![Enterprise Strategy Group by TechTarget logo]

Storage Networking's Role in Data Center Modernization

Innovations in Fibre Channel Are Advancing Essential Data Center Modernization Strategies

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Overview

We are witnessing a near-universal desire among IT organizations to modernize their on-premises infrastructure and operations. Their goal is to overcome the ever-present and still-increasing obligation they feel to accelerate operations and scale the application infrastructure, all while reducing the burden of daily administration.

These on-premises challenges are also fueling the desire to "cloudify" resources, or in other words, to make the on-premises infrastructure available more quickly and autonomously to applications and users—often in a self-service manner.

On-premises data center environments, however, come with built-in challenges that can make this kind of modernization work more difficult. On-premises environments often house a mix of legacy and new technologies, and a full rip-and-replace approach is not a feasible option. Conversely, leveraging public cloud services for every workload is not an option for most organizations, either.

Given the mission-critical nature of storage network infrastructure, this means that the strategies for modernization must be carefully reviewed. While Fibre Channel has established itself as the pacesetter in terms of performance and reliability in storage networking, recent innovations in Fibre Channel technology have built an extremely compelling counter to perceived cost-effectiveness of commodity Ethernet solutions. When the true cost of the commodity solutions are understood (the amount of configuration work, hand-holding, difficulty in monitoring or troubleshooting, etc.), the math typically swings in favor of the operational efficiency benefits of Fibre Channel.

Unpacking Data Center Modernization

TechTarget's Enterprise Strategy Group has conducted extensive research on the state of data center modernization, finding that data centers are not going away. Rather, investment is increasing. Among survey respondents, 50% expected to increase their spending on data center infrastructure, with an additional 42% reporting that they expected to maintain 2022 spending levels.[1]

However, given current widespread economic worries, one-third of those surveyed IT decision-makers expected their organizations to freeze hiring in 2023, even though 96% of respondents also reported that at least one area of their IT function is experiencing problematic skills shortages. For example, 40% of organizations have a problematic shortage of IT architecture/planning specialists, 23% have a shortage of network administrators, and 19% can't find enough skilled storage administrators.[2] This situation is especially troublesome because 65% of IT decision-makers identified infrastructure modernization as a top five priority.[3]
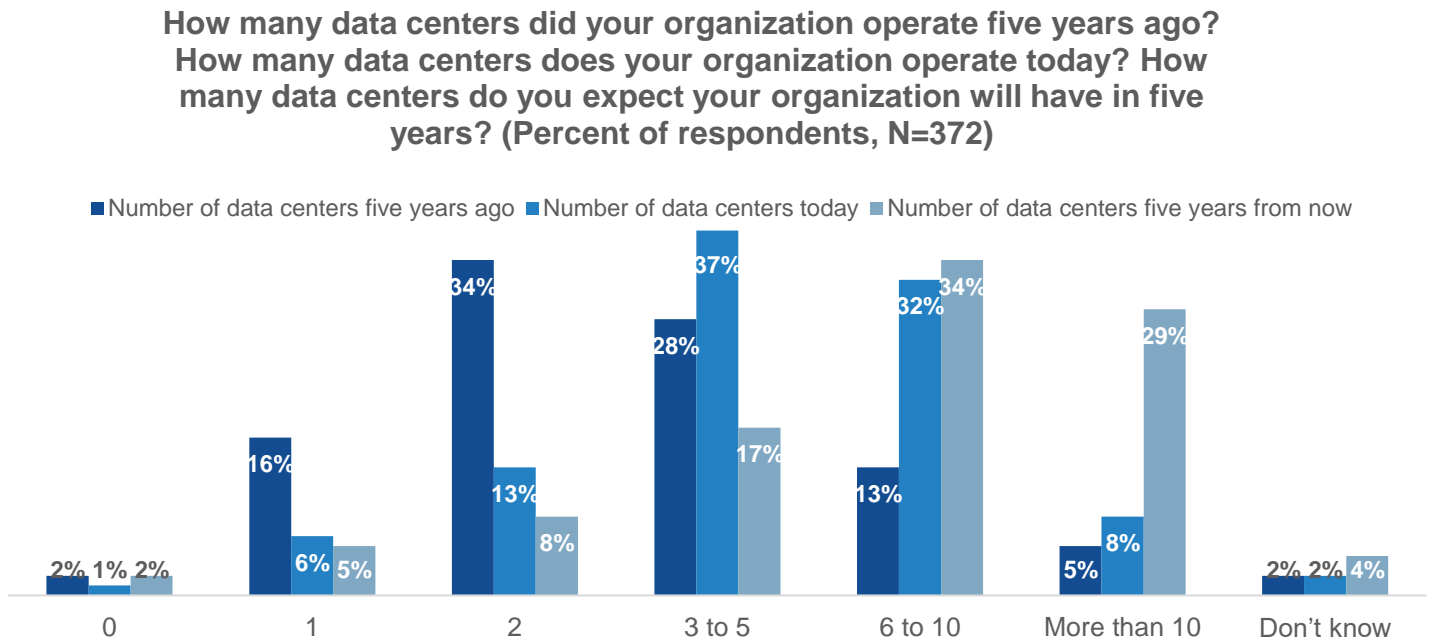
And again, the average number of data centers these short-staffed IT organizations will have to manage is likely to increase, not decrease. In fact, Enterprise Strategy Group expects that the percentage of organizations leveraging six or more data center locations will increase from 40% to 63% in five years (see Figure 1).[4]

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[1] Source: Enterprise Strategy Group Research Report, *2023 Technology Spending Intentions Survey*, November 2022.
[2] Ibid.
[3] Source: Enterprise Strategy Group Research Report, *Application Infrastructure Modernization Trends Across Distributed Cloud Environments*, March 2022.
[4] Ibid.

Figure 1. Data Center Numbers Are Expected to Increase in the Next Five Years

How many data centers did your organization operate five years ago? How many data centers does your organization operate today? How many data centers do you expect your organization will have in five years? (Percent of respondents, N=372)

Source: Enterprise Strategy Group, a division of TechTarget, Inc.

With data at the heart of all these issues, digital modernization efforts must focus on optimizing both applications and the data environment behind them—and not just the data storage, but also the network infrastructure supporting the connection to that high-value data storage.

The Goals for Modernization

What do organizations wish to achieve with infrastructure modernization? Almost all of the respondents surveyed by Enterprise Strategy Group (99%) said they believe that infrastructure modernization will bring them closer to achieving full digital transformation.[5]

Digital transformation supports the real underlying objective of any business: more revenue generation. Fifty-nine percent of organizations now identify data as being their business.[6] The relationship between effective data usage and revenue generation has spurred a massive movement to adopt digital transformation initiatives and undertake modernization projects to support those initiatives.

Ideally, digital modernization simultaneously:

- Maximizes the speed and efficiency at which a business can deliver digital initiatives.

- Reduces burdens on personnel.

- Avoids compromising the essential needs of applications.

- Adds no new risks to the environment.

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[5] Ibid.
[6] Source: Enterprise Strategy Group Research Report, *Data Infrastructure Trends*, November 2021.

Accelerating IT operations, deploying new apps and initiatives, and using data effectively while reducing costs, risks, and impacts on IT personnel requires focusing on:

- **Availability.** Ensure that critical applications are always available and that the storage network provides the highest levels of consistency, predictability, and reliability.

- **Performance.** Eliminate "the application seems slow" concerns that steal IT personnel bandwidth and ruin the customer and employee experience.

- **Automation and simplicity.** Reduce the burden on IT personnel as much as possible to free them to concentrate on accelerating digital business initiatives.

- **Visibility and insights.** Provide the highest level of operational insight to accelerate issue isolation and troubleshooting when concerns arise.

- **Security.** Provide the highest level of security to protect the business applications and associated data.

- **Scalability.** Ensure that all of those other essential focus areas continue to be delivered as the IT environment grows.

Essentials of Modernization: Availability

Availability has long been a central tenet of good IT infrastructure design, but it is arguably more important now, simply because the stakes are higher.

What do businesses require from their modernization initiatives in terms of availability? When the success of a business is built on digital products, digital services, digital operations, and digitally based engagements, downtime events and even brief hiccups in data or application availability will negatively impact revenue. One example would be losing the ability to accept credit card transactions. Another would be damaging customer satisfaction. Application development fuels innovation and revenue growth. When the infrastructure is not sufficiently resilient, the result is a loss of developers' time, impacting the schedule for new digital products or services and thereby resulting in delayed or missed revenue opportunities. For digital firms, only about one-third of developer time is allocated to net-new innovation.[7] Any disruptions, such as those due to insufficient resiliency, only further degrade the time spent on innovation.

In order to provide a fully resilient IT infrastructure, the environment must deliver the highest levels of both security and uptime. This need for resiliency is even more critical today given the ever-increasing prevalence of security threats and an increased business focus on 24x7 uptime for applications. Not only does Fibre Channel provide the highest levels of visibility and performance, but it also offers multiple recent innovations to ensure availability, resiliency, and security levels beyond the capabilities of traditional commodity hardware. Fibre Channel offers a dedicated storage network focused on data traffic to the server environment. A fundamental aspect of its design is the buffer-to-buffer credit architecture to manage and control flows in the network, making sure data is never placed on the network unless there is available space to receive the data. This mechanism of buffers provides a lossless network, which is crucial for storage performance and availability. In addition, forward error correction is built into the Fibre Channel standard to increase resiliency by automatically detecting and recovering network transmission errors.

Fibre Channel also separates management traffic, protecting application traffic and control plane traffic to ensure that full bandwidth is available to the data path. This characteristic simplifies planning and improves performance

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[7] Source: Enterprise Strategy Group Complete Survey Results, *Distributed Cloud Series: Observability Trends*, May 2022.

consistency. In addition, this design of Fibre Channel, with a separate physical layer, offers air-gap isolation between management and data traffic, which provides protection superior to that of Ethernet where traffic can be combined on the same network.

In addition, Fibre Channel offers granular measurement of the fabric to accelerate the identification and mitigation of congestion issues. For example, the Brocade Gen 7 solution has a runtime engine in every switch called Monitoring Alerts Policy Suite (MAPS) that compares telemetry against over 300 rule sets to identify issues and solutions with minimal effort needed from the administrator. With the addition of Fabric Performance Impact Notification (FPIN), the Fibre Channel fabric now has the capability to notify the attached servers and storage systems of problems. For example, a "sick but not dead" link can be identified to the server so that the Multi Path IO (MPIO) driver can be alerted to fail over to a good path and avoid the problem.

To ensure optical and signal integrity for Fibre Channel optics and cables, the [Broadcom](#) Brocade division has developed a way to use ClearLink Diagnostic Port (D_Port) capability to quickly identify small form-factor pluggables, patch panels, and fiber runs as points of failure, thereby keeping applications running nonstop.

Overall, a strong availability-related foundation reduces planning and maintenance operational burdens and helps accelerate operations by reducing impacts to personnel.
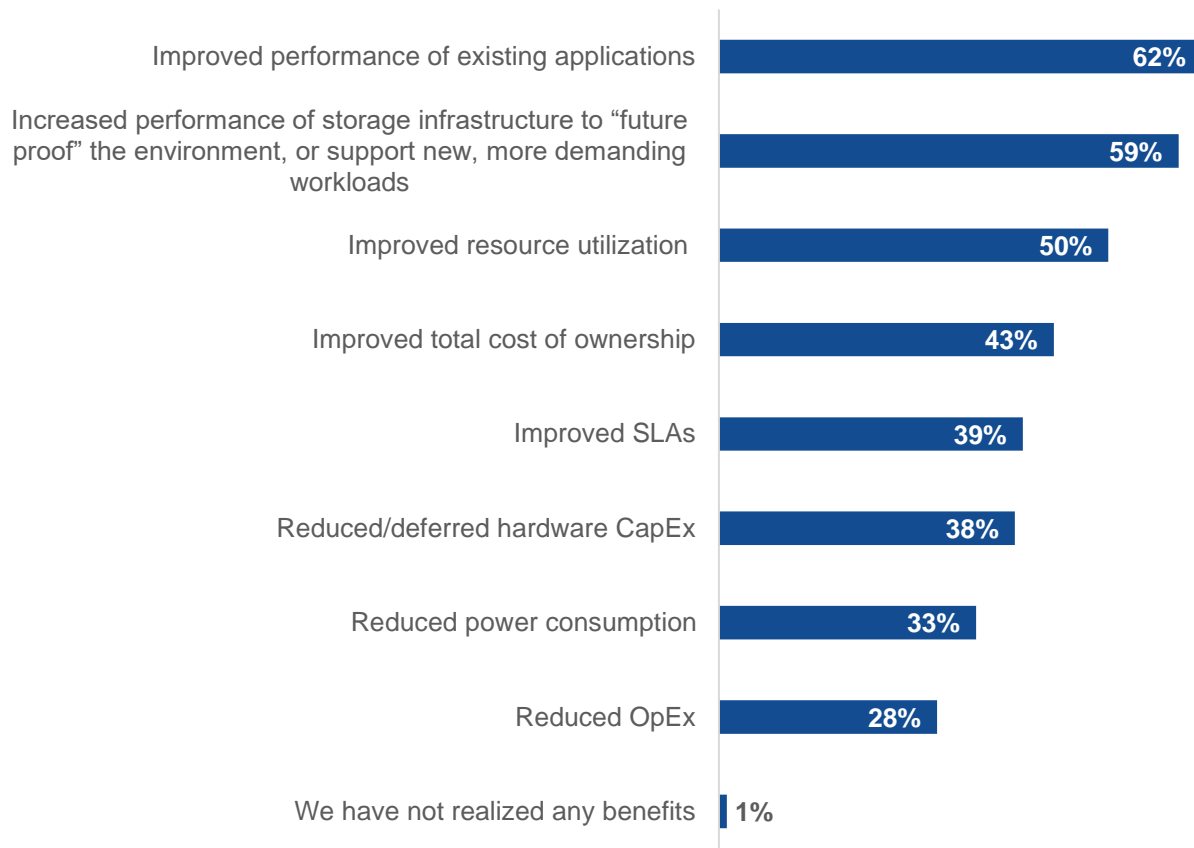
Essentials of Modernization: Performance

When digital experiences fuel customer/employee satisfaction and produce revenue, slow performance can be just as detrimental as application downtime. That's where non-volatile memory express, or NVMe, comes in. Investments in NVMe technology often focus on ensuring better performance for existing apps and providing headroom for additional growth (see Figure 2).[8]

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[8] Source: Enterprise Strategy Group Research Report, *Data Infrastructure Trends*, November 2021.

Figure 2. Realized Benefits of NVMe Flash Storage Adoption

Which of the following benefits has your organization realized as the result of deploying on-premises NVMe-based flash storage technology? (Percent of respondents, N=119, multiple responses accepted)

Benefit	Percent
Improved performance of existing applications	62%
Increased performance of storage infrastructure to "future proof" the environment, or support new, more demanding workloads	59%
Improved resource utilization	50%
Improved total cost of ownership	43%
Improved SLAs	39%
Reduced/deferred hardware CapEx	38%
Reduced power consumption	33%
Reduced OpEx	28%
We have not realized any benefits	1%

Source: Enterprise Strategy Group, a division of TechTarget, Inc.

The storage network must be able to take advantage of the performance advancements of the surrounding infrastructure. Diagnosing "application performance seems slow" issues is one of the most difficult, costly, and time-consuming efforts for IT. It's important to architect the environment to minimize the chance of those issues occurring.

The capabilities of Fibre Channel enable organizations to do that. Storage traffic is independent from control traffic, and maximum bandwidth is allocated to the data path to ensure latencies stay low and application performance remains strong and predictable as the environment scales. Dedicating the Fibre Channel network to the data path also eliminates the temptation to leverage the storage network for other types of traffic that might impair data-path performance.

Broadcom's innovations to its Brocade Gen 7 SAN technology further improve Fibre Channel's innate capabilities in these areas. With Brocade Traffic Optimizer technology, traffic with like characteristics—such as the destination ports' speeds and the storage protocol, SCSI or NVMe—is automatically placed in applicable performance groups. As data transactions increase across the SAN, those transactions are then allocated across virtual channels based on performance group.

In this manner, traffic destined to go to ports of the same speed (e.g., 16 Gb,32 Gb, or 64 Gb) can access SAN devices at equal rates without impeding other devices on the SAN or increasing the risk of congestion.

These advancements help to prevent erratic storage performance hiccups that can negatively affect mission-critical workloads and consume the time of personnel who are tasked with diagnosing, isolating, and resolving issues.

Essentials of Modernization: Automation and Simplicity

According to Enterprise Strategy Group research, 64% of IT decision-makers agreed that the complexity of their IT infrastructure is slowing down IT operations and digital initiatives. Over three-quarters (76%) also reported that they have taken on additional or new responsibilities to support their organization's digital transformation goals and initiatives, or they are under pressure to do so.[9]

An essential component of any modernization strategy centers on leveraging technologies that reduce these burdens on staff by adding as much automation as possible. For example, Fibre Channel Name Service automatically supports the integration of NVMe over Fibre Channel with existing Fibre Channel protocols. Leveraging NVMe does not require new configurations—or in many cases, any new investment—because these innovations are often available in a firmware update.

In another automation benefit, Broadcom's Brocade Fibre Channel SAN technology offers the ability to self-learn, self-optimize, and self-heal. With its Autonomous SAN technology, Brocade can automatically identify data-traffic congestion issues and then automatically fail over or adjust traffic to relieve that congestion. If the congestion occurs at the server due to abnormal or unexpected server behavior, for example, Brocade will identify that congestion and notify the adapter card of the issue through a Fabric Performance Impact Notification signal to the edge device. The adapter then takes automatic corrective action to mitigate the congestion's impact.

Fibre Channel networking technology, like that from Brocade, a Broadcom company, can instantly identify and then notify IT staff when something goes wrong or changes, thereby simplifying troubleshooting and management. In fact, it can even identify and address issues automatically without any human intervention at all.

Essentials of Modernization: Visibility and Insights

Improving monitoring and visibility offers an additional way to reduce the impact on personnel. This is an essential capability for an IT environment that is scaling up.

When one considers recent innovations by Brocade Fibre Channel in terms of providing better insight and visibility via VM Insight and SANnav technology, the differentiated value of Fibre Channel to a large, rapidly scaling environment becomes clear:

- IO Insight provides monitoring of I/O performance and behavior through integrated network sensors to pinpoint the source of issues, such as congestion, oversubscription, or sick but not dead links.

- VM Insight adds the same visibility as IO Insight all the way to the virtual machine

- One of the challenges with monitoring and measurement is how to get very granular visibility to the applications and their performance without having a negative impact on the performance of the infrastructure. The Brocade SANnav Management Portal uses Kafka to consume a very compressed binary set of log data on health, status, performance, and more from the Fibre Channel switches. Kafka then streams this data northbound from SANnav into other tools. Teams can then leverage that data to verify SLAs, audit compliance status, and billing status. They can also use the information to isolate issues and troubleshoot performance; in fact, Brocade SANnav automates a significant portion of troubleshooting and violation monitoring while providing actionable insights to the customer for how to solve the issue. If users attempted to achieve the same

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[9] Ibid.

level of monitoring through a CLI, SNMP interface or polling of the switch, they would severely burden the management subnet before ever achieving the same level of measurement detail.

Essentials of Modernization: Security

Security is essential to any modernization strategy. According to recent Enterprise Strategy Group research, more than one-third of IT decision-makers (35%) anticipated that strengthening cybersecurity would be among their organization's top spending initiatives in 2023.[10]

Fibre Channel's sole focus on storage networking and its inability to connect to other networks offers intrinsic protection from external intrusions. In addition, Broadcom innovations continue advancing the security benefits of Fibre Channel. For example, Brocade Fabric Operating System (FOS) validates the integrity and security of Brocade hardware and software automatically, including capabilities such as Secure Boot, Brocade Trusted FOS (TruFOS) Certificates, and FOS hardening with removal of root access.

In particular, Brocade TruFOS Certificates ensure that enterprises running Brocade directors and switches can securely perform critical operations without having to worry about the operating system being tampered with.

Essentials of Modernization: Scalability

According to Enterprise Strategy Group research, 63% of survey respondents agreed that it is often challenging to properly size workloads to achieve the optimal infrastructure environment.[11] All of the other essentials of modernization influence how quickly and easily a data center environment can scale. The infrastructure needs predictability in performance and availability in order to streamline scalability.

When it comes to flexibility and scalability, the level of disruption involved often determines how quickly an organization can scale its mission-critical networking environment. With Brocade Fibre Channel technology, for example, the addition of another switch or director to the fabric is completely nondisruptive. The new element in the storage network will get its addressing from the existing fabric, a distributed copy of both the Name Server and Zoning databases. New storage and server elements can be dynamically added to the new platform to scale either performance or capacity or both.

Network scalabiltiy must be measured based on how effectively and efficiently a network can scale not just the number of ports or switches, but also the performance of the application environment. Scaling to hundreds or thousands of ports may not be useful if the application environment does not reap the benefits. Similarly, systems that perform well on a single switch or small number of switches may struggle if the application demands scale rapidly, such as with increased business growth.

Data center infrastructure is trending more and more to being an on-demand business. The ability to seamlessly and non-disruptively add scale to the compute, storage, and network is vital. Fibre Channel SAN allows for the secure and seamless increase of the fabric, while allowing independent scaling of compute and storage without wasted resources.

Further, with the director platforms, IT has access to inter-chassis links (ICLs). These ports, situated on the core routing blades, are quad-connections that are the equivalent of four normal ports on any of the port blades and are specifically intended for scaling the bandwidth between director platforms. The addition of an ICL between two chassis platforms dynamically adds 200 Gb or more of bandwidth between them in a nondisruptive fashion. An

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[10] Source: Enterprise Strategy Group Research Report, *2023 Technology Spending Intentions Survey*, November 2022.
[11] Source: Enterprise Strategy Group Research Report, *Data Infrastructure Trends*, November 2021.

added benefit of this is that one doesn't consume any ports on the actual device port blades to provide chassis-to-chassis connectivity, which enables the customer to make maximum use of all the device ports on the chassis.

The Counterargument: Use Ethernet as an Alternative?

There is a school of thought that suggests that because Ethernet is everywhere and because it is possible to use Ethernet for block storage, file-based storage, or object-based storage, that it should become the one network for all things. While it is certainly true that organizations often have use cases for iSCSI and NAS storage in addition to Fibre Channel, it is overly simplistic to believe that all workloads can be made to easily fit any one of those topologies. The infrastructure architecture, along with the storage network technology, instead should be driven by the needs of the application base. Does the application have transactional value? Is it time deterministic in nature? Does it require high performance? Low latency? Application uptime of 99.999%? Zero data loss?

While some of the benefits of using Ethernet for storage are real, the simplicity-related benefits of leveraging a single technology are often overemphasized. The fact is, when architecting in Ethernet for SAN, NAS, object, or hyper-converged environments, the configuration considerations are going to be distinct in each case. Mixing them all together in one topology often adds new complexities.

Further, assuming commonality where it doesn't exist can hinder planning and ongoing operations later on. Specifically, the consolidation of diverse workloads on a single Ethernet network can hinder performance planning and diagnosing, especially as the application environment scales. This is often pointed out in the best practices guides for NVMe over TCP, software-defined storage, or hyper-converged infrastructure, where it is commonly indicated that dedicated network infrastructure for storage traffic is required.

Overall, Ethernet, like Fibre Channel, is definitely an option. But the simplicity benefits will likely not be as profound as expected, especially if the environment already has an established Fibre Channel footprint.

Conclusion

Modernizing the data center is essential, and the storage network is an essential element of that effort. Recent innovations in Fibre Channel make a compelling case for using it as the modernization fabric for the SAN fabric.

The needs of the application should drive the infrastructure decisions, not the other way around. An essential tenet of modernization is to ensure that the most mission-critical business applications get the best of all the modernization-related advantages: availability, performance, automation/simplicity, visibility and insights, security, and scalability. In this way, it is possible to provide the best digital experience for all while reducing the burden on IT personnel.

Given all the innovation integrated into Fibre Channel technology to simplify and automate operations as environments scale, and combined with foundational capabilities in performance, availability, and resiliency, Fibre Channel should be a priority and a foundational part of any organization's on-premises modernization initiatives. And while Ethernet can provide consolidation benefits, the focus of the organization must be on delivering the best infrastructure to meet the needs of the application environment while minimizing the operational burden on IT personnel.

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