

WHITE PAPER

The Evolution of the Datacenter and the Need for a Converged Infrastructure

Sponsored by: IBM

Matthew Eastwood

Jed Scaramella

June 2011

IDC Opinion

In many enterprise datacenters, virtualization and blade computing have become key technologies deployed by the IT department in an effort to consolidate resources and cut costs while still providing increasing service-level agreements (SLAs) and supporting an expanding workload base. IDC sees this trend continuing, with increased convergence of the infrastructure occurring to create modular environments in which applications and infrastructure are available via virtual resource pools. With a converged infrastructure, the IT department can provide the flexibility and scalability to turn IT into a more service-oriented corporate function.

As the economy begins to recover from the recession, organizations will begin to reevaluate how they deploy technology. Currently, enterprise datacenters are very heterogeneous environments that typically handle a lot of applications running on a variety of platforms. In this very complex environment, there's a burgeoning need within datacenters to drive efficiencies by changing how staff members spend their time and how money is spent. IDC believes that the continuing shift to x86 servers for mission-critical workloads, combined with consolidation, virtualization, and automation, will drive the move toward a converged infrastructure — in effect the integration of servers, storage, and networking coupled with virtualization and management to create a more agile and simple IT infrastructure. As a result, the move to converged infrastructure will reshape investments and expenses in the enterprise datacenter.

This IDC White Paper discusses the move toward a more converged infrastructure in the enterprise datacenter — a move that often leverages virtualization and blade computing to deliver flexible IT services in a cost-effective manner. In addition, this paper discusses the role that IBM plays in the increasingly important market for converged infrastructure products in the datacenter.

Virtualization's Impact on the Datacenter

Both the advent and the continued adoption of virtualization in the datacenter have profoundly changed how IT delivers services. As a consequence of virtualization, IT needs to adopt management tools and automation throughout the datacenter. IT managers are currently challenged with complicated, siloed infrastructure due to the rise of x86 and virtualization, which has resulted in physical machine and virtual machine (VM) sprawl. Maintaining these systems is time-consuming and, in some organizations, distracts IT from supporting the business. To deal with sprawl and

management issues, IT managers are considering the entire datacenter environment when making purchase decisions. This comprehensive view of the datacenter is driving IT managers to look to converged infrastructure as an option.

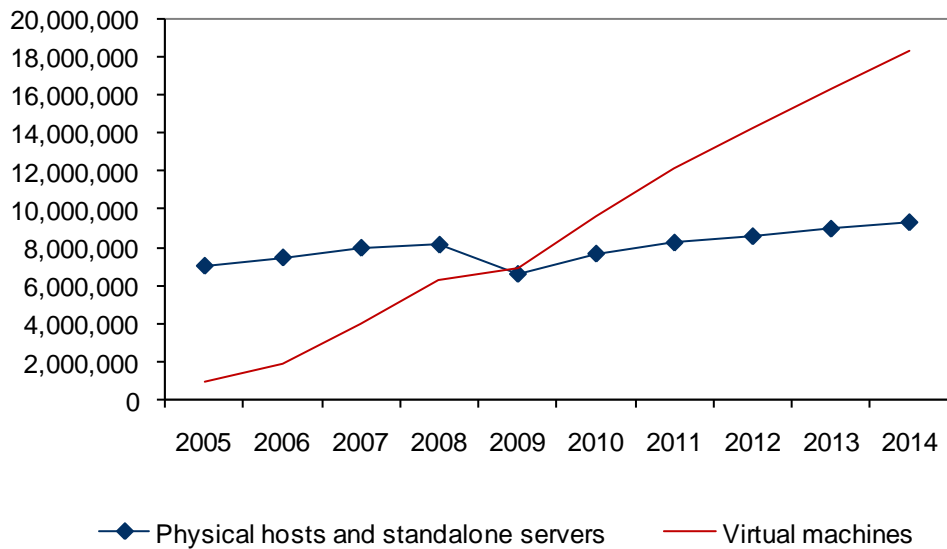
Support Varied Workloads with x86 and Blade Servers

For the past 14 years, the server market has been shifting, and today, x86 servers represent more than 64% of the worldwide server market. From 1997 to 2008, revenue for x86 servers increased \$16 billion. Within the same time frame, blade server revenue increased \$6.6 billion, and blade servers now make up approximately 19% of the x86 market. IDC expects the recent trend with x86 systems to continue in 2011 and beyond. Originally an extension of the PC market, the platforms were once viewed as suited for only lightweight or prepackaged applications. As innovations in reliability, availability, and serviceability continue, x86 servers will increasingly support an expanding range of workloads, penetrating more and more into high-end business and mission-critical applications.

In the datacenter, overprovisioning server resources had been a prevailing tactic to ensure application performance and service levels. Only about five years ago, the predominant computing x86 model in the datacenter consisted of one application per physical server. As server virtualization has found a foothold — driven initially by the need to consolidate servers to reduce capital expenses — the number of virtual machines has increased significantly. In 2005, only 5% of physical servers shipped with some level of virtualization; today, virtualization adoption has risen to the point where 1 in 5 physical servers is shipping with virtualization. IDC estimates that virtualized servers will make up more than 23% of the shipments in the market by 2013 (see Figure 1). More virtual machines are being deployed than physical machines, and IDC anticipates that virtualization will continue to be the default build for applications going forward. As a result, VM density is on the rise, with more VMs per physical host and more workloads running on VMs.

FIGURE 1

Worldwide Server Virtualization Shipment Forecast, 2005–2014



Source: IDC's *Server Virtualization 2010*

Virtualization not only has improved the utilization rates of existing server hardware but also has lowered capital spending requirements for new server hardware. However, a new challenge has emerged. As the growth in physical infrastructure flattens, the number of virtual machines increases. In the past four years, the number of VMs per physical machines has more than doubled. In fact, IDC estimates that more virtual machines than physical servers were deployed in 2010. As a result, there is increased pressure on the server infrastructure in terms of memory, systems, I/O, and storage. In particular, the ability to grow the networked storage environment in line with the virtual server environment is a challenge that is top of mind for IT managers.

While virtualization can help alleviate some of the IT complexity issues by reducing hardware costs and creating a more dynamic and mobile infrastructure, the ability to successfully implement and manage virtualization is complicated. Lack of integration is an increasing concern as the ability to move virtual machines across disparate datacenter sites becomes increasingly fundamental. Consequently, the challenges faced by IT departments only increase as virtualization becomes the default standard for the datacenter. As datacenters strive to provide flexible IT services to the business, the increase in virtualization will affect the type of infrastructure organizations deploy and the subsequent strategies they must implement in the datacenter.

The Limits of an Inflexible Infrastructure

Complex and inflexible infrastructures limit an organization's ability to respond to changes in the business and make it difficult to provide service-centric applications or innovate or launch new projects. As IT organizations struggle with systems integration issues, the management costs associated with systems deployment, integration, and maintenance stress IT budgets and staffing resources. A lack of automation results in IT personnel being mired in repetitive, lower-level work that leaves them little time to innovate or perform more business-critical tasks.

While virtualization has reduced datacenter costs by 25%, IT is still spending 80% of its annual budget on maintaining and managing existing systems and only 20% on value-added activities and initiatives, such as building new IT services and developing innovative business services. What is driving the need for converged infrastructure is the need to flip the 80/20 equation by reducing the time and money spent on maintaining what already exists and instead applying more resources toward the value-added activities that support and drive new business.

Converged Infrastructure: Evolving Toward Virtualized I/O and Networks

In essence, convergence involves the integration of servers, storage, and networking deployed with virtualization and management to create an agile IT infrastructure. The convergence includes virtualized I/O, converged networking, virtual switching, load balancing, and storage connectivity. Managing a converged infrastructure is accomplished with new integrated tools that create server/infrastructure profiles (loosely akin to VMware Virtual Machine File System). Integrated toolsets replace individual point products that were used to manage static physical infrastructure.

To deliver value to the enterprise's ever-changing business environment, IT executives must offer an infrastructure that is not only flexible but also scalable at minimal financial expense. The continued use of virtualization is critical but will require new ways of thinking in terms of processes, infrastructure, and management.

Server virtualization has delivered outstanding capex savings on hardware, power, cooling, and real estate through consolidation of hardware and higher levels of resource utilization. As virtualization has matured and advanced, it is beginning to deliver operational efficiencies. No longer just a server technology, virtualization is the foundation for what IDC calls the "dynamic datacenter" — also referred to as agile infrastructure or internal cloud — which has impacted all areas of the datacenter, including storage, networking, security, and management. Virtualization also is leading the way to cloud computing.

Moving to Integrated Hardware Offerings

As organizations look to cloud computing, enterprises will see more integrated hardware offerings for servers, storage, and networking — signaling the shift from isolated resource silos in the datacenter to a more integrated approach that fulfills the need of infrastructure clouds. External infrastructure clouds are being built to extend virtual infrastructure resources outside the walls of the enterprise, but all will be managed using a single set of tools.

This converged infrastructure model will change the way datacenters operate and thus impact infrastructure software and hardware. Successful converged solutions will require the following:

- ☒ Strong bundling and interoperability of robust physical and virtual infrastructure platforms with advanced management and automation tools
- ☒ Heterogeneous management and integration capabilities
- ☒ The delivery of virtualization software platforms on preintegrated infrastructure blocks that consist of server, storage, I/O, security, and networking resources that are logically defined and tightly coordinated
- ☒ A strong professional services channel that can integrate and deploy solutions across traditional IT silos and guide IT organizational and process change as enterprises eventually move to adopt a cloud services model

This converged infrastructure is about the shift to infrastructure clouds, whether internal, external, public, private, or hybrid. It represents a major change to IT, in terms of architecture and as a service model. Architecturally, this computing model is fully modular, driven by server virtualization, but in tight concert with I/O, storage, and network virtualization. This model will abstract the infrastructure and present it as a service to application owners (infrastructure as a service, or IaaS), shifting datacenter savings from capex to opex.

Implementing Virtual Resources to Meet Changing Demands

As a result of the move to a virtual resource-based model of IT, applications have uniform and universal infrastructure services, such as on-demand provisioning, dynamic scaling, and high availability/disaster recovery. Enterprises may also tightly couple a virtualization-aware application runtime environment with the virtualized infrastructure to create a platform-as-a-service offering. As virtual servers explode in number and outstrip physical servers, a converged infrastructure must have a very intelligent management layer to automate most tasks through a policy-driven, service-oriented approach to scale. In the longer term, external virtual servers purchased from cloud providers also become an integrated enterprise resource.

This converged infrastructure model will also lead to I/O and network virtualization, in which the operating environment and associated applications become completely separated from CPUs. "I/O virtualization" is a broad term, referring to a varied set of technologies that abstract the hardwired world of devices such as network interface cards (NICs), host bus adapters (HBAs), and disks and the networks, cables, and adapters that connect them. I/O virtualization provides virtual views of I/O devices, adapters, or networks that are more flexible than physical. Network virtualization also permits instant instantiation of logical networks, private VLANs, switches, and load balancing. The result is a "wire-once" environment that is inherently more flexible than traditional environments.

IDC believes that I/O virtualization plus network virtualization will create a system of virtual resources that can be utilized, and changed, to meet changing business needs.

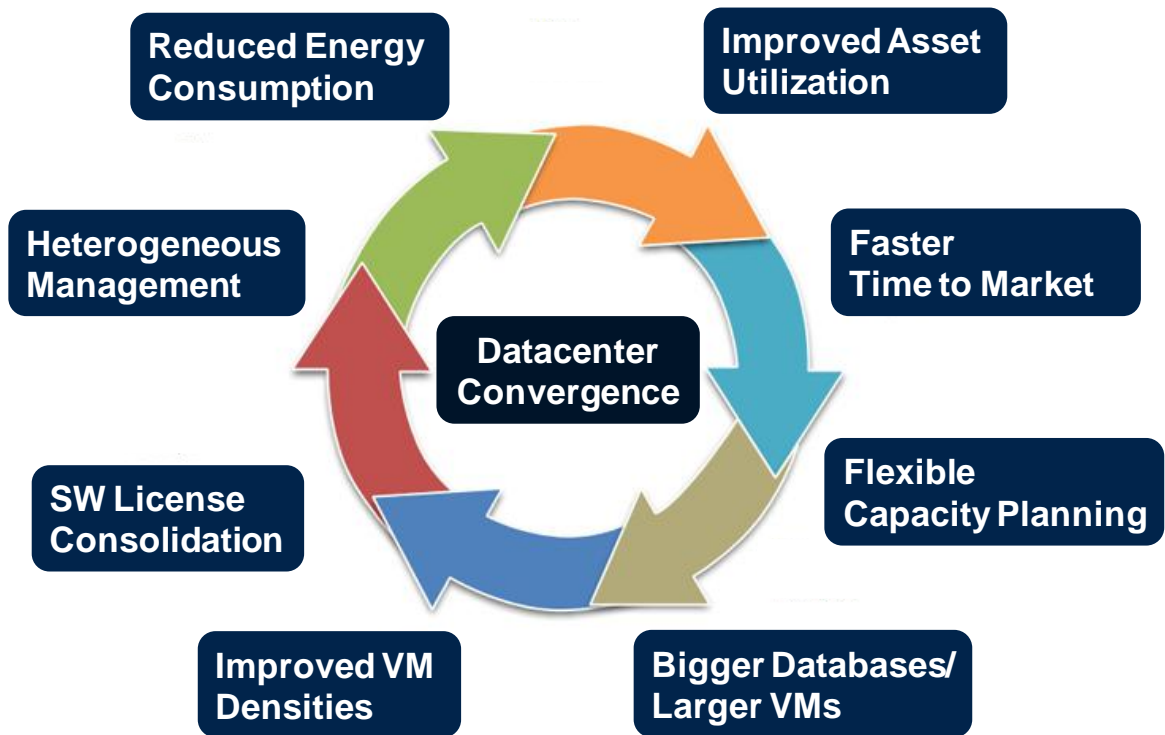
Benefits of Converged Infrastructure

There are many benefits of a converged infrastructure in terms of operational and capital costs, as well as improvements in datacenter operations (see Figure 2). Among the main benefits datacenters can achieve with converged infrastructure are the following:

- ☒ **Improved asset utilization.** In a converged environment, there is no longer one application per box.
- ☒ **Faster time to market.** Automation and systems management, combined with the flexibility of virtualization, enable applications and services to be deployed rapidly.
- ☒ **Flexible capacity planning.** With the limits of one application per box removed, enterprise datacenters can mix and match workloads to available resources.
- ☒ **Bigger databases, larger VMs.** Increasingly, more production mission-critical workloads and databases run off of x86 and virtual machines.
- ☒ **Improved VM densities.** Due to innovations in x86 processors, a single machine can run more VMs, which in turn reduces costs.
- ☒ **Software license consolidation.** As datacenters reduce the number of systems deployed, organizations purchase the appropriate amount of software for these systems.
- ☒ **Heterogeneous management.** A converged infrastructure provides simplified and heterogeneous management across servers, networking, and storage, with centralized management for all of the disparate components.
- ☒ **Reduced energy consumption.** Virtualizing reduces the need for excess hardware and the associated energy use/costs.

FIGURE 2

Benefits of Convergence



Source: IDC, 2011

In the longer term, enterprises will have heterogeneous management throughout their datacenters. This kind of holistic, end-to-end and centralized management across the infrastructure can facilitate agility and flexibility and enable IT to more effectively support the business by offering service-centric applications and capabilities.

Barriers to Converged Infrastructure

Over the past decade, the market has seen the emergence of blades as a form factor. Blades have always been seen as a great consolidation platform, and they have significant management advantages due to centralized management of all the components and servers that reside within a chassis. Blades have been and are expected to continue to be at the forefront of management, virtualization, and automation innovations.

For the enterprise, x86 blades are a key element of converged systems, and vendors are offering blades as building blocks for private cloud environments. In effect, blades are a key element in the intersection of virtualization, servers, and converged infrastructure.

Deploying converged infrastructure requires much more significant adoption of management tools and more widespread automation adoption in the datacenter. One issue that is prevalent in the market is that today IT administrators are reluctant to adopt automation due to the perceived loss of control. In terms of consolidation and virtualization, many IT organizations are still focused on tangible benefits, such as reduced power and cooling costs, reduced capital investments, and real estate (floor space) savings. The opportunity with converged infrastructure centers around staffing and systems management; rather than IT losing control or reducing staff, automation can enable IT to shift staff away from routine tasks to more value-added activities.

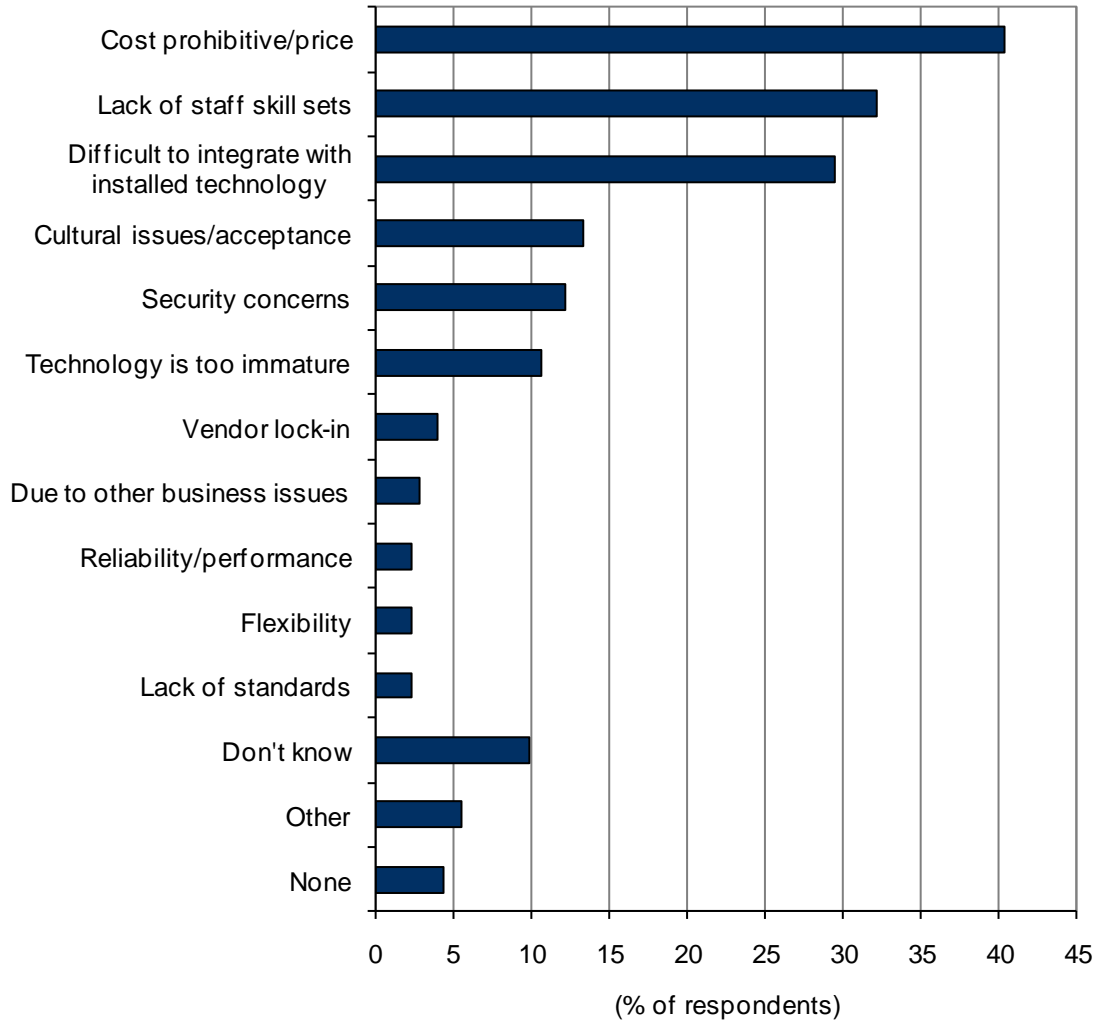
IDC believes that the natural progression toward converged infrastructure will include virtualization first. With just over 17% of physical servers virtualized as of 2010, with a five-year CAGR of 13%, there is a small, but growing, market for converged infrastructure. As virtualization grows and organizations struggle to meet the management challenges of VM sprawl, converged infrastructure will be increasingly considered and understood.

A recent IDC survey of 255 IT decision makers found that there is some awareness of converged infrastructure and its benefits. The feature of converged infrastructure that 46% of respondents are most interested in is virtualization and automation management tools. This interest further confirms that the drive toward converged infrastructure will come from IT decision makers wanting to simplify increasingly complicated, siloed infrastructure. Over 40% of survey respondents have not heard of or considered converged infrastructure. The survey also identified the top challenges to implementing a converged infrastructure (see Figure 3).

FIGURE 3

Top Challenges of Converged Computing

Q. *What do you see as the top 2 challenges in moving to converged computing?*



n = 255

Notes:

Multiple responses were allowed.

Total may exceed 100%.

Source: IDC's *Datacenter and Cloud Computing Survey*, January 2010

In addition to cost (also mentioned as a benefit of converged infrastructure), there are a host of inertia-driven challenges. IDC believes that challenges to implementation are the flip side of the greenfield opportunities in converged infrastructure — including a lack of internal skill sets, internal cultural and organizational issues, and many IT decision makers taking a "wait and see" attitude.

IT infrastructure enables businesses today to capture market opportunities and satisfy clients on a day-to-day basis. However, since the rise of x86, independent optimization and piecemeal environments have complicated infrastructure immensely. These carefully calibrated and integrated systems are difficult to change, upgrade, and scale.

Virtualization has only increased infrastructure's complexity. Previously, physical machine sprawl was difficult to manage; now there is the additional layer of virtual machine sprawl. IT managers need to contend with physical maintenance of servers, storage, and networking and virtual maintenance of VM images and life cycles. These two layers of carefully tailored architectures are pushing IT managers to consider simpler, less expensive solutions. As in the mainframe era, IT operators are again considering the entire IT environment when making purchase decisions through the use of converged infrastructure.

Considering IBM BladeCenter Foundation for Cloud

IBM is pursuing the growing market for converged infrastructure with the IBM BladeCenter Foundation for Cloud, an integrated platform with network, servers, storage, management, and services that enables fast virtualized platform deployment today. According to the company, the IBM BladeCenter Foundation for Cloud is designed to streamline the deployment of virtualized infrastructure and to provide the following benefits:

- Improves time to value:** Rapidly deliver a virtualized platform that is preloaded and integrated
- Improves innovation:** Help improve business agility and resiliency with smart workload management and robust infrastructure
- Decreases IT cost:** Maximize current capital usage and reduce need for future capital with built-in virtualization
- Reduces complexity and risk:** Preloaded and integrated to minimize the human error factor
- Allows for evolution:** Migrate to cloud when ready without rip and replace

Features and Benefits

The IBM BladeCenter Foundation for Cloud includes:

Built-in server virtualization

- Allows for significant consolidation of workloads
- Facilitates higher asset utilization/cost avoidance
- Creates resource pools to allow agile workload deployments

- Enhances business resiliency
- Creates a highly managed virtualized environment

Platform/virtualization management

- Monitors and manages physical and virtual resources in same manner
- Dynamically manages virtual workloads to optimize resource usage
- Automatically migrates virtual machines across systems to maintain service levels
- Provides network isolation via multiple VLANs

Energy management

- Provides visibility into key energy metrics (power, cooling, temperature, airflow) within the solution
- Identifies areas where energy consumption can be reduced/rebalanced
- Provides energy metrics to other management products, as appropriate, to drive actions

Consulting and Services

IBM has a strong heritage in consulting and services, and the company is helping clients transform their datacenters. IBM can assess clients' needs and then create a road map for building a converged infrastructure that is specific to each client.

In conjunction with the purchase of the IBM BladeCenter Foundation for Cloud, IBM includes the following start-up services:

Installation and configuration

- Installs and configures IBM BladeCenter Foundation for Cloud in client's datacenter
- Configures network and storage to client requirements
- Configures virtualization resources and management

Hands-on training

- Covers broad range of management considerations
- Addresses administrator and user levels

IBM BladeCenter Foundation for Cloud is extensible, designed to allow datacenters multiple ways to extend their environments:

- ☒ Adds additional workloads to base servers driving higher asset utilization
- ☒ Adds more virtualization capacity servers to the initial IBM BladeCenter environment
- ☒ Expands to cloud environment with new software functionality like ISDM with no need to rip and replace

Technology

IBM BladeCenter Foundation for Cloud integrates IBM server, networking, storage, and management with VMware vSphere 4.1 Enterprise Edition, VMware vCenter 4.1, and IBM Systems Director.

The IBM BladeCenter H chassis with HS22V servers provide the performance and memory footprint to virtualize workloads with confidence. Management node responsibilities are supported by the System x3550M3 with System Storage DS3524 providing flexible and reliable storage. The BladeCenter Foundation for Cloud offers a high degree of flexibility, enabling you to deploy now and scale as your business requirements change. Standard configurations offer the ability to scale up to 2,000 virtual machines.

Challenges / Opportunities

In 2010, IBM acquired BLADE Network Technologies (BLADE), a move that advances the company's push into the market for converged infrastructure. At the time, BLADE was a \$100+ million datacenter network company with worldwide presence and over 300 employees. The acquisition of BLADE makes perfect sense for IBM; IBM is a significant participant in the \$21.5 billion worldwide enterprise network consulting and integration services market, and the acquisition will help IBM with its blade strategy. This move enables IBM to continue its industry-leading services methodologies and go-to-market practices while working with multiple networking participants in the market. The addition of BLADE enables IBM to bring networking IP assets in house in order to build a converged infrastructure platform.

IDC believes that the industry is now entering a phase where a converged IT infrastructure will become an increasingly attractive option for enterprises. Networking architecture will be an integral component of converged infrastructures — where server, storage, software, and networking are brought into closer alignment. A converged architecture provides efficiency, high performance, and the ability to quickly deliver IT services based on business demands by leveraging pools of resources. A component of this tightly coupled architecture is ease of provisioning and fabric management, which can be achieved only if the network is an integral component of the solution.

IBM sees the network as a conduit to an agile and on-demand IT service and decided to acquire BLADE to pursue a converged infrastructure strategy. BLADE's strategy and vision is singularly focused on the datacenter network market. The company had

succeeded in shipping highly reliable, high-speed, low-latency, and low-power network switching utilizing ASIC and merchant silicon in order to bring speed and intelligence to the edge of the network.

IDC believes a new unified fabric is emerging for the datacenter — a fabric that enables clients to capture opportunities such as cloud and overcome obstacles such as infrastructure complexity. IBM will be an active participant in this transformation.

Challenges

Significant technology transitions have consistently shown that IT management practices are slow to adapt in response to new technology. From open systems to PCs to mobile devices, technology enables new operating models that often require a rethinking of the IT organization's internal architecture, funding, and priorities. IDC believes that converged infrastructure is an important new technology architecture that requires just such an IT organization rethinking for maximum value to be realized. After all, one system managed by three separate groups is really three separate systems.

For IBM, as well as other vendors, one of the primary challenges in deploying a converged infrastructure with clients is cultural. In many organizations today, decisions about storage, networking, and systems management are often made by different individuals in the IT organization. So while converged infrastructure offers operating cost advantages, IBM will likely have to overcome political resistance inside some entrenched IT organizations. To mitigate this challenge, IBM needs to educate clients about the intangible benefits of a converged infrastructure (i.e., the cost savings and flexibility that can result by automating systems management and shifting staff to provide more value-added IT services).

For vendors, success will be determined in large part by the ability to be flexible and offer converged infrastructure solutions based on each client's needs and situation. Most potential clients will not be abandoning their currently installed infrastructure wholesale for a converged solution. Vendors need to respect clients' installed base and investments that IT managers have already made. One approach for vendors is to ensure how their solution fits into a client's overall IT environment.

Vendors need to educate IT managers about converged infrastructure in general and vendor-specific offerings. Because over 40% of IT decision makers have not heard of or considered converged infrastructure, IBM needs to be careful not to overwhelm potential clients and needs to make a special effort to articulate what converged infrastructure is before delving into a branded solution. In particular, vendors should stress how converged infrastructure can decrease time spent on maintenance and management. In addition, IBM and other vendors should stress automation and virtualization management tools because they are the most popular aspects of converged infrastructure.

Essential Guidance

For enterprise IT, converged infrastructure is here to stay, and it is a great alternative to siloed computing. With systems that are calibrated to work together in concert, new efficiencies are available that lower costs and increase IT agility. Additionally,

converged infrastructure management should be simpler because everything comes preintegrated to work together out of the box. Due to these highly converged systems, vendors and partnerships are converging as well. Just like IT organizations are rethinking their internal architectures as they undergo technology transitions brought about by converged infrastructure, vendors are considering how to reorganize their strategies to maximize their ability to deliver converged infrastructure. Competition between IT providers is an important factor for enterprise IT to consider when making purchasing decisions. There are pros and cons to partnership agreements to deliver converged infrastructure versus a one-vendor vertically integrated solution.

For enterprise datacenters, the migration to converged infrastructure needs to follow an evolutionary approach leveraging standards. A converged infrastructure doesn't require forklift upgrades. In addition, enterprise datacenters should deploy integrated physical and virtual fabric switch management allowing for discovery and management of VMs across the network. In addition, IT managers should recognize that in the short term, datacenter convergence allows for close alignment of server, networking, and storage management. In the longer term, converged infrastructure will enable IT managers to manage datacenters as discrete units of enterprise computing.

Conclusion

Even though many IT decision makers have not heard of or are not considering converged infrastructure, converged infrastructures are rapidly becoming an attractive option over standalone solutions. Convergence not only lowers complexity but also is an enabling vehicle for a shared service model of computing — one that maximizes hardware utilization, improves availability, contains management costs, and reduces time to deployment. Single, tightly integrated systems allow organizations to create a dynamic environment where infrastructure can automatically grow, contract, and redeploy at an optimized price point or monthly fee, as business demands change. Converged infrastructures can be deployed faster than standalone hardware, and they provide improved availability with preset SLAs. In addition, the use of automation tools can lower management costs.

Converged infrastructures are more adept at supporting governance, which enables an organization to align business and IT. Governance also facilitates improved resource allocation, strategic planning, decision making, communication, and performance between business units and across IT functional silos. Moreover, automating governance within a converged infrastructure facilitates stringent standardization of components and processes, making compliance and enforcement easier to achieve.

Converged systems and automated processes create a more agile environment while eliminating or minimizing the need to perform manual tasks. They ensure a predictable operating environment, enabling business value to be achieved more quickly. Tightly integrated systems also allow an organization to build an infrastructure that supports cloud services within the walls of its own datacenters. Blade platforms are being leveraged in converged solutions that integrate servers, storage, and networking with virtualization and automation to deliver efficient and flexible IT services. With its IBM BladeCenter Foundation for Cloud integrated platform, IBM is targeting the important market for converged infrastructure products.

Copyright Notice

External Publication of IDC Information and Data — Any IDC information that is to be used in advertising, press releases, or promotional materials requires prior written approval from the appropriate IDC Vice President or Country Manager. A draft of the proposed document should accompany any such request. IDC reserves the right to deny approval of external usage for any reason.

Copyright 2011 IDC. Reproduction without written permission is completely forbidden.