Solve the Top 6 Enterprise Storage Issues

Learn How to Meet the Challenges of Rapid Data Growth With Storage Virtualization

By Hitachi Data Systems
March 2014
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Solve the Top 6 Enterprise Storage Issues

Executive Summary

Nowhere is the exponential growth of data felt more acutely than in the world of enterprise storage. In fact, the growth of storage budgets now threatens to eclipse the growth of an organization’s overall IT budget. Instead of continuing to add more storage systems and more management complexity, a more cost-effective, sustainable approach is required. That approach is storage virtualization.

This white paper offers answers to the question: What can storage virtualization do for my organization? Through various use cases and common issues that IT organizations face, readers will learn the various business issues that can be effectively resolved with storage virtualization technology. For those experiencing exponential data growth, ongoing capital expenditures and escalating storage management complexity, storage virtualization technology from Hitachi Data Systems provides ready answers.

Readers will learn how much or how little disruption such a technology could cause when implemented in their environments. They will also learn various questions to ask vendors about their virtualization approaches.

This white paper also discusses how storage virtualization will allow organizations to:

- Reduce operational costs and storage-related capital expenditures.
- Improve overall efficiency and storage management.
- Offer more choice in vendor hardware.
- Extend the life of existing storage assets.
- Provide better service delivery to internal customers and line-of-business applications.
- Incorporate more eco-friendly data center storage practices.

Readers will also learn why no company is better positioned than Hitachi Data Systems to help them achieve answers through virtualization.

Building on the company’s long history of innovation, Hitachi Data Systems continues to lead the market in its storage virtualization knowledge and customers, with over 25,000 virtual storage controllers shipped worldwide.
Behind Virtualization: Real Help for Real World IT Issues

Much has already been written about virtualization and storage virtualization in particular. This paper seeks to bring the virtualization discussion down to a more pragmatic level; it focuses instead on the tangible business benefits that enterprise environments have begun to experience with storage virtualization technology. Routinely referenced by analysts as a critical next phase in enterprise network storage architectures, the use of storage virtualization technology is touted as a necessary foundation to:

- Combat exponential data growth.
- Increase utilization of existing storage assets.
- Reduce storage capital expenditures (capex).
- Reduce operating costs (opex) and total cost of ownership (TCO).
- Simplify storage management.
- Implement a truly successful tiered storage architecture.
- Deliver IT (and storage) as a utility, including the ability to deliver "metered" storage resources to specific lines of business and applications.
- Reduce power and cooling consumption in the data center.

One analyst sums up its value: "Storage virtualization is not the only method for improving IT efficiency, but it is also critical because it provides a foundation for sustained improvement.

"The foundation for the effective and efficient transformation of the traditional siloed data center to the next-generation highly virtualized dynamic data center requires not only the virtualization of the compute and server platform. A storage infrastructure that can be as flexible, capacity-efficient, power-efficient as the server infrastructure is mandatory."1

Many people have heard about virtualization as applied to servers and the compute or processing side of the business. The proliferation of virtual server machines with VMware is 1 example of a successful virtualization strategy currently in use. Other examples of virtualization also exist, where the image of the IT resource or system presented to the end user is logically simplified, or "virtualized" to mask the underlying complexity.

Similarly, storage virtualization is a way to logically combine storage capacity and resources from various heterogeneous, external storage systems into 1 virtual pool of storage. This virtual pool can then be more easily managed and provisioned as needed. A single set of tools and processes performs everything from online, any-to-any data migrations to heterogeneous replication.

Help to Solve 6 Common Storage Issues

This section demonstrates 6 specific ways storage virtualization can help solve many of the most common issues IT organizations deal with regarding cost control, management and use of existing resources. Each case demonstrates how organizations can use the technology to resolve the issue and create a more adaptive, flexible service-based infrastructure to reflect ongoing changes in business requirements. The top 6 issues include:

- Exponential data growth and disruptive storage upgrades.
- Low utilization of existing assets.

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1 "The Economic and Operational Value of Storage Virtualization," ESG Report, March 2012
Growing management complexity with flat or decreasing budgets for IT staff head count.

Increasing hard costs and environmental costs to acquire, run and manage storage.

Ensuring rapid, high-quality storage service delivery to application and business owners.

Achieving cost-effective business continuity and data protection.

The impact of virtualization on each of these issues is described in the following sections.

Issue Number 1: Exponential Data Growth and Disruptive Storage Upgrades

With 45% of organizations saying exploding capacity growth is their No. 1 pain point, IT is being called to creatively manage data growth beyond just buying more storage. If more storage must be added, avoiding lengthy, painful data migrations and extended application disruptions is recommended for any technology refresh, vendor system change-out or storage capacity addition.

Organizations now recognize not all data needs to reside on high-performance storage. Data copies used for backup, archival, test or development often perform fine on lower-cost, high-capacity disk storage. But, introducing such systems into an existing storage infrastructure can lead to multiple isolated storage silos. It can result in more management complexity and an inability to easily move data from high-performance storage to lower-cost systems.

Solution: Storage Virtualization Offers Nondisruptive Data Migration to Heterogeneous Storage Tiers and Lower-Cost, Modular Storage

Analysts refer to the dynamic nature of virtualization adoption and deployment as a catalyst for changes in data protection. Virtualization technology from Hitachi Data Systems offers a single management interface for nondisruptive data movement amongst all tiers of storage. This functionality extends to disk-based backup and archival tiers that use multiple disk technologies. Some lower-level tiers are often designated for use by virtual tape library or archival applications.

In this way, storage virtualization becomes the foundation for building intelligent tiered storage environments. With Hitachi Data Systems, just 1 set of storage-based data migration and data management tools is required to migrate application or file data in the background. Data can be migrated from any to any heterogeneous storage system, all while production applications remain up and running. This capability also applies for data migrated from mainframe environments to lower-cost storage.

For Hitachi storage platforms, that means data can be seamlessly migrated between Hitachi enterprise systems and other storage tiers, such as Hitachi NAS Platform, as well as Hitachi Unified Storage systems. Equally important, storage virtualization technology from Hitachi allows seamless data migration between Hitachi solutions and other heterogeneous tiers of storage from EMC, IBM, NetApp and other suppliers.

When performing routine maintenance, refreshes or upgrades, data volumes are moved to the Hitachi virtual pool temporarily. Then, they are moved back to the native device, without disrupting ongoing application or data access. This method is simpler than other storage virtualization methods that often require building an extra “holding” space for intermediate staging volumes to serve as temporary storage during the migration process.

Issue Number 2: Low Utilization of Existing Assets

Most enterprise organizations purchase ever-growing numbers of storage systems, only to find that the average utilization of the storage capacity is about 53%. However, it is not unreasonable to see rates as low as 20%. That

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means over half of the free capacity in most systems remains idle and unused, even while requisitions for new storage systems continue to be filled.

**Solution: Virtualization Significantly Increases Storage Capacity Utilization**

Storage virtualization technology consolidates isolated silos of stranded storage capacity into a logical pool of storage. This pool can be easily re provisioned and assigned on an as-needed basis to various data needs. Such needs can include primary application data storage, nearline backup or archival, development and testing projects, file shares, and so forth. Better utilization of existing storage assets can be achieved in a number of ways, including:

**Better utilization through thin provisioning.** When combined with other virtualization components like Hitachi Dynamic Provisioning software, storage virtualization technology allows organizations to eliminate a large cost of utilization waste: already allocated storage capacity that remains unused yet reserved "just in case" an application needs it in the future. Instead, with Hitachi Dynamic Provisioning software, organizations can use "thin provisioning" functionality to assign large virtual storage volumes of almost any size to the needs of a specific application. In the background, however, the actual physical capacity used is only a fraction of that virtual volume’s total size, just enough to accommodate the current needs of the application. Dynamic Provisioning software allows both internal and externally attached heterogeneous storage assets to gain the benefits and increased asset utilization of thin provisioning. This feature alone can significantly extend the life of existing and legacy heterogeneous storage, not to mention postponing the purchase of new storage systems.

**Better utilization through tiered storage.** Gaining better utilization of different price and performance "tiers" of storage is also key: "Tiering has become a storage best practice; the benefits are numerous and significant. Self-optimizing, policy-driven hierarchical storage management (HSM) software automatically moved data to the ‘best fit’ tier available. Optimized tiered storage enables storage managers to place the right data in the right place at the right time. ... Hitachi Dynamic Tiering is one of many technologies HDS offers to improve capacity efficiency by helping its customers reduce the need for more storage, reclaim capacity and defer purchases."

**Better utilization through automation.** Most data is rarely or never accessed after it is created. Therefore, the data should be moved to a lower-cost, less-expensive storage tier rather than put on the most expensive tier of storage. Managing the movement and placement of data is the promise and premise of data lifecycle management methodologies. However, defining where and for how long data resides at any point in its lifecycle can be complex and problematic. Dynamic tiering is a revolutionary new solution that eliminates the time-consuming manual processes of data classification and movement to different storage tiers. It optimizes tiered storage usage while actually improving performance.

By consolidating storage into a single virtual pool and deploying thin provisioning with Dynamic Provisioning software and tiering storage devices, organizations can reclaim 50% their storage capacity. They can also see a 30% performance improvement, as well.

**Issue Number 3: Growing Management Complexity With Flat or Decreasing Budgets for IT Staff Head Count**

Many environments face an ever-growing complexity in the underlying infrastructure needed to support their core applications. At the same time, IT organizations are being asked to do more with budgets and staff sizes that remain the same or are decreasing. This environment makes it more critical than ever to invest in a simplified storage management infrastructure that supports the goal of doing more with less.

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Examples of the increased complexity now found in today’s enterprise data center include:

- Support for multiple host operating systems (OSs).
- Data storage for multiple terabytes (TB) or petabytes (PB) of application and file data.
- Multiple storage systems in the environment, often from different vendors.
- Storage, often existing as isolated "silos," each with separate management tools.
- Application downtime or maintenance that is unacceptable for routine tasks (protection, adding capacity, management) on key production systems.
- Growing concern regarding data center "hot spots" and real estate constraints as capacity increases.

Solution: Storage Virtualization Simplifies Complexity, Allowing 1 Administrator to Manage 3 to 10 Times More Storage

Storage virtualization technology from Hitachi Data Systems can simplify the management of otherwise complex storage infrastructures in many ways.

**Simplified management via 1 virtual pool.** Storage virtualization solutions from Hitachi Data Systems consolidate many physical storage systems from different vendors into 1 virtual pool capable of scaling up to 255PB of total storage. Virtual pooling functionality masks the complexity of the underlying physical structure, making it easier to manage.

**A single, common management tool set for all heterogeneous storage.** A single, standard set of storage management tools can be used to perform common functions across heterogeneous storage systems, including:

- Creating or modifying storage volumes.
- Quick provisioning or allocation of storage capacity to applications (via Hitachi Dynamic Provisioning software with thin provisioning functionality for both internal and externally attached heterogeneous storage devices).
- Nondisruptive data or volume migration from any to any storage system.
- A single, unified platform for snapshot, archive, backup and replication (either locally or to remote sites).

**Increased data under management per IT administrator.** IT environments reaping the operational benefits of using just 1 set of tools can significantly reduce training costs and manage more data with less staff. Over half of Hitachi virtualization customers have been able to reduce the amount of time it takes to manage tiered storage on average 25% to 30%, or more. This efficiency allows staff skill sets to be redeployed on other projects of higher value to the business.

Issue Number 4: Increasing Hard Costs and Environmental Costs to Acquire, Run and Manage Storage

Growing storage complexity and mounting data requirements often lead to related growth in both capital expenditures (capex) and operating expenditures (opex) needed to support the storage infrastructure. More storage on the data center floor can also negatively translate into growing environmental impact, as the systems often require more power to run and keep them cool. Other ongoing costs can come from many areas, including:

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6 Source: TechValidate. TVID: EA3-6FC-989
Cost of hardware acquisitions and support.
Cost of software licensing.
Increased floor space and real estate required.
Total cost to manage the storage, estimated by analysts at many times more than its cost of acquisition.

Solution: Virtualization Reduces Capex and TCO While Promoting a More Eco-Friendly Data Center

Virtualization technology can lead to significant cost reductions, including:

- Reduced need for redundant software applications and licenses. (Both high-performance and low-cost storage systems now "inherit" the same virtualization functionality.)
- Fewer storage systems needed. (Hitachi storage virtualization allows consolidation of more data on less hardware. This reduced architecture, in turn, requires less floor space, along with less power and cooling.)
- Reduced number and cost of future acquisitions (fewer overall systems, more modular storage).
- Reduced labor costs to manage, support or train IT staff on using virtualized systems.
- Longer utilization of legacy (and lower-power-consuming) storage systems that is now possible. (Legacy systems can now go off lease and fulfill asset depreciation schedules, yet still be utilized in the virtual pool. Data safeguards maintain virtual access to data in case of system failure.)

Sample opex savings. One example of these types of savings can be found in the IT environment of Overstock.com, the online retail company, and a Hitachi Data Systems virtualization customer. Hitachi was brought in to help address their growing complex storage environment and increase the utilization of their current storage assets. Hitachi Data Systems reduced the unit cost of storage by 43% in year 1 and an extra 37% in year 2.

Virtualization as an eco-friendly solution. Environmentally conscious data centers can reduce their overall data center footprints, power consumption and cooling costs through storage virtualization. Primary ways include:

- Better elimination of data center hot spots, without disruption. If a certain section of disk systems becomes a hot trouble spot, Hitachi storage virtualization makes it easy to migrate the data to other disks and adjust the storage rack’s heat distribution. These tasks can be accomplished without having to bring systems down.
- Managing larger quantities of data with a single storage controller. Storage controllers, themselves, consume significant power and cooling resources. Since Hitachi storage virtualization separates 1 controller (the metadata) from the drives and their underlying spinning disks, it can more effectively minimize environmental impacts.
- Better use of existing storage assets leading to fewer overall systems in use. Hitachi storage virtualization implementations that incorporate tiered storage or Hitachi Dynamic Provisioning software (for thin provisioning to internal and externally attached storage) can achieve higher asset utilization of existing systems. This approach reduces the need to continuously acquire more storage.

Issue Number 5: Ensuring Rapid, High-Quality Storage Service Delivery to Application and Business Owners

Most application owners and specific lines of business view the success or failure of IT services on how well their own day-to-day applications are running. This daily functioning includes the level of services (in terms of access, availability

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and reliability) that they have come to expect. But for IT, juggling these varied data needs while delivering high quality of service (QoS) can sometimes be a challenge. So can determining how much to "bill" each department for the level of services it requires. Convincing departments to give up control of their own storage "box" in favor of a centralized storage management scheme may also be an issue. Assurance of consistently high application performance and responsiveness must be offered, even when storage resources are pooled or shared with other competing applications on the network.

Solution: Storage Virtualization Enables Delivery of Metered Storage Services and Guaranteed QoS via Application-Specific Virtual Storage Machines

Specific to Hitachi virtualization technology is the unique feature that allows logical partitioning of storage resources into multiple virtual storage machines. Each virtual machine (VM) has its own dedicated internal and external capacity, cache and ports. Logical partitioning allows IT organizations to apply storage policies to specific applications, matching business requirements for performance, capacity and availability to designated storage resources. Because each partition has its own serial number, IT teams can also associate specific business applications with selected departments and business units, then charge back accordingly. These unique capabilities allow administrators to create a utility model to deliver "metered" storage resources to select business entities. The management of these virtual storage machines can then be addressed centrally or by local administrators.

In this way, organizations can ensure that service level agreements (SLAs) successfully align the performance needs of an application with the commensurate cost required to achieve that QoS.

Issue Number 6: Achieving Cost-Effective Business Continuity and Data Protection

Closely linked to the prior issue of application-level QoS is the topic of data protection. From an overall corporate governance perspective, this issue widens to encompass contingencies and processes in place for application-specific, local data center and site-wide disaster recovery and business continuity. Many reports find the cost of just an hour of system downtime in most enterprise organizations can be staggering. But, likewise, the typical costs to implement robust disaster recovery practices can mount. Consider the expense of replication software often available in enterprise-class storage systems, not to mention the cost of replicating critical data to 1 (or even 2) remote data centers, which often contain other storage and servers. Achieving the right mix of protection and investment can require tough decisions.

Solution: Virtualization Allows for Heterogeneous, Any-to-any Replication With Just 1 Set of Tools and a Common Interface

Storage virtualization technology from Hitachi Data Systems makes the same, high-performance data replication services available to each externally attached storage system. This availability extends to lower-cost modular devices, direct attached storage (DAS), network attached storage (NAS) or just-a-bunch-of-disks (JBOD) storage. Therefore, lower licensing costs are experienced as the process is standardized and applied across the organization’s infrastructure.

Features include:

- Local replication of multiple copies of data within the same storage tier or a different tier.
- Distance replication from any to any storage system and 1 or more target locations that are any distance away. (Hitachi virtualization technology supports both synchronous and asynchronous data replication.)
Evaluate Your Options for Virtualization

After an IT organization decides to explore different storage virtualization options, it is often difficult to sort out the various vendor offerings presented in the marketplace.

From an architectural perspective, many vendors will talk about “where the virtualization resides” in an IT environment. This relates to where the virtualization software layer and functionality have been set up to operate. In general, vendors offer 3 main virtualization architectures:

- **Host-based virtualization** handles storage virtualization functionality through the host or servers that have access to the underlying physical storage systems.

- **Network-based virtualization** offers virtualization functionality from somewhere within the storage network fabric or “cloud,” between the path of servers and underlying physical storage devices. Typical implementations of network-based virtualization include virtualization appliances and “intelligent” switch-based virtualization solutions.

- **Storage controller-based virtualization** offers storage virtualization as a component of an enterprise storage controller’s functionality, such as the functionality built into a high-performance storage system. Depending on the solution, this virtualization functionality can also be available as a standalone storage system controller, without accompanying internal storage.

Hitachi Data Systems currently offers the storage controller-based approach to virtualization in Hitachi Virtual Storage Platform and Hitachi Unified Storage VM. Widely heralded for its innovation, 3-D scalability and eco-friendly feature set since its original launch, Virtual Storage Platform is virtualizing enterprise storage worldwide.

The benefits of the Hitachi approach are described by ESG analyst Mark Peters: “HDS virtualized, tiered storage simplifies management because the complete, heterogeneous storage infrastructure delivers common storage services. The HDS approach goes beyond consolidating storage to providing an extremely efficient, dynamically allocated set of tiered storage pools. HDS customers are reducing the amount of IT staff needed to manage their storage infrastructures, improving capacity utilization, deferring purchases, eliminating frames and reducing costs related to hardware and software maintenance, floor space, electricity and air conditioning. Extending useful life reduces future capital expenditures while improving the performance and availability of data.”

15 Questions to Ask Your Vendor

Technical differences are involved with each approach. The Hitachi approach is further examined in technical papers, including “Storage Virtualization: How to Capitalize on its Economics Benefits.”

Rather than itemize specific technical differences, this section offers a set of 15 questions to ask vendors when evaluating virtualization solutions:

1. Where does the virtualization functionality reside?
2. Will the solution make my current infrastructure more complicated?
3. How many enterprise customers currently use the solution?
4. How much extra latency will the solution add to performance (such as ongoing disk read and write operations)?
5. How well does the solution scale to support large installations, and even petabytes of storage?
6. Does the solution let you logically partition storage capacity, cache and ports?
7. Can the solution be implemented in smaller phases? How easy is it to roll back?
8. How well does the solution support clients or hosts running other operating systems?
9. How well does the solution support use of external, low-cost disk systems from other vendors?
10. How reliable is the tiered storage model currently supported by the virtualization solution?
11. Will the solution cost more than my current high-performance storage system?
12. How do you ensure extra virtualization elements won’t decrease system reliability or availability?
13. Does the vendor’s vision adequately support my organization’s current and future goals?
14. How easy is it to migrate or replicate data between systems or back out once you begin the migration process?
15. What would be required to move to a different virtualization platform (or vendor solution) later?

Table 1 provides more background on each of these questions, along with some ways that Hitachi Data Systems virtualization solutions compare.

**TABLE 1. 15 QUESTIONS TO ASK YOUR VENDOR**

<table>
<thead>
<tr>
<th>Question</th>
<th>How Hitachi Data Systems compares</th>
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<tbody>
<tr>
<td>1. Where does the virtualization functionality reside?</td>
<td>Solutions from Hitachi Data Systems offer virtualization from the storage controller. These solutions extend the mature controller-based storage services Hitachi developed to support both internal and external heterogeneous storage. Noted by industry analysts as one of the simplest yet most robust ways to implement virtualization, the Hitachi approach still has no direct competition since its introduction in 2004. Identifying it as the 1st example of a new evolution in storage architectures, IDC coined the term &quot;network storage controller&quot; to describe the Hitachi approach.</td>
</tr>
<tr>
<td>2. Will the solution make my current infrastructure more complicated?</td>
<td>Instead of needing extra hardware layers (management servers, application blades, new switches and separate management software), Hitachi virtualization is easily deployed by enabling an existing software key within Virtual Storage Platform and Unified Storage VM. Yoshida sums up the simplicity of this approach as follows: &quot;First, storage virtualization should not add complexity. It should not require you to tear apart the SAN to insert another layer of management complexity. For that reason, Hitachi’s storage virtualization solution resides in the storage controller and not in the SAN.&quot;</td>
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8 Ibid. 10.
10 Ibid. 12.
11 Ibid. 12.
TABLE 1. 15 QUESTIONS TO ASK YOUR VENDOR (CONTINUED)

In addition, Hitachi Dynamic Tiering software enables the management of multiple storage tiers as a single entity. It self-optimizes for high performance and space efficiency to have the right data in the right place at the right time. The storage administrator does not need to classify data or define policies; once the tiers are configured, the storage system does all the work, freeing up the storage administrator to focus on other storage-related responsibilities.

3. How many enterprise customers currently use the solution?

Some virtualization solutions are so new that they have difficulty naming many enterprise-level reference customers who have already deployed the solution in their environment. This information is critical for learning how the solution is operating in the real world.

How Hitachi Data Systems compares: Hitachi Data Systems has shipped more than 25,000 virtual controllers, many of which have been employed by the largest data centers in the world. Hitachi virtualization technology is based on some of the most mature and field proven virtualization features in the storage industry, for use by both open systems and IBM® mainframe environments.

4. How much extra latency will the solution add to performance (such as ongoing disk read and write operations)?

Some virtualization solutions can introduce added I/O latency due to the following conditions:

- Opening Fibre Channel packets; I/O must then be redirected with other systems.
- Maintaining, updating and referencing a separate mapping table, with the use of extents or added LUNs that maintain the ongoing relationship between the underlying physical and logical volumes.
- Additional control path processing that can be required for servers or appliances to communicate with an intelligent switch.
- The added impact of virtualized replication, migration or mirroring services on core directors or switches.

How Hitachi Data Systems compares: Hitachi storage virtualization platforms do not introduce significant latency.

Shortly after the release of the groundbreaking Hitachi Virtual Storage Platform, analyst firms like IDC acknowledged the enterprise levels of performance the solution provided. Since then, Hitachi enterprise storage solutions have continued to increase in performance and reliability.

For example, Virtual Storage Platform offers the following high-performance features:

- Massively parallel, scalable crossbar-switch architecture with 192GB/sec aggregate internal bandwidth.
- Superior scalability up to 255PB of total storage capacity, including as much as 2.5PB of internal storage.
- High-speed global cache to boost performance and data migrations.
- Best-in-class performance platform for intelligent tiered storage.
- Hitachi Dynamic Provisioning software to apply thin provisioning practices to both internal and externally attached storage, thereby simplifying storage management and capacity planning while reducing TCO.
- Hitachi Dynamic Tiering software to automate data placement for speeding performance and lowering cost.

5. How well does the solution scale to support large installations, and even petabytes of storage?

While many virtualization solutions claim to support many terabytes of storage, exactly how easily or how well they scale may still be in question. Some network-based virtualization solutions indicate they can be scaled up or out through the addition of more storage routers. These additions can increase complexity, as more data transactions are required to keep the routers in synch. Some of these solutions also may not be able to virtualize and scale out other storage services beyond capacity (such as the ability to scale cache or access ports as well).
### TABLE 1. 15 QUESTIONS TO ASK YOUR VENDOR (CONTINUED)

**How Hitachi Data Systems compares:** Virtual Storage Platform scales to support tens of thousands of host connections and petabytes of storage. The system’s superior scalability includes 255PB of total storage capacity and up to 2.5PB of internal storage. Just as importantly, the system includes not just the ability to scale storage capacity, but also the ability to scale and virtualize storage services like cache and access ports. This scalability allows IT teams to develop secure private partitions that assign the right mix of storage, cache and ports in order to ensure high QoS on an application-by-application basis.

At the core of Virtual Storage Platform is the massively parallel and scalable Hi-Star crossbar-switch architecture, which is now in its 5th generation.

**6. Does the solution let you logically partition storage capacity, cache and ports?**

Some analysts maintain that logical partitioning is a critical component of a successful tiered storage architecture. This functionality allows other storage resources to be virtualized and reprovisioned as well, including capacity, cache and ports; therefore, specific applications have the guaranteed processing resources they need to maintain steady service levels and be able to charge back using a "utility" model to internal customers.

**How Hitachi Data Systems compares:** Hitachi virtualization technology provides the most extensive logical partitioning functionality on the market today. This includes the ability to partition storage resources into multiple resource groups, each with its own dedicated internal and external capacity, cache and ports. This functionality allows IT organizations to apply storage policies to specific applications, thereby matching business requirements for performance, capacity and availability to designated storage resources. Because each partition has its own serial number, IT teams can associate specific business applications with selected departments and business units, then charge back accordingly. These unique capabilities allow organizations to create a utility model to deliver "metered" storage resources to select business entities. Subsequent management of partitions can be addressed centrally or by local administrators. In this way, organizations can make sure that SLAs successfully align the performance needs of an application with the commensurate cost required to achieve that QoS.

**7. Can the solution be implemented in smaller phases? How easy is it to roll back?**

Some sites may prefer to pilot a virtualization solution's data migration or replication functionality. Or, they develop a small-tiered storage environment associated with a key application and then add other applications or business groups over time. Others might want to revamp the entire architecture with virtualization. Learn whether the solution offers these options, as well as any rollback options for reverting to the "previrtualized" configuration.

**How Hitachi Data Systems compares:** Technology in the virtualization platforms can be turned on or off, and rolled out in either large implementations or small pilot projects. Organizations also have the option to choose whether to use the system as just another storage system or fully activate its existing virtualization functionality. The system can also be deployed as just another storage system and then used to easily "discover" any externally attached heterogeneous storage volumes, which can be assigned as virtual volumes.

**8. How well does the solution support clients or hosts running other operating systems?**

Learn what support and connectivity the virtualization solution offers clients using different operating systems.

**How Hitachi Data Systems compares:** Hitachi virtualization solutions support multiple OS clients, including mainframes, Fibre Channel or iSCSI SAN, Fibre Channel DAS and NAS. They use standard transport protocols (supports CIFS, NFS, FCIP, iSCSI, IBM FICON® and ESCON® for mainframe connectivity).

**9. How well does the solution support use of external, low-cost disk systems from other vendors?**

Many high-end storage systems that integrate with virtualization software do not support external storage. Learn what type of support is offered for low-cost disk systems from other vendors. This component is integral to a tiered storage architecture.
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<td>high-end, Tier 1 storage. This approach not only offers greater customer</td>
<td>not only critical Tier 1 data, but also any Tier 2 or Tier 3 backup copies, which may have been stored in the same</td>
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<td>buying choice and the option to reuse legacy systems as lower level</td>
<td>storage unit.</td>
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<td>storage tiers, but also eliminates the “single point of failure” risk</td>
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<tr>
<td>to both tiers of data. Physical separation of tiers also allows any</td>
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<tr>
<td>rebuild efforts ultimately required on high-capacity disks to be more</td>
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<tr>
<td>easily isolated: There is no impact on the performance and availability</td>
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<tr>
<td>of any surrounding application data. Since Hitachi virtualization</td>
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<tr>
<td>technology allows data to be seamlessly migrated in the background</td>
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<tr>
<td>during such rebuilds, access to the impacted tier’s data is also assured</td>
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<tr>
<td>even during this type of maintenance activity.</td>
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<tr>
<td>11. Will the solution cost more than my current high-performance storage</td>
<td>Hitachi Data Systems notes that tiered storage should cost less than Tier 1 (high-performance) storage. The total</td>
</tr>
<tr>
<td>system?</td>
<td>cost includes the cost of software and hardware to move the data between tiers.</td>
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<tr>
<td>How Hitachi Data Systems compares: Hitachi virtualization functionality</td>
<td>Hitachi virtualization functionality does not require increasing the cost of the infrastructure with more SAN</td>
</tr>
<tr>
<td>does not require increasing the cost of the infrastructure with more SAN</td>
<td>network hardware, servers, virtualization appliances or switches. Instead, the solution requires only enabling a</td>
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<tr>
<td>12. How do you ensure extra virtualization elements won’t decrease</td>
<td>Some network-based solutions may require additional clustered servers or appliances to support their availability</td>
</tr>
<tr>
<td>system reliability or availability?</td>
<td>goals. While offering limited availability, performance of these virtualization solutions can still be dramatically</td>
</tr>
<tr>
<td></td>
<td>reduced by as much as 50% if half of the cluster goes down.</td>
</tr>
<tr>
<td>How Hitachi Data Systems compares: Reliability and availability levels</td>
<td>Reliability and availability levels do not rely on clustering technology. Instead, these levels are based on the</td>
</tr>
<tr>
<td>do not rely on clustering technology. Instead, these levels are based on</td>
<td>already mature and proven reliability of the underlying Hitachi storage controller, which has already been field</td>
</tr>
<tr>
<td>the already mature and proven reliability of the underlying Hitachi</td>
<td>proven for reliability in large enterprise storage environments. In fact, Hitachi Data Systems offers a 100% data</td>
</tr>
<tr>
<td>storage controller, which has already been field proven for reliability</td>
<td>availability warranty.</td>
</tr>
<tr>
<td>in large enterprise storage environments. In fact, Hitachi Data Systems</td>
<td>13. Does the vendor’s vision adequately support the enterprise organization’s current and future goals?</td>
</tr>
<tr>
<td>offers a 100% data availability warranty.</td>
<td>Given the relatively young nature of virtualization technology, it is important to focus on vendors that seem to</td>
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<td></td>
<td>offer a pattern of ongoing innovation and integration in their current virtualization offering and technology</td>
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<td></td>
<td>roadmap.</td>
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</table>
How Hitachi Data Systems compares: Widely acknowledged for its ability to accurately predict technology changes in the market, Hitachi Data Systems won newfound respect and recognition when it launched the Hitachi Universal Storage Platform in September 2004. This 1st-of-a-kind, storage controller-based virtualization platform was now capable of extending virtualization functionality to externally attached, heterogeneous storage. Universal Storage Platform has been heralded as everything from a "new category" in storage, to "game-changing technology." It has garnered comments from analysts regarding how much its introduction had dramatically shifted the underlying storage landscape for both customers and competing vendors. Following the introduction of Hitachi Universal Storage Platform V in 2007, Hitachi also announced another market 1st: an enterprise-class implementation of virtualization with thin provisioning (Hitachi Dynamic Provisioning software) for both internal and externally attached heterogeneous storage. With the introduction of Virtual Storage Platform in 2010, Hitachi added dynamic tiering for the automation of data placement in storage pools. The Unified Storage VM followed in 2012 to bring enterprise virtualization to the midmarket.

"With the Universal Storage Platform V, Hitachi has achieved what other storage companies have yet to envision and has clearly extended its leadership position in high-end, enterprise storage solutions," said Hitachi Data Systems CTO Hu Yoshida.

14. How easy is it to migrate or replicate data between systems or back out once you begin the migration process?

Learn how much support virtualization solutions offer for data migration or replication across heterogeneous systems and different price and performance storage tiers. Watch for:

- Any added storage capacity required to "stage" interim volumes during migration to the virtual layer.
- Potential vendor lock-in after data is migrated into the virtual layer; ask specifically how easy it is for data to return to the native storage mode of the underlying physical controller.
- Maturity of replication and data migration functions; some virtualization solutions that place virtualization functionality farther away from the data have had to redevelop and re-architect the use of common storage services like replication and data migration.

How Hitachi Data Systems compares: Any-to-any replication, seamless data migration and centralized data management are part of Hitachi virtualization functionality. Hitachi controller-based virtualization has been carefully integrated with Universal Volume Manager and other Hitachi software. This integration results in a single set of management tools for performing snapshot, migration, archiving, backup and replication of data across heterogeneous storage systems, even from mainframe systems to lower-cost open systems.

15. What would be required to move to a different virtualization platform (or vendor solution) later?

Once storage volumes in some solutions have been "virtualized," their data contents can exist under a new, proprietary volume format that the originating physical storage device may not be able to read. These issues encourage vendor lock-in and can make it difficult for an IT organization to decide to try a different virtualization solution later.

How Hitachi Data Systems compares: Data migrated and then stored on Hitachi virtual volumes is still stored in the native format of the originating external device, instead of a proprietary data format or one that uses intermediate mapping schemes. If the end user wants to discontinue use of Hitachi virtualization technology, they can switch back to managing the data from within the external device’s interface.\[12\]

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The Hitachi Data Systems Approach to Virtualization

Introduced in September 2004, Hitachi Universal Storage Platform, the controller-based virtualization approach offered by Hitachi Data Systems, has since been heralded as the 1st of its kind to pair both enterprise-class storage system functionality with robust virtualization functionality. With the introduction of Hitachi Universal Storage Platform V in May 2007, followed by the midrange Hitachi Universal Storage Platform VM, Hitachi went on to announce another market 1st: an enterprise-class implementation of virtualization with Hitachi Dynamic Provisioning software, which extends the capacity savings of thin provisioning to both internal and externally attached heterogeneous storage.13 With the introduction of Hitachi Virtual Storage Platform (see Figure 1), in 2010, Hitachi added dynamic tiering for the automation of data placement in storage pools.

Fulfilling a Promise of Simplicity

With the latest introduction of Hitachi Unified Storage VM, Hitachi Data Systems continues a course in virtualization. That approach is based on its fundamental belief that virtualization functionality should be simple and easy to implement into existing enterprise environments.

Figure 1. Hitachi Virtual Storage Platform

This simplified approach differs significantly from competing virtualization solutions. Competing solutions tend to come with many new layers of either software or hardware that can increase an organization’s cost and complexity of managing storage. Whether they come billed as “host-based virtualization,” “network-based virtualization” or “switch-based virtualization,” Hitachi Data Systems avoids adding to these solutions. It avoids complex new hardware components and intermediate mapping schemes that would be otherwise required to move physical resources into a logical or virtual world.

13 For more reference materials surrounding the Hitachi Data Systems virtualization approach, go to: http://www.hds.com/solutions/resource-centers/virtualization-resource-center/?WT.ac=us_ft_storage
Implementing Hitachi virtualization technology also fulfills the promise of simplification. Hitachi built a powerful, yet straightforward, virtualization layer it now calls Hitachi Universal Volume Manager software on top of its already mature storage system controller functionality. To take advantage of this virtualization layer, organizations need a Hitachi virtualization-enabled storage solution. When they are ready to "turn on" virtualization functionality, for use with either a smaller pilot or test application or even a large-scale implementation, they need a Universal Volume Manager license key. Then, they can externally attach storage systems from EMC, IBM, Hewlett Packard or Sun, among other vendors. They are ready to start managing these resources from the virtual pool of storage within the Virtual Storage Platform. It’s that simple.

Benefits of This Approach

Now, with over 25,000 virtual storage controllers shipped, the Hitachi approach to virtualization lives up to its promise to reduce costs and simplify storage infrastructures. Hitachi provides 1 platform for all data and eliminates the barriers to sharing storage capacity among different vendors’ hardware and various storage tiers. The Hitachi approach to storage virtualization helps organizations achieve sustainable, long-term savings on the cost of storage management, while being able to defer the purchase of new storage assets.

Hitachi is the only storage vendor that provides true heterogeneous data migration, replication and management services through a storage controller-based virtualization approach, regardless of the manufacturer of the underlying storage system. That means organizations can now attach, combine, migrate, replicate and universally manage external, heterogeneous storage from vendors such as Hitachi, EMC, IBM and NetApp, among others.

Organizations use a single logical pool and a single set of management interface tools to simplify their storage operations. They have been able to implement intelligent tiered storage and perform nondisruptive data migrations as well as data replication from any system to any other storage system. Many are also benefiting from their ability to reuse legacy assets.

No vendor lock-in. The virtualization technology does not use intricate mapping schemes. Instead, it communicates with each external system in the system’s own native SCSI command format. This format allows Hitachi Data Systems customers to have extra peace of mind that they are not being "locked in" to the Hitachi Data Systems vendor path to virtualization once they make the move. Since volume data is always stored in its native system format, storage systems can be just as easily "unplugged" from the Hitachi storage platform at any point in the future. They can be returned to operation in native format, without incurring new migration penalties.

A strong foundation for tiered storage and data lifecycle management. True progress in areas like data lifecycle management and tiered storage means that data or volumes can be easily assigned to the needs of specific applications or classes of data. It also means data can be easily migrated between different price and performance tiers of storage as its usefulness and frequency of access changes over time. With Hitachi virtualization, organizations can:

- Assign pooled resources in the SAN to the needs of specific applications, or to key storage tiers.
- Assign legacy storage systems for use as lower-level tiers, which now become part of the virtual pool of storage.
- Perform transparent data migration from any to any heterogeneous storage system, including to pools of virtual storage assigned to a specific tiers.
- Develop and automate policies to effectively handle data movement at preset intervals, or in accordance with specific events.

Integration with a rich storage management suite. A virtualization solution’s ability to present a unified, virtual pool of storage capacity is only as good as the accompanying tools used to manipulate and manage the now unified storage assets. Here, the Hitachi virtualization solution benefits from deep integration with the best-in-class Hitachi
Command Suite software products. Available for all Hitachi storage platforms (and also able to be utilized in conjunction with any externally attached storage system with a single Universal Volume Manager license) are key Hitachi storage services, as shown in Table 2.

**TABLE 2. SAMPLE OF STORAGE SERVICES AVAILABLE TO ANY ATTACHED, HETEROGENEOUS STORAGE SYSTEMS**

<table>
<thead>
<tr>
<th>Storage Management Services</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td><strong>Hitachi ShadowImage Replication software</strong></td>
<td>Offers local, nondisruptive point-in-time (PiT) replication for any pool of storage virtualized by any model of Hitachi Virtual Storage Platform (VSP) or Hitachi Unified Storage VM (HUS VM). A mature technology, ShadowImage software allows rapid, high-speed copies to be made of a consistency group of related data, including copies of an entire system, database or any related volume sets. ShadowImage copies are also used as the basis for more remote replication processes, such as those handled by Hitachi TrueCopy synchronous and TrueCopy Extended Distance software.</td>
</tr>
<tr>
<td><strong>Hitachi Tiered Storage Manager software</strong></td>
<td>The foundation of Hitachi intelligent tiered storage functionality, Hitachi Tiered Storage Manager software allows granular data sets (or whole volumes) to be dynamically and nondisruptively migrated from one tier of storage to another without impacting production applications. Tiered Storage Manager allows true, any-to-any heterogeneous data migration.</td>
</tr>
<tr>
<td><strong>Hitachi TrueCopy synchronous software</strong></td>
<td>Having already solved the problem of “any-to-any” remote replication within its own product lines with Hitachi TrueCopy software, Hitachi was able to easily extend this mature cross-copy functionality to other external storage systems attached. Cross-system copying occurs without adding a new replication appliance or creating new intermediate software for the process. TrueCopy software’s remote replication functionality allows for ShadowImage copies of data to be replicated, either synchronously or asynchronously, up to 50 kilometers away (or more). Hitachi TrueCopy software also enables data copies to be replicated between 2 disparate storage systems attached.</td>
</tr>
<tr>
<td><strong>Hitachi TrueCopy Extended Distance software</strong></td>
<td>Hitachi Universal Replicator software extends the concept of remote replication to allow any-to-any replication, up to any distance, using a unique “pull” (not “push”) architecture that minimizes bandwidth, cache usage and latency at the primary site. When combined with the Hitachi virtualization solution, Universal Replicator software now makes it possible to select any storage system target and any storage initiator at multiple data centers spread around the world. In this way, it can retain replicated versions of volumes, data sets or entire systems.</td>
</tr>
<tr>
<td><strong>Hitachi Universal Volume Manager software</strong></td>
<td>This software provides the fundamental virtualization functionality that allows all other storage services in this table to be used with externally attached storage. This virtualization function can be simply “turned on” within an existing Hitachi storage platform using the software.</td>
</tr>
<tr>
<td><strong>Hitachi Virtual Partition Manager software</strong></td>
<td>Hitachi Virtual Partition Manager software is an interface that allows administrators to set up as many as 32 partitions with virtual serial numbers that allow partitioning of certain amounts of pooled capacity, ports and cache. This functionality supports the secure, multitenancy requirements and service levels of specific applications.</td>
</tr>
</tbody>
</table>
Conclusion

Hitachi Data Systems believes that an inevitable shift in storage infrastructure is underway. This shift depends on virtualization as the interlocking layer to smooth out the rough edges between disparate, underlying systems. In that supposition, Hitachi Data Systems is joined not only by analyst opinion but, more importantly, by a growing, 25,000 strong customer base that has already acquired Hitachi virtualization technology. Storage virtualization is a critical next step in storage that Hitachi Data Systems believes will be needed in order for enterprise organizations to achieve many of the expanding goals now before them: optimized operations; faster, more agile data movement; tiered storage; and more advanced-stage storage consolidation.

If your organization consistently struggles with maintaining storage costs, managing capacity growth, ensuring effective service levels and an overly taxed IT staff, why not explore what Hitachi storage virtualization solutions could do for you?

Hitachi virtualization solutions avoid complexity while offering a varied path to implementation. Hitachi Data Systems CTO Hu Yoshida identified the key difference between Hitachi and other virtualization solutions as follows:

"Some virtualization solutions require a whole new layer of management complexity, defining disk extents and mapping them to virtual volumes through a mapping table, and requiring additional SAN zones to be established. The Hitachi Data Systems solution has none of this complexity since we do virtualization and tiering through our controller for external storage just as we do for internal storage."14

Hu Yoshida
CTO
Hitachi Data Systems

In terms of its breadth of virtualization capabilities, product innovation and overall maturity, one customer shares exactly how far ahead the Hitachi Virtual Storage Platform is from the competition:

"Hitachi Virtual Storage Platform is a single solution that is able to work with all other vendors, including legacy systems. Money is tight and no one can afford to replace everything so a system that seamlessly fits into our needs as we grow into the new world is the solution for us."15

IT Director
Large Enterprise Insurance Company

To explore how virtualization can work for your organization, including its potential cost savings or the different paths available for implementation, please contact your local Hitachi Data Systems representative. For more information, go to http://www.hds.com/solutions/resource-centers/virtualization-resource-center/.

15 TechValidate. TVID: BB4-2D3-673