Enhancing Continuous Operations and Data Integrity for Microsoft Hyper-V Environments

Hitachi Next Generation VSP Storage Systems in Microsoft Environments

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Executive Summary

An increasing number of IT departments have multiple data centers that need to have synchronized operations and application mobility to optimize operations. Active-active stretched cluster technology has become key to global IT operations and business continuance achieving that operational level.

Hitachi is a well-established storage vendor that has been offering enterprise class storage to their customers for many years. They have now taken that enterprise class storage technology to a new level by offering global storage virtualization across its family of storage systems with the announcement of the Hitachi next generation Virtual Storage Platforms. Hitachi now provides the ability to virtualize storage across geographically dispersed clusters using active-active stretched clustering technology for non-disruptive data migration, data mobility and disaster recovery applications.

In earlier research, Evaluator Group noted that VSP systems offer significant performance and capacity scaling from a single controller image that can automatically balance workloads across virtual machine environments. For performance in business-critical Microsoft Hyper-V environments, Hitachi’s symmetric active-active controller technology distributes paths across all controllers, eliminating the risk of application degradation due to thrashing. In addition, Hitachi Dynamic Provisioning (HDP) provides side striping, allowing distribution of load across all storage media and dynamic performance and capacity expansion as storage media are added to disk pools. These are all capabilities expressed in software and built into its Storage Virtualization Operating System (SVOS).

With the announcement of new VSP systems that run SVOS, Hitachi extends these capabilities to multiple models in the family. For Microsoft application environments, this means Microsoft Hyper-V virtualization and applications now have more mobility, with non-disruptive storage operations and data migration capabilities that span enterprise data centers for cloud-based IT services that maintain continuous application availability with easier manageability (see Business Continuity graphic above). And they now have the flexibility to choose either large or small storage platforms to do this.
Additionally, Hyper-V administrators are now more incentivized to distribute their tier 1 applications and still maintain continuous application availability with easier manageability.

The Next Gen Virtual Storage Platform

Hitachi has announced the next iteration of its SVOS-based storage systems to join the VSP storage system family.

Overall highlights from this announcement include:

- SVOS as the platform OS supporting external array storage virtualization, GAD, Virtual Storage Machines, and other features previously only available on VSP enterprise class systems
- Hitachi NAS capabilities that include hardware-accelerated file systems, dedicated NFS controllers that are software-defined, and primary storage deduplication
- New “single pane of glass” management application for unified block and file storage management
- Hitachi Accelerated Flash (HAF) supports tiered flash (hybrid) or all flash storage (max. 1.8 PB) configurations defined by software
- Active Flash enhancement to Hitachi Dynamic Tiering allows data to be promoted to a high performance tier immediately after an increase in load has been detected
- Approximately three times the performance and twice the throughput vs preceding HUS models
- 12 Gb/s SAS back-end and twice the number of front-end ports

Hitachi SVOS is now software-based storage technology that will allow for consistency across large enterprise and midrange Hitachi Data Systems (HDS) storage platforms. This means that SVOS can eliminate complex migrations, provide transparency for technology updates and extend the lifespan of the underlying storage system. To reduce complexity and create a foundation for automation also

The Next Generation Hitachi Virtual Storage Platform Details

- Three new models: G200 (2U), G400 (4U), and G600 (4U). All models will run SVOS. An additional high-end model (G800) will be available later in 2015.
- The new models will be unified (file plus block) via integration with the HNAS 4000 line.
- Support for global active device and active flash will be available later in 2015.
- The first release of the new management platform will also be available in early 2015. Additional capabilities will be added later in 2015.
means that consolidated management is made easier and creates a base for hybrid (private/public) cloud infrastructures with an SVOS instance also located at a public cloud site.

**Active-Active Stretched Clusters - The Global-Active Device Feature from Hitachi**

There were a number of capabilities introduced in SVOS with the previous VSP G1000 announcement that are significant for IT administrators managing Microsoft application environments. One of them is Hitachi’s global-active device (GAD). To understand Hitachi’s global-active device feature it is important to first understand the concept of Hitachi virtual storage machines introduced with the first release of the VSP. Virtual storage machines are loosely comparable to server-based virtual machines (VMs). VSMs help maximize storage resource utilization and offer multi-tenancy for storage (isolation of access). The more advanced features offer non-disruptive migration of data and remote copies, active-active stretched clusters, and high availability operations.

![Diagram comparing server-based virtual machines (VMs) to Hitachi’s virtual storage machines (VSMs)](image.png)

*Figure 1 – Comparing Server-based virtual machines (VMs) to Hitachi’s virtual storage machines (VSMs)*
VSMs can be thought of as virtual machines that are used to apply software defined storage services across heterogeneous physical storage resources. These include:

- Automated tiered storage (Hitachi Dynamic Tiering)
- Thin provisioning (Hitachi Dynamic Provisioning)
- Storage resource pooling
- Secure multi-tenancy
- Data replication (snapshots and clone copies with Hitachi Thin Image, ShadowImage Replication, TrueCopy, and Universal Replicator)

Data migration and remote replication are now attributes of each VSM and can be extended across all physical storage—HDS and third party arrays—attached to SVOS controllers. A single VSM can span metro and remote (future) geographical distances.

**Figure 2 – Data replication within a VSM that spans geographical distance for range of application scenarios that include continuous operations, data mobility, and hybrid cloud deployment**

When used in conjunction with VSMs, the global-active device feature sets up cross-mirrored volumes between two VSP systems that accept read/write I/Os on both sides and are continuously updated (see Figure 3 below). If a disk controller failure occurs at the main site, a reserve controller at the remote site automatically takes over and accepts read/write I/Os. Conversely, if a controller failure occurs at the
remote site, the main site controller automatically takes over. A quorum controller that is external to either system is used to determine the operational controller when a failure occurs.

The global-active device feature assures that an active and up to date storage volume is available to a production application in spite of the loss of a virtualized controller. In addition, the use of active-active stretched clustering can also be used for non-disruptive workload migration and non-disruptive data migration without requiring the use of a separate system between VSPs including the newly announced storage systems.

![Diagram showing volume mirroring using Hitachi GAD to assure data volume availability](image)

**Figure 3 – Volume mirroring using Hitachi GAD to assure data volume availability**

**Implications for Improving Microsoft Application and Hyper-V Environments**

Highly available clusters are designed to reduce the risk of a component failure. To protect clusters at a site level, stretched clusters were introduced. A stretched cluster can be configured to be geographically dispersed among multiple sites. Microsoft does this by requiring a quorum disk that synchronously mirrors between sites in addition to the data disks. This allows for applications like Hyper-V to function without the need of being aware of the geographic distance. This relies heavily on the implementation of the network and storage within the infrastructure. Since the storage architecture is geographically dispersed, this means there needs to be an arbitration mechanism to ensure that the cluster believes it only has one disk to use for cluster communication of information. This is where Hitachi offers a solution.

Evaluator Group believes that Hitachi’s implementation of active-active stretched clusters known as global-active device feature has significant implications for Microsoft administrators. These include:
- **Non-disruptive Operations**—The assurance of continuous availability for critical business applications running in a Microsoft environment
- **Workload Mobility**—Movement of primary or secondary applications and virtual machines to another location to balance the current workload, or to take the primary application server temporarily off-line for technology updates
- **Non-disruptive Data Migration**—The ability to non-disruptively migrate data when performing technology updates and Microsoft application upgrades
- **Implementation of Private Cloud**—Hitachi Global Active Device feature-enabled active-active stretched clusters that span the enterprise multi-site data center

**Non-disruptive Microsoft Operations and Storage Continuity**

Microsoft applications are tied to the underlying storage system by identification elements such as serial number and device ID. Changes to a storage system can disrupt application operations for Microsoft products like Exchange and SharePoint. This disruption usually involves an application restart, possibly a system reboot that can involve multiple administrators and contribute to operation complexity. This can cause Microsoft administrators to hesitate when it becomes time to do an upgrade or make a change, which could cause a delay in performance and efficiency improvements from new storage technology.

Microsoft clustering solutions coupled with storage continuity means that the cluster is extended to multiple physical locations without disruption to applications. Microsoft clustering uses a similar concept for storage as their local site clustering for continuity. This requires partnering with a certified storage vendor, such as HDS, for their replication and stretched cluster technologies. HDS SVOS-based storage systems meet the required storage needs to handle non-disruptive operations in Microsoft cluster environments. SVOS provides an abstraction layer of software that separates the application from physical storage dependencies so changes to the hardware are independent and transparent to the application. Figure 4 below demonstrates this using the new VSP as an example, but the underlying storage could be any model in the VSP family.
Figure 4 – VSP failover for non-disruptive Microsoft application operations

1. VSP concurrent data mirroring capability (metro distance) makes data immediately available at each site.
2. Live Migration moves VMs for Hyper-V environments.
3. Multi-path software allows application access to replicated data from the shortest path to maintain performance.

Some of the benefits of using Hitachi SVOS storage systems in a Microsoft cluster environment are:

- Higher protection in the event of a datacenter loss when extending a cluster to multiple sites
- Automatic failover, which can reduce downtime and lower complexity for DR plans
- Reduce administrative overhead by automatically synchronizing application and cluster changes. This means service packs and upgrade operations can be performed without production disruption

Figure 5 shows that the issue of applications having a direct link to the underlying hardware can be resolved by installing Hitachi SVOS-based storage so there is no impact to application availability. VSMs isolate applications from the underlying storage hardware making updates to the storage hardware transparent.
Workload Mobility

Microsoft depends on storage providers to offer replication and active-active stretched cluster technologies to help support their multi-site metro cluster solutions. This allows for virtual infrastructures using Hyper-V to use Live Migration across multiple sites, not just locally within the datacenter, and makes those operations transparent to Microsoft environments.

Hitachi SVOS systems also have a storage virtualization software layer that provides a complete abstraction from the underlying storage hardware. In this case, server applications are unaware of the accessible physical disk location and the underlying storage is fully compatible with Cluster Share Volumes (CSV) provided by the Microsoft cluster. For Hyper-V, this allows for automatic or manual movement of resources via Live Migration between virtual hosts cluster wide. This virtualized storage is integrated with Microsoft’s failover cluster and uses remote replication across geographical distances, which greatly improving business continuity.

Figure 5– Software Abstraction Layer separates applications from storage HW specifics
Storage Virtualization Abstraction

Figure 6 – Hitachi SVOS offers a virtualized software (abstraction) layer compatible with CSV

Figure 7 shows an example of workload mobility in a Microsoft Hyper-V application environment. The current situation shows two sites at a metro distance used for business continuity. Either a VSP Enterprise or Midrange can be located at each of the two sites and support critical application volumes using the Global-Active Device (GAD) for active-active stretched clusters. The Microsoft administrator can move virtual machines (VMs) transparently back and forth between sites to either balance the overall infrastructure workload or use it for a site failover when necessary with Windows Server Failover Clustering. This leads to higher availability and accessibility to data as access automatically switches through a multi-pathing architecture requiring no data migration, application interruption or administrative action for storage.
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Figure 7 – MS Hyper-V / Hitachi VSP in an Active-Active Stretch Cluster Environment

Non-disruptive Data Migration

Many Microsoft administrators have previously been hesitant when it comes time to upgrade storage systems, partly because downtime it would take to do these changes cannot be tolerated. The average time it takes to perform a data migration to a new storage system can take days and requires many sequences of application interruption. Microsoft administrators have a difficult time in planning for enterprise applications to be disrupted. IT operations may not get the benefits of new technology that could increase their productivity and reduce costs in a timely manner. The use of active-active stretched clusters can be used for non-disruptive workload migration and non-disruptive data migration.

In the following example, a VSP system at a remote site A has critical application volumes in use. These data volumes can be migrated to another VSP at a centralized data center site B without disruption to
normal operations while maintaining data protection during a migration. Two capabilities unique to SVOS allow this to happen:

1. Snapshots and replicated copies created by Hitachi Storage Adapter for Microsoft Volume ShadowCopy Service and Thin Image will be migrated as well so there is no lapse in data protection.
2. SVOS VSM maps the secondary site serial number, model, and device number to the VM after it is moved so applications will not have to be restarted after the move.

![Diagram of non-disruptive data migration](image)

**Figure 8 – Non-disruptive data migration without lapse in data protection using one VSP at a remote site another VSP in a centralized data center.**

1 Data volumes and associated snapshots and clone copies are migrated from VSP (Site A) to VSP (Site B) using a VSM. 2 Data access is switched to the VSP at Site B.

**Cloud Deployments**

In participation with Microsoft’s Hyper-V Private Cloud Program, Hitachi SVOS supports Microsoft’s hybrid cloud solution, which combines Microsoft System Center, Windows Server, Microsoft Hyper-V Cloud, and Windows Azure Pack connectivity. This means workloads can be moved from between datacenters using Windows Azure Pack integrations to build hybrid Windows applications to leverage resources from both the local datacenter and Azure cloud services.

Cloud deployments have persistent applications and infrastructure that need periodic updates which can in some cases result in a complete re-install. That means performance and efficiency benefits may
be delayed and the administrator(s) may wait until the next major application refresh if the process to make these changes become too complex.

SVOS allows cloud environments to be independently updated along with their applications. Virtual storage machines enable this to happen. Immediate economic benefits can be taken when cost reductions from new storage advances from Hitachi for VSP systems are applied to cloud environments. SVOS VSMs are also applied to the requirement for secure multi-tenancy. The non-disruptive failover and data migration capabilities can support cloud deployments with active-active stretched clusters between the user and service provider. Taking advantage of this virtualized consolidation can result in reductions in physical hardware, which means environmental improvements in space, power, and cooling.

Figure 9 shows how updates can be done independently with the use of VSMs isolating applications. Any updates to the infrastructure or Microsoft applications are contained by the configured isolation.

![Figure 9 – Cloud Deployments with SVOS-based VSP Storage Systems (Enterprise and Midrange)](image)

**Evaluator Group Assessment**

Hitachi’s implementation of active-active stretched cluster technology integrates well with Microsoft’s cluster solution and increases flexibility and storage continuity to support non-disruptive operations for Microsoft applications and Hyper-V environments. Using VSP Enterprise systems at the primary and VSP Midrange systems at failover locations for example, the Microsoft administrator need only move the Hyper-V VM to the secondary location. By virtue of the fact that SVOS systems continuously mirror data-application data and data copies between locations, the data belonging to the VM in motion is already
at the failover site. The ability to have VSP at a central site and one or more HUS systems at remote/satellite sites can also be used in applications requiring non-disruptive data mobility/migration and failover capability among sites. This allows Microsoft applications to work in a metro cluster without being aware of the physical location of the storage.

An added benefit from SVOS falls into the realm of software defined storage. It is designed for modular hardware architectures, allowing for the incremental addition of storage, processing, and networking resources while retaining the original system platform. Because the software-based storage architecture is a true abstraction layer separating the application from the physical storage hardware, the underlying hardware can change without disruption to Microsoft applications. This effectively extends the useful life of SVOS systems to five-seven years and reduces the impact of periodic storage hardware upgrades to the critical application environment.

The need to assure the stability, recoverability, and data integrity of critical applications has been an inhibitor to virtualizing them. Now, the complete VSP storage systems family addresses these issues.

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