

WHITE PAPER

Building Business Value with HP's Virtual Connect FlexFabric Module

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EXECUTIVE SUMMARY

Enterprise IT environments are increasingly taking on a strategic role in the organization, both as a point of differentiation and as a means of gaining a competitive edge in the market. Unfortunately, as the number of servers in datacenters has grown, the server management burden has also grown to the point where it now consumes the lion's share of IT budgets, squeezing out time and resources that could be spent on more strategic projects. The server load has also increased the power and cooling burden to the point where it is often the limiting factor in increasing server capacity.

IT managers have turned to solutions, including blade server technologies and virtualization, to consolidate and simplify their infrastructures. While these technologies have helped reduce operating costs, improve capacity scaling, and simplify server management, they have introduced new challenges, foremost of which is the additional burden on network input/output (I/O).

As the number of virtual machines per server rises, the demand on server I/O rises, adding to network cost, density, and complexity. Challenges associated with I/O in virtualized blade server deployments include bottlenecks introduced by additional workloads, increased energy consumption and demands on management time, network change management complexity, and increased interconnect hardware and software costs and complexity.

To address these issues, HP has introduced the Virtual Connect FlexFabric 10Gb/24-Port module, a new interconnect built upon Virtual Connect's Flex-10 technology. The Virtual Connect FlexFabric module consolidates Ethernet and storage networks into a single network with the goal of reducing network costs and complexity. It extends previous-generation HP Virtual Connect Flex-10 technology with the inclusion of iSCSI, Converged Enhanced Ethernet (CEE), and Fibre Channel over Ethernet (FCoE) protocols. IDC interviewed three customers that have implemented early-stage HP Virtual Connect FlexFabric module and FlexFabric adapter deployments and credit the module with helping them improve their overall flexibility to move resources within their infrastructure to adapt to changing business requirements; reduce the costs associated with network, server, and storage administration; and reduce costs for networking hardware, including switches, NICs, HBAs, and cabling.

SITUATION OVERVIEW

IDC research indicates that enterprises are increasingly using their datacenter and IT environments as a point of differentiation and as a means to gain a competitive edge in the market. The ideal for a customer is an IT environment that is flexible and agile yet still cost-effective. Progressive companies are reassessing their operations and rethinking how IT can be more strategic to the business. They are exploring concepts such as cloud computing, transforming their IT infrastructure by breaking down distinct technology silos, and creating shared resource pools that can be dynamically provisioned to business units as demands require. While a handful of large-scale public clouds are being built today, many companies aim to recreate the same benefits using similar design principles in their internal datacenters.

Unlike public clouds, which typically build standardized homogeneous infrastructures that are required to deliver relatively simple applications to a large number of users, internal or private cloud environments must support a wide range of applications for a variety of business users, albeit usually fewer than the number supported by public clouds. Additionally, with a private cloud, a company is able to tightly control and manage business-sensitive applications and data sets, alleviating concerns over security and data privacy issues. In many cases, public clouds are being built on fleets of scaled-down servers that are low cost and extremely energy efficient. IDC believes that private clouds will be built on converged systems that integrate server, storage, and networking resources coupled with virtualization and automation capabilities that create virtual resource pools to maximize system utilization and business flexibility.

Rapid Adoption of Low-Cost Servers Leads to Datacenter Inefficiencies

Even though the recent hype over cloud computing may lead observers to believe that simplifying IT infrastructure and moving toward a dynamic environment is a relatively new trend, the industry has been focusing on this problem for several years.

As companies grew their use of IT over the past decade, they typically installed applications on individual servers, leveraging distributed architectures built on new lower-priced x86-based systems. While the use of these low-cost systems allowed companies to keep their server capital expenditure relatively flat, it resulted not only in a rapid expansion of the server footprint within their datacenters but also in an inflexible infrastructure that was riddled with unused capacity, networked together with a large number of cables connected to expensive and fixed network switch ports.

Server and server I/O bloat in the datacenter is taxing IT staff time and budgets due to both increasing management and operational expenses and the mounting challenges of datacenter power and cooling. IDC estimates that server management costs have outpaced capital expenditures by a factor of four, while server energy expense has increased 53% over the past five years. IT managers are looking for ways to reduce these expenses while still delivering highly available resources to business users who are demanding constant access to IT services.

Blade Technologies Create Flexible, Cost-Effective IT Environments

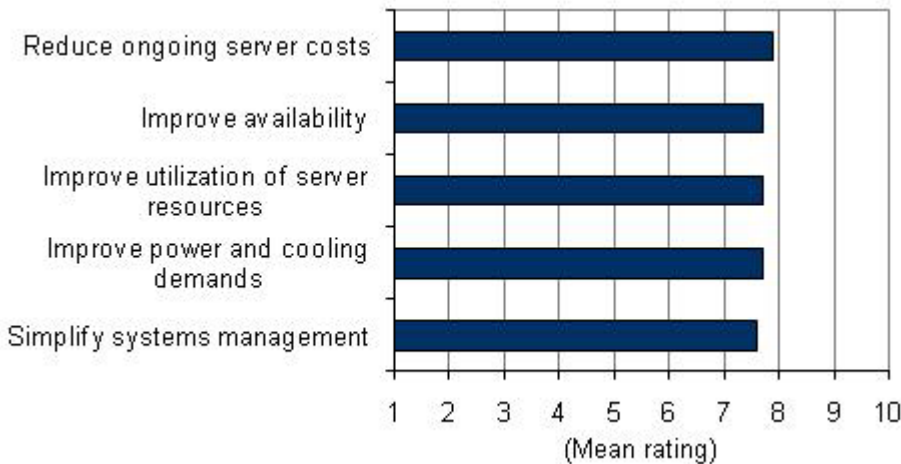
IT managers have turned to blade server technologies, realizing that blade servers can help optimize their IT environments, reduce operating costs, and help them keep pace with ever-changing business demands. The integrated nature of the blade server platform can benefit IT organizations by simplifying their infrastructure while simultaneously improving asset utilization, IT flexibility, and energy efficiency.

The blade server value proposition has evolved beyond mere consolidation and density as blade server vendors have built an integrated ecosystem that drives efficiency, reliability, and flexibility in the datacenter. IDC found that this value proposition resonated with customers in the recent *IDC Blade Market Survey: The Dynamic Platform for the Future*. Figure 1 displays the top five criteria that drive customers' decisions to adopt blade servers.

FIGURE 1

Top 5 Drivers of Blade Server Adoption

Q. On a scale from 1 to 10, how important were the following criteria in your decision to purchase blade servers?



n = 204

Note: Mean rating is based on a scale of 1 to 10, where 1 = least important driver and 10 = most important driver.

Source: IDC, 2010

As Figure 1 shows, the primary value of blade servers lies in efficiency, whether in cost, energy, system utilization, or staff time. The blade server platform enables IT to easily scale capacity to meet business demands by adding new blade servers into a previously deployed chassis. IT organizations have also realized operational benefits through blade servers' centralized management features and the ability to house different chip architectures (x86, EPIC, and RISC) with storage and network blades in the same chassis.

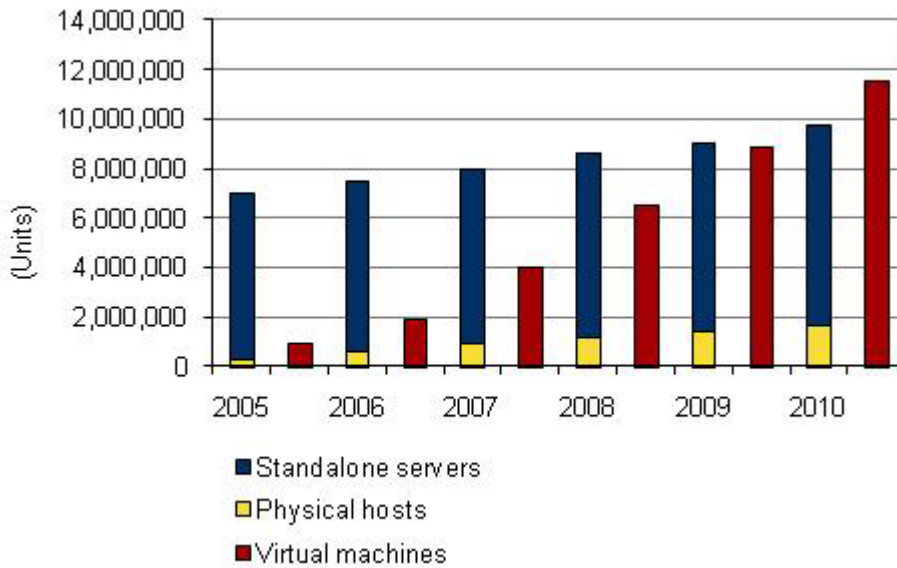
Virtualization Complements Blade Server Technology and Drives Further Efficiencies

Server virtualization is another technology that enterprises have adopted to control expenses by consolidating workloads onto fewer physical servers. Blade servers and virtualization are closely associated technologies; companies are creating a dynamic IT infrastructure by combining the efficiencies and flexibility of virtualization with the integrated nature of the blade server platform. The result is simplified IT infrastructures and increased staff productivity.

Figure 2 displays server virtualization adoption from 2005 to 2010. IDC estimates that 20.3% of the physical servers shipped in 2010 will include some level of virtualization; this is up significantly from 4.6% of shipments in 2005. IDC studies show that customers have been extremely bullish on virtualization due to the many benefits it delivers to both capital and operational budgets. Virtual machine (VM) density has increased as well, given that IT departments are now deploying an increasing number of VMs per physical host. The average density today is seven to eight VMs per physical host, more than double the amount of three VMs per host in 2005.

FIGURE 2

Server Virtualization Adoption, 2005–2010



Source: IDC, 2010

Virtualization on Blades Introduces New I/O Challenges

As companies roll out blade-based virtualization deployments, many find that they have limited choices for network I/O. VMs not only increase the number of applications on each server but also place additional demand on network I/O, add complexity, and increase network costs and density.

Most blade servers today support a maximum of six to eight physical Ethernet connections, which is the bare minimum typically required to support VM applications, and that does not include the extra mezzanine slots required for other network fabrics such as Fibre Channel, InfiniBand, or SAS. To work within these limitations, companies find that they are often forced to compromise on server network capacity.

Additionally, to facilitate increasing VM densities and ensure the operation of enterprise applications running inside those VMs, the amount of compute, memory, and I/O bandwidth in blade systems must increase.

Specific challenges pertaining to virtualization and blade server I/O include:

- ☒ **Bottlenecks introduced by virtualization.** As companies increase their VM density, they run into memory constraints and I/O bottlenecks. To solve the memory problem, server vendors are developing systems that keep the memory capacity in line with the advancements in processors. But as more VMs are deployed per server, more connections are also required to that server, creating I/O bottlenecks. Connectivity requirements are usually addressed by additional NICs and higher-bandwidth network connections, both of which come with an increase in cost, space, and power consumption, undermining the original goal of reducing datacenter costs.
- ☒ **Energy expense.** The amount of energy, as well as the correlating energy expense, necessary to operate a datacenter has risen sharply in recent years, to the point that today datacenter managers consider power and cooling their number 1 challenge. Frequently, energy availability and consumption is the primary limiting factor for operating budgets and IT capacity expansion. This surge in energy challenges goes hand in hand with the shift toward distributed environments; the energy required to power multiple smaller devices is exponentially greater than that required to power a single larger system. The problem is exacerbated by supporting higher VM densities, which requires additional memory, NICs, HBAs, and core switch ports, all of which increase the energy demand of the system.
- ☒ **Time.** The cost of management and administration has increased to the point where it has eclipsed all other IT budget categories, and the time required to configure and manage network I/O is a contributing factor to the burden. Server configurations are typically static, hardwired, and relatively difficult to change. Virtualization adds to the burden as administrators must set up and manage a vast number of VM network connections. While the blade server platform solves many issues by providing a unified management approach to the blade servers housed within the chassis, the interconnect layer between the blade servers and the LAN, and by extension to storage via SANs, still presents a challenge.

- ☒ **Change management.** The industry shift toward a scale-out infrastructure has resulted in a significant increase in the number of individual systems within companies' IT environments. This has increased not only management cost but also network complexity, especially for tasks associated with server provisioning, reprovisioning, and maintenance. Change management in this environment presents challenges, particularly when altering interconnects between systems and the network and when adding networks and storage resources that boot volumes from virtualization.
- ☒ **Interconnect costs and complexity.** Most virtualization vendors strongly recommend six to eight physical function NICs per physical server. A server blade with eight NICs requires two network expansion cards, and supporting up to eight connections per server blade enclosure requires eight Ethernet switches and consumes eight to 16 core ports. The cost of all this equipment can be quite high. Further, deploying blade servers currently requires coordination between server, network, and storage administrators because the network addresses are encoded directly into the NICs and HBAs. This coordination is inefficient and time-consuming.

HP VIRTUAL CONNECT FLEXFABRIC

Built on Proven Technology

The Virtual Connect FlexFabric module virtualizes server I/O into a single fabric. It consolidates Ethernet and storage networks at the server edge to reduce networking costs and complexity. The Virtual Connect FlexFabric module extends the HP Flex-10 technology to include iSCSI, CEE, and FCoE technologies.

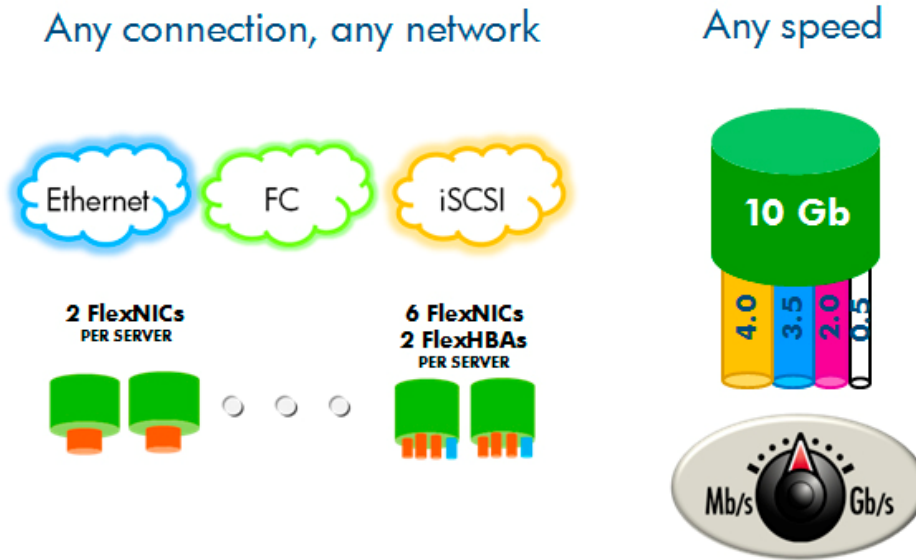
First introduced with the 2006 launch of the BladeSystem c-Class, Virtual Connect was designed to provide a simpler way to connect blade servers to datacenter networks by creating pools of LAN and SAN addresses that can be assigned dynamically to server bays in software, instead of being hardwired into the servers' NIC and HBA cards.

If server administrators are managing the server I/O connectivity for more than four BladeSystem enclosures, they can further simplify server I/O management by using HP Virtual Connect Enterprise Manager (VCEM), an optional software package that can manage up to 250 Virtual Connect domains. With up to four BladeSystem enclosures per domain, VCEM can be used to set up and manage server I/O connectivity for up to 1,000 enclosures.

For HP's FlexFabric architecture (see Figure 3), HP has introduced a new interconnect module and converged network adapters (CNAs). This latest-generation module converges network connections with the goal of enabling customers to reduce the cost of LAN and SAN networks in terms of equipment purchase costs, power and cooling, and management.

FIGURE 3

HP Virtual Connect FlexFabric Module



HP Virtual Connect FlexFabric module

Source: HP, 2010

Simplify Network Connections

The HP Virtual Connect FlexFabric module consolidates the number of network cards, switches, and cabling normally required for server connections. When connected to a Virtual Connect FlexFabric module, one FlexFabric adapter provides a server with up to eight physical I/O functions, of which two can be Fibre Channel or iSCSI initiator. The FlexFabric adapters eliminate Ethernet NICs and Fibre Channel HBAs in favor of a shared port using a 10 Gigabit Ethernet (10GbE) physical connection, so fewer network connections are required. HP's next generation of ProLiant server blades contains embedded FlexFabric adapters; thus, when they are installed, the connection profile of the chassis bay will automatically set up the server connections for Ethernet NIC, FCoE, or iSCSI initiator.

By using Virtual Connect FlexFabric modules and FlexFabric adapters in their environments, datacenters are able to eliminate network sprawl at the server edge by consolidating, virtualizing, and even automating server connections. Virtual Connect is a wire-once deployment: After the initial installation, IT administrators are able to add, move, or change server and network connections from a single management console. The benefit comes from minimizing the touch points required for server and network administrators to add or replace servers and move workloads. HP's goal is to enable administrators to move resources quickly and easily to meet changing business needs, eliminate bottlenecks, and scale to accommodate spikes in demand.

Increase Flexibility

The HP Virtual Connect FlexFabric modules and FlexFabric adapters build on Flex-10 technology that partitions each 10GbE connection into up to four individual virtual NICs, which HP refers to as FlexNICs. FlexFabric adapters introduce a FlexHBA, which performs the physical function of a PCIe-based FC HBA and appears to the host operating systems as a discrete HBA with its own driver. Alternatively, this same physical function can be assigned as an iSCSI function supporting iSCSI boot.

The bandwidth of each FlexNIC and FlexHBA can be set from 100Mb to 10Gb in increments of 100Mb. This adds flexibility and control, enabling each VM connection to get the right amount of bandwidth without having to resort to overprovisioning or underprovisioning the network. The bandwidth of each VM network channel can be prioritized, dynamically adjusted, and adapted as workload requirements change.

CUSTOMER EXPERIENCE WITH HP VIRTUAL CONNECT FLEXFABRIC

To assess the benefits of the HP Virtual Connect FlexFabric module, IDC interviewed three companies with early deployments: a major telecommunications provider and a large pharmaceutical company, both based in North America, and an R&D company based in Asia/Pacific. All are longtime HP customers with previous-generation Virtual Connect technology implementations, and all are running largely virtualized datacenters with hundreds or thousands of HP server blades.

These interviews revealed three primary value propositions:

- Improved flexibility at the interconnect level, enabling IT to adapt the infrastructure to more quickly meet changing business requirements
- Reduced costs for hardware, including switches, NICs, and HBAs
- Reduced labor costs for network, storage, and server administration

Improved Flexibility

The customers interviewed indicated that the most important benefits associated with HP Virtual Connect FlexFabric modules are the flexibility they provide at the interconnect level and the ability to manage connections between the virtualized CPU environment and storage pool as a virtual resource. Over time, these customers had built up a network hierarchy of hardwired connections between servers, storage, and switches; unfortunately, as their infrastructure grew, this hierarchy became unmanageable, and reconfiguring it was costly, time-consuming, and risky.

With Virtual Connect, these companies enjoy the ability to quickly and easily change connections and configurations dynamically, without the need to physically move cards or cables. "Flexibility is the main thing," stated the Asia/Pacific-based R&D company. "At the CPU, virtualization gives us the ability to adapt quickly, and we get the same thing in storage through SANs. Virtual Connect gives that to us in the middle. It links servers to networks and storage and lets us dynamically change connections and configurations as required."

"Flexibility is the main thing. ... It links servers to networks and storage and lets us dynamically change connections and configurations as required."

With Virtual Connect, the companies found it much easier to assign specific amounts of storage to virtualized applications to meet those applications' needs. In traditional hardwired environments, modifying the storage allocated to each application requires unplugging and plugging HBAs into backplanes and reconfiguring cables. Taking advantage of the FCoE capabilities of the Virtual Connect FlexFabric modules and FlexFabric adapters, the companies are now able to assign certain amounts of storage to specific processors, enabling them to more easily tailor storage to match applications' requirements. And because cards and cables do not need to be physically reconfigured, these customers stated that Virtual Connect FlexFabric modules reduce the risk of unplanned downtime associated with inadvertently pulling the wrong cable.

Reduced Hardware Costs

In the words of the North American pharmaceutical company, "On the hardware side, Virtual Connect FlexFabric modules are an obvious win." On a per-chassis basis, the customers noted the savings associated with the replacement of the several separate HBAs and adapters required to provide SAN connectivity with the FlexFabric adapter. The North American telecommunications provider believes that it will be able to replace 16 HBA mezzanine cards and two SAN modules per enclosure using built-in FlexFabric adapters with the Virtual Connect FlexFabric modules, saving it tens of thousands of dollars in hardware costs per blade enclosure.

"On the hardware side, Virtual Connect FlexFabric modules are an obvious win."

But the other customers see Virtual Connect FlexFabric modules as a door opening to even greater savings in the longer run. Taking advantage of the Virtual Connect FlexFabric module's FCoE capability, the three customers see the opportunity to retire all or a portion of their dedicated SAN networking infrastructure and move to Ethernet for all connections into its blade chassis. They can realize savings at the edge in the shorter term, and in the long run (over the next four to five years), they even see the opportunity to retire core switches in their SAN infrastructure.

Reduced Labor Costs

The customers believe that hand in hand with hardware cost savings is IT staff time. Like many other IT organizations, these customers are scrambling to do more work with fewer resources, and anything that reduces their administrative burden can free up time to work on more strategic projects. They see implementing Virtual Connect FlexFabric modules as an important step toward creating a "lights-out datacenter" by reducing the need to take down servers and networks for patch management, changes, and other network administrative tasks. These customers believe that after fully implementing the HP Virtual Connect FlexFabric module, they could save up to 30% of server and datacenter staff management time compared with the time required to manage a nonvirtualized interconnect environment. "Fewer hardware components to manage lead to management savings as well: The fewer components to manage, the less time you need to spend on firmware updates, releases, and configuration," stated the North American telecommunications provider. "Fewer people are required to support the infrastructure."

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Another example of labor cost savings was cited by the Asia/Pacific-based R&D company. It has a project currently under way to make SAN storage available to a number of servers in its environment that do not yet have interconnects. Its staff is physically pulling connections and reconfiguring them, a project that it estimates will cost it \$30,000 to \$60,000 in labor costs alone. The customer believes that were Virtual Connect FlexFabric modules and FlexFabric adapters already in place for these servers, it would be able to achieve its goal much faster and at a fraction of the cost.

CHALLENGES/OPPORTUNITIES

In the study *IDC Blade Market Survey: The Dynamic Platform for the Future Datacenter*, customers indicated that obstacles to blade server deployments have decreased in recent years. Enhancements in the platform from earlier generations, better customer understanding of the technology, and improved services from vendors have made it easier to deploy blade servers into their environments. The greatest remaining obstacles include a price premium over other server form factors and organizational issues such as internal or management resistance to the platform.

This shows that HP and other vendors face a number of nontechnical challenges as they seek to deliver blade-based solutions. Today, blade servers represent approximately 15% of the server market in terms of revenue. To drive further blade server adoption, blade server vendors will need to convey a message to the market that blade servers deliver a better total cost of ownership and dispel lingering perceptions that blade servers are costlier than other form factors.

The HP Virtual Connect FlexFabric module and associated built-in FlexFabric adapters deliver financial benefits associated with reducing network and server administration staff time and costs for hardware beyond the server blade — HBAs, cards, switches, and cables. Unfortunately, many customers do not consider these cost categories when evaluating the cost of a server. Understanding the full value of a solution such as HP Virtual Connect often requires a more sophisticated IT organization — one that evaluates where all the expenses are generated within its infrastructure.

Customer education is necessary to help IT organizations fully understand where the costs lie in their environments and how a solution implemented with Virtual Connect FlexFabric modules can achieve cost savings in areas besides server capital expenditures. This may require working with customers individually to develop ROI models and/or perform other financial analysis.

According to HP, a traditional rack-based network infrastructure requires 217 network components. The same capability can be provided by just two Virtual Connect FlexFabric modules with HP BladeSystem — this results in a greater than 95% reduction in networking components.

CONCLUSION

Over the past several years, companies have seen the operational costs of their datacenters increase drastically, taxing their IT budgets. It is not uncommon for routine maintenance and management tasks to account for the majority of a customer's IT budget, leaving little budget or time for value-add or strategic initiatives.

IT executives are searching for solutions that will alleviate pressure on both budget and staff resources, with the goal of freeing up IT staff time to focus on tasks that will drive greater value to the business. HP designed the Virtual Connect FlexFabric module and built FlexFabric adapters into the latest generation of ProLiant blade servers to address these challenges by reducing the complexity within datacenter networks.

Interviews with three early adopters of the Virtual Connect FlexFabric module revealed that Virtual Connect has improved flexibility at the interconnect layer, enabling them to better tailor their infrastructure to users' requirements and adapt it to serve changing business needs. In addition, the customers credit the technology with dramatically reducing the administrative burden associated with ongoing network, server, and storage management and with reducing hardware costs and requirements associated with SAN connectivity.

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