WHITE PAPER

Expert Integrated Systems: A Next-Generation Computing Platform

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IDC OPINION

IT's influence has been continuously growing within virtually every business for the past 50 years. During these 50 years, we have seen the evolution from monolithic systems to distributed systems and the Web and, recently, to what IDC calls the 3rd platform. This 3rd platform introduces cloud computing and adds mobile device support, big data, and social business dimensionality — but, most importantly, leverages advances in converged systems and integrated platforms to bring IT to the center of the business. This IDC white paper discusses the move toward a converged infrastructure leveraging compute, I/O, storage, and network virtualization to deliver simplified, highly available IT services on a highly integrated and modular infrastructure designed for tomorrow's workload. However, this converged infrastructure, when combined with an integrated software platform and designed for pattern-based deployment based on requirements of the workload, represents a highly advanced approach to system engineering.

IN THIS WHITE PAPER

This white paper discusses an important sea change happening in IT: the development of expert integrated systems. Converged systems are becoming increasingly important in the systems market. Similarly, convergence is occurring in middleware core runtime services for application development and deployment that are being unified as an enterprise application platform. Given the similarity in derived value propositions, converged systems and platforms are coming together as integrated systems; with the addition of capabilities focused on deployment, management, and optimization, integrated systems become expert integrated systems.

SITUATION OVERVIEW

Introduction

IDC continues to observe massive growth in devices, users, virtual machines (VMs), and data occurring in both large and small businesses operating in every industry. While these trends create many new long-term opportunities for organizations best able to seamlessly incorporate these developments into their businesses, in the short term, they are clearly putting significant pressure on the datacenter. Many users are finding that their traditional client/server architecture is not able to scale effectively

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and economically. At the same time, enterprise IT continues to look for ways to shift more IT spend from maintenance (keeping the lights on) into innovation (growing the business), and the market is looking for a new modular infrastructure platform capable of supporting applications connected to billions of devices and users.

The Business Case for Converged Systems

As client/server architectures gained widespread acceptance over the past 25 years, specialized teams were often created in the datacenter, focusing on managing physical resources including servers, storage, and networking. Typically, companies maintained a one-application-per-server model, which required IT to overbuild infrastructure to meet peak demand, disproportionately increasing management costs. Virtualization has made it possible to more efficiently use server hardware, but this has put pressure on systems administrators to set up and efficiently manage the vast number of virtual machine connections. IDC predicts there will be nearly 120 million virtual and physical servers installed by 2015, which will increase the pressures on staff as they work to manage multiple different applications. Operational demand also increases as servers, I/O, networks, storage devices, and applications must be integrated and the staff coordinated. So the search continues for solutions that automate day-to-day tasks, streamline processes, and minimize errors in order for IT staff to concentrate on innovation and value-added projects.

IDC is forecasting a 10-fold increase in the number of virtual machines between 2005 and 2015, while the physical server installed base in most enterprises will largely remain flat. Furthermore, the advent of policy-based live migration is causing IT to rethink its infrastructure requirements. The traditional siloed approach to IT isn't keeping up with the growth in virtualized workloads in the datacenter, and IDC finds that large and small IT shops are increasingly focused on:

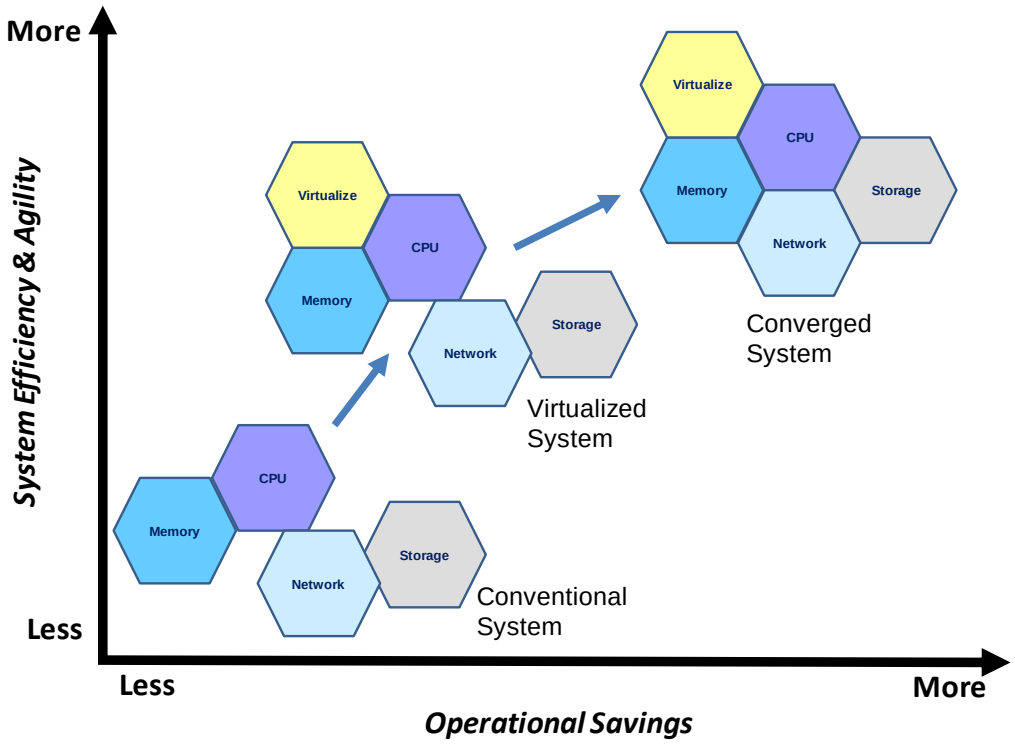
- Reducing costs (consolidation, virtualization, automation)
- Business alignment (modernization, analytics, and mobile)
- Risk management (business continuity, disaster recovery, security)

Where IT had previously sized each silo for a peak load that was seldom seen, IT is now sizing a shared infrastructure that spans compute, storage, and networking for a virtual workload that continues to grow quickly but predictably. What's more, the market is on the verge of private cloud discovery and users want to control their applications and data, but there's a major shift from traditional IT into shared and automated IT. The IT organization is focused on cutting costs while still providing support for distributed applications. Virtualization and automation have become key strategies in enterprises' move to consolidate resources and deliver private cloud capabilities to the business. IDC sees this trend continuing, with increased convergence to create modular environments in which applications and core infrastructure software are abstracted from processing, storage, and networking to provide the flexibility and scalability to turn IT into a service-oriented corporate function.

IDC believes the next phase of transformation is about application portfolio management, which incorporates elasticity and modularity at the infrastructure level. More and more end users will make capital investments in converged infrastructure designed to lower operational expenses in the datacenter and accelerate the time-to-market needs associated with new IT services. Industry focus will shift quickly to end-to-end integration of modularized hardware and management software. Figure 1 highlights the increases in component integration and benefits that come with converged systems. While Figure 1 suggests that virtualization provides benefit without material changes to the underlying system infrastructure, there is added benefit for all of the "-abilities" from adopting converged systems. Convergence requires a balanced approach to systems design by colocating storage with CPU and memory and connecting all of these with high-bandwidth networking. The result is a system with a high degree of horizontal and vertical scalability. This new model will extend from the enterprise datacenter into the world of service providers to further help users manage workloads, including at peak times.

FIGURE 1

The Transition from Conventional to Converged System



Source: IDC, 2012

Converged systems will be deployed to support workloads with high business value and relatively high delivery costs when deployed on traditional client/server architectures. IDC believes that going forward, a careful balance between cost and availability needs to be maintained. Additionally, when infrastructure needs extend from the private cloud to the service provider, IDC expects the off-premise infrastructure to follow the maturity of service providers, including:

- Timely delivery of IT
- Aging facilities and infrastructure can be the driver
- Start-ups and growth markets are not tied to legacy infrastructure

IDC believes the concept of converged systems is simple and indisputable. Optimization at the component or silo level in the datacenter is capable of delivering only small gains in efficiency. Now that adoption of modular architectures and virtualization is largely complete, the focus moves to end-to-end optimization, which IDC believes can return 30% price-performance gains to the user. However, the user needs to be willing to trade higher capital expenses for lower operational expenses. Additionally, the shift toward converged infrastructures that span the entrenched silos in the datacenter requires a champion to drive multidisciplinary conversations across the enterprise. Other observations regarding converged infrastructures include:

- Leading-edge adopters with resource-constrained customers will favor convergence initially.
- Private cloud built using converged infrastructure will continue to thrive in the off-premise world.
- IDC believes workloads are the critical decision point for making converged infrastructure decisions.
- CIOs are looking to better balance time, money, and people to overcome political barriers to adoption in the datacenter.

FUTURE OUTLOOK

The benefits of converged systems coalesce around the configurability, manageability, efficiency, and agility that result from advanced system engineering. While the benefits that accrue from convergence and virtualization are considerable, this represents just a critical foundational step in the direction of expert integrated systems.

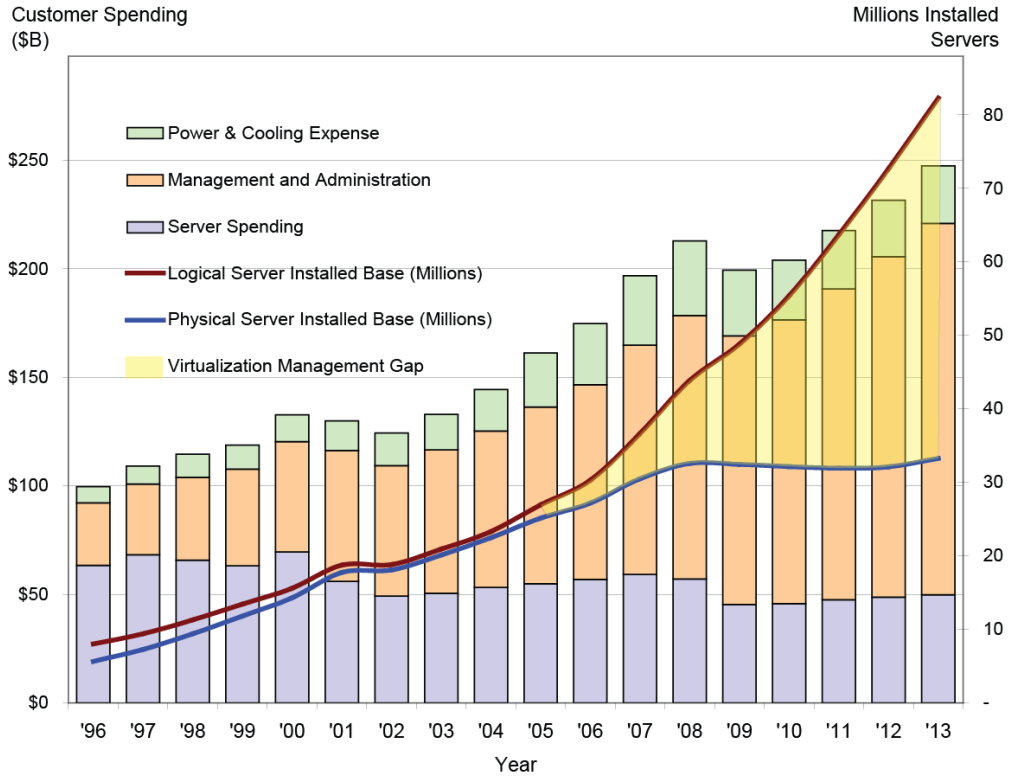
Building the Business Case for Converged Systems

IT organizations are aggressively virtualizing the workloads in their datacenters in a move designed to reduce capital costs while boosting employee productivity and increasing the utilization of IT equipment. However, this pursuit of operational efficiency has often resulted in unintended resource challenges, including overloaded network infrastructures, overprovisioned storage capacity, and sharp increases in

administration costs. In total, as Figure 2 shows, these problems can quickly overwhelm the anticipated economics in the datacenter as the scope of virtual server deployment expands. Virtualization allows application builders to broaden their addressable user base and accelerate the design and deployment of new IT services. While the rapid growth in virtual environments has reduced IT costs per unit of workload, improved deployment times, and reduced downtime, it has heightened the challenge associated with acquiring, provisioning, and deploying the right level of server, network I/O, and storage infrastructure capacity necessary to optimally support this expansion in virtualized workloads. IDC believes the next phase of virtualization growth will require infrastructures that incorporate end-to-end integration or convergence of core IT resources and management tools.

FIGURE 2

The Escalating Cost of System Management and Administration



Source: IDC, 2012

The shift to virtualized servers often leads to strains in other areas of the infrastructure, and IDC finds that as a result, virtualization reaches a plateau in many datacenters. Examples of this include the following:

- Virtual server sprawl stresses server/storage/network infrastructure and the accompanying administrative burdens required to deal with this stress. This threatens application performance and makes support/maintenance more challenging.
- Managing overprovisioned storage and networking infrastructure requires expensive hardware upgrades and slows IT deployment.
- Plans to migrate business-critical applications to virtual environments can be inhibited by application performance and recovery concerns associated with data recovery.

IT managers have traditionally acted as a systems integrator and sourced multiple products from a variety of suppliers and built their own IT infrastructure solutions, which span servers, storage, networking, and systems software. Converged systems provide a set of standard infrastructure elements including bladed servers for compute, modular storage systems for data, and an integrated 10GbE fabric for internode and storage connections. Converged offerings are factory configured as a "balanced system" in order to provide predictable amounts of "IT capacity." IDC finds that in addition to improving performance and decreasing staff time associated with typical self-assembled IT infrastructure, speed — or reducing the time necessary to deploy new IT services — is an equally important driver for converged offerings. IDC believes that the market is entering a new business cycle where IT customers are prepared to trade choice for both ease of installation and simplicity of management. IT environments large and small will increasingly value improved IT agility, IT staff productivity, end-user productivity, and lower IT infrastructure costs associated with converged infrastructure offerings.

The Significance of the Platform

If we look across the past 25 years of application development and deployment (AD&D) revenue, we see a remarkable transformation taking place that has shifted the market to a new equilibrium. In 1990, 66% of the spending in AD&D was on development tools. Most of this was focused on compilers, IDEs, and 4GLs. What deployment spending there was in 1990 was mostly centered on relational database management systems. Today, approximately 75% of spending in AD&D is on deployment-oriented products. Database accounts for close to 50% of this spend, and the rest is associated with application servers, business process management systems, portals, business rule management systems, life cycle, and other products that deliver value through runtime engines.

This transformation occurred because quality and time to market significantly improve when well-vetted services are used as the foundation for custom applications. Many elements of transactional, information, and analytics applications (be they custom or packaged) require recognizing a change of state, making decisions, invoking business processes, persisting data, generating events, and managing service delivery.

Deployment environments now exist for each core construct for application development, and together they represent the enterprise application platform of the future. Consequently, the momentum behind platform-based development is increasing due to the efficiency, configurability, manageability, and agility that these platforms represent when it comes to developing and deploying applications.

Convergence and the Origin of Integrated Systems

The convergence occurring in systems is conceptually identical to the convergence that is occurring in software deployment environments. The arguments for this are essentially identical: preintegrated components that are engineered to work seamlessly together and that deliver a highly configurable and customizable platform for supporting any workload. While this argument can be made for both converged systems and enterprise application platforms, the union of this converged infrastructure and software platform into an integrated system delivers added benefits that extend the value proposition.

In an integrated system, virtual machine instances and enterprise application platform components from the embedded software catalog can be provisioned in minutes instead of hours or days. Performance and availability requirements become logical configuration decisions instead of physical coding activities. Standardized hardware and software components enable nonstop operations and provide high levels of maintenance and upgrade transparency right to the bare metal. The enterprise application platform is also strategically situated between the end user–facing application and the system infrastructure. Consequently, the enterprise application platform is centrally situated and uniquely positioned to mediate the service levels required for the application and orchestrate underlying system resources for each application and across all applications running on the integrated systems to deliver continuously optimized results.

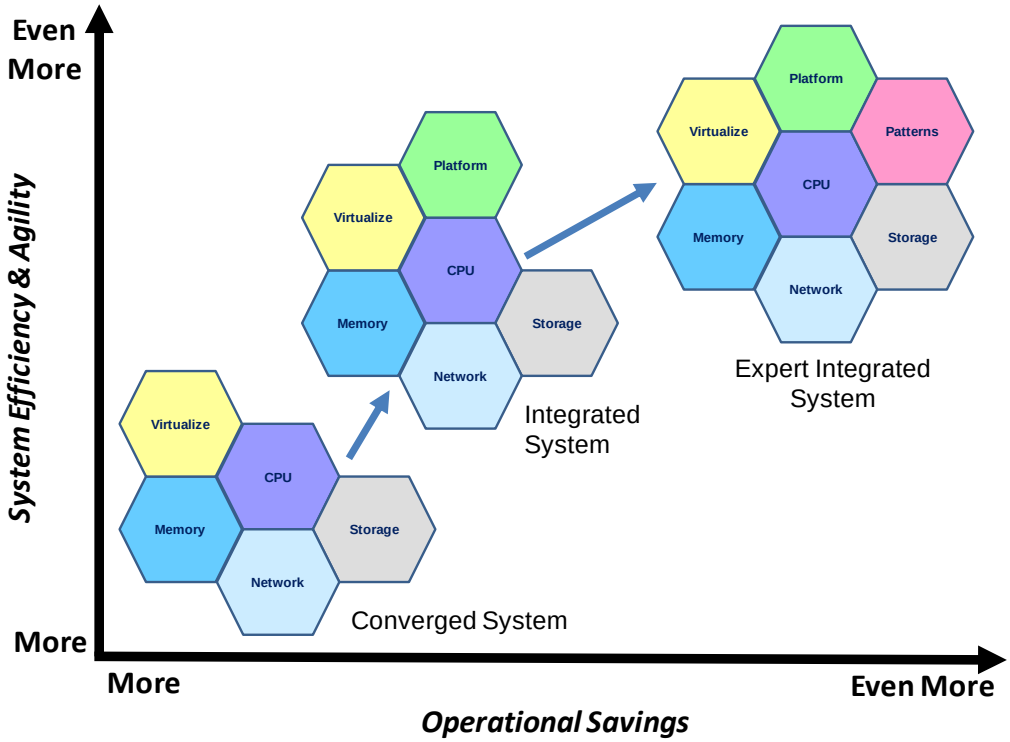
From Integrated to Expert Integrated System

While an integrated system offers compelling capabilities well beyond what can conventionally be achieved, once you have the ability to configure a virtual machine and provision software components, the stage is set for deploying groups of these assets according to predefined patterns. A virtual application pattern is therefore a collection of application components, behavioral policies, and component relationships. Core components could include Web applications, databases, queues, connections to existing resources, business process models, batch jobs, and mediations. Core policies of the pattern could include high availability, SLAs, security, multitenancy, and isolation. Virtual application patterns therefore represent an abstracted environment for deploying integrated system assets to further configure, speed, and simplify application deployment.

Figure 3 builds from the transition described earlier to converged system. As we have discussed, the transition from converged system to integrated system occurs when an enterprise application platform becomes an embedded component of the system.

FIGURE 3

From Converged to Expert Integrated System



Source: IDC, 2012

The further transition from integrated system to expert integrated system comes as a result of domain expertise that allows system components to be arranged into virtual patterns that further automate the deployment and ongoing management of applications.

IDC's belief is that expert integrated systems provide an opportunity for unsurpassed automation of IT systems. They say in the air force that the pilot is the limiting factor. This applies equally in IT due to the cost of well-qualified FTEs as well as the mushrooming complexity of systems that erodes quality of service. There are seemingly endless possibilities for impedance mismatches when applications are paired with system infrastructure. An expert integrated system not only eliminates the potential for hardware and software component inconsistencies but also offers a highly automated way to deploy and manage deployed assets in a continuously optimized manner.

CHALLENGES/OPPORTUNITIES

Despite the remarkable advances brought about by expert integrated systems, there will always be implied challenges and opportunities.

Challenges

Pursuing Price-Performance

Historically, workload performance could be improved by simply moving the application to a faster server. Each subsequent generation of processors (regardless of core microarchitecture) has run faster, allowing virtually all workloads (both monolithic and modular) to execute more quickly. When the workload exceeds the fastest processors running the software threads available, the application needs to be rewritten. Furthermore, additional message passing conversion may be needed when the application exceeds the largest SMP system available in order to efficiently scale horizontally across a cluster. As the number of cores increases with little to no increase in processor speed, most scalable applications will not realize a predictable performance improvement. As general-purpose SMP systems increasingly leverage large numbers of cores, applications that want to use all the capacity must be written to have similarly large numbers of software threads.

Unfortunately, a single simple metric does not exist that can adequately guide infrastructure acquisition decisions, and the challenge is only going to get worse. Developing a new understandable model predicting future system performance would need to include factors such as core density, energy efficiency, multithreaded software execution, and application scaling (horizontal vs. vertical). As a result, one of the chief drivers for converged system design is the increased difficulty enterprise customers are having getting predictable price-performance gains from multicore and multithreaded processors. And this challenge extends to the datacenter network and storage environments in virtualized datacenters.

Software Development Impacts

Processor performance improvements from one generation to the next have traditionally allowed applications to execute faster on new servers than the prior-generation system. However, as multicore architectures began appearing in the market about five years ago, processor performance is now largely gained through the multiplication of cores and threads. In other words, there will generally be minimal increase in performance for single-threaded applications hosted on systems leveraging multicore architectures. Some software such as DBMS already incorporates multithreaded designs, while the majority of other workloads including massive numbers of custom enterprise applications have limited or no inherent parallelism.

Enterprise applications continue to grow for a variety of reasons, and many of these applications are increasingly linked with core business processes. This is compounded as enterprise organizations grow either organically or via mergers and acquisitions, often resulting in even more applications. During regular IT consolidation and infrastructure refresh initiatives, these applications could be rehosted on new servers with faster processors and larger memory footprints, and performance gains

could be fairly easily achieved. However, these same applications are not designed to thrive in multicore and multithreaded environments, requiring expensive rewrites to run in parallel.

Parallel programming continues to be a complicated task. Developers must deal with uncertainties regarding the order of execution in their applications by employing synchronization techniques. Most programmers don't have the skills necessary to write parallel applications. Compounding this challenge is that when synchronization techniques are applied incorrectly by developers, the result can be seriously degraded performance for the application. These types of coding errors can be particularly difficult to debug because it can be very difficult to accurately trace the actual order of execution. In short, performance improvement for modern applications increasingly depends heavily on exactly which portion of the software can run in parallel. Due to the complexity of parallel programming, commercially available packaged software will increasingly be seen as a potential solution to the problem.

Opportunities

Expert Integrated Systems Alignment with Solutions

The pace of business change in the market is accelerating. IDC believes that enterprise IT customers will look to increasingly modular converged infrastructures that centralize management to efficiently share IT resources in order to help users consolidate systems, increase utilization, improve flexibility, and lower IT service delivery costs. The marketplace is increasingly looking for end-to-end solutions that cross both infrastructure and operations with application development needs. Very few vendors are capable of having a meaningful conversation regarding datacenter infrastructure and operations challenges together with the needs of application development professionals. The IT supplier that is able to drive a credible conversation that runs across the many silos present in the datacenter and also extends to the needs of the business and the application development team will have an advantage in the marketplace. At the same time, more cloud-based delivery of IT services will look to converged infrastructures as a more efficient way to provision and scale to match workload demands.

The Economics of Converged Infrastructure

The costs associated with system management and administration have doubled in the past 10 years, as shown in Figure 2. While the physical installed base of servers has plateaued, the logical installed base of servers (virtual machines) has nearly tripled. To date, management and administration costs are more closely correlated with logical servers than physical servers given the missing automation around the life cycle for these virtual machines. The automated provisioning, scalability, and optimization delivered by expert integrated systems provide an effective way to control these mushrooming system management and administration costs. While there is clearly capital cost to consider, it is dwarfed by personnel costs, as shown in Figure 2. Consequently, the operational cost structure of converged infrastructure appears to provide an opportunity to rein in system management and administration costs.

CONCLUSIONS

After 50 years, the datacenter continues to transform itself in order to keep up with and anticipate challenges facing the underlying business. Converged system deployments in datacenters are beginning to play an important role in helping IT organizations keep pace with rapidly evolving business needs facing a modern enterprise. IDC believes these systems are also critical to achieving ongoing reduction in both capital and operational costs associated with maintaining and managing a modern datacenter infrastructure. The market needs to begin requiring that IT suppliers deliver infrastructure solutions that securely integrate hardware and software components in order to support fully orchestrated resources across entire datacenters. It's critically important that organizations not allow organizational and institutional issues to become a barrier in the shift toward converged systems. Buying and deploying converged systems often requires changes in product selection and procurement practices. Finally, it is important for executives in the IT organization to meet with executives in the finance department because IT budgeting and cost allocation practices may need to be adjusted.

Converged systems and enterprise application platforms represent a significant step forward in their respective hardware and software domains. The benefits of converged systems or integrated platforms are similar: greater configurability in marshalling and orchestrating components, a higher level of manageability due to a more simplified usage metaphor, increased operational efficiency from a more componentized approach to design and construction, and far higher levels of agility in the development, deployment, and ongoing management of applications.

While the benefits that accrue due to this converged and platform-based approach to IT are compelling, the unification of the system infrastructure and platform provides another dimension of utility because of the vertical integration of infrastructure, platform, and application that is now possible. First, complex application deployment architectures can be reliably and quickly deployed when driven by virtual application patterns. Second, there is an opportunity for understanding the end user's application experience in the context of the platform and system resources utilized. Policy specific to the supply and demand for resources can be leveraged to ensure the optimized performance of all workloads running the integrated platform.

This extreme degree of resource integration allows IT to be far more responsive to the needs of the business while simultaneously delivering unparalleled efficiency in operations. The result is that expert integrated systems enable IT to be an equal partner in business policy definition and process enablement.