make the transition may find themselves hostage to an expensive proprietary architecture.

An interesting side effect of this transition is that many vendors and users are working on architectural changes that will better incorporate commodity graphics components. In particular, graphics processing units (GPUs) are getting easier to program, and future architectures may allow users' codes to access GPUs directly.

The result of commoditization has been a productivity gap for many users in the current workstation market. Users on one side of the gap may wish to have a more powerful graphics workstation but cannot justify the added expense of a traditional UNIX workstation. Users on the other side of the gap have the capability and scalability they need but are not taking advantage of the advancements made in commodity components. IBM is targeting this productivity gap with DCV.

There is also a third category of potential customers for DCV. Adapting a workflow to take advantage of a new technology is usually a massive undertaking that cannot be done without considerable support from the vendor. As a result, not all users who might benefit from advanced visualization are currently doing so.

Users in some industrial markets, such as financial analytics and fraud detection, are suffering from data overload but may not have used visualization in the past, largely because the available solutions do not readily fit into their existing workflows. Another potential barrier to adoption is the cost of traditional visualization systems.

Even within organizations that are currently using visualization for some tasks, the usage might not be pervasive. For example, an oil exploration company might use visualization to determine a drill site but not to communicate updates to remote sites.

This type of workflow modification is a hurdle to further adoption of visualization. IBM's worldwide services organization gives IBM the ability to sell DCV to nontraditional visualization customers and to expand the usage of visualization within an organization.

The DCV Concept

DCV is a visualization infrastructure that combines commodity components with a scalable architecture and remote visualization features. The goal of DCV is to leverage the price/performance advantage of commodity graphics components and InfiniBand or Gigabit Ethernet interconnect adapters without sacrificing the needs of high-end users.

At the heart of IBM's DCV infrastructure is middleware that links multiple IBM xSeries IntelliStation workstations into a scalable configuration, effectively combining the output of multiple graphics adapters. DCV is based on Linux and OpenGL.

DCV is positioned to address three major market demands for visualization:

- For users of traditional proprietary graphics systems, DCV aims to provide equivalent levels of performance at a lower cost on many applications.

- For users of personal workstations and PCs, DCV aims to provide a more scalable solution that is still based on commodity technologies.

- For users who wish to incorporate visualization into their workflows for the first time, IBM can deploy DCV in conjunction with its worldwide services organization and its external partners to enable collaborative visualization while easing potential pain points in the transition.

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DCV has two built-in functional modes — scalable visual networking (SVN) and remote visual networking (RVN) — that previously were available only on high-end proprietary graphics systems. SVN is a "one-to-few" mode that displays applications, without modification, on multiple projectors and/or monitors, creating immersive or stereo visualization environments. RVN is a "one-to-many" mode that transports rendered frames to multiple remote locations, allowing geographically dispersed users to simultaneously participate in collaborative sessions. SVN and RVN can be used simultaneously or separately without additional setup, allowing both local and remote users to participate in immersive environments.

The DCV Architecture

DCV is a collection of middleware that links commodity components in a scalable architecture and provides SVN and RVN functionality (see Figure 2). This middleware provides a translation layer that essentially allows an application to view multiple workstations as a single system, such that most OpenGL applications will parallelize over DCV without modification.

With DCV, each workstation can render a portion of the final image. These individual portions are then composited before the final picture is displayed. The individual nodes communicate over a high-speed fabric — either Gigabit Ethernet or InfiniBand — to achieve the necessary bandwidth to render and composite images interactively.

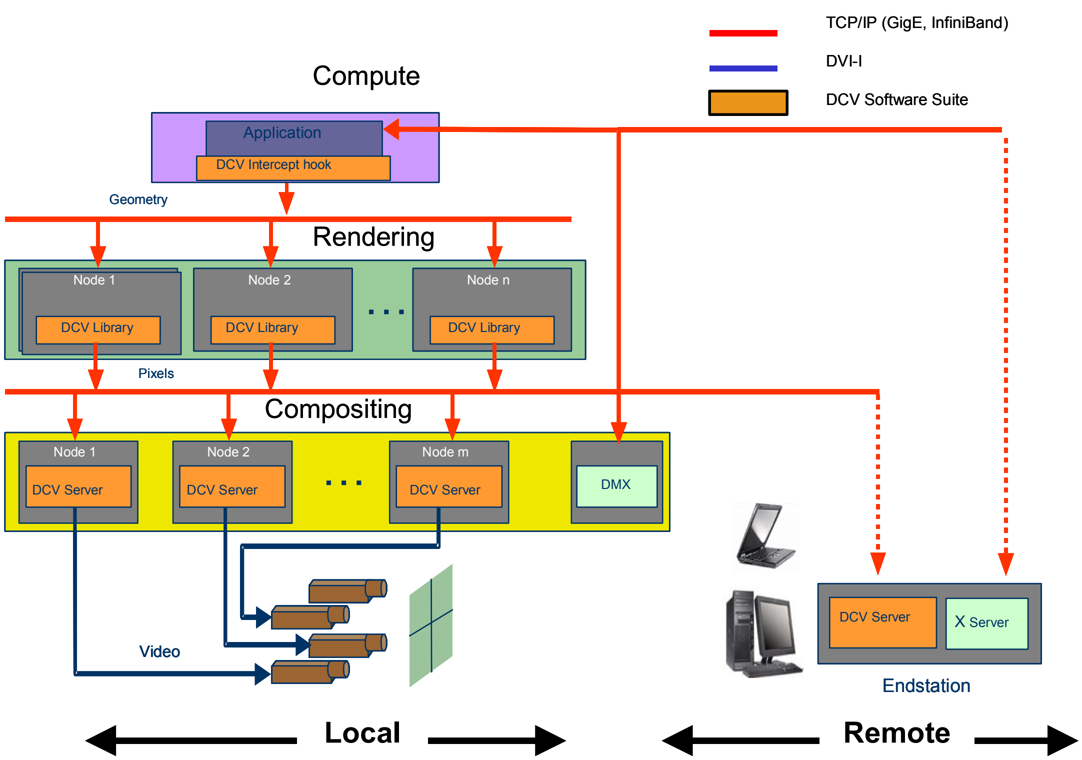
The SVN mode parallelizes the graphical parts of an application by intercepting the graphics stream on the master application node and distributing it over multiple rendering nodes. The rendering nodes all contribute to the final image. SVN can nest multiple OpenGL windows on large-format displays and also supports nonrectilinear environments (such as caves, hives, or other immersive visualization environments).

RVN allows users to participate remotely in visualization sessions. With RVN enabled, the frame buffer is captured, compressed, and transported over a network so that the displayed images can be shared by multiple users in a collaborative session. The primary benefit of RVN is that geographically dispersed experts have access to the computational and visualization capabilities of a scalable graphics computer. This can improve communication between team members and shorten cycle times in decision-making processes. (IBM will support RVN with up to four simultaneous users initially.) RVN also can improve data integrity and security, because multiple users are accessing centralized data sets, and therefore data is not being replicated in multiple locations.

The RVN endstation can be any platform supporting a native or emulated X server, which decompresses the frame buffer image sent from the DCV server. The RVN client can be accessed over LAN or WAN and can be used productively on typical networks, down to DSL and cable modem speeds. Higher-bandwidth connections are preferred for maximum quality, and the user can additionally tune RVN between maximum image quality and maximum frame rates to utilize the available bandwidth in a manner that is efficient for the application.

FIGURE 2

Logical Representation of DCV Architecture



Source: IBM, 2005

CHALLENGES/OPPORTUNITIES

Challenges

Although there are several current trends that support the introduction of a scalable graphics system based on commodity technologies, IBM needs to be aware that it is trying to reverse a trend away from sophisticated visualization systems. IDC believes that this will be primarily a marketing challenge to reeducate the market on the values of advanced visualization.

IBM must also address the challenges a customer faces in integrating advanced visualization into a workflow. Adapting an organization's intellectual infrastructure to incorporate advanced visualization — especially collaborative visualization — can be as challenging as it is rewarding.

In identifying nontraditional target customers for DCV, IBM might ask CXOs a set of questions:

- What pieces of information would be most helpful to you in making decisions that affect your organization?

- Does that data exist somewhere within your organization, and is it accessible?

- If you had the data, do you also have skilled people in your organization who would know how to properly analyze it?

If the answer to all three questions is yes, then IBM can target the organization as a candidate for DCV, but IBM must also address the question of why that organization does not already implement visualization solutions. Doing so may require an organizational and infrastructural overhaul to allow the key experts access to the critical data at the right point in a design process.

For example, consider a consumer products company that wishes to employ visualization for the first time to assess the manufacturability of a product before it is test-marketed. This would involve integrating product management, manufacturing, and finance, prior to final product design, to discuss trade-offs in cost, packaging, and appeal. The potential savings are enormous, but the integration task is daunting.

To meet this challenge, IBM must develop a full suite of visualization integration services to complement the product technology. This implies a great deal of cooperation between the product and service areas within IBM, as well as with IBM's external partners. If successful, IBM may find that some of its sales in industrial sectors will be fronted by its consulting arm rather than its product arm.

Opportunities

IDC believes the visualization market is currently in the midst of a transitional shift in search of a new equilibrium. A well-executed introduction supported by the appropriate efforts in marketing and services could support the establishment and growth of the "graphics server" architecture category as a common choice for incorporating visualization. IBM's greatest opportunity lies in the possibility that the industry could shift to this new architectural paradigm as the preferred technique for advanced visualization, with IBM poised to take advantage of the new dynamic.

If IBM is successful in promoting its vision, it can pick up significant mindshare from each of the three target profiles:

- Customers currently using proprietary visualization solutions might find better price/performance with DCV than they see with their current platforms. Sample target customers in this category include oil companies, for applications such as seismic processing and reservoir simulation, and certain manufacturing groups, for applications such as computer-aided design, crash simulations, or multidiscipline design optimization. Although this group is probably the easiest to identify and sell to, it is not a growth market in itself, and IBM will need to seek additional sales from the other two profiles.

- Customers that have previously migrated to PCs or personal workstations could adopt DCV in an attempt to achieve better scalability or lower TCO. Potential sales that fit this profile include scientific fields such as computational chemistry as well as biosciences and life sciences and broad manufacturing applications such as product design management. Combined with the first profile, this second profile would represent a stable-to-growing total addressable market.

- Potential customers that are not traditional users of advanced visualization but whose requirements for data analysis and communication are ever increasing could turn to DCV. This customer set is the one that most requires an investment in marketing and services to complement the product offering. It also represents a breakout growth opportunity for the visualization market. Potential applications include financial analytics, fraud detection, and business intelligence.

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