

Tiered Storage Solutions Brief

*Lowering the Capital and Operational Cost
of Enterprise Storage*

Executive Summary

Corporate storage environments are experiencing unprecedented growth in capacity, technical complexity, and cost. Driven by new application demands, regulatory requirements for long-term data archival, and greater corporate awareness of business continuity needs, the rapid rate of change is stretching already strained IT budgets and exposing inefficiencies in conventional storage architectures.

Today, although corporate data centers invariably host a range of multivendor storage solutions, each with different dollar-per-gigabyte and application-capability characteristics, most capacity is allocated in a one-size-fits-all approach. Single-vendor management tools and isolated pools of storage fragment the infrastructure, making it difficult to share resources, improve operational efficiency, and lower costs.

Tiered storage offers a way to optimize the storage infrastructure to dramatically lower capital and operational expenses. A tiered storage architecture ranks storage systems by cost, quality of service, and functionality and then places data on the most cost-effective platform based on the service-level needs of the business application. This approach ensures that high-end storage capacity is used only by high-value application data, maximizing the efficient use of these costly resources.

To effectively implement a tiered architecture, heterogeneous storage resources must be virtualized to provide a single, consistent interface for business and storage management applications. In addition, a comprehensive range of tiered storage management tools must provide seamless and dynamic movement of data between tiers as the value of the data changes.

Application Optimized Storage™ solutions from Hitachi Data Systems provide an integrated hardware, software, and services platform, allowing the storage infrastructure to be optimized based on the price, performance, availability, and functionality requirements of business applications. At the heart of Application Optimized Storage is a virtualized, multitier storage infrastructure, hosted by the Hitachi TagmaStore™ Universal Storage Platform or Network Storage Controller and managed by a comprehensive suite of tiered storage management tools. These solutions enable an organization to more closely align business and IT objectives to reduce costs, boost performance, improve availability, and enhance functionality.

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The Cost and Complexity of Storage

Storage environments large and small face increasingly sophisticated demands from business applications and requests to maintain data online for longer periods of time. As a result, total capacity being managed by IT storage administrators has exploded, and the complexity of the storage infrastructure has grown enormously. These factors are raising the total cost of the storage ownership and significantly affecting the IT budget.

Take business resilience as a case in point. As organizations become increasingly dependant on IT for routine business processes, the risk that a disruption to online applications will result in a quantifiable loss has grown. This has driven demand for more sophisticated storage-based data protection applications, like snapshots and disk-based backups—minimizing downtime by speeding recovery, and remote data replication—eliminating data loss during a total site outage.

Regulatory compliance efforts offer another example. The Health Insurance Portability and Accountability Act (HIPAA), SEC rule 17a-4, Sarbanes-Oxley, and New Basel Capital Accord (Basel II), along with other legislation, are setting mandatory guidelines for data protection and data retention, with financial and legal penalties for noncompliance. Like business resilience measures, ensuring your organization is in compliance with government regulations implies increased capacity and complexity in the storage environment.

Meeting the need for enhanced data protection, greater regulatory compliance, and escalating demand for application storage capacity inevitably drives up the cost of storage.

Hardware Costs

Hardware costs are the most obvious expense in the storage environment and include storage systems and the switches, directors, and gateways of the storage networking infrastructure. Fragmentation of the storage environment, caused by disconnected islands of storage and interoperability problems, creates stranded capacity and duplicates storage networking equipment. Both factors contribute to escalating hardware costs.

Improving the efficient use of available resources can substantially lower the cost of storage and storage networking hardware. Eliminating barriers to sharing and improving capacity utilization rates can deliver sustainable long-term savings by allowing future purchase of storage assets to be deferred.

Software Costs

Software costs are another highly visible expense in the storage infrastructure. Not so obvious is the impact multiple software tools have on IT administrator productivity. With heterogeneous configurations the norm in enterprise data centers, managing storage requires the use of many software tools from different vendors. These tools frequently do not communicate well with each other, complicating the process of

provisioning, optimizing, moving, and protecting data and increasing training costs.

Maintenance Costs

Hardware and software maintenance costs correlate directly with the amount of capacity deployed in the environment and the number of tools in use by storage administrators. Improvements that reduce hardware and software costs will also benefit maintenance costs.

Labor Costs

Labor expenses represent as much as 40 percent of the total cost of storage ownership. The only meaningful way to lower storage labor costs is to improve productivity. This is achieved by lowering the complexity of the storage environment, allowing administrators to manage more capacity.

Soft Costs

Soft costs cover a wide range of less tangible but no less valid expenses in the storage environment. They include storage system performance, scalability, downtime, and regulatory compliance. If a business application demands more of any of these factors than can be delivered by the storage environment, the result is a net loss for the business. For example, if inadequate data protection raises the risk of revenue and productivity losses from an outage, actual losses experienced during downtime are attributable to the storage infrastructure, even if the failure occurred elsewhere.

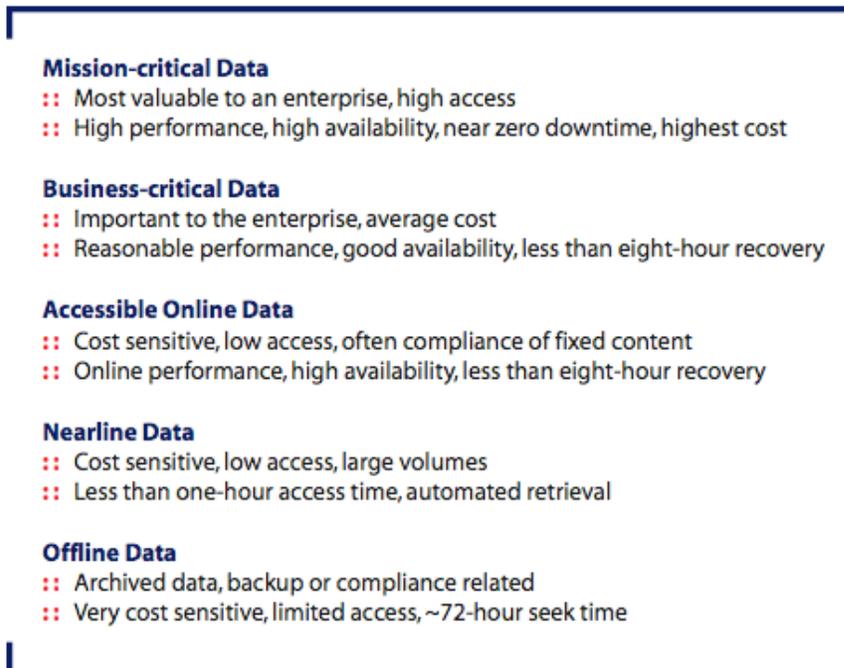
Driving Out Storage Inefficiencies

The solution to continually escalating storage costs is to focus attention on the needs of the business. By aligning business application requirements with the capabilities of the storage environment, IT managers can lower costs, improve performance and availability, and increase access to advanced functionality.

The path to greater alignment between applications and storage is a tiered storage infrastructure.

Tiered Storage

Tiered storage provides an architecture that allows storage administrators to provision capacity based on a business application's sensitivity to price, demand for quality of service, and requirements for advanced storage functionality. By matching the service level needs of the application to the characteristics of the storage infrastructure, administrators can make the most effective use of available resources, ensuring all allocations are optimally placed.



Source: IDC Classifications 2004

Figure 1. IDC tiered storage data classifications

E-mail offers an excellent example of how a tiered storage architecture lowers costs. With many revenue-generating business processes reliant on e-mail, messaging applications are now frequently considered mission critical, with performance, data protection, availability, and uptime requirements that match more traditional online transaction processing (OLTP) systems.

Not all e-mail data has the same value, however. For example, typically only relatively recent messages have the high-end requirements associated with top-of-the-line storage systems. As messages age and are archived, access frequency declines and performance and availability needs change. Storing all e-mail data on high-performance, highly available storage is wasteful. In a tiered storage environment, the IT administrator can establish policies where only new e-mail messages are stored on tier one, high-end, enterprise-class storage. Older e-mail messages can be hosted on tier two storage, offering performance and availability slightly below tier one at a much lower cost. And archival messages, the bulk of all e-mail storage, can be stored on cost-efficient SATA disk, offering online access but with lesser performance. This tiered configuration frees large amounts of high-end storage capacity for use by other applications and lowers the cost of providing storage for the e-mail application.

Tier Name	Mission Critical	Business Critical	Accessible Online	Nearline	Offline
Availability	99.999%	99.999%	99.99%	99.90%	Offline
Performance	5	4	3	2	1
Maximum Backup Time (hours)	0.02	0.02	3	0.02	N/A
Maximum Local Recovery Time (hours)	1	4	6	4	1
Local Recovery Point (hours)	24	24	24	24	N/A
Remote Recovery Time (hours)	1	72	72	72	72
Remote Recover Point (days)	1	7	7	30	N/A
Offering Cost/GB (relative)	100%	80%	60%	40%	10%
Point-in-time Snapshots	Yes	Yes	No	No	No

Figure 2. Metrics of a tiered storage implementation

Classifying business applications according to their service level demands gives administrators the basic information needed for a tiered storage architecture. Storage systems can then be ranked according to cost, service level, and functionality provided. Correlating this information with application service level data allows IT administrators to effectively align the storage infrastructure with the needs of the business.

The Technology of Tiered Storage

A tiered storage architecture depends on the ability of administrators to seamlessly move storage allocations between tiers as the business value of data changes. In a heterogeneous storage environment, this requires data movement technology capable of nondisruptive cross-vendor provisioning and copying. Managing tiered storage also demands new, high productivity approaches to storage administration. The key to satisfying both of these requirements is storage virtualization technology.

Storage Virtualization

Today's enterprise data centers feature storage systems and storage network infrastructures from many vendors. A tiered storage architecture consolidates multivendor storage solutions in a single pool using virtualization technology. Virtualization masks the individual differences between vendor storage implementations, allowing a consistent interface to be presented to business and storage management applications. This dramatically simplifies storage provisioning and management.

Virtualization enables a single set of storage management tools and advanced storage software to operate across all resources. For example, in a virtualized environment, a single data replication tool can perform all remote copy functionality, regardless of the vendor of source and target storage systems.

Seamless data movement between heterogeneous storage resources is critical to a tiered storage infrastructure. As the value of application data changes, storage administrators must be able to move volumes between storage tiers without affecting access to data by business applications.

Lowering the Cost of Storage Ownership

Tiered storage offers a path to substantial infrastructure efficiencies and promises to sharply reduce a wide range of storage environment costs, including:

- :: Hosting application data on the most cost-effective storage platform
- :: Leveraging lower-cost storage resources for lesser tiers
- :: Eliminating stranded capacity by consolidating storage in a single pool
- :: Boosting administrator productivity by simplifying the storage infrastructure
- :: Improving application access to advanced storage functionality
- :: Reducing hardware and software maintenance costs through consolidation, deferring future purchases, and deploying a single set of storage management tools for heterogeneous resources

Implementing a tiered storage architecture significantly reduces the capital and operational costs of a storage environment and allows greater alignment of business and IT goals.

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A Common Pool of Storage

Although heterogeneous storage is a fact of life for most data centers, storage resources are rarely hosted in a common pool, due to infrastructure interoperability issues and proprietary vendor tools. These factors can make implementing tiered storage a challenge.

Ideally, the heterogeneous layers of a tiered storage infrastructure will be masked by a common interface, allowing applications and administrators consistent access to all resources. A common interface allows administrators to easily manage the storage tiers and eliminates the need to change application platforms when data is moved between tiers.

The mechanism for achieving a common interface to a heterogeneous pool of storage is virtualization. Virtualization technology masks the differences between the underlying layers of storage in a tiered configuration and supports significant productivity enhancements. For example, allowing administrators to use a single set of storage management tools to maintain all heterogeneous resources in the environment.

The Hitachi TagmaStore™ Universal Storage Platform and Network Storage Controller employ breakthrough controller-based virtualization technology to allow internal and external storage resources to appear as a single consolidated pool of storage. This technology allows storage systems from Hitachi Data Systems, EMC, IBM, and Sun to be aggregated and attached to the Universal Storage Platform or Network Storage

Controller, providing a complete tiered storage configuration. For example, a three-tier configuration might reflect internal Universal Storage Platform volumes defined as tier one, an EMC Symmetrix system defined as tier two, and a Hitachi TagmaStore™ Adaptable Modular Storage system with SATA disks defined as tier three. Support for multitenancy and virtual private machines, in addition to massive connectivity, allow secure sharing of all tiered resources.

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Data Migration

According to the Enterprise Strategy Group, data migration is a frequent task performed by data center storage administrators. Whether managing the replacement, relocation, consolidation, or lease renewal of servers and storage or balancing workloads for performance, data migration is a fact of life for the storage administrator. It is also a task that is prone to error. And when problems occur, they can frequently affect application availability and performance.

Data migration is also a fundamental component of a tiered storage strategy. As the cost, quality of service, and functionality demands of application data change over time, data must be migrated between tiers. This is how a tiered storage architecture maintains an optimal match of storage system characteristics and data requirements. For many administrators, however, the prospect of even more data migrations may be unwelcome: These relatively risky projects almost always take place on the weekend, when application downtime is more palatable to business users.

Hitachi HiCommand® Tiered Storage Manager software is designed specifically to help storage administrators manage the constant data migrations necessary to ensure a successful tiered storage implementation. The software dramatically simplifies the task of moving data between heterogeneous tiers of storage. And, most important, it is able to perform migrations without affecting application access to data, allowing administrators to move data between tiers nondisruptively during normal business hours.

Tiered Storage Manager software provides a single tool for migrating data between the multivendor storage systems attached to the Universal Storage Platform and Network Storage Controller. Masking the complexity of analyzing and provisioning storage during a data movement task, Tiered Storage Manager software simplifies the process of data movement and eliminates the need to pause or quiesce applications during a migration, significantly boosting productivity and eliminating the downtime associated with data migration.

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University of Utah Success and a Positive ROI

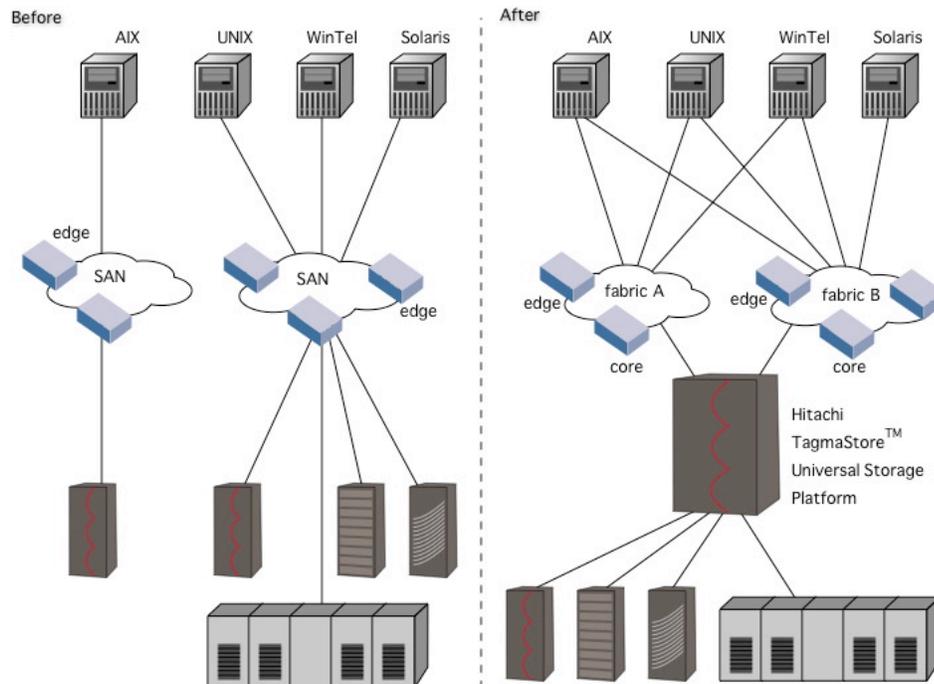
The University of Utah Health Sciences Center (UUHSC) Information Technology Services (ITS) group provides technical resources and support for a wide range of departmental, hospital, research group, and clinic-based facilities in Salt Lake City, Utah. With demand for storage capacity growing at around 200 percent per year, and more UUHSC departments signing up to share resources managed by the ITS group, the existing storage infrastructure was beginning to show signs of stress.

ITS supports several SANs from a number of different vendors. But, as deployed capacity has increased, storage administrators noted several problems. Each vendor's SAN requires its own set of tools and storage management procedures. This has frustrated attempts by administrators to cross-train on the different tools. The fragmented management tools have also resulted in siloed management practices and in administrators themselves becoming a single point of failure for the environment. In addition to storage management concerns, backup windows started to intrude on production work hours, and the amount of storage capacity wasted by stranded space on SANs was growing.

Storage virtualization was identified as a technology that could address many UUHSC growth and management issues. However, after ITS evaluated several appliance- and fabric-based storage virtualization products, it determined that the risk of managing another fabric element, the necessary increase in head count and training, and the single point of failure that would be introduced into the system did not warrant further investigation. The ITS group then decided to evaluate the Hitachi TagmaStore™ Universal Storage Platform.

Figure 3. The University of Utah Health Sciences Center site before and after deploying Universal Storage Platform

UUHSC Site Before and After Deploying the Universal Storage Platform



The storage controller-based virtualization of the Universal Storage Platform allowed UUHSC to implement a new tiered storage architecture. All fabric elements were kept the same, older storage systems were virtualized behind the Universal Storage Platform, SAN management was collapsed into a single point of control, and a multitiered storage strategy was implemented.

Economic Impact of the Universal Storage Platform

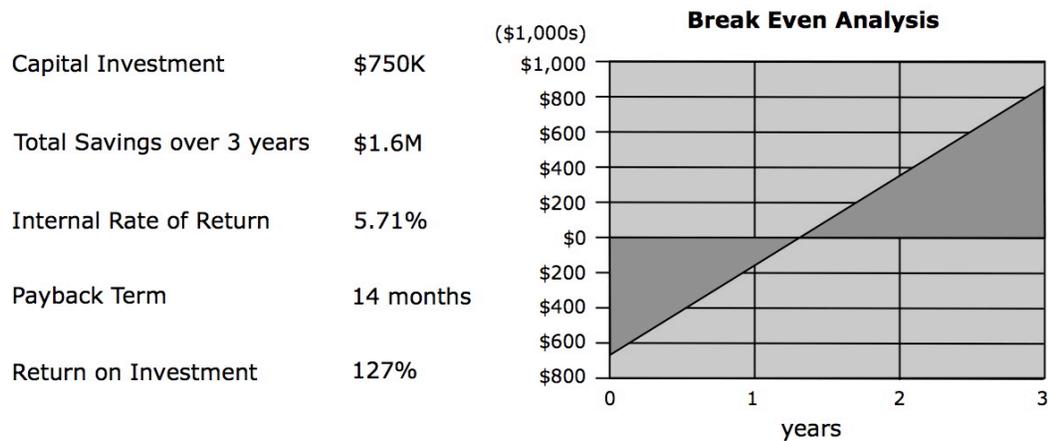
The implementation of the Universal Storage Platform and a tiered storage infrastructure resulted in a dramatic range of financial savings for the UUHSC:

- :: Reduced the number of people needed to manage the storage infrastructure by two people (saving US\$320K)
- :: Improved capacity use, deferring planned purchase of 18TB of new capacity for 3 years
- :: Removed three storage frames, with associated reduction in hardware, software, maintenance costs (US\$200K) floor space, electricity, and air-conditioning expenses (US\$28K)
- :: Extended the life of older storage assets, reducing future capital procurement expenses
- :: Removed older Fibre Channel switches from the SAN, further reducing hardware and maintenance costs

- :: Improved availability, with estimated risk cost avoidance for patient and billing systems conservatively put at US\$118K, and for other systems at US\$138K
- :: Improved performance, an estimated US\$340K savings in faster access to data
- :: Improved access to tiered storage for all ITS customers

Figure 4. Payback chart for Universal Storage Platform initiative

**University of Utah Health Sciences Center
Universal Storage Platform Financial Investment Results**



Deploying Tiered Storage in Your Infrastructure

This Hitachi Data Systems Tiered Storage Solutions Brief outlines a strategy that will substantially reduce the cost and complexity of a storage environment. You now have a basic understanding of what is involved in implementing a tiered storage solution, and what kind of engagement will equip you to choose from among the available hardware, software, and services to achieve a closer match between business and IT goals.

Although reading is a good first step, Hitachi Data Systems strongly recommends that customers engage our Global Solution Services group before they seriously undertake a tiered storage strategy. Global Solution Services can help customers:

- Provide a framework for data lifecycle management
- Quickly assess organizational needs for access, retention, and protection of data
- Evaluate patterns of access across the data's lifecycle

- Define common storage and applications management environment services
- Establish an optimized, cost-effective, and long-term reference architecture to meet the needs of your business

Pertinent offerings from Global Solution Services include:

- Application Optimized Storage™ Assessment and Planning
- Application Optimized Storage™ Tiered Storage Design
- Data Classification Service
- Risk Analysis Workshop
- Storage Economics Strategy Service
- Implementation Service for Hitachi TagmaStore™ Universal Storage Platform
- Implementation Service for Hitachi HiCommand® Tiered Storage Manager
- External Storage Implementation for Hitachi TagmaStore™ Universal Storage Platform

To learn more about how Hitachi Data Systems can help with your tiered storage plans and to read more about tiered storage, please visit www.hds.com/solutions/tiered_storage or call Hitachi Data Systems at 888 234 5601, ext.950, to explore an engagement that will result in the optimal solution for your tiered storage needs. (Hitachi Data Systems Channel Partners should contact their Channel Managers for information.)