The Economic Effects of Virtualization, Tiered Storage and Hitachi Dynamic Provisioning Software

Application Brief

By David Merrill and Vijay Ramaswamy

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Executive Summary

In an era of explosive data growth and flat or diminishing budgets, organizations must evaluate potential technology purchases not only on their technical merits but on their economic merits as well. Virtualization, tiered storage and Hitachi Dynamic Provisioning software can all deliver significant economic benefits to the organization by helping to increase storage utilization and overall efficiency while reducing costs and complexity. By addressing capital expenses as well as operational expenses, these three elements together represent an economically superior solution — a comprehensive and sustainable approach to storage — both today and for the future.

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Introduction

Today’s CIOs face the same challenges they have faced for years: doing more with less. But in the current economic climate, with increased global competition, shrinking budgets and rising energy costs driving up virtually every aspect of doing business, the old cliché has taken on a fresh sense of urgency. And when it comes to data storage, a confluence of factors brings extra pressures to bear. Dramatically increasing amounts of data, the increased importance of data to business, the rising management costs of increasingly complex storage networks, and increasing pressure to hold or reduce IT costs leaves a CIO little room for waste or error.

And these are only the problems they confront today. Even if the current storage architecture works well, they will still have to cope in the future with the ever increasing pace of technological change and the requisite migrations or upgrades that accompany it. The universal commandment for the CIO, for today and the foreseeable future breaks into three very basic, very difficult challenges:

- Reduce costs
- Reduce complexity
- Improve QoS (quality of service)

*Figure 1. Challenges for today’s CIOs leave little room for waste or error.*
Because of the way storage is packaged, businesses must buy up to 75 percent more capacity than they actually need. (See Figure 1.) It's cheaper to simply buy more storage than to hire somebody to manage it, so an organization's first response to a storage crisis will be to throw more storage at the problem. Of course, the many different business units in a given organization may not want to share storage, so they each purchase it piecemeal through a variety of different vendors with an eye to the lowest cost option. The result is a confusing tangle of heterogeneous storage systems and management software, which requires more IT staff expertise, and massively underutilized storage assets and "stranded storage," which are a waste of already shrinking budgets. Ultimately, coping with exploding data requirements by simply purchasing more storage can lead to very costly consequences (see Figure 2).

Figure 2. Capacity far outstrips most organizational storage requirements, leading to widespread waste.

There is an alternative, however. By taking advantage of three basic innovations — virtualization, tiered storage architectures and Hitachi Dynamic Provisioning software — an organization can realize greater efficiencies in their current storage environment and pave the way for easier data migrations in the future. In other words, they can reduce cost and complexity while increasing quality of service. Beyond these organizational benefits, tiered storage, virtualization and Dynamic Provisioning are economically superior architectures that can reduce both the initial cost of acquisition as well as ongoing costs, leading to a lower total cost of ownership (TCO) and a better return on investment.

Assessing Economic Value

A number of metrics apply in assessing the economic impact of storage solutions, but three of them are more commonly used — CAPEX (capital expenditure), OPEX (operating expenditure) and TCO total cost of ownership.

First, CAPEX refers to, essentially, investments that add value to the business and normally come in the form of the purchase of assets or the extension of an asset’s useful life. Meanwhile, OPEX represents the costs associated with managing, supporting, maintaining and upgrading investments over their lifespans. Many people assume CAPEX cost is a one-time cost, and that the lowest purchase price will naturally lead to the lowest total cost of ownership. This is not the case in most storage and data center environments. Hitachi Data Systems has found that for every 12TB of installed and usable disk capacity within the storage infrastructure, on average there is a US$1 million net OPEX reduction potential over a period of four years. These savings come primarily through reductions in storage waste, outage time, management labor, maintenance fees and other outlays.
Figure 3. Potential reductions in OPEX costs are important to consider when evaluating TCO.

It is also important to make a distinction between TCO and total cost of purchase (TCP). TCO is a financial estimate designed to help assess the costs of deploying information technology during its whole lifecycle. TCP, on the other hand, is typically between 20 and 30 percent of TCO.

TCO analysis can also be used to compare two or more possible options. The analysis places the total lifetime operating and purchasing costs of the assets side by side for comparison. IT purchasing best practices, documented by independent analysts, frequently cites the importance of including a TCO analysis in any competitive bid situation.

Working with clients around the world, Hitachi has taken principles of storage economics to create strategies, roadmaps, architectures and solutions that reduce TCO. Virtualization, tiered storage and Hitachi Dynamic Provisioning software are key enablers of strategies and solutions that help IT simplify storage management and reclaim, utilize and optimize storage space.

This paper examines CAPEX and OPEX as they contribute to TCO in order to provide the most comprehensive analysis of the economic impact of tiered storage and virtualization strategies.

The Hitachi Data Systems Virtualization, Tiered Storage and Dynamic Provisioning Strategy

Hitachi Data Systems customers are using tiered storage and virtualization in a variety of ways and at a variety of stages of maturity, in order to simplify management, increase utilization, consolidate assets, reduce risk, lower operational costs and reduce complexity. The Hitachi Data Systems comprehensive maturity model shows how organizations can realize the vision of tiered storage through a well planned and phased approach (see Figure 4).
Level 0: Heterogeneous Storage Environment
Most organizations today have a heterogeneous storage environment, characterized by multiple storage systems from different vendors with multiple management interfaces. This disparate storage strategy results in underutilization of storage assets with very high storage management costs. Unfortunately, the final symptom of this level is that both CAPEX and OPEX are out of control.

Level 1: Virtualization
Virtualizing heterogeneous storage assets behind a Hitachi Universal Storage Platform™ simplifies the storage infrastructure, which increases storage utilization and enables organizations to maximize both existing and future IT investments. It minimizes complexity by providing a common platform for storage management, business continuity and other storage services like NAS, content management and virtual tape. Virtualization also enables organizations to align storage tiers with business needs, so that tiers have different provisioning and management processes according to their business value. This dramatically reduces CAPEX and OPEX.

Level 2: Data Mobility
Organizations that have realized the benefits of virtualization (Level 1) can further improve IT efficiencies by incorporating data mobility tools in their virtualized storage environment. Data mobility tools can make formerly onerous technology refreshes and data migrations become seamless. Easier, faster data migration reduces risk, reduces operational costs and increases application uptime.

Level 3: Policy-based Automation
The next level of the Tiered Storage Maturity Model automates the alignment of storage tiers to business needs. Policy-based automation dynamically moves data across storage tiers based upon preset policies. Organizations adopting this level of automation benefit from optimized performance, reduced infrastructure and management costs, and assured service level agreements (SLAs).
Level 4: Content-aware Automation

This is the highest level of automation where, based upon metadata, the application is automatically provisioned and tiered to meet SLAs. This is totally self-healing on an intelligent tiered storage platform.

At each of these levels, tiered storage and virtualization solutions from Hitachi Data Systems help organizations simplify infrastructure, maximize IT investments, ensure QoS, reduce risk and align the right storage tier to the right application, thereby reducing CAPEX and OPEX.

Virtualization Benefits

Virtualization helps organizations do three important things that help create an economically and ecologically superior data center — reclaim, utilize and optimize. Hitachi Data Systems sees a path that starts with reclamation and progresses through utilization to optimization. This maturity model lets IT pool all its storage, apply it as needed to meet application requirements, and manage it using one common set of software and processes. As the environment matures, IT moves from simple consolidation and migration of data, to right-sized tiers and data mobility, to implementing automated, policy-based (or even content-based) assignment of data to its optimal tier.

Hitachi Data Systems approaches storage virtualization by enabling it in the storage controller. This approach offers the simplest yet most robust way to implement virtualization for today’s heterogeneous storage environment. Controller-based virtualization gives organizations ability to manage their existing heterogeneous, multivendor storage assets as a single pool of storage and through a single pane of glass. Virtualization enables cost lowering functions — reducing hardware costs, SAN infrastructure costs and environmental costs — by providing a single management interface for all virtualized storage hardware and extending the useful life of all assets.

Storage utilization is an important metric and a major component of storage related CAPEX. With virtualization, the average storage utilization increases substantially as storage is not purchased, managed and provisioned in a fragmented manner and for peak capacity. Organizations can reduce wasted storage costs, as much of the storage in the IT environment is stranded capacity.

Through virtualization, older storage systems can be relegated to lower tiered storage pools in a multitiered architecture; these assets are often fully depreciated and may still have several years of useful life. Storage managers must carefully weigh the cost of maintenance versus the cost of replacement, but many older storage systems can still be used for non-critical data storage or data that will not be adversely affected by possible outages. By virtualizing, these older modular storage systems inherit many of the enterprise capabilities of the Universal Storage Platform. For example, if an application is provisioned on a modular storage system it inherits the availability characteristics of that system. However, through virtualization it can nondisruptively be moved to a different storage tier during maintenance, hence inheriting the capabilities of the enterprise storage system. On the same note, virtualized storage can leverage advanced capabilities, such as replication and data mobility, which are available on the Universal Storage Platform.

There are also economies of scale to be gained in terms of licensing in virtualized storage environments. For example, instead of using multiple replication software modules from different vendors, virtualized environments leverage one replication strategy, thereby saving both on licensing costs and learning curves associated with different software.
The Benefits of Multitiered Architectures

Organizations using a single tier storage architecture store all data in a single pool, purchased at a general rate, with an expected growth rate that applies uniformly to all applications and data in the pool — regardless of their individual resource requirements or business value. High value data thus tends to receive insufficient resources, while low value data and archive data enjoy resources far beyond what is required. As a result, storage is underprovisioned and poorly utilized, and it commands a relatively high CAPEX.

Tiered storage presents a superior alternative by assigning the right applications to the right storage tier for current and future access requirements. Since the tiers of storage represent various service levels and costs, stratifying storage across lower cost tiers (as opposed to a single, higher cost tier) will result in less CAPEX spending in upcoming years. As shown in Table 1, multitiered storage allows costs and price erosion factors to be leveraged or spread between multiple tiers, thus reducing CAPEX costs over the short term.

<table>
<thead>
<tr>
<th>Category</th>
<th>One Storage Pool</th>
<th>Multiple Tiers of Storage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pools or Tiers</td>
<td>One standard for all data storage</td>
<td>• Two to five tiers of storage, matched to the applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Highest tier for critical applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Middle tier for everyday applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lower tier for archive, tape replacement</td>
</tr>
<tr>
<td>Cost</td>
<td>One base rate for all storage</td>
<td>• Higher cost disk for limited number of applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Moderate cost disk for majority of applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Low cost disk for archive, backups, etc.</td>
</tr>
<tr>
<td>Price Erosion</td>
<td>One base rate for all storage</td>
<td>• Moderate erosion for higher tier</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• High erosion rate for middle tiers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Very high erosion rate for lowest tiers</td>
</tr>
<tr>
<td>Growth Rate</td>
<td>A blended growth plan, usually for the worst-case projects</td>
<td>• Rates of growth and capacity — planned by tier or category of applications</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Higher tiers tending to be more stable, and therefore slower growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Middle tiers tending to have higher growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Lower tiers can have often erratic growth</td>
</tr>
</tbody>
</table>

With different tiers of storage, the level of management effort applied can be commensurate with the value and use of the data on each tier. This may have relatively little impact on the labor costs in small-to-medium-sized environments. However, in larger environments, the stratification of management effort in proportion to tier has been observed to result in seven percent to ten percent labor impact and effectiveness.

In a single pooled environment, all data receives a relatively uniform amount of labor regardless of its value. Provisioning is about the same, and problem resolution and event handling are also uniform since an error may impact critical and non-critical applications alike.

In contrast, a multitiered architecture allows administrators to allocate levels of support and proactive management time according to the business value of each tier. Applications and data can be split between multiple pools, with administration efforts applied at different rates to each pool. Upper tier resources are managed more closely, with more labor effort for optimization, protection, performance, etc. Response time,
service level and problem responses vary for each tier. Provisioning time is different as well, so that higher tier storage purchases are done in bulk, and less frequently (and according to capacity plan). Lower tier storage capacity can be provisioned faster, since there may be more headroom capacity already in the storage systems, waiting to be allocated. Remember that the lower tiers tend to have low average utilization, so there is space available for rapid provisioning.

**Hitachi Dynamic Provisioning Software Benefits**

Hitachi Dynamic Provisioning software reduces CAPEX by increasing the relative efficiency of each block of storage so that organizations no longer need to devote physical space to storage that is allocated but never used (see Figure 5). This results in a smaller physical footprint for the storage that remains. The improved performance that derives from dynamic provisioning also creates indirect CAPEX savings by reducing the amount of infrastructure necessary to obtain a certain level of performance.

Dynamic Provisioning can also dramatically reduce the operational expenses associated with the coordination and human labor involved in provisioning. Provisioning storage from a virtual pool reduces administration costs by cutting the time needed to provision new storage. It greatly simplifies the storage provisioning process, reducing manpower expense by increasing the number of terabytes one administrator can manage.

Complexity is reduced because administrators no longer need to add physical storage to provision new application volumes. With Dynamic Provisioning software, the administrator simply draws from the Dynamic Provisioning pool without needing to add physical disks.

*Figure 5. Hitachi Dynamic Provisioning software increases storage utilization by allowing storage to be allocated to an application without actually being physically mapped until it is used.*
Planned outages are further reduced because administrators don’t need to change application server and storage system configurations as often thanks to Dynamic Provisioning software’s ability to provision large virtual volumes without incurring the full expense, coupled with the ability to painlessly add physical storage on a more frequent planned basis.

Dynamic Provisioning increases storage utilization by allowing storage to be allocated to an application without actually being physically mapped until it is used. This “just in time” provisioning allows an application to utilize more storage capacity without physically adding more storage. As a result of increased rates of utilization, organizations can postpone the need to purchase new storage. This in turn means that organizations have fewer occasions to take systems down while they increase physical disk capacity.

**Migration: An Increasing Challenge**

It is simply a fact that data will not stay forever on its current storage medium. The value of data may decline or increase as it ages, necessitating a migration to a different storage tier. In addition, disk capacity changes every year to 18 months. Most organizations can expect to undergo a significant technology refresh every three to five years, at which point they will have to migrate their data from its existing disk (possibly five or more years out of date at that point) to a new one.

When an organization purchases new storage, they have to move, migrate or re-master the data onto the new frame. Re-mastering can add even more time to a migration, in effect diminishing the useful life of an asset while generating greater costs. Also, consider the cost of labor, the cost of tools and the cost of loss or corruption every time data is moved or re-mastered. New laws and regulations requiring data to be around for 5, 10, 50 or 100 years means that during the lifetime of the data, re-mastering events may need to happen 3 to 20 times.

The cost of migration is further affected by the amount of data that has to move — an amount that only increases over time. Every day more data is replicated and kept longer, while an increasing number of transactions require more servers that need more connectivity and bandwidth from their storage. Storage growth is poised to explode over the next several years: a compounding growth rate of 50 percent means that 100TB will be 506TB in four years.
In summary, migration and re-mastering can be disruptive, prone to human error and time consuming, carrying with them significant risk of scheduling overruns and disruptions to business.

Virtualization is a key enabler in technology refresh processes. By virtualizing existing assets, migration to the new storage platform is seamless — without any application downtime.

Hitachi Data Systems provides high-performance data migration technology, combining best-in-class storage systems such as the Hitachi Universal Storage Platform with Hitachi Tiered Storage Manager software. Combined, these Hitachi products provide a comprehensive solution that solves the major challenges of data migrations.

When virtualization is used to perform data migrations, the process is fast and completely transparent, even in heterogeneous storage system environments. The data migrations can happen online while users and applications are accessing data on the platforms, which makes scheduling easier and leads to overall faster data migrations.

Benefits of virtualization for migration include:

- Seamless, scalable architecture for cross-platform migration
- Significantly less application downtime than alternatives
- Scalable process for simultaneous multiserver migration
- Reduced demands on system administrator time
“Based on previous approaches, the bank’s IT department expected to spend 33 days to migrate the volumes on the storage systems. With Hitachi technology, the application was brought down for less than an hour.”

Anand Sankararaman
Vice President, IT Infrastructure
HDFC Bank

Also, virtualization increases the useful life of existing assets (see Figure 7). For example, in many firms storage assets have a useful life of three years. Many organizations spend up to three months putting the asset into production. On the tail end they start preparing for migration three months prior to end of lease or depreciation cycle. Virtualization technologies substantially reduce the time and effort for deployment, thereby increasing the useful life of the asset.

*Figure 7. Virtualization increases the useful life of existing assets.*
Conclusion: A Compounding Effect

Tiered storage architectures leveraging virtualization and Hitachi Dynamic Provisioning software are key building blocks of an economically and ecologically superior, sustainable storage architecture — an architecture that breaks down silos of existing storage and masks the complexity of a multivendor storage environment by transforming multivendor storage assets into a common pool of shared resources. The result is a more flexible, scalable and cost efficient infrastructure that helps IT lower operational and capital expenses (see Figure 8).

Storage virtualization solutions from Hitachi Data Systems don’t simply let you consolidate storage — they give new life to your legacy storage assets. Benefits include a smaller storage footprint, reduced number of storage systems and better aggregate utilization. Fewer systems and a better alignment of data to tiers provide an overall reduction in hardware and software maintenance costs. A single management framework is less complex and highly scalable, allowing fewer people to manage storage even if it comes from a variety of vendors. Finally, organizations don’t have to be locked into a single high cost vendor for all their storage. Disk drives are becoming increasingly commoditized and vendors face increasing pressure because any storage system can work in the virtual pool. With tiered storage, virtualization and Hitachi Dynamic Provisioning software, enterprises can actually improve their purchasing power and leverage with vendors.

Figure 8. With Hitachi Data Systems tiered storage solutions, the result is a more flexible, scalable and cost efficient infrastructure that helps IT lower operational and capital expenses.
“The improvements in operational efficiencies have been significant. We have realized an operating cost reduction of over 2,100 man hours per year and an increase of application uptime of 372 hours just from a change management perspective.”

C. N. Ram
Head of IT
HDFC Bank, Mumbai, India

Organizations must assess potential storage tools and assets outside their pure technological merits. Economics are a necessity. Many CIOs are happy to spend money in the short term if it helps them reduce costs in the long term and thus reduce total cost of ownership. Virtualization, tiered storage and Dynamic Provisioning can lessen both the cost of acquisition and the cost of regular upkeep — delivering lasting savings that over time can constitute a real business and competitive advantage.

For more information visit: www.hds.com/virtualization.