# Lab Validation Report

## IBM SVC with Real-time Compression

Efficient , Reliable, and Easy-to-use Storage Virtualization

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# Contents



## ESG Lab Reports

The goal of ESG Lab reports is to educate IT professionals about data center technology products for companies of all types and sizes. ESG Lab reports are not meant to replace the evaluation process that should be conducted before making purchasing decisions, but rather to provide insight into these emerging technologies. Our objective is to go over some of the more valuable feature/functions of products, show how they can be used to solve real customer problems and identify any areas needing improvement. ESG Lab's expert third-party perspective is based on our own hands-on testing as well as on interviews with customers who use these products in production environments. This ESG Lab report was sponsored by IBM.

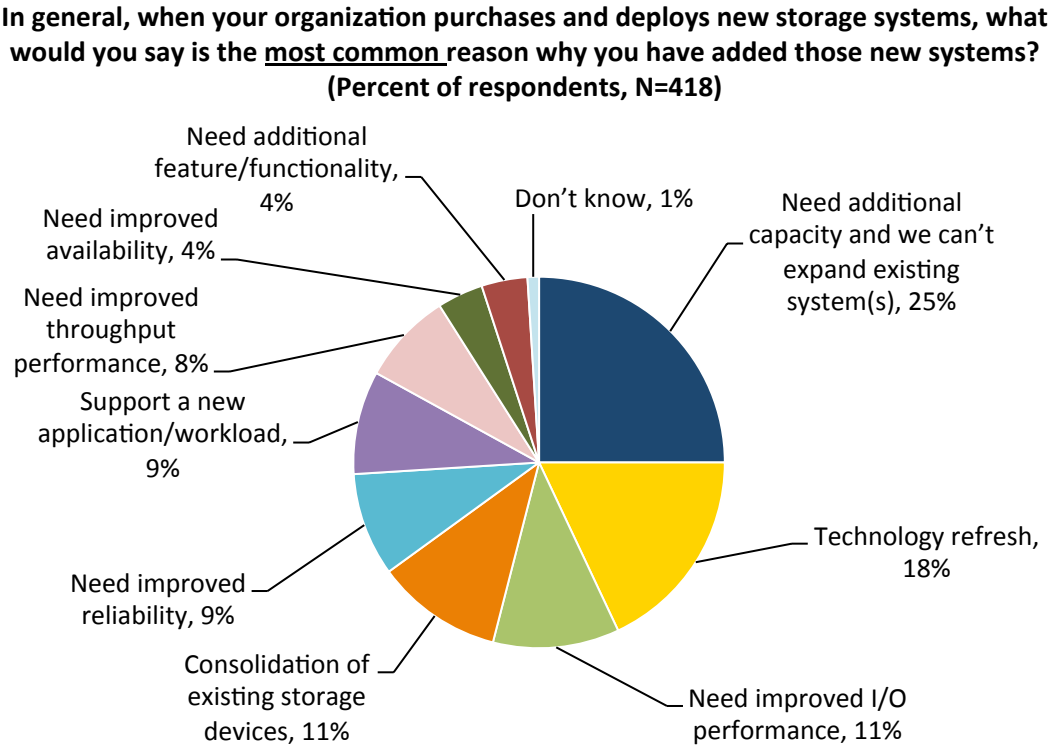
# Introduction

This ESG Lab Validation is an update to a 2008 report on IBM SAN Volume Controller (SVC), and includes new testing to highlight the efficiency of IBM Real-time Compression (RTC) and ease of management with the new graphical user interface (GUI). Additional topics include performance, agility, and high availability.

## Background

ESG asked respondents to a recent research survey what their most common reasons for adding new storage systems were. The reason most often cited (by 25% of respondents) was the need for additional capacity with an inability to expand existing systems. Other top reasons included a desire to refresh technology (18%), the need for improved I/O performance (11%), and consolidation of existing storage devices (11%).[1]

*Figure 1. Most Common Reasons for Purchasing and Deploying New Storage Systems*




*Source: Enterprise Strategy Group, 2013.*

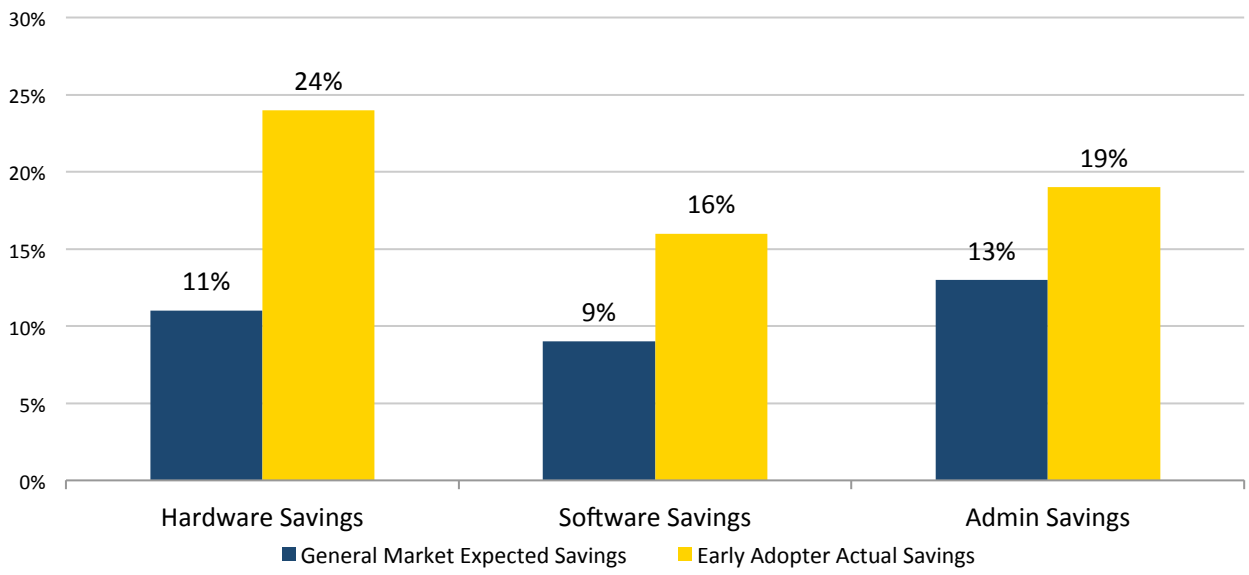
What lies behind these motivations? The ongoing growth of data storage is a key factor. The ability to quickly launch new virtual servers is one cause of data growth, along with business-driving applications that generate mountains of data. At the same time, mobile devices are used to both create and consume data continuously and every web activity or transaction generates data that will likely be copied multiple times for analysis. Additional pressure comes from ongoing escalation of end-user performance demands, as the ease and speed of spinning up VMs makes it seem like IT can deliver any service instantly. Finally, IT organizations are faced with delivering services quickly but also efficiently, as budgets remain constrained.

Storage virtualization can solve many of these challenges while keeping costs to a minimum. Deploying virtualized pools of consolidated storage capacity can enable simpler management, better storage utilization, and reduced equipment and operational costs. Heterogeneous storage devices from multiple vendors can be managed and provisioned together, and automated tiering can move data between storage tiers to optimize fast disk such as

[1] Source: ESG Research Report, *2012 Storage Market Survey*, November 2012.

solid-state disk (SSD) while streamlining costs. Storage virtualization can improve efficiency, ensure agility, and still deliver high performance along with a full range of data services like instant copies, easy migration, and replication. It is notable that early adopters of intelligent storage network solutions such as storage virtualization reported *achieving savings above and beyond what was expected*. As Figure 2 shows, reclaiming and reusing existing storage generated the most significant savings (after all, the storage you already own is surely the least expensive), but software and administrative savings also exceeded expectations.[2]

*Figure 2. Storage Virtualization Early Adopter Savings*




## IBM System Storage SAN Volume Controller

IBM's SAN Volume Controller is an integrated hardware and software solution that provides a single point of management for heterogeneous storage resources from IBM and other vendors. By virtualizing storage behind SVC controllers, IT can make optimal use of storage resources for efficiency and flexibility, while insulating hosts and applications from disruption during storage tasks.

Redundant pairs of SVC controllers form an I/O group and are deployed for high availability. Based on the IBM System x server technology, SVC controllers include six-core Xeon processors, 24GB of cache, ports for 8Gbps Fibre Channel, 1 and 10 Gbps iSCSI, and (optionally) 10Gbps iSCSI/FCoE. Performance and bandwidth can be increased by adding I/O groups to the cluster. Clusters can scale to support four I/O groups and up to 4,096 host servers, 8,192 volumes, and 32PB of virtualized storage capacity.

SVC includes numerous advanced features that deliver efficient, flexible data services. These include:

- *Real-time Compression*. IBM Real-time Compression enables more effective storage capacity of up to 5X by compressing active, primary data; saving on floor space, power, and cooling; and minimizing hardware costs.
- *Next-generation GUI*. IBM's new and well-received storage GUI now covers XIV, Storwize V7000, Storwize V7000 Unified, and SVC implementations, providing a consistent interface for configuration and management, even for virtualized storage. Plug-ins to MS System Center Operations Manager and VMware vCenter ensure efficient management in these environments.

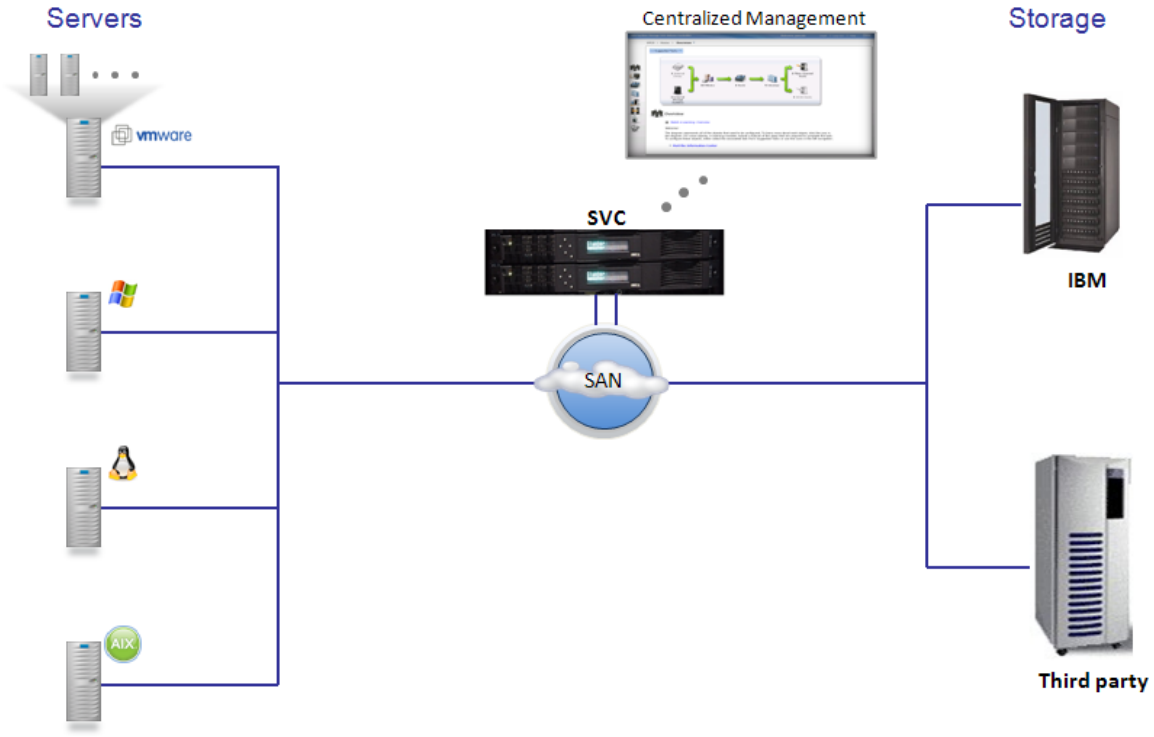
[2] Source: ESG Research Report, *The Future of Network-based Storage Intelligence*, September 2004.

- *Flash solid-state disk support.* SVC supports up to 12.8TB of Flash per controller system, and Flash in virtualized disk systems. The tight integration enables non-disruptive data movement, replication, and consolidated management of Flash capacity.
- *Automated tiering.* IBM System Storage Easy Tier automatically identifies highly active data and moves it to Flash (or other disk) to maximize performance.
- *Thin provisioning.* This feature enables automated provisioning for greater productivity and minimal disruption.
- *Dynamic data migration*. SVC enables non-disruptive data movement between storage systems while maintaining data access.
- *Replication*. SVC's advanced replication services operate consistently regardless of storage type, eliminating the like-to-like box limitation of traditional arrays. SVC also supports IBM FlashCopy operations, enabling almost instant copies of active data for backup, test and dev, and parallel processing.
- *Mirroring*. Synchronous metro mirroring and asynchronous global mirroring ensure application availability in case of a failure or disruption; SVC automatically uses the available copy for production operations. These functions speed DR with VMware vCenter Site Recovery Manager.

SVC storage virtualization complements server virtualization, ensuring that storage services keep up with the advanced functionality of server VMs. SVC support for automated provisioning, vMotion, VMware vStorage APIs, and replication to dissimilar remote infrastructures ensure that the flexibility, mobility, and cost saving benefits of server virtualization are duplicated on the storage side. These features also provide the highly available infrastructures required for cloud deployments.

Figure 3 provides an overview of SVC functionality. The left side shows SVC's wide range of supported virtual and physical hosts, including Windows, Linux, AIX, and virtual servers. In the middle is a pair of SVC engines, providing redundancy for high availability, which is centrally managed using the IBM storage GUI. Using the SAN, these SVC engines connect hosts to virtualized pools of storage from IBM, other high-end storage vendors, and commodity storage. SVC enables even commodity storage to inherit advanced functionality for high-end data services.

*Figure 3. IBM SAN Volume Controller*



# ESG Lab Validation

ESG Lab performed hands-on evaluation and testing of the IBM SAN Volume Controller with Real-time Compression solution at an IBM facility in Gaithersburg, Maryland, and conducted a remote testing session with the RTC development team based in Israel. Testing was designed to demonstrate how RTC improves SVC storage efficiency by using compression on a large range of active data sets, and the ease-of-use improvements brought to the solution by the new GUI modeled on IBM XIV storage system. Also of interest was a review of the strong virtualization and availability features inherent in the solution.

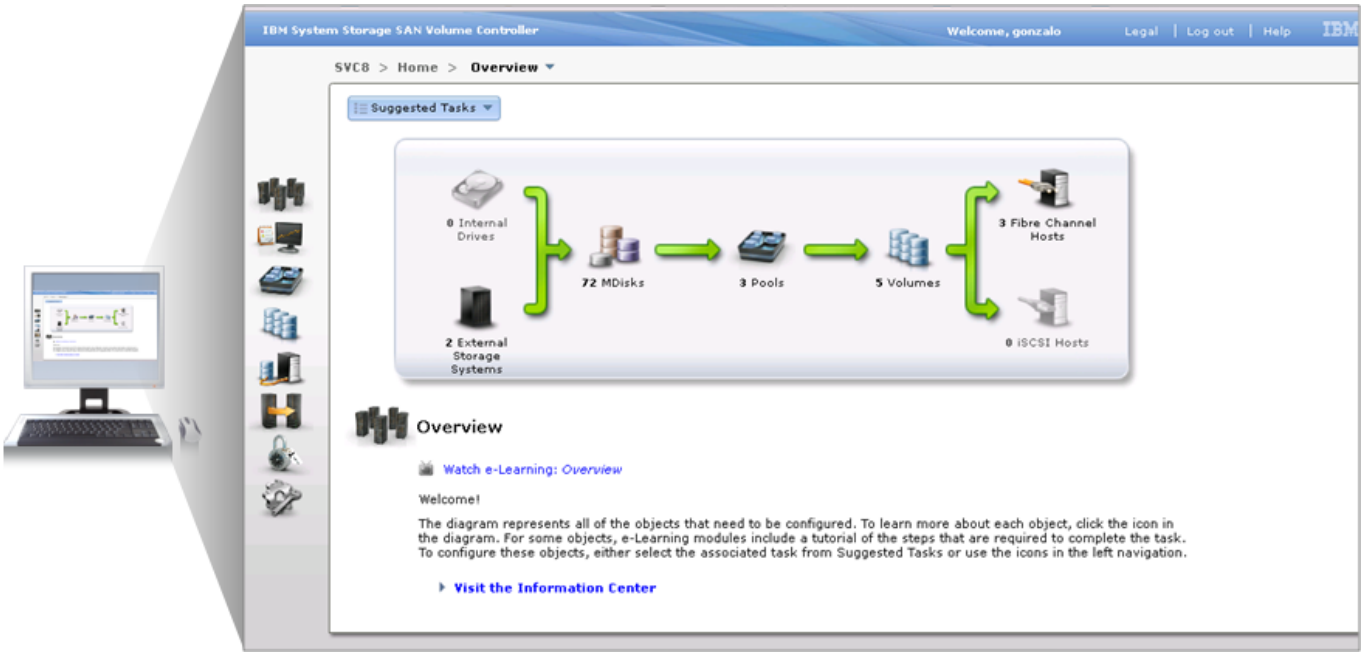
## Getting Started

This section explores how the new user interface improves ease of management and configuration of the SVC storage solution. It focuses on intuitive workflow visuals and easy-to-navigate wizards available in the interface that simplify storage virtualization administration.

### *ESG Lab Testing*

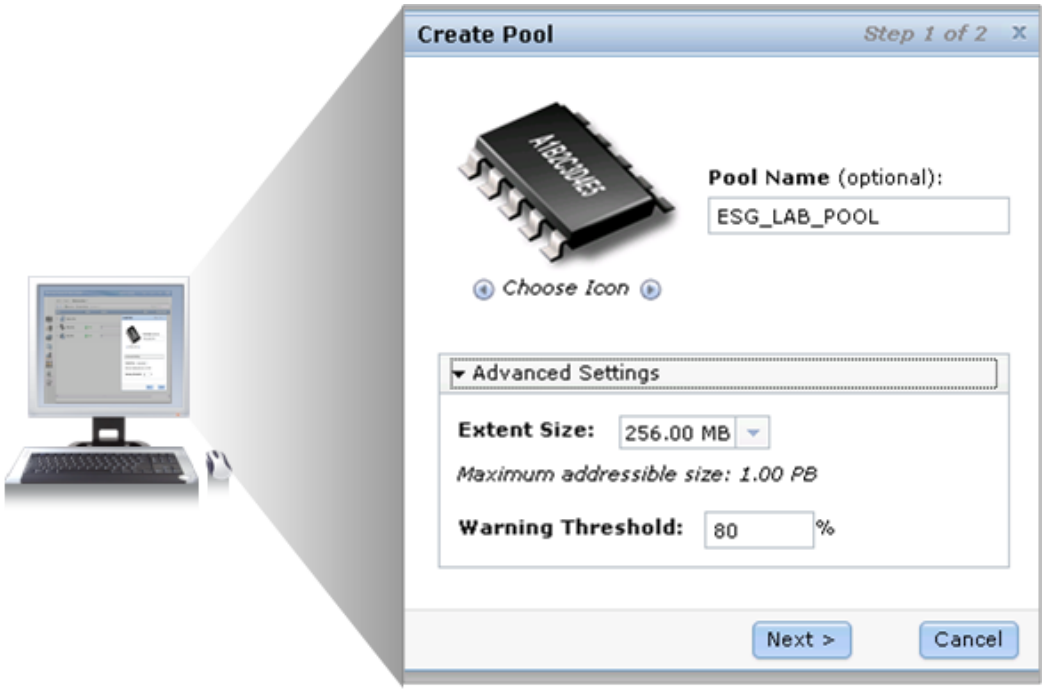
ESG Lab began its validation testing by launching and navigating the new SVC graphical user interface. As shown in Figure 4, the Lab selected the overview page from the interface to display an easy-to-follow view of the provisioning workflow from the array to the host. The overview page also provides an at-a-glance summary of the current configuration of the solution.

*Figure 4. New SVC Graphical User Interface*



Next, the Lab used the pool configuration wizard within the user interface to create a pool of disk on which volumes would subsequently be configured. As shown in Figure 5, the ***create pool*** wizard allows different built-in icons to be selected to visually represent the pool. Once a pool is created this way, the icon will be used to represent that pool in other views throughout the interface, making it easy to identify pools by storage attributes.

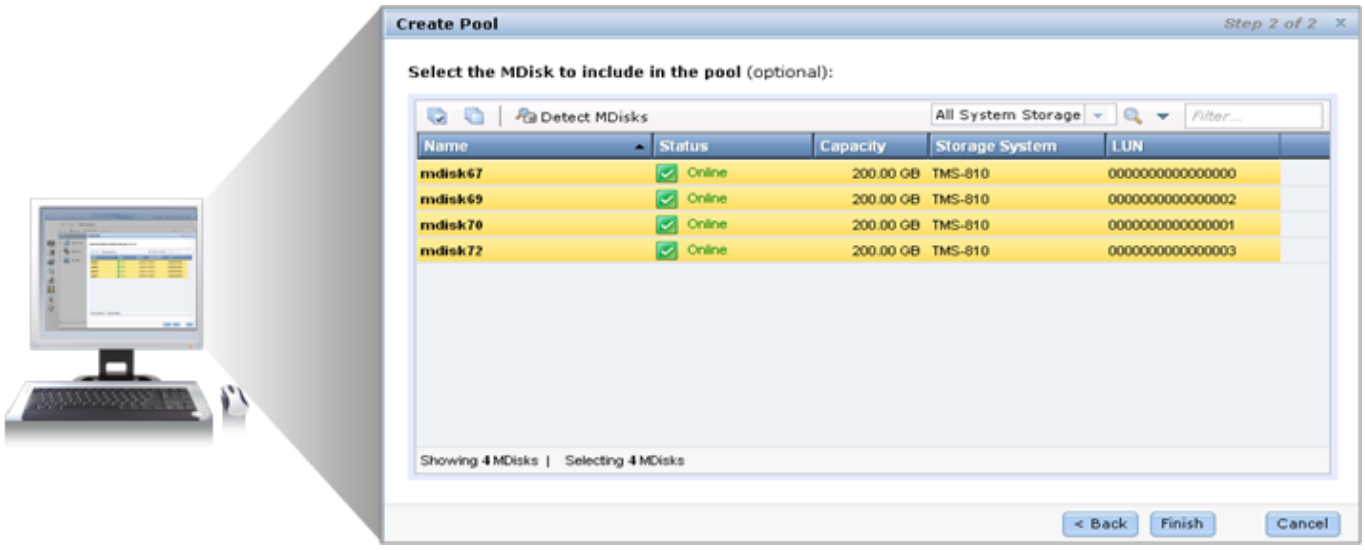
*Figure 5. Create SSD Pool Wizard*




In this case, the Lab chose to create a solid-state disk pool call *ESG_LAB_POOL* with the built-in icon that represents SSD devices. This icon selection allows the administrator to quickly understand the attributes (e.g., SSD vs. HDD) of the pool when selecting it as a target for creating a new volume.

Finally, ESG Lab selected the actual MDisk for the pool creation from a list of available devices. As shown in Figure 6, the Lab selected four 200GB devices from the IBM FlashSystem 810 storage devices. This step is optional, as selection can be done automatically by the configuration wizard. Providing this step gives the administrator the ability to more granularly define the size and attributes of a storage pool.

*Figure 6. MDisk Selection Option*




## Why This Matters

Server virtualization and continuously growing data volumes present numerous challenges, among them the difficulty in monitoring and management across a complex and heterogeneous infrastructure. Without an end-to-end view, it is difficult to properly manage and provision resources to ensure optimal data services while minimizing costs.

ESG Lab has evaluated the IBM storage GUI on several occasions, for the XIV, V7000, and now SVC platforms. The Lab continues to be impressed with its clarity and simplicity. The interface makes it easy to understand the topology and relationships and makes the management of advanced functions intuitive and fast. The workflow offers a clear view of components that can be configured and managed with just a mouse click, which ESG Lab discovered while creating pools and volumes of various components.

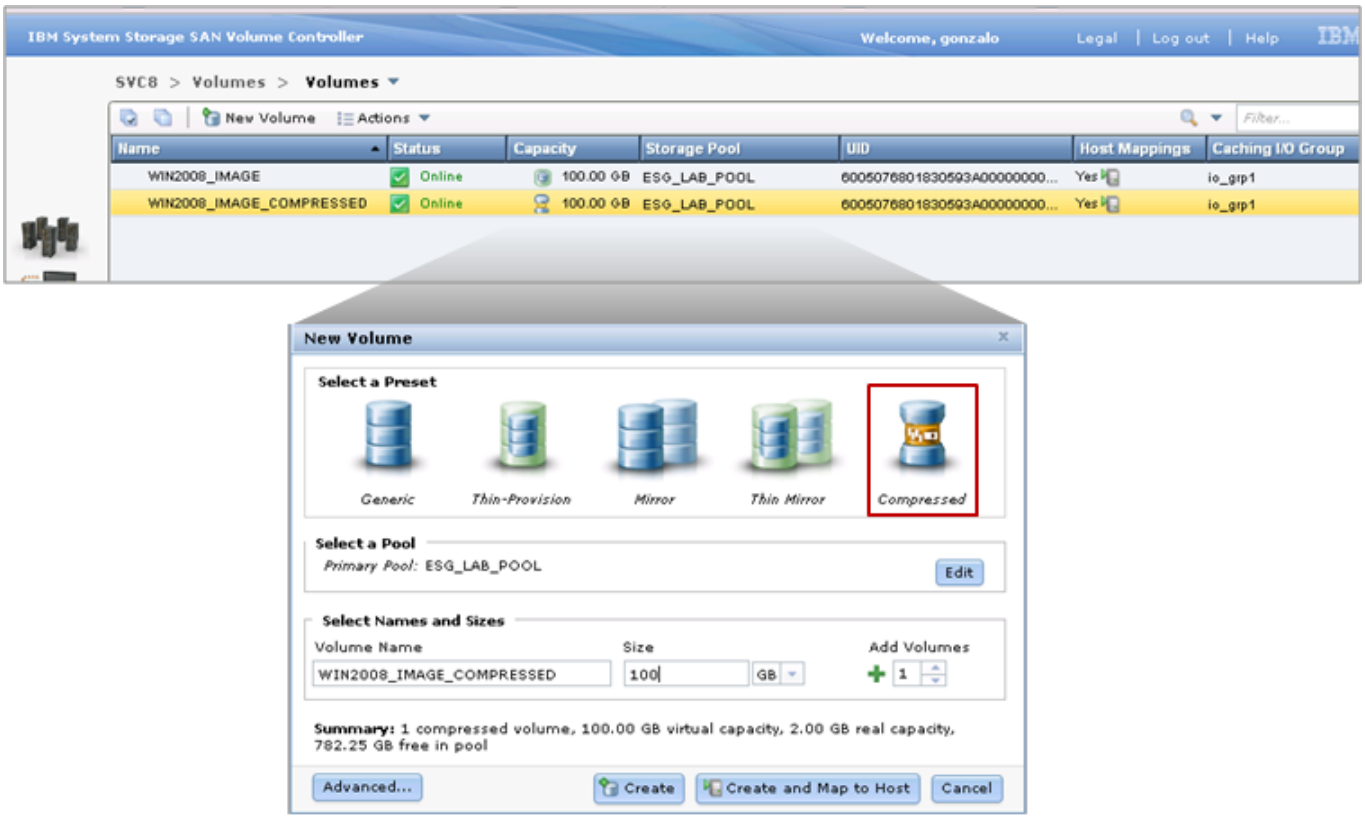
## Efficiency

This section reviews how Real-time Compression, newly introduced into the solution, enables better storage utilization through active data compression. ESG Lab compared the capacity savings before and after compression for three different operating systems common to most IT environments.

### *ESG Lab Testing*

ESG Lab started efficiency testing by creating non-compressed and compressed volumes on which hosts and file systems were deployed. As shown in Figure 7, the non-compressed volume *WIN2008_IMAGE* and the compressed volume *WIN2008_IMAGE_COMPRESSED* were created on the storage pool *ESG_LAB_POOL* using the new volume creation wizard and preset icons. The Lab then deployed identical Windows 2008 R2 servers on each of the volumes. The volume creation process (not shown in figure 7) was then repeated for database directories on a group of Linux servers. Identical Oracle databases were deployed to both the non-compressed and compressed Linux volumes for subsequent performance testing.

*Figure 7. New Volume Wizard Compression Option*




Next, as shown in Figure 8, the two Windows volumes were presented to a VMware vSphere server as datastores. Identical Windows 2008 R2 virtual machines were then deployed on the non-compressed and compressed datastores. The red box at the bottom of Figure 8 shows the compression savings observed for the Windows virtual machines when hosted on the compressed volume. It should be noted that the compression details and other important LUN information are available via the IBM storage tab through VMware API integration.

*Figure 8. VMware vSphere with IBM Storage Tab View*

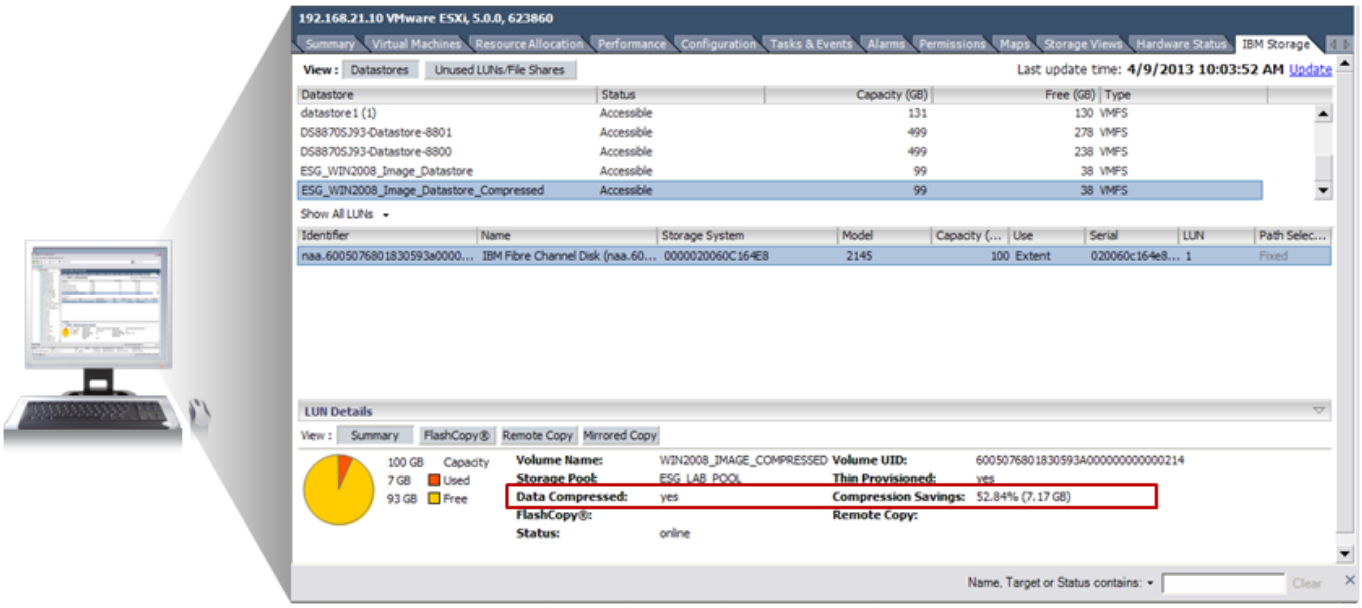



*Table 1. Compression Savings Details*

| Data Type | Volume Capacity | Used Space Non-Compressed | Used Space Compressed | Compression Savings |
|---|---|---|---|---|
| Linux Oracle | 1TB | 1TB | 173GB | 82% |
| VMware Windows VM | 100GB | 13.6GB | 6.4GB | 52.8% |
| Windows Physical | 100GB | 14GB | 7.2GB | 48.8% |

***What the Numbers Mean***

- Compression savings ranged from 48.8% to 82% depending on the data type.
- Oracle data on Linux achieved the greatest capacity savings at 82%.

## *Why This Matters*

Ever-expanding data volumes drive up the costs of storage, data management, backup, and archiving. These in turn drive up the costs of data center operations, floor space, power, and cooling. Any opportunity to reduce the amount of stored data is a chance to save money, streamline operations, and increase agility. There are numerous solutions designed to reduce data volumes during the backup process, but these offer no help to the challenges of growing production storage.

SVC comes equipped with IBM Real-time Compression, a data reduction technology designed for use with active primary data, such as e-mail and databases. Data is compressed during the write process, eliminating the extra storage needed by post-process data reduction solutions. ESG Lab validated the ease of creating a compressed volume by selecting a preset icon, which has been added as an option to other volume presets, and presented that volume to various hosts. ESG Lab validated Real-time Compression savings of 48.8% to 82% for Linux, Windows, and VMware volumes.

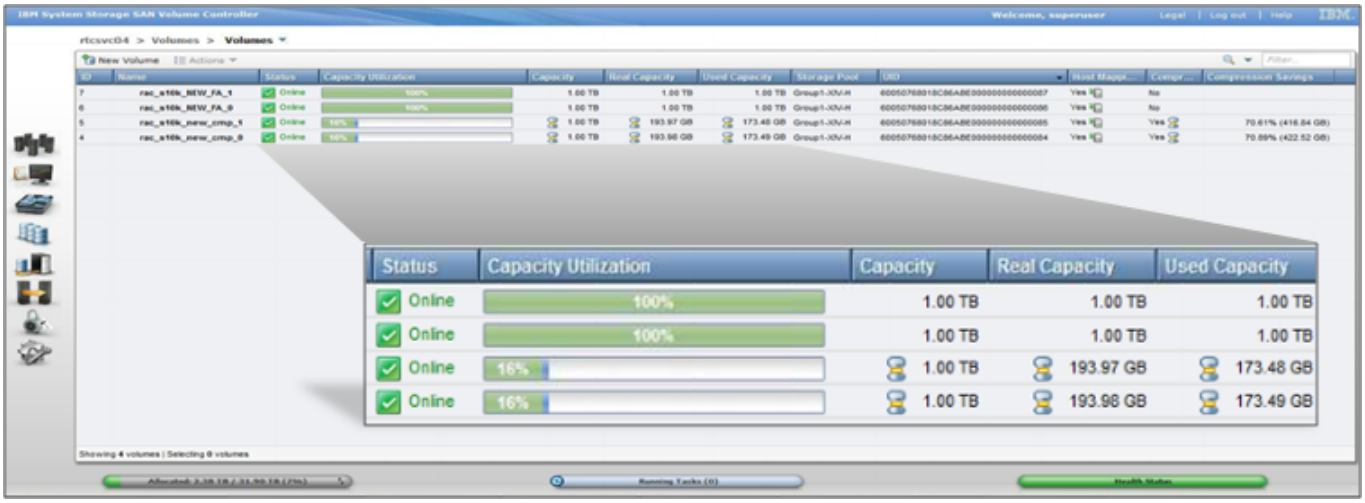
## Performance

The performance section of this report focuses on how using RTC with an active data set impacts overall application performance. Here, ESG Lab reviewed performance metrics of an OLTP workload running on an Oracle database with and without RTC enabled for the database volumes. The Lab also confirmed the capacity savings achieved by enabling RTC for the same Oracle database volumes.

### *ESG Lab Testing*

ESG Lab began performance testing by validating the storage configuration of the Oracle 11g database volumes. As shown in Figure 9, four 1TB volumes were created to support two similar database instances. Two of the volumes were compressed and two volumes were not. Figure 9 shows that the compressed volumes reduced the amount of used space consumed by the database from 1TB to approximately 173GB, or approximately 82%.

*Figure 9. Oracle OLTP Volume Detail*



Next, the Lab observed and compared the performance results of an OLTP workload running on the non-compressed volumes to that of the workload running on the compressed volumes. The OLTP workload simulated a group of users executing transactions against the test databases. The simulation consisted of a mix of concurrent transactions including: entering and delivering orders, checking order status, and monitoring inventory levels.

*Figure 10. Compressed and Non-Compressed Performance Metrics*


As shown in Figure 10, ESG Lab used the monitoring capabilities available in the SVC user interface to review system performance details as the simulated OLTP workload was run against the non-compressed and compressed volumes. The left side of the figure displays performance metrics for the non-compressed volume while the right side of the figure displays metrics for the compressed volume. The performance metrics include SVC controller CPU utilization, network utilization, Volume IOPS and response times, and MDisk IOPS and response times. A zoomed-in view of the MDisk IOPS and response time (bottom left and right) is shown for both the non-compressed and compressed volumes.

*Figure 11. Compressed and Non-Compressed OLTP Response Times*

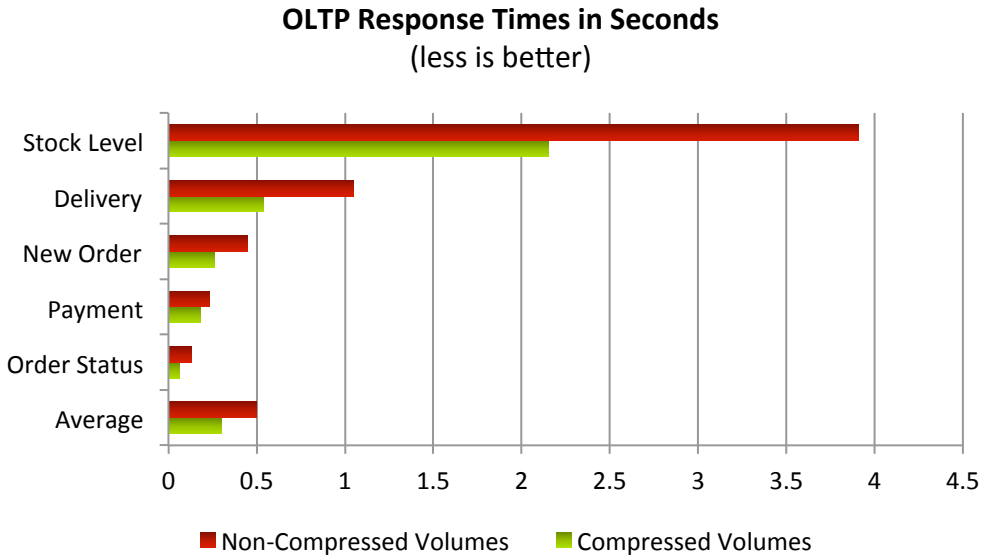



*Table 2. Performance Details*

| Configuration | Transactions per minute | Average Response Time (Seconds) | New Order Response Time (Sec) | Payment Response Time (Sec) | Order Status Response Time | Delivery Response Time | Stock Level Response Time |
|---|---|---|---|---|---|---|---|
| Non-Compressed | 11,335 | .50 | .45 | .23 | .13 | 1.05 | 3.91 |
| Compressed | 11,265 | .30 | .26 | .18 | .06 | .54 | 2.15 |

***What the Numbers Mean***

- Transactions per minute were almost equal between the non-compressed and compressed DB volumes.
- Average and individual transaction response times improved when using the compressed volumes.
- There was an 82% reduction in consumed storage capacity observed when using compressed volumes.
- SVC volume level IOPS were approximately the same for compressed and non-compressed volumes.
- Compression improved back-end storage efficiency by reducing MDisk I/O activity.

## *Why This Matters*

Delivering expected application performance is one of IT's primary goals and, as a result, administrators must use caution when implementing infrastructure changes. Historically, data compression algorithms caused too much performance degradation to be used with primary storage. IBM developed compression algorithms that could operate in real time, but these algorithms originally supported file-based data only. Bringing Real-time Compression to block workloads vastly expands the universe of applications that can reap its benefits.

ESG Lab compared the performance of compressed and non-compressed volumes using an OLTP test harness designed to simulate heavy transaction processing workloads. The Lab validated that once the volume was compressed, the number of OLTP transactions remained almost identical (a difference of <1%) while response times improved. In the final analysis, there was virtually no performance trade-off for compressing primary data volumes.

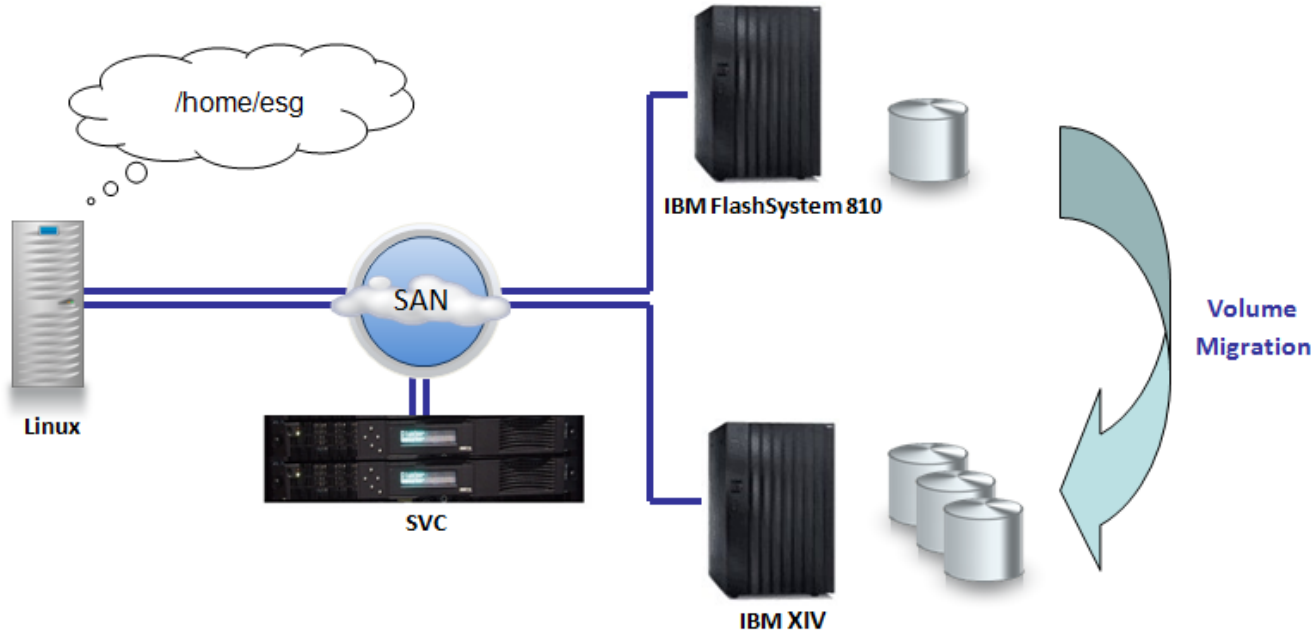
## Agility

Agility is central to storage virtualization. By abstracting the physical storage from the applications it supports, storage virtualization enables IT to manipulate physical resources in the background to optimize cost and capacity without disrupting production operations. To test agility, ESG Lab used SVC to non-disruptively migrate a volume between arrays.

### *ESG Lab Testing*

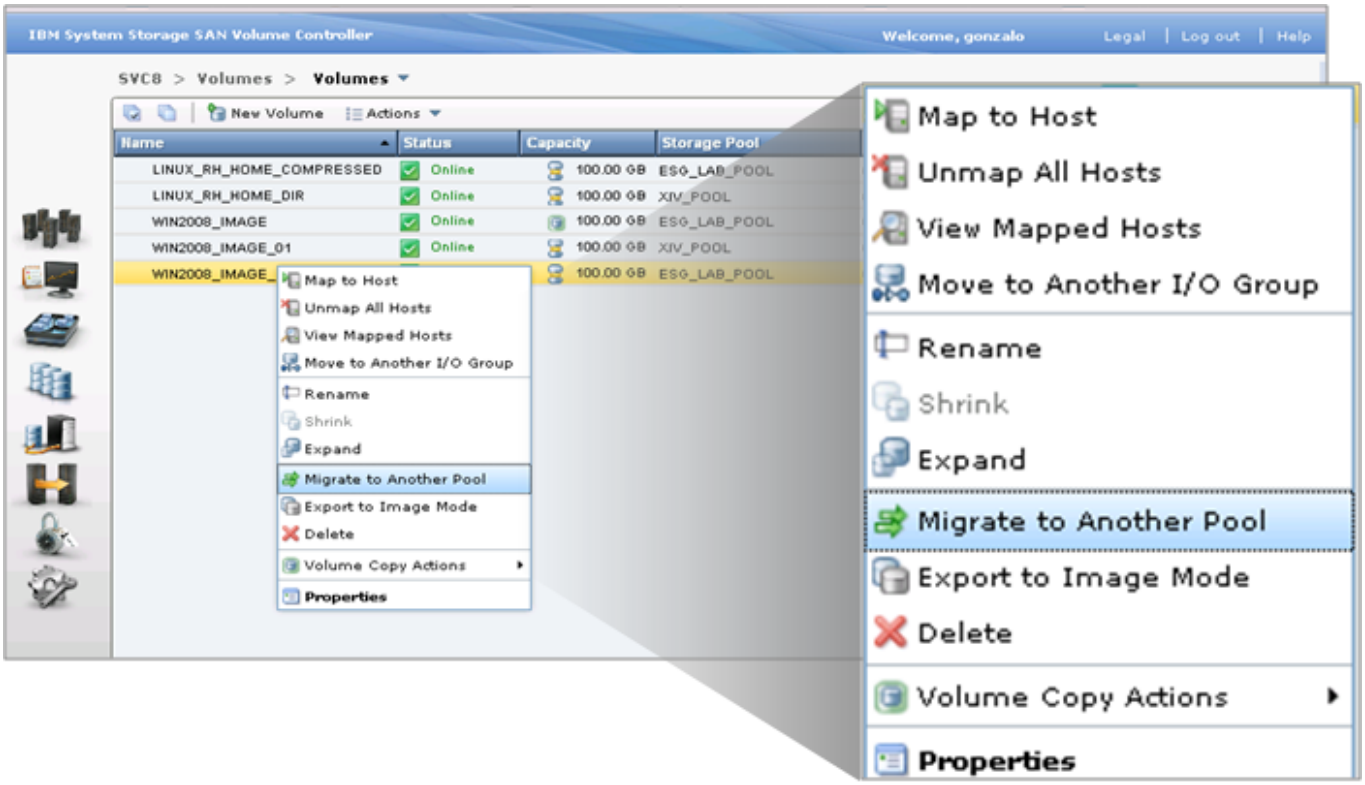
ESG Lab tested agility by selecting one of the volumes previously created on a FlashSystem 810 pool in the test environment. The Lab then chose a pool on a different storage array as the migration target. As shown in Figure 12, the target volume contained file system test data mounted as */home/esg* on the Linux test host. To confirm the ability to non-disruptively migrate data, ESG Lab ran a number of common user operations while the migration was in progress. These operations included creating a file, deleting a file, modifying a file, and copying files and directories.

*Figure 12. Volume Migration*



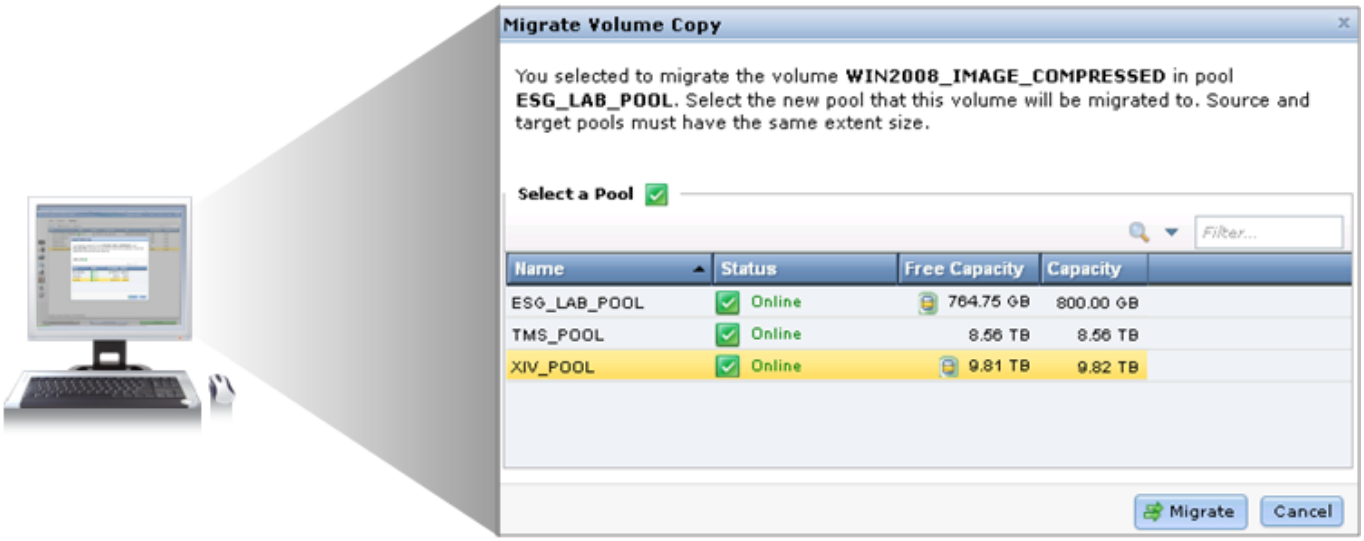
ESG Lab used the built-in GUI automation to configure and run the migrations. As shown in Figure 13, the Lab selected the *WIN2008_IMAGE_COMPRESSED* volume as the migration source. With the volume selected, the Lab was able to simply right-click in the interface to display the actions that could be performed on the volume. The right side of Figure 13 shows a zoomed-in view of the available actions, from mapping the volume to a host through simply displaying the volume properties. The blue highlighted area in the zoomed-in view shows that the Lab had selected the option to migrate the volume to another pool.

*Figure 13. Volume Mapping and Migration Options*



Finally, the Lab selected the target pool for the volume migration. As shown in Figure 14 and highlighted in yellow, the *XIV_POOL* was selected as the migration target. The migration was initiated and the volume was moved non-disruptively from a pool on the FlashSystem 810 to a pool on the XIV storage system. It should be noted that the migration process can be used to move data from non-compressed volumes to compressed volumes and vice versa.

*Figure 14. Migrating a Volume Copy*




## *Why This Matters*

Server virtualization separates application workloads from dedicated hardware, enabling organizations to be more flexible. Workloads can be moved as needed, for tasks such as capacity reclamation, load balancing, data migration, and hardware refresh, but also to maintain production operations in case of a failure or outage. But moving server VMs accomplishes little if the storage doesn't have the same capabilities. The new reality of the virtualized and cloud-focused IT landscape is that company and end-user expectations necessitate that kind of agility.

ESG Lab validated that the SVC storage virtualization engines facilitate the same type of agility as virtual servers. ESG Lab easily migrated volumes between IBM FlashSystem and XIV arrays and between non-compressed and compressed volumes without downtime or disruption. Using the GUI this process was simple, intuitive, and seamless. The Lab also confirmed that in an SVC with RTC solution the migration process is a powerful tool that can be leveraged to improve ROI by better aligning storage. Non-compressed data can be seamlessly moved to compressed volumes, freeing up existing storage resources for other applications.

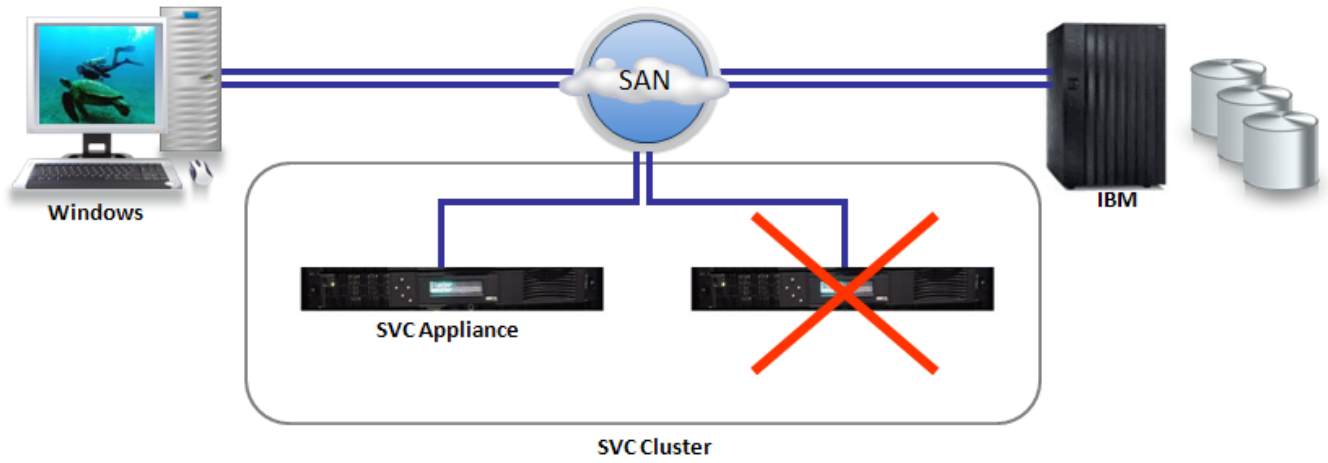
## Availability

Availability is always an important component of an enterprise storage solution. Here, ESG Lab confirmed the ability to configure SVC for different high-availability scenarios. The Lab used current validation testing results as well as results from our previous SVC validation to demonstrate these availability features.[3]

### *ESG Lab Testing*

SVC appliances, which are deployed in pairs for fault tolerance, provide bi-directional failover. ESG Lab tested this feature by having a Windows server play a video from a file residing on an SVC-managed volume. As shown in Figure 15, ESG Lab shut down power to one SVC engine in the cluster during video playback. The video continued to play without interruption and the SVC management console noted the failure.

*Figure 15. High-availability SVC Cluster*



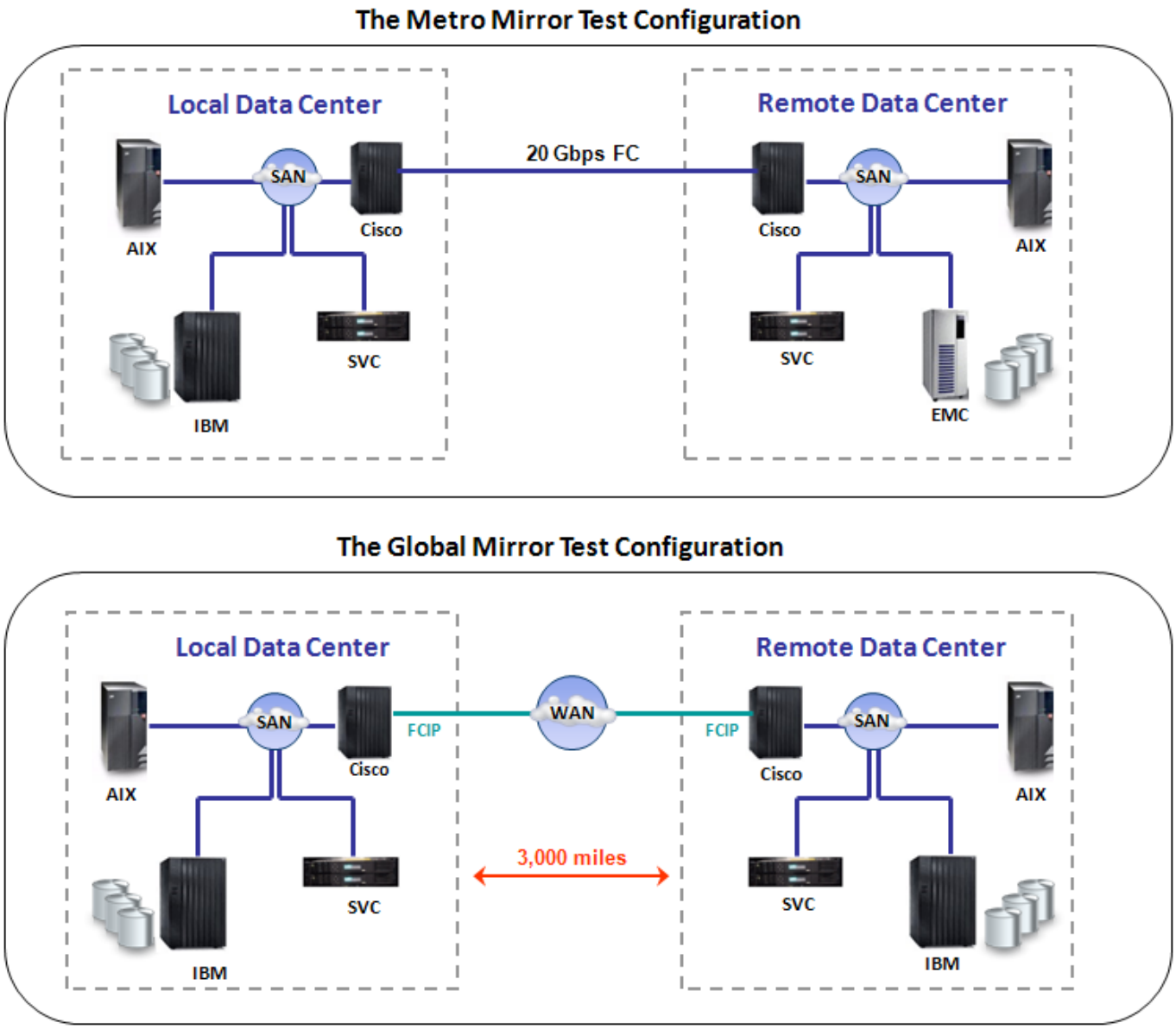

Next, ESG Lab tested SVC's ability to create volume mirrors, remotely replicated copies of data that can be used for high availability and disaster recovery. Metro mirrors can be created within a campus or metropolitan area, and provide a synchronous copy of the volume in real time. This volume is always completely in sync with the production volume and can be used instantly if needed. Global mirrors can be created between data centers in distant geographic regions, and provide asynchronous copies. These volume copies are not completely up to date, but run slightly behind the production volume. They enable a fast application restart without the last few transactions that get caught during the sync process.

Figure 16 shows the metro and global mirror test configurations. ESG Lab simulated metro and global mirrors using SVC clusters on different floors of the same data center. The Lab used the SVC console to create a metro mirror between local IBM storage and a remote EMC array. A 20 Gbps Fibre Channel trunk and Cisco switches were used for high-speed replication. The Lab simulated an unplanned outage by severing the FC connection; using a script that created time-stamped files, the Lab verified that all files written to the local SVC cluster were copied and readable on the remote cluster. ESG Lab also verified that there was no impact on application performance.

[3] The previous SVC Lab Validation was published in August, 2008.

To test the global mirror, ESG Lab replaced the high-speed FC link with an Emperix WAN simulator, which simulated a DS3 link between data centers 3,000 miles apart. An FCIP connection in the switches at each location was used to connect the simulated WAN. The Lab monitored the synchronization using the SVC console, and verified that files created before the mirroring operation were available at the remote site once the mirror reached the "Consistent Synchronized" state.

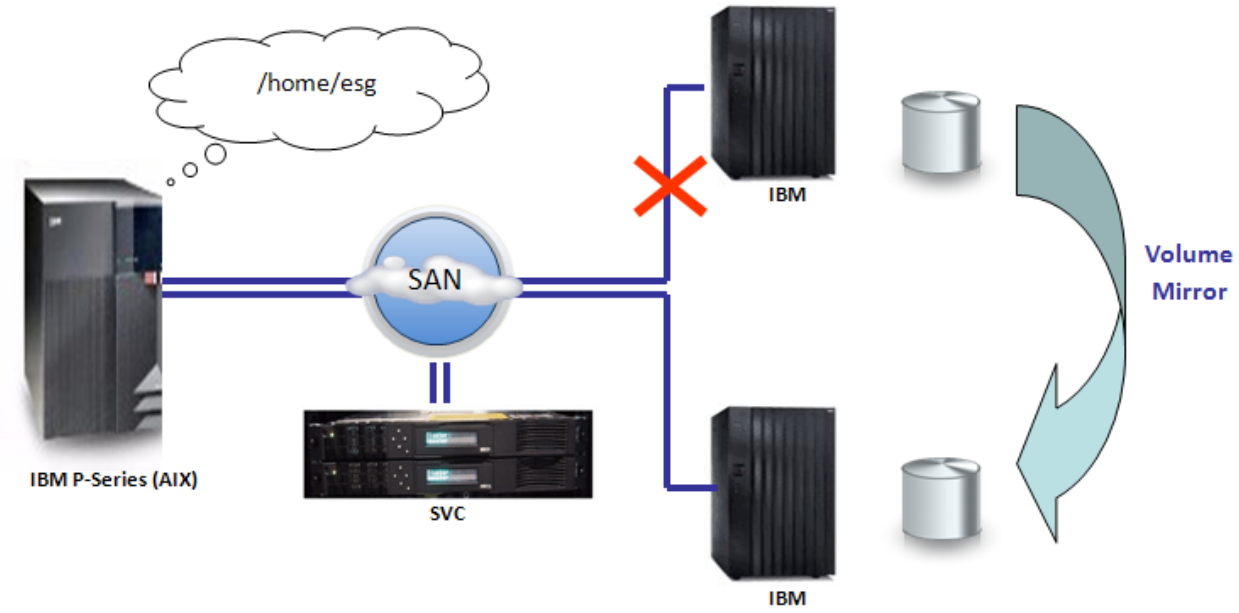
*Figure 16. Metro and Global Mirror Configurations*



Finally, ESG Lab tested SVC local mirroring and response time during a simulated array failure. First, the Lab simulated writes from an online transaction database application using a test utility to generate update operations at a rate of four I/Os per second. Next, the Lab used the SVC console to mirror an AIX home directory across two IBM DS8300 arrays (see Figure 17).

Response time was monitored during the mirror synchronization and during a simulated array failure by using an AIX utility. During the synchronization, a response time of two milliseconds was maintained. Once the sync was complete, ESG Lab disabled the SAN fabric zone connection on one of the arrays to simulate an array failure. The test utility continued without interruption or error as SVC failed over to the mirrored volume. During the failover, there was a small performance impact, as response time increased to 16 milliseconds for approximately two seconds and then returned to normal.

*Figure 17. Local Mirroring*




## Why This Matters

ESG recently asked enterprise and midmarket storage professionals what features were "must haves" when purchasing storage systems. First on the list, cited by 59% of respondents, was high availability. Whether for disasters, maintenance, or technology refresh, downtime tolerance is shrinking, particularly for mission-critical applications, and keeping applications available rises above all else.[4]

ESG Lab validated that with redundant SVC engines, losing a controller had no impact on production operations, and required no administrative intervention; a video that was playing before a controller was shut down continued uninterrupted during the failover. In addition, SVC failed over seamlessly to metro, global, and locally mirrored volumes without errors or interruption, and maintained excellent performance during the failover.

[4] Source: ESG Research Brief, *Data Storage Technology Purchasing Trends*, April 2013.

## ESG Lab Validation Highlights

- ☑ ESG Lab was thrilled to see the new XIV modeled interface available for the SVC solution. We find this GUI to be one of the most intuitive and easy to use storage interfaces on the market to date. The new GUI helped make the overall testing experience a pleasure to conduct. It was easy to jump in and conduct configuration tasks even after not seeing the interface for almost a year.
- ☑ We were also impressed with the compression results. We observed production data capacity savings of 48.8% to 82%.
- ☑ The Lab was able to maintain close to equal performance for our Oracle OLTP test environment while still achieving 82% capacity savings with Real-time Compression.
- ☑ Even while delivering compression savings in real time, SVC provides agility by abstracting the back-end storage, which ESG Lab validated by seamlessly migrating data non-disruptively between storage devices. This makes it an excellent solution for technology refresh and now, with RTC, a powerful tool for capacity reclamation.
- ☑ The high availability essential in today's business environment is maintained using redundant SVC engines and multiple data mirroring features.

## Issues to Consider

- ☑ If you are considering implementing RTC in your current SVC environment, deployment may require software and possibly a hardware upgrade. IBM recommends that the SVC controllers running RTC be upgraded to a higher performing model, though they currently have customers running RTC on standard SVC controllers. The size of the SVC environment will play an important role in the upgrade decision.
- ☑ As with any data reduction technology, "your mileage will vary" depending on data type. The more compressible your data is, the more capacity savings you will realize. ESG Lab tested with data sets common to most environments and found the compression savings to be significant, but it is important for environments with highly specialized data sets to understand data compressibility beforehand. It should be noted that IBM offers a quick and accurate host-based utility that can be downloaded and used to analyze potential compression savings on existing data sets.[5]

[5] Comprestimator Utility: http://www-01.ibm.com/support/docview.wss?uid=ssg1S4001012

## The Bigger Truth

To support today's complex, virtualized, globally distributed business environments, applications require greater availability, performance, agility, and mobility than ever in the past. At the same time, market and economic conditions demand CAPEX and OPEX reductions along the way.

Some vendors develop and/or purchase exciting new technologies to meet these needs, with high hopes of integrating them to add value to their existing product sets, but end up struggling and often failing to bring the pieces together into a cohesive whole. Other vendors are experts at bringing it all together, taking the time and putting in the effort to do it right. IBM is the latter kind of company. ESG Lab has been evaluating IBM solutions for many years, and this validation demonstrates once again how IBM has organically pulled together key technologies that solve the problems customer face today and integrated them effectively.

IBM SAN Volume Controller has been providing storage virtualization for a decade now. By pooling capacity from different arrays and vendors using redundant engines, SVC lets organizations leverage all of their storage investments with greater flexibility. Instead of standing up separate infrastructure stacks with separate storage capacity for growing data analytics, test and dev, replication, etc., organizations can use the storage they already have for these different purposes. They can also purchase storage without having to match it to a specific project, which means that they no longer have stranded storage sitting idle, unable to be shared out where it's needed. SVC storage virtualization lengthens the useful life of storage assets, enables consolidated management across heterogeneous resources, and even adds advanced capabilities such as thin provisioning, FlashCopy, and mirroring to arrays that were not natively endowed with those features.

ESG Lab last evaluated SVC in 2008, and the improvements IBM has added since then bring it to a whole new level. Certain improvements along the way were expected and necessary, such as support for iSCSI and FCoE. The really exciting improvements we see with today's SVC are the addition of Real-time Compression for primary block data, and the integration of what ESG considers the best storage GUI on the market. IBM Real-time Compression was originally deployed for file-based data in NAS systems, and the value has been proven over and over. Bringing Real-time Compression to block-based e-mail, database, and other business-driving applications without slowing application performance is an exciting development that offers tremendous economic and operational benefits. Extending the industry-best GUI now to SVC as well as XIV and V7000, IBM adds better visibility and easier management to an increasingly complex environment—another economic benefit.

ESG Lab testing demonstrated how SVC meets all the key requirements of today's advanced infrastructures. The new GUI is simple and intuitive, even for advanced functions. The Lab demonstrated Real-time Compression savings of 48%-82% for block-based Linux, Windows, and VMware volumes, minimizing equipment and operational costs for primary data. OLTP testing showed that compressed volumes suffered virtually no performance degradation, even for demanding transaction-oriented workloads, and in fact transaction response times improved with compressed volumes. Finally, ESG Lab proved the ease of migrating workloads with SVC (for availability as well as capacity reclamation), and also proved that the redundancy and mirroring features ensure continuous application availability, an essential feature for today's "always-on" infrastructure.

IBM's tag line is "Let's Build a Smarter Planet." The new and improved SVC fits right in, bringing together essential features in a storage virtualization engine that enables customers to spend more time on their business and less on the supporting infrastructure.

# Appendix

*Table 3. ESG Lab Test Bed Detail*

| | |
|---|---|
| **SVC** | |
| (2) SAN Volume Controllers | Model: Enhanced CG8<br>CPU: Dual 6 Core Intel Xeon E5645 2.4GHz<br>48GB RAM<br>SVC Version: 7.1.0.0 |
| **Storage** | |
| XIV Storage System | Model: XIV-gen3<br>6 Nodes<br>72 Disk Drives<br>Software Version 11.1.1 |
| IBM FlashSystem 810 | Model: IBM FlashSystem 810<br>10TB eMLC Flash<br>Firmware: 5.6.0-RC23 |
| **Servers** | |
| (1) IBM Intel Server | Model: x3650<br>CPU: 12 core Intel Xeon 5680 3.3GHx<br>RAM: 193GB<br>Driver: (2) 140GB 10k SAS |
| (2) IBM Intel Servers | Model: x3550 M4<br>CPU: Dual 8 core Intel Xeon E5-2680 2.7GHz<br>RAM: 78GB |
| **Software** | |
| Windows | Windows Server 2008 R2 |
| Linux | Red Hat Release 6.3 |
| VMware | vSphere Version 5.0 |
| Oracle | Oracle 11.2.0.3 |
| Benchmark Factory | Version 6.6.1 |

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