

Enterprise-class Solutions for the Midrange

A White Paper

By Steve Smith and Kevin Sampson

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Executive Summary

Most businesses, regardless of size, face similar data storage challenges—escalating data growth, application performance and availability requirements, business continuity, shortened backup windows, and complex, difficult-to-manage storage infrastructures. For departmental groups and midsized businesses, it's all a matter of scale; facing enterprise challenges on a smaller scale, they need enterprise-strength storage solutions scaled for their business requirements and budgets.

With the introduction of the Hitachi TagmaStore™ Network Storage Controller model NSC55, Adaptable Modular Storage models AMS200 and AMS500, and Workgroup Modular Storage model WMS100, Hitachi Data Systems sets new standards for midrange storage systems and opens new possibilities to organizations of all sizes for aligning storage infrastructure with application and business needs. These organizations now can choose from wide variety of storage systems to build Application Optimized Storage™ solutions from Hitachi Data Systems that match application requirements, such as performance, availability, functionality, and cost, to storage attributes.

This paper describes a few of the business and storage scenarios, including business continuity, simplification, disaster recovery, and compliance, that are addressed by Application Optimized Storage solutions for small- and medium-sized businesses—solutions built on the new TagmaStore storage models and the complete portfolio of software and services from Hitachi Data Systems.

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The Need to Optimize Storage for Applications

Businesses in nearly every industry face several major issues.

- :: Corporate governance and compliance concerns are changing the way many businesses operate.
- :: Risk preparedness and business continuity planning are not only good business practices, but also are now mandated in several industries.
- :: Optimizing operational efficiency is important to survival in a competitive climate.

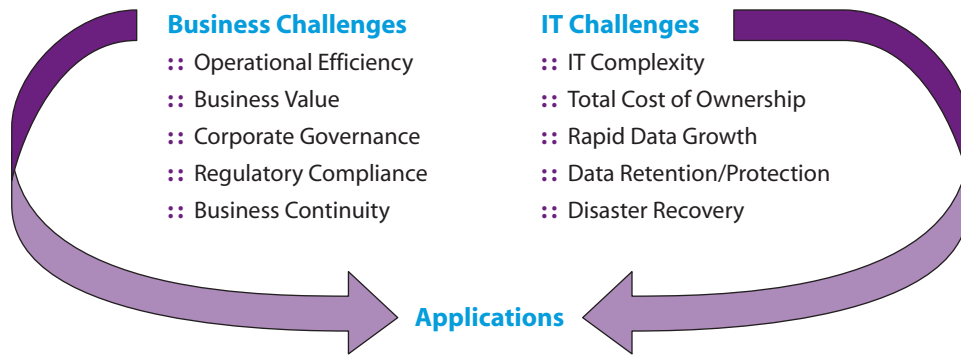
These issues affect all parts of the business, including finance, human resources, sales, marketing, and product development. The IT organization or function bears a particular burden as these issues turn into everyday data storage challenges—escalating data growth, application performance and availability requirements, business continuity, shortened backup windows, and complex, difficult-to-manage storage infrastructures. The rapid and constant change within IT only increases the burden. With rapid technology change, a problem once solved doesn't stay solved for long.

Fortune 100 companies often have large IT organizations to wrestle with these problems, yet the same challenges face all kinds of businesses, many of which have fewer resources to handle them. Hitachi Data Systems believes that by optimizing application delivery, businesses of every size can address the larger business issues for a real top-line and bottom-line return.

Application Optimized Storage™ Solutions from Hitachi Data Systems

The application is where IT intersects with business objectives—the moment of truth in terms of a technology system's ability to support business requirements (see Figure 1). Keeping applications up and running at acceptable performance levels and bringing new applications online to support business objectives are the main tasks of IT departments. Data access and availability are a big part of how applications perform. Indeed, data is the lifeblood of a business, essential to compliance, business continuity, and even operational efficiency. Managing and protecting growing volumes of data is one of the largest problems facing nearly every company.

Figure 1: The Intersection of IT and Business Objectives



Managing and protecting growing volumes of data to ensure that business challenges are met is one of the largest problems facing nearly every company.

Application Optimized Storage™ solutions from Hitachi Data Systems ease these burdens by matching storage, software, and services with application and business requirements according to cost, functionality, performance, and availability. The addition of the Hitachi TagmaStore™ Network Storage Controller, Adaptable Modular Storage, and Workgroup Modular Storage as foundations for Application Optimized Storage solutions provides yet more precision in your ability to match application requirements to storage attributes.

Application Optimized Storage Solutions for Mid-sized Companies Based on the Network Storage Controller

Network Storage Controller Model NSC55: A New Class of Midrange Storage

The Hitachi TagmaStore™ Universal Storage Platform created a revolutionary approach to managing storage across hosts, storage architectures, and heterogeneous storage devices. According to global market intelligence and advisory firm IDC, the Universal Storage Platform is a new category, called networked storage controller, of “potentially market changing” products in the storage solutions marketplace that will make it possible to extend many of the capabilities of intelligent controllers to multiple, attached storage systems without sacrificing performance or reliability.

The NSC55, with a small footprint and priced for midrange, extends the high-end capabilities of the Universal Storage Platform to the midrange market, expanding the storage options to serve the diverse and dynamic needs of mid-sized businesses. The new system, based on the same global cache and crossbar switch architecture of the Universal Storage platform, offers the availability and performance of an enterprise Hitachi storage solution, supports both open systems and mainframe environments, and delivers the unique controller-based virtualization with the ability to attach and manage heterogeneous storage¹, logical partitioning of internal and external storage resources, and universal replication.

¹ See Appendix A to learn about the Hitachi approach to virtualization.

The NSC55 will change what you expect from midrange storage systems by enabling new ways of deploying and managing storage, including tiered storage, that strategically align application storage with specific business requirements while improving operational efficiency and reducing costs.

Key Features

The NSC55 offers several unique features, including:

- :: *Embedded virtualization of both internal and externally attached storage.* You can attach external, third-party storage, including storage systems from IBM and EMC, to the NSC55 to create a consolidated pool of storage, which you can manage with a single interface.
- :: *Logical partitioning of both internal and external storage.* Create “virtual storage machines” with dedicated capacity, cache, and ports to support multiple applications without the potential for service degradation or interference.
- :: *Replication across internal and external storage systems,* using Hitachi TrueCopy™ Remote Replication software and Hitachi Universal Replicator software. Replication supports a wide range of data protection and disaster recovery solutions.

Storage Virtualization

Why should mid-sized companies care about virtualization? Simply put, virtualization is the process of making one or more physical components appear as simplified logical entities. Virtualization masks the complexity of the underlying infrastructure for administrators, users, and applications, making it easier to manage.

With the Universal Storage Platform, Hitachi introduced embedded storage virtualization within the controller. The controller can create virtual storage pools not only from internal storage but also for externally attached storage, which can include third-party storage systems, such as those from EMC, IBM, HP, Sun, and Hitachi. The NSC55 extends controller-based virtualization from the enterprise to midrange storage.

This revolutionary approach to storage virtualization is unique in the industry. With the controller managing virtualization, neither the application nor the storage itself needs to be “aware” of the virtualization technology. Controller-based virtualization introduces no additional complexity to the storage infrastructure.

The Hitachi approach has many advantages over other virtualization technologies:

- :: It does not require any external switches, appliances, or host software.
- :: It is storage network independent; there’s no need to buy new switches or change your storage area network (SAN) to use it. You don’t even need a SAN; controller-based virtualization also supports direct attached storage (DAS) in open systems and mainframe environments.
- :: Because it works within the storage controller, controller-based virtualization is already compatible with storage software you may be using, including the entire suite of Hitachi storage solutions.
- :: It extends the life of existing and legacy storage systems, which can participate in the virtual storage pool by connecting to an NSC55.
- :: Storage administrators can use a single set of management tools to manage heterogeneous storage, offering true storage simplification.

You can attach different kinds of external disk storage to an NSC55 and manage it as a single storage pool. As external storage devices have different availability performance and cost attributes, by attaching them to the NSC55 you've created a tiered storage environment, in which you can manage and deliver to applications different levels of storage services or cost from a single interface. There are many potential uses for a tiered storage platform, from very simple, tactical implementations to broader data lifecycle management. A few scenarios are listed below.

Scenario: Leveraging Storage Not Yet Depreciated

Challenge: It's often the case in technology that you haven't finished paying for a system before you find it doesn't quite meet your needs. For example, an application's capacity, availability, and performance requirements may change before the storage is depreciated.

In this scenario, a transportation company decides to upgrade its Microsoft Exchange servers to Exchange Server 2003, consolidating multiple servers to a single Exchange server. The midrange storage systems the company bought two years ago for the Exchange storage will not provide adequate performance and capacity for the consolidated environment.

Solution: The company acquires an NSC55 with sufficient internal storage to support the consolidated Exchange environment and then attaches and virtualizes the existing devices to the storage system as well. Using Hitachi HiCommand® Protection Manager software for Exchange, administrators create and maintain snapshots on one of the older storage systems to provide fast recovery for the Exchange data. And they use the other disk for disk-to-disk backups, which they later write to tape. The older storage continues delivering value, while the application has the performance and availability it needs.

Scenario: Using SATA Storage for Mainframe Systems

Challenge: A research organization uses a mainframe system but wants to take advantage of the lower-cost storage for less-critical data or data that must be retained to meet regulatory requirements.

Solution: Using an NSC55 storage system, which supports both ESCON and FICON connections, the firm attaches and virtualizes SATA-based storage systems, such as the TagmaStore Workgroup Modular Storage model WMS100, to deploy a tiered storage configuration. As a DFSMSHsm user, the customer leveraging this tiered storage configuration can cost-effectively expand the size of the Migration Level 1 storage pool and turn off the host-based data compression software. The result: lowered storage costs and reclaimed expensive host-processing cycles.

Scenario: Data Lifecycle Management

Challenge: A retail organization's finance department needs high-performance, high-availability storage for current information. But, as a financial number-cruncher, it wants to use less-expensive storage for older data not only for occasional historical analysis but also to meet regulatory requirements for tamperproof retention.

Solution: The NSC55 provides a foundation for complete data lifecycle management—nondisruptively moving data between levels of storage depending on its age and business value. The organization uses an NSC55 complemented by a TagmaStore Adaptable Modular Storage model AMS200 and a WMS100 to create a three-tiered storage platform:

- :: Current financial data resides on the fast internal disk storage, in mirrored configurations for optimal availability.

- :: Once the data has closed for the quarter, the HiCommand Tiered Storage Manager software moves the data to AMS200 and WMS100 systems. Alternatively, older, existing storage connected to the NSC55 could be used in the lower tiers. This older storage does not have the performance of the highest tier, but it is fine for the less-frequent access of older storage.
- :: For tamperproof retention, data supporting financial reporting and results is copied to a “write once, read many (WORM) archive within the same NSC55 storage pool, created with the Hitachi Data Retention Utility software.

Partitioned Storage: Private Virtual Storage Machines

Taking the virtualization story even further, the NSC55 can partition storage, connection, and cache resources to create Private Virtual Storage Machines. This capability enables storage and applications to view a single NSC55 as multiple dedicated, standalone storage devices.

A Private Virtual Storage Machine allocates capacity, cache, and ports in a logical partition. The data and activities taking place in the Private Virtual Storage Machine cannot interfere with other applications using the NSC55, nor can other applications’ traffic affect the Private Virtual Storage Machine.

A Private Virtual Storage Machine can serve many purposes:

- :: *Workload isolation.* Resource-intensive workloads cannot degrade the performance of other applications using the shared storage device.
- :: *Application-specific security and quality of service (QoS).* You can define Private Virtual Storage Machines that meet specific application requirements, ensuring that the application’s service levels are not affected by other activities.
- :: *Chargeback and accounting.* Creating Private Virtual Storage Machines lets you account and charge for storage resources used by specific applications or departments.

The NSC55 supports as many as eight Private Virtual Storage Machines, which can work with both internal and externally attached disk storage.

Scenario: Ensuring Service Levels for a Critical Application

Challenge: An online retail business wants to consolidate storage for several applications on the NSC55. One of the applications is the company’s customer order database, which has stringent requirements for availability, security, and performance. The customer order application is absolutely critical to the entire business operation.

Solution: The company creates a logical partition, called a Private Virtual Storage Machine, using Hitachi Virtual Partition Manager software for the customer order application with dedicated cache, fast Fibre Channel drives, and ports. The Private Virtual Storage Machine eliminates potential resource contention with other workloads running on the NSC55. Using Private Virtual Storage Machines enables the company to achieve the benefits of storage consolidation without sacrificing QoS for its most critical application.

The NSC55 supports eight Private Virtual Storage Machines. In this case, additional partitions could be created to support additional applications with different QoS requirements. For example, a backup application would not have high performance requirements and could use an externally attached SATA-based system, such as the WMS100, as a tape replacement option.

Simplification for Reduced Operational Costs

One of the most significant problems facing businesses of all sizes is the increasing complexity of the technology supporting essential business systems. The NSC55 helps organizations simplify the storage infrastructure by consolidating heterogeneous storage in a single pool, which can be managed by a single set of software tools.

Reducing storage management complexity has many significant benefits:

- :: Reduced training costs (administrators don't need to learn many different management tools)
- :: Faster problem resolution
- :: Faster deployment of new applications, because the storage infrastructure to support them is already in place
- :: More efficient utilization, because storage capacity is consolidated and available to a wide range of applications

Scenario: Simplifying a Heterogeneous Storage Environment

Challenge: An online publisher acquires another online publishing organization and finds itself managing storage from multiple vendors, each with different interfaces. Because knowledge is segregated into “specialists” for each device type, the organization’s staff finds it difficult to ensure application uptime and to resolve problems quickly.

Solution: The publisher deploys an NSC55 to create a consolidated storage environment and attaches the existing storage systems to the device. This provides immediate simplification, letting the organization manage and maintain all of the storage by using a single interface and set of tools provided by the Hitachi HiCommand® Suite of software. The staff finds it easier to manage the storage, and everyone has the tools and expertise to troubleshoot and resolve problems. As the company’s storage needs continue to grow, it can add internal storage or more external storage to the NSC55 and continue managing it with the same staff, processes, and policies.

Regulatory Compliance and Risk Avoidance

Whether you’re a large, publicly traded company concerned about Sarbanes-Oxley requirements or a privately owned organization worried about complying with legal discovery requests, you cannot ignore the importance of digital information in today’s business and legal environment.

Retaining essential data is one of the key factors in compliance; providing rapid and easy access to that data on demand is another. With mandated data retention periods, compliance concerns are increasing the amount of data that organizations manage and maintain—aggravating a growing burden of storage management.

Often, companies address compliance concerns by adding more complexity to their IT environment. For example, one approach is to buy storage with WORM characteristics to ensure that data hasn’t been tampered with and to use this to maintain archives of regulated data. Unfortunately, this approach creates additional islands of data that must be managed and maintained separately.

The data being retained for regulatory purposes doesn't need the same high-performance characteristics as the data serving online production systems. Inexpensive SATA storage can be a good choice, as long as you can create the necessary systems to prevent or audit changes to data.

The NSC55 lets you create compliant data stores from storage that's part of the centralized storage pool. The Hitachi Data Systems solutions for compliance are outlined in Table 1.

Table 1: Hitachi Data Systems Solutions for Compliance

Hitachi Storage Solution	Function
Hitachi Data Retention Utility software	Provides WORM capabilities on storage connected to NSC55
Hitachi Message Archive for Compliance solution	Automatically archives e-mail according to policies, using WORM capabilities of Hitachi storage
Hitachi HiCommand® Tiered Storage Manager software	Automatically moves older or less-valuable data to lower-cost storage

Scenario: E-mail Retention

Challenge: A consulting company has decided to implement e-mail retention policies for regulatory and legal purposes as well as good business practices. But the company doesn't want to undertake purchasing and managing dedicated WORM storage.

Solution: The company uses the NSC55 storage system already storing its Exchange databases. It implements the Hitachi Message Archive for Compliance solution and the Data Retention Utility software to turn its existing disk storage into a WORM device for message retention. Implementation is quick, retention is automated according to policies, and the ongoing cost of managing the solution is minimal.

Risk Avoidance: Data Protection

The NSC55 gives you many options for reducing backup windows and accelerating recovery times. For example, you can:

- :: Attach inexpensive SATA storage, such as the WMS100, to the NSC55 for disk-to-disk backups.
- :: Use the Hitachi ShadowImage™ In-System Replication software for snapshots to create online images of production volumes. You can then perform backups to tape from these images, without having an impact on the production system or the local area network (LAN).
- :: Maintain snapshots of production volumes from ShadowImage or Hitachi Copy-on-Write Snapshot software to support rapid recovery. Hitachi Data Systems offers several application-specific solutions that create "application-aware" snapshots integrated with the application.

For an overview of backup technologies and options, see the white paper "Backup Technology: Overview and Perspectives" on the Hitachi Data Systems Web site (www.hds.com; Tools & Resources).

Scenario: Reducing Backup Time

Challenge: A regional medical practice finds that its traditional tape-based backups are taking too long as the patient database grows in size. Worse, recovering the database from tape takes several hours—hours in which patient care is impeded by lack of access to the database.

Solution: The company deploys an NSC55 to store the patient database, giving it significant scalability to accommodate future growth. It then attaches SATA storage to the NSC55 to handle disk-to-disk backups. Using the Hitachi Data Protection Suite, powered by CommVault®, the company now backs up the patient database to disk and then archives those backups to tape. In case of a database corruption problem, the administrator can recover the patient database very quickly from the disk-based backup, while tapes offer long-term protection and archiving capabilities.

Business Continuity

When it comes to business continuity, there is no single answer that can be applied to every company. The range of options can be overwhelming, from improving operational procedures, to local disk-to-disk or tape backup and to replicating data out-of-region to recover from wide area disasters and comply with ever-tightening regulations. You have to make an informed decision based on business requirements and cost, and weigh such factors as risk exposure, regulatory compliance, and best practices².

For example, for disaster recovery every organization and application will have different requirements for how quickly it needs to be running after an outage (recovery time objective) and how current the data needs to be (recovery point objective).

Data replication is an essential technology for applications that need rapid and up-to-date recovery capabilities; by replicating current data to an alternate site, you protect it from a site-wide problem. However, two factors are inhibiting many organizations from using replication:

- :: *The hardware cost.* Often replication is bundled with high-end storage devices, so that you need two (one in each location) to make the solution work.
- :: *The bandwidth cost.* For most replication solutions, you need adequate bandwidth to handle peak traffic volumes. Dedicated bandwidth is expensive.

The NSC55 supports two replication solutions to address these problems:

- :: Hitachi TrueCopy™ Remote Replication software makes replication capabilities available on Hitachi Thunder and Lightning family systems as well as on the Universal Storage Platform and the Network Storage Controller, and supports both synchronous and asynchronous (long-distance) replication on most Hitachi storage systems. You can replicate data between different kinds/classes of devices, as long as there is adequate capacity on the “receiving” end of the replication.
- :: Hitachi Universal Replicator software on the Universal Storage Platform and Network Storage Controller offers asynchronous, remote replication to/from both internal and externally attached heterogeneous storage. And, it uses a journal-based replication that is able to buffer replication changes if the communications link is unavailable or not large enough for peak loads. With this technology, you do not need to reserve peak bandwidth capabilities, so you reduce the cost of the replication communications.

² For more information, please see the Hitachi Data Systems white paper “Risk Management and Business Continuity” on www.hds.com; Tools & Resources.

Scenario: Alternate Data Center

Challenge: A manufacturer has a main data processing center, with smaller data center facilities at regional offices. For business continuity purposes, the company wants to replicate its manufacturing database, which is stored on a Hitachi Lightning 9980V™ enterprise storage system, to one of the alternate data centers.

Solution: By putting an NSC55 at a regional data center, the company can use TrueCopy replication. The NSC55 provides a cost-effective platform for replication and ensures that the critical data is available in case of disaster.

Application Optimized Storage Solutions for Smaller Companies Based on the Adaptable Modular Storage and Workgroup Modular Storage

AMS200, AMS500, WMS100

The AMS200, AMS500, and WMS100 are built on the dual controller architecture that is typical of midrange modular storage, but offer advanced high-end features, such as logical cache partitioning and virtual storage ports with secure Host Storage Domains. The models AMS200 and AMS500 are today's most scalable high-performance, high-availability modular storage systems, supporting native Fibre Channel, SAN, or network attached storage (NAS) workloads on high-performance Fibre Channel or cost-efficient SATA intermix drives. The WMS100 supports cost-effective SATA drives while maintaining the performance and reliability edge that Hitachi's world-class engineering delivers.

These Adaptable Modular Storage and Workgroup Modular Storage systems can serve as the main storage in smaller companies or complement the Network Storage Controller and Universal Storage Platform in tiered storage configurations at mid-size and large enterprises.

Key Features

The AMS200, AMS500, and WMS100 systems offer unique features, including:

- :: *Scalability and Performance.* Provide unequalled application-specific performance and capacity that scales beyond 80TB.
- :: *Application Quality of Service.* Dedicate cache to specific applications and volumes to enhance performance.
- :: *Configuration Flexibility.* Host virtually any workload and multiple performance and archive requirements on the most economical storage system with SATA and Fiber Channel intermix; use also for disk-to-disk backup and tape replacement.
- :: *Ease of Management.* Simplify configuration and storage administration through easy-to-use graphical user interfaces.
- :: *High Availability and Reliability.* Leverage RAID-6 dual-parity striping to improve availability and speed RAID group rebuild times; maximize uptime with redundant hot-pluggable components and high-reliability Hitachi SATA implementation.
- :: *Lower Total Cost of Ownership.* Maximize storage utilization, centralize management of storage through consolidation, improve storage administrators' productivity, and reduce downtime.

Tiered Storage

Smaller companies can understand the value that tiered storage brings: decreased costs, better recoverability, higher performance, and increased utilization. The problem is, figuring out how to implement and effectively use tiered storage is not that simple in a typical IT environment. Manually moving data from tier to tier is cumbersome and ineffective, while allowing users to store their data on any tier of storage is downright dangerous.

Scenario: Effectively managing tiered storage

Challenge: A small financial services firm is facing a number of storage-related problems that are affecting its business results, including continued data growth, running out of disk space for critical applications, failing to meet application availability and performance requirements, and inability to back up all data within the existing backup window.

Solution: Implement tiered-storage based on Adaptable Modular Storage and/or Workgroup Modular Storage combined with Hitachi Data Migrator software, a component of the Hitachi Data Protection Suite, powered by CommVault®. Simply adding this solution to an existing primary storage environment will provide immediate and tangible results by freeing up critical and expensive primary storage. In addition, it is laying the foundation for ongoing data lifecycle management. Freeing up budgets and reducing time spent on managing data allows more investment and focus in the right area; increasing the bottom line.

Backup

Backing up data should be simple: choose your files, mount a tape, and click on [Start]. These days, however, data is mushrooming faster than the ability to back it up, some of the most critical information is on tapes that can't be read, or can't be found, and every backup period is spent hoping for an error-free run. And even when backups are done problems occur. In a recent survey, the Enterprise Strategy Group found that one-fifth of corporate backups to tape either fail or have errors.

Scenario: Completing Successful Backups

Challenge: A small retail chain is having the typical backup problems encountered across just about all businesses. They are unable to back up critical data within the allotted backup window, their tape and tape media growth are completely out of hand, and their restore of critical data takes much too long and is not backed up frequently enough to recover data to the required point in time.

Solution: Implement a disk-based backup solution built on Adaptable Modular Storage and/or Workgroup Modular Storage and the Data Migrator software. You can back up all of your data (disk-to-disk or disk-to-disk-tape) more often while eliminating the two biggest causes of failure from the backup environments: tape and human error.

Summary

With the introduction of the Hitachi TagmaStore Network Storage Controller model NSC55, Adaptable Modular Storage models AMS200 and AMS500, and Workgroup Modular Storage model WMS100, Hitachi Data Systems opens new possibilities to organizations of all sizes for aligning storage infrastructure with application and business needs. These organizations now have a wide variety of choices in storage systems when building Application Optimized Storage solutions from Hitachi Data Systems that match application requirements, such as performance, availability, functionality, and cost, to storage attributes.

Whether deployed as the main storage system in smaller companies or as part of a tiered storage configuration in larger enterprises, these systems represent the latest developments in Hitachi storage innovation to bring value to customers.

Appendix A: Storage Virtualization

What's Virtualization?

Simply put, virtualization is the process of making one or more physical components appear as simplified logical entities. Virtualization masks the complexity of the underlying infrastructure for administrators, users, and applications. Storage virtualization creates logical storage volumes from a shared pool of storage resources. With Hitachi storage virtualization, these storage resources can include heterogeneous storage.

The point of storage virtualization is to make things simpler. It's ironic, then, that virtualization has become a topic of complex and technical arguments between storage vendors with different ways of approaching the task. The typical storage buyer, looking for ways to simplify the storage environment, might easily decide that virtualization is too complex to undertake.

The argument has centered on where to perform the logical abstraction or virtualization of storage. One answer is to perform it on the host (logical volume software). This approach was popular in the DAS environment, but the evolution of networked storage makes it problematic, because many hosts may need to access a common pool of storage. Other vendors suggest embedding virtualization in dedicated virtualization appliances or in the network switches. Each of these approaches has its benefits and drawbacks—most involve adding complexity to the infrastructure or restricting infrastructure options to specific vendors.

The Hitachi Approach: Controller-based Virtualization

With the Universal Storage Platform, Hitachi embedded storage virtualization within the storage controller. The controller can create virtual storage not only for internal storage but also for externally attached storage, which may include third-party storage attached to the device. The NSC55 extends controller-based virtualization from the enterprise to the mainstream midrange storage market.

This revolutionary approach to storage virtualization is unique in the industry. With the controller managing virtualization, neither the application nor the storage itself needs to be “aware” of the virtualization technology. The storage virtualization introduces no additional complexity to the storage infrastructure.

The Hitachi approach has many advantages over other virtualization technologies:

- :: It does not require any external switches, appliances, or host software.
- :: It is storage network independent; there's no need to buy new switches or change your SAN to use it. You don't even need a SAN; controller-based virtualization also supports DAS in open systems and mainframe environments.
- :: Because it works within the storage controller, controller-based virtualization is already compatible with storage software you may be using, including the entire suite of Hitachi storage solutions.
- :: It extends the life of existing and legacy storage systems, which can participate in the virtual storage pool by connecting to an NSC55.
- :: Storage administrators can use a single set of management tools to manage heterogeneous storage, offering true storage simplification.

If you are interested in the evolution of this technology, see the paper "*Virtualization Without Limits*," available on www.hds.com (enter your search criteria under the Tools & Resources link). Although the paper discusses the Universal Storage Platform, it also applies to the NSC55, which uses the same virtualization technology as the Universal Storage Platform.

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