Enhancing Continuous Operations and Data Integrity for Critical VMware Applications

Hitachi’s Virtual Storage Platform G1000 in VMware Environments

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Executive Summary

Hitachi has been in the vanguard of vendors offering enterprise-scale, storage system virtualization for the last ten years. With the announcement of the Hitachi Virtual Storage Platform (VSP) G1000, Hitachi now adds global storage virtualization—the ability to virtualize across metro and (later) remote distances to its virtual storage platform.

Global storage virtualization extends virtualized storage services across multiple sites and disparate, heterogeneous physical storage systems under the control of VSP G1000. A key enabler is the introduction of active-active stretched cluster technology for storage systems that underpins a significant feature introduced with VSP G1000—global active device\(^1\). We believe this will be of particular value in VMware environments where administrators still hesitate to virtualize critical business applications over a concern for their ability to maintain continuous application availability.

In an earlier research, the Evaluator Group has noted that previous versions of VSP offer significant performance and capacity scaling from a single controller image that can automatically balance workloads across virtual machines. Hitachi Device Manager can be integrated with VMware vCenter to monitor and manage entire I/O paths between individual VMs and VSP storage that can include the attachment of third party arrays. It also maps correlations between ESX servers, VMs, data stores and volumes.

For performance in business-critical VMware 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 wide striping, allowing distribution of load across all devices and dynamic performance and capacity expansion as devices are added to disk pools.

Here we review the highlights of the VSP G1000 announcement and then examine in more detail the Hitachi implementation of active-active stretched clusters for virtualized storage controllers. Additional benefits to the management of VMware environments available via VSP G1000 include:

Non-disruptive Operations for the assurance VMware-based application availability

\(^1\) Separately licensed feature available after initial release.
Workload Mobility for the movement of VMs and associated applications

Non-disruptive Data Migration between storage arrays

Virtualization for Cloud-based IT Services—spanning the enterprise data center and a cloud services provider

VSP G1000

Hitachi has announced the next iteration of its VSP storage systems, the VSP G1000. Hitachi Virtual Storage Platform family was first introduced in 2010 and pioneered the concept of virtual storage machines (VSMs, discussed in more detail below).

Highlights from the announcement include:

- Global active device feature – implements mirrored volumes between VSP systems that are continuously updated and available (described in more detail below).
- Enhancements to the non-disruptive data migration capabilities
- Extended SAS and PCIe connectivity
- 25% greater power efficiency
- Hitachi Unified Compute Platform (UCP)Director v3.5 includes support for VSP G1000

A new release of Hitachi Command Suite (v8) that includes unified management of block, file, and object storage (via integrated Hitachi NAS Platform management) as well as the management of global storage virtualization,

Increasing VM Density

VSP G1000 represents the “next generation” release of VSP. In addition to enhancing the reliability and availability of supporting VMware infrastructure, the VSP family including the G1000 also allows for greater efficiency through increasing VM density per server. Characteristics of the VSP family that can be used by administrators to support a gain in VMs per server include:

Hitachi Dynamic Tiering—reduces the possibility of performance degradation by assuring that active VMDKs are always allocated to the highest performance storage tier.

Hitachi Dynamic Provisioning—increases the efficiency of physical storage so that administrators can effectively utilize a greater percentage of available capacity while assuring performance within VMware’s random I/O environment.

VMware VAAI support—for overall server performance improvements that in turn allow administrators to deploy more VMs per server.

VSP G1000 performance enhancements that will further allow VMware administrators to increase VM density per server include:

- Greater than four times the internal VSP system bandwidth
- Twice the cache capacity for active VMDK performance
- More than three times the maximum I/O bandwidth in terms of IOPS
- Four times the maximum number of system processing cores
- Hitachi Accelerated Flash (HAF) for Tier 0 storage performance
global active device feature, and non-disruptive data migration enabled by VSP G1000 was also announced.

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

To understand the global active device feature, it is important to first understand the concept of Hitachi virtual storage machines which were introduced with the first release of VSP. Virtual storage machines are loosely comparable to server-based virtual machines (VMs).

![Figure 1. Comparing Server-based virtual machines (VMs) to Hitachi virtual storage machines](image)

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)
With the introduction of VSP G1000, data migration and remote replication are now attributes of each VSM and can be extended across all physical storage—HDS and third party arrays—encompassed within the VSP G1000 image. A single VSP can also span metro and remote (future) geographical distances.

Figure 2. Data Replication within a VSM that spans geographical distance for a range of application scenarios that includes continuous operations, data mobility, and hybrid cloud deployment.

When used in conjunction with VSPs, 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 stretch 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.
Implications for Improving VMware Environments

Evaluator Group believes that the Hitachi implementation of active-active stretched clusters as the global active device feature has significant implications for VMware administrators. These include:

- **Non-disruptive Operations**—The assurance of continuous availability for critical business applications running in a VMware environment

- **Workload Mobility**—Movement of a primary or secondary application VM 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 in when performing technology updates and scaling-out VMware environments

- **Implementation of Hybrid Cloud**—Hitachi global active device feature-enabled active-active stretched clusters that span the enterprise data center and a cloud services provider
Non-disruptive VMware Operations

Currently with VMware, failure of access to data (storage array or FC link failure for example) requires application interruption and failover using SRM to another copy of data, potentially at a second site. Hitachi Virtual Storage Platform-based virtual storage machines can now provide active-active stretched clusters over metro distances. Multi-path software allows application access to replicated data from the shortest path. Therefore, to activate a failover locally or between metro distance sites, vMotion only has to move virtual machine compute because the data is already at the failover target. As a result, complexity and overhead are eliminated. VM high availability is now a continuous operation with access to data, assuring critical business application availability and integrity.

Figure 4. VSP failover for non-disruptive VMware operations that is based only on the need to move VMs. ① VSP provides a concurrent data mirroring capability (metro distance) that makes data immediately available at Site B.② vMotion moves VMs. ③ Multi-path software allows application access to replicated data from the shortest path.

Workload Mobility

In order to balance a processing workload during peak usage periods, administrators often move an application to a second server to balance the workload. vMotion is used to move the VM and application(s). With VSP G1000 systems at two sites, the VSP concurrent data mirroring capability (metro distance) makes the VM’s data immediately available to the migrated VM at the second server.
Data access can be automatically switched to the alternate server via the VSP multi-pathing capability. The workload is migrated without application interruption. This process could also be used to take a VMware server temporarily off line for routine maintenance and updates.

Figure 5. Two-site, non-disruptive workload mobility that uses VSP G1000 for data mobility. ① vMotion is used to move the VM and application(s). ② The VSP concurrent data mirroring capability (metro distance) makes the VM’s data immediately available to the migrated VM at the second server. ③ Data access is automatically switched to the alternate server via the VSP multi-pathing capability.

**Non-disruptive data migration**

In the case where another VSP G1000 is installed and brought online when the primary VSP has critical application volumes in use, data volumes can be migrated to the second VSP without disruption to normal operations and while maintaining data protection during the migration. Two capabilities unique to the VSP allow this to happen:

1. Snapshots and replicated copies created by Hitachi ShadowImage and Hitachi Thin Image will be migrated as well so there is no lapse in data protection supported by these facilities.
2. VSP VSMs map the secondary site serial number, model, and device number to the VM after it is moved so that its applications will not have to be restarted after the move.
In the future, this capability will be supported for third party arrays attached to VSP.

Figure 6. Non-disruptive data migration without lapse in data protection using VSP G1000. ① Data volumes and associated snapshots and clone copies are migrated from VSP A to VSP B using a VSM. ② Data access is switched to VSP B.

**Hybrid Cloud**

Tying together two VSP G1000 systems can be used as a bridge between the enterprise data center and a cloud services provider that supports data replication and migration. In addition, VSP G1000 with VSMs offers a number of storage-based data management attributes that will be of particular interest to cloud services providers as well as enterprise IT organizations undergoing a transformation to a cloud services model. VSMs are easily applied to the requirement for secure multi-tenancy. And, the non-disruptive failover, workload and data migration capabilities can support hybrid cloud with active-active stretched clusters between the VSP user and service provider.
Evaluator Group Assessment

Using VMware vMotion in conjunction with Storage vMotion addresses some of the challenges associated with assuring continuous application availability. However, issues remain. Currently with VMware, when a failure occurs, there can be performance impacts if data needs to be migrated. The Hitachi implementation of active-active stretched cluster technology at the virtualized storage controller level improves application performance in these situations. Using VSP G1000s at the primary and failover locations, the VMware administrator need only move the VM to the secondary location. By virtue of the fact that VSP G1000s continuously mirror data-application data and data copies—between the locations, the data belonging to the VM in motion is already at the failover site.

An added benefit from VSP G1000 is its modular architecture that allows for the incremental addition of storage, processing, and networking resources while retaining the original system platform. Because VSMs define the resources dedicated to VMs and to the VMware environment, the underlying hardware can change without disruption. This effectively extends the useful life of the VSP to five-seven years and removes the impact of periodic storage hardware upgrades to the critical application environment.

For many enterprise VMware users, more than 70% of applications and workloads have been migrated to virtual machines. The more challenging applications are those regarded as business critical. The need to assure their stability, recoverability, and data integrity has been an inhibitor to virtualizing them. VSP G1000 addresses these issues.

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