White Paper

HP 3PAR StoreServ

Autonomic Management

August 2013
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Executive Summary

System Management is a significant portion in the cost of delivering a shared storage environment. As deployed storage capacities continue to grow at exponential rates, many IT departments are looking to do more with less and save money by optimizing the administration function.

As data grows, system administrators reach “decision points” that determine their course of action in managing storage environments. This includes how to expand or reconfigure storage, initial deployment design, and changes to improve performance.

Through the use of Autonomic Management, the HP 3PAR StoreServ Storage systems remove the effort involved in designing, deploying, operating, and monitoring this complex and critical part of IT infrastructure.

Edison compared the HP 3PAR StoreServ platform to systems from the major competitors in the marketplace, including EMC, NetApp, IBM, and Dell. Based on functionality, the HP 3PAR StoreServ platform proved significantly easier to use than the competing platforms for each of the autonomic features compared.

Edison also performed a lab test, evaluating HP 3PAR StoreServ against systems from NetApp and EMC for configuration complexity and managing autonomic features. The test results confirmed HP 3PAR StoreServ’s significant ease-of-use advantage over the competitors in every category.

Overall, HP 3PAR StoreServ represents the best solution in the marketplace today, reducing both risk and operational complexity, particularly when reaching decision points that have a large impact on storage management.
Introduction

HP asked Edison to perform a review of the Autonomic Management features of the HP 3PAR StoreServ platform, and to compare these results to the major storage vendors in the marketplace, including EMC, NetApp, and Dell. The aim of this comparison is to demonstrate the HP 3PAR StoreServ platform’s leadership in delivering efficient and scalable storage functions in the areas of design and deployment, provisioning, and ongoing management.

This white paper is based on a combination of hands-on reviews, interviews with storage administrators with first-hand knowledge and experience with the technologies, and published documentation from all of the included vendors.

Audience

This white paper should be read by anyone responsible for choosing storage solutions for their organizations, or for making administrative personnel decisions in the data center.

Contents of this Report

- **Executive Summary**—a summary of the background and results of the testing and analysis from Edison’s research.

- **Storage Hardware Lifecycle**—a discussion of the tasks involved in end-to-end deployment of storage arrays, including design and deployment, provisioning, and management.

- **HP 3PAR StoreServ Autonomic Features**—detailed information on each of the autonomic features of the HP 3PAR StoreServ platform.

- **Competitive Analysis**—a comparison of the HP 3PAR StoreServ features with those of the major competitors.

- **Conclusions**—a summary of the results of Edison’s research.

- **Appendices**—a more detailed discussion of the evaluation methodology and a terminology glossary.
Storage Hardware Lifecycle

A significant part of the deployment of a storage array is the cost of management. This includes the initial design, ongoing provisioning and decommissioning of resources to hosts, along with management and monitoring to keep the storage array running optimally. These requirements can take highly skilled personnel considerable time. The cost of management escalates significantly as storage environments scale up and over time. Administrators reach “decision points” that require choosing a path or direction on design, implementation, or storage reconfiguration. In traditional storage systems, these decisions can have a significant adverse impact on performance and utilization if made incorrectly and, in many instances, decisions made in the early stages of deployment prove difficult or impossible to rectify later.

Autonomic Management Defined

Autonomic Management is the name for the vastly simplified management and provisioning processes for providing storage in a HP 3PAR StoreServ system. Many of the functions handled automatically by the HP 3PAR StoreServ system—including data placement, load balancing, thin provisioning, and system tuning—are done manually in a traditional storage environment.

The specific HP 3PAR StoreServ features are:

- Rapid Provisioning
- Autonomic Groups
- Virtual Copy
- Thin Provisioning
- Dynamic Optimization
- Autonomic Rebalancing
- Adaptive Optimization
**Why Autonomic Management Matters**

Autonomic Management provides a number of benefits:

- It reduces the “time to storage” — the time it takes a storage administrator to provide resources to a customer after a request has been received. With traditional environments, delivering storage to a host can be complex and time consuming. HP 3PAR StoreServ significantly reduces the time required, through features such as Rapid Provisioning and Autonomic Groups.

- It enables customers to scale their storage environments without significant increases in personnel, since less time is spent in initial deployment, provisioning, and ongoing management of HP 3PAR StoreServ arrays.

- It reduces the risk when administrators reach “decision points” by ensuring that these decisions are eliminated or mitigated in a way that allows them to be easily reversed or changed. One example on the HP 3PAR StoreServ platform is the ability to dynamically change the RAID setting of a volume without moving data or affecting users.

- It enables 3PAR StoreServ deployments to be optimized for performance based on block-level data from an entire storage array. That would be impossible to achieve using manual processes and human interaction.
Design & Implementation

In legacy storage array designs, the administrator has to spend a significant amount of time in the initial planning and design of an array deployment. With some vendor hardware, that design process results in a static configuration. Once the array itself is in use, that configuration is nearly impossible to change without actually moving the data to another location. This static design precludes the ability to adjust for uses an array may be put to over time. That can result in underutilized hardware or an infrastructure that needs significant management and application outages to cope with growth.

HP 3PAR StoreServ arrays require significantly less up-front effort in design and deployment than traditional arrays. Instead, the focus is on service-based requirements such as IOPS (Input/Output Operations Per Second), throughput, and availability levels.

Administration

Once deployed, the use of Common Provisioning Groups enables volume creation to be tied to a service level, based on the RAID requirements of the host, and without having to choose a specific RAID group or set of disks. Over time, HP 3PAR StoreServ arrays can easily be expanded with additional capacity, with minimal requirements for manually rebalancing workloads.

Rapid Provisioning — enables a storage administrator to create storage with only a few mouse clicks on the Graphical User Interface (GUI) or using a single Command Line Interface (CLI) command. Provisioned storage is referenced using administrator-defined labels rather than numbers, making identification of resources easier and less error prone.

Autonomic Groups — enables the storage administrator to add storage or hosts to an existing related group of servers in the simplest manner possible. This is good for cluster environments, for example VMware ESXi., Microsoft’s Hyper-V and Linux clusters. The use of autonomic group reduces both the effort and the risk associated with adding storage to clustered or grouped servers.
**Performance Management**

**Dynamic Optimization**—automatically manages the dynamic placement of data across the storage array. At any time, the customer may choose to alter the RAID level, subsystem failure-protection level, drive type and stripe width of any single data volume. The system rebalances resources to meet the new specifications.

**Autonomic Rebalancing**—acts at the lowest system level, spreading data evenly across all available resources, while maintaining the specified protection levels. Over time, as the system workload increases and changes, or additional hardware resources are added, Autonomic Rebalance ensures that the array continues to deliver optimal performance and eliminate bottlenecks. The autonomic rebalancing feature also applies to system cache, ensuring resources are efficiently used at all times.

**Adaptive Optimization**—this feature enables volumes to be created from multiple tiers of storage and to automatically balance the distribution of a volume across the tiers, based on either a performance or a cost model. AO collects data from a 3PAR StoreServ array and stores the information in an external database using System Reporter. This information then uses advanced algorithms to move data between CPG tiers to match the required optimization model.

**Data Protection**

**Virtual Copy**—enables the creation of up to 500 point-in-time snapshot copies from a single base volume, of which up to 256 may be read/write copies. Copies are created without system impact and minimal space overhead, only consuming space as data changes. This also applies to copies of copies, which can be created without impact to the original volume.

**Capacity Planning**

**Thin Provisioning**—all HP 3PAR StoreServ volumes are thin provisioned by default. This ensures data is only reserved on physical disk once the host has written that data. Blocks that are written, but contain no content (binary zeroes), are automatically detected and not stored on disk. HP 3PAR StoreServ is the most efficient thin
provisioning solution available today, both for initial deployment and the ongoing management of thin provisioned storage, and covers all part of the infrastructure including Virtual Copy snapshots.
Competitive Analysis

Edison has compared the operation of competitive vendors in the marketplace today, based on both a practical “hands-on” lab analysis of common provisioning, and maintenance tasks, and performed an analysis of the method of operation of the hardware, using freely available product documentation.

EMC VMAX

EMC’s VMAX platform is the current incarnation of the Symmetrix line of storage arrays, now well over 20 years old. VMAX has evolved over the years and today uses mostly commodity, rather than custom-made, components. However, the system does retain the Symmetrix legacy implementation. In particular, VMAX configurations are maintained in static configuration files that are typically established at the time of system implementation.

VMAX deploys storage in disk groups. Disks in each group are divided into slices known as hypers, from which LUNs are created. The size of a hyper directly determines the size of a LUN, so creating a static configuration for user volumes. With the introduction of thin provisioning to VMAX, EMC layered the new technology on top of the existing LUN configuration, creating thin pools comprised of LUNs created from hypers. While this design provides for some flexibility in LUN size creation, it still requires manual configuration to ensure user volumes are spread across all disk devices, especially when additional capacity is added to an array.

- **Rapid Provisioning**—VMAX provisioning is achieved using either the CLI, through an additional software tool called Solutions Enabler, or through EMC’s Unisphere management platform. For traditional volumes, the size of the LUN is predefined, having been established when the system was installed. Thin volumes, created from thin pools, can be deployed with custom sizes, but the LUN must be created first, then associated with a thin pool, before it can be made available to the host.

- **Autonomic Groups**—VMAX enables simplified provisioning through the use of auto-provisioning groups but the auto-provisioning feature simply masks the underlying process of associating storage and hosts, which still occurs on the array. The user is also required to create port groups, initiator groups, storage groups, and
masking views for each use of auto-provisioning, making the overall process much less flexible than HP 3PAR StoreServ.

- **Virtual Copy** — EMC provides three types of snapshot volumes under their TimeFinder offering:
  - TimeFinder Clone—for full copy, high performance copies (maximum of 16 per volume).
  - TimeFinder Snap—for space-efficient copies (maximum of 128 per volume).
  - TimeFinder VP Snap— for virtual provisioning (thin) volume copies (maximum of 32 per volume). Each of these products has been added over time and as a result provides different features that are not compatible with each other.

HP 3PAR StoreServ provides a single snapshot technology with much greater numbers of both read-only and read-write snapshots.

- **Dynamic Optimization** — EMC VMAX provides no specific facilities for automated load balancing of workloads across an array. The user is required to invest time and effort to design and manage the layout of both traditional and thin volumes, especially where performance and capacity limits within a single thin pool are reached. In contrast, HP 3PAR StoreServ automatically ensures that all resources are used efficiently and automatically eliminates any hotspots.

- **Autonomic Rebalancing** — EMC VMAX volumes are created from slices of storage known as hypers. The customer must spend time during the design phase to establish the optimal size for hypers, without actually knowing the full details of the anticipated workload. This can result in hotspot performance issues on the disk. Hyper sizes cannot be changed easily after deployment of the array. Any such change requires considerable effort and can potentially affect performance. HP 3PAR StoreServ works at a much finer level of granularity—the 16KB page size. The Autonomic Rebalance feature enables chunklets to be distributed across the infrastructure to obtain the best level of performance.

- **Adaptive Optimization** — EMC VMAX systems implement FAST—Fully Automated Storage Tiering, which enables storage volumes created across multiple tiers to be dynamically re-balanced for performance. EMC’s implementation requires knowledge of the underlying architecture and the manual construction of FAST
policies. By contrast HP 3PAR StoreServ uses a simpler service-level approach based on either performance or cost.

- **Thin Provisioning**—EMC VMAX implements thin provisioning as an additional layer on top of traditional volumes. As such, thin technologies are not native to the array and require additional up-front planning for design and subsequent ongoing management. EMC recommends creating large traditional volumes as the basis for thin pools. In many cases, these larger volumes are not suitable for traditional deployments and so significant work can be needed to change storage usage between traditional and thin volumes. HP 3PAR StoreServ was designed to specifically cater for thin provisioned volumes, including the additional features of Thin Conversion and Thin Persistence, so none of these restrictions apply.

**EMC VNX**

EMC’s VNX platform evolved from the CLARiiON storage array, developed by Data General and subsequently acquired by EMC in 1999. EMC merged CLARiiON with the Celerra NAS platform to create a hybrid device that supports both block and file protocols. In the hybrid design, the Celerra components form the file mover part of the configuration, while the CLARiiON provides both block storage and the storage for files.

VNX retains two methods for creating storage volumes. There are “traditional RAID groups” which have a limit of up to 16 drives. Alternatively, physical disks can be placed into storage pools, built on multiple RAID groups. The VNX configurations permit RAID1/0, RAID-5 and RAID-6 configurations, each of which supports a maximum of 16 drives. However, EMC recommends specific fixed RAID configurations (e.g. RAID-5 4+1 or 8+1) for optimum performance. A storage pool can be homogeneous, where all of the disks have the same size and performance; or heterogeneous using multiple tiers of storage with different performance characteristics.

Storage volumes are created from and associated with a single storage pool or RAID group, based on the recommendation to use separate pools to differentiate multiple workload types.

VNX uses a dual-controller architecture in which each volume is assigned ownership to a specific storage controller or service processor (SP). The administrator can allow the system to balance volumes across the controllers at creation time, or specify this
manually. However, in either event, this controller affinity is static and means activity can be unbalanced across the controllers. Controllers act in an “active/passive” configuration with only one controller serving active I/O for a volume. EMC continues to recommend the use of PowerPath for path optimization, rather than the built-in MPIO (Multipath I/O) offerings provided by most operating systems.

- **Rapid Provisioning**— placement of data on VNX systems requires planning on the RAID size, pool sizes, and the specific pools to which workload should belong. The provisioning process requires the administrator to make decisions on where to place data, based on the hardware configuration and the load on the system at the time of the provisioning process. This can result in uneven workload responses with some heavily used and some underutilized disks. By contrast, HP 3PAR StoreServ has no requirements to plan data placement at provisioning time and makes full use of all resources.

- **Autonomic Groups**— VNX provides the facility to group hosts together as a single entity and provides similar features to HP 3PAR StoreServ autonomic groups.

- **Virtual Copy**— VNX provides two snapshot features. SnapView operates on volumes that are not created from a storage pool; it is the legacy implementation of the technology using a Copy on Write methodology for updating the volume. For volumes created in storage pools, VNX Snapshot must be used. Snapshots consume space from the pool and are written using Redirect on Write. The new Snapshot feature allows only up to 256 snapshots per volume. With HP 3PAR StoreServ, Snapshots can be directed to a tier of storage other than that of the source volume, both reducing the cost and improving availability.

- **Dynamic Optimization**— VNX provides no specific feature to allow the RAID type of a volume to be changed dynamically in place. Instead, there are two possible solutions. A volume can be migrated to a different storage pool using the LUN migration feature or be destroyed and recreated in a pool that matches the new RAID characteristics. This is because the RAID settings are static within a pool at pool creation time.

- **Adaptive Optimization**— EMC VNX implements FAST (Fully Automated Storage Tiering) VP to optimize the distribution of storage volumes across multiple tiers of storage. FAST VP only applies to volumes created from storage pools and does not work with traditional volumes.
• **Autonomic Rebalancing**—VNX provides no facilities to balance workload across the entire storage array. Volumes use only the physical disk capacity of their assigned pool, which can result in imbalanced workloads.

• **Thin Provisioning**—EMC implements thin provisioning for volumes within storage groups. Each volume reserves a minimum of 3GB of space, irrespective of the volume size, making it costly to allocate them in large numbers. EMC recommends using thin volumes when “capacity benefits outweigh performance requirements,” resulting in a penalty for using thin provisioning technology. EMC recommends that at least two virtual volumes should be created for each storage pool, and the pool ownership should be balanced across both controllers. Controller (or service processor) ownership of a volume must not be changed, as this causes adverse performance. Instead, volumes must be moved using the LUN Migration feature.

**IBM V7000**

IBM developed the StoreWize V7000 from their existing SVC (SAN Volume Controller) platform. In effect, the V7000 is an SVC with internal disk and the capability to use both internal storage and externally connected third-party vendor arrays. For management, the V7000 uses either a CLI or embedded browser-based GUI on each device. The GUI runs directly on the storage controller, which means each array has to be managed individually using a separate sign-on.

V7000 storage is taken either from internal disks, which are placed into RAID arrays (supported levels RAID-0, RAID-1, RAID-5, RAID-6, RAID-10) or from external storage as a logical volume from another storage array. Each chunk of source storage is known as an MDISK. In order to administer the storage and present to hosts, MDISKs are placed into storage pools, where the characteristics of MDISKs added to the pool are expected to be the same, in terms of RAID protection and IO performance. If storage pools are created from MDISKs of different performance, then the entire pool will operate at the performance of the slowest devices.

MDISKs are divided into extents of between 16MB to 8GB, with a default size of 256MB. Extents are then combined to create volumes presented to a host system. Volumes can use either striped extents, where the volume is comprised of extents taken in turn from each MDISK in a pool, or it can be allocated sequentially, taking all the extents from one MDISK before moving onto the next.
• **Rapid Provisioning**—provisioning of volumes on the V7000 requires the system administrator to make a series of choices. These are dictated by the performance and capacity requirements of the request, and by the physical options available on the hardware for deployment. The administrator will need to choose the storage pool that both matches the user requirements and does not compromise the performance of data already in that pool.

• **Autonomic Groups**—the V7000 system provides no similar features to autonomic groups and, in fact, does not allow hosts to be grouped together for rapid deployment against groups of servers. The administrator must manually ensure that new volumes are allocated to all the respective hosts.

• **Adaptive Optimization**—IBM V7000 systems implement the Easy Tier feature, which enables data within a volume to be moved between tiers of storage. However, in contrast to HP 3PAR StoreServ systems, Easy Tier only supports the use of solid-state disks as an additional acceleration tier.

• **Virtual Copy**—the V7000 volume copy feature is known as FlashCopy. The administrator must choose from three types of FlashCopy volumes: Snapshots, which are point-in-time copies; Clones, which are a full copy of a volume; and Backup, which is a full copy of a volume that maintains the relationship with the original source volume for subsequent backups. In addition to FlashCopy type, the administrator is also required to set the pace of background copying for Clones and Backups, taking care to ensure that performance of the system is not affected. A FlashCopy volume can be placed in a different storage pool to the source, but it can only use the physical disk storage in that pool. In contrast, HP 3PAR StoreServ snapshots are all point-in-time thin copies and are fully distributed across all system resources.

• **Dynamic Optimization**—V7000 deployments differentiate RAID characteristics using storage pools. As such, the administrator must design the RAID requirements in advance and create LUNs from those storage pools. Changing the underlying RAID characteristics of a LUN can only be achieved by migrating the LUN to another pool with those RAID characteristics. It is possible to create an imbalanced storage pool, where the RAID stripe size is different for the RAID groups in those pools. This directly affects performance, but provides the flexibility to use all physical resources. The administrator is responsible for ensuring that imbalanced configurations do not affect performance. HP 3PAR StoreServ systems use all
available resources, and can change the RAID type of individual volumes dynamically without any impact on system performance.

- **Autonomic Rebalancing**—The V7000 system provides no direct functions to distribute workload evenly across all resources. Instead, the system administrator is expected to design the physical layout of the array, including RAID design, storage pool type and size, and the location of volumes within those pools. This results in a significant manual management overhead to ensure V7000 arrays are efficiently managed for performance.

- **Thin Provisioning**—V7000 supports thin provisioned volumes.

**NetApp FAS**

NetApp’s FAS platform has evolved from the original NAS (Network Attached Storage) offering to encompass block protocols including iSCSI, Fibre Channel, and Fibre Channel over Ethernet. FAS systems run the Data ONTAP operating system, which provides all of the features of a unified storage platform in one system and operates in two modes.

The “7-mode” is the original, and now legacy, version of the operating system, first developed over 20 years ago. A 7-mode system operates with either one or two nodes in an active-passive cluster (although each node can be active with separate aggregates and volumes).

Approximately 10 years ago, NetApp acquired Spinnaker Inc. and attempted to incorporate the Spinnaker operating system into Data ONTAP. Today, the Spinnaker platform exists as Data ONTAP “Cluster Mode.” Rather than merge the code, NetApp allows a customer to choose their operating system at deployment time. It is not possible to change between 7-mode and cluster-mode without destroying the data and configuration of an array. Almost all of the 7-mode features have now been incorporated into the latest Data ONTAP, version 8.2.

Data ONTAP 7-mode uses groupings of disks into RAID sets and aggregates. An aggregate consists of a number of RAID sets grouped together. Aggregates are then used to create volumes that can be used as file shares for NAS, or as the source of block devices, where each file share folder (or qtree) on a volume represents a block device.
The use of aggregates as the underlying storage pool fixes the RAID architecture of all data created from that aggregate. While aggregates may be extended, they may not be shrunk. So great care and thought has to be taken when initially planning an aggregate layout, and subsequently extending the capacity of an aggregate over time.

Data is written on aggregates using WAFL (Write Anywhere File Layout). All write I/O is directed to free disk blocks with no data being written back in place after an update.

- **Rapid Provisioning**—NetApp volumes can be created using one simple command, or through the GUI tools by specifying volume name, target aggregate, and volume size. However, more work is required to map that volume to a host. This must also create initiator groups and add each LUN to the group. Through the CLI, this process has to be repeated for each volume, a time consuming process for large quantities of data.

- **Autonomic Groups**—NetApp provisioning uses the concept of initiator groups (igroups) for associating related hosts via World Wide Names to storage LUNs. Additional storage can be added to a group of hosts by associating it with an igroup. This is analogous to the method used by HP 3PAR StoreServ systems.

- **Virtual Copy**—Data ONTAP provides for up to 256 snapshot copies to be created from a single volume. Therefore, the process for copying a LUN is to copy the volume that contains that LUN, then to use the clone command to copy the LUN within the snapshot. This process is necessary because the original volume and snapshot commands were focused on the file format rather than block device presentation. NetApp’s implementation of LUN snapshots is far less flexible than HP 3PAR StoreServ. An entire volume snapshot must be dedicated to LUN copying, and if a volume contains multiple LUNs, then the available snapshot count per LUN can be significantly limited. Any copy for a LUN also copies the other LUNs on that volume as part of the snapshot. One option is to create a single LUN per volume, although this limits the scalability of volumes per aggregate and per system.

- **Dynamic Optimization**—Data ONTAP RAID groups are all by default configured as RAID-4 or RAID-DP (NetApp’s implementation of RAID-6), depending on whether the administrator has implemented dual parity. Although dual parity can be enabled or disabled dynamically, the change is made at the aggregate level and affects all data within that aggregate. By comparison, HP 3PAR StoreServ allows the
RAID level to be set per volume and dynamically manages the balancing of workload across all disks based on the characteristics required.

- **Adaptive Optimization** – NetApp has implemented automated storage tiering features through their Virtual Storage Tier offerings. These consist of two products; Flash Cache and Flash Pool. Flash Cache implements a read cache for frequently accessed data, and so operates in addition to tiering. Flash Pool uses solid-state disks (SSDs) to accelerate the performance of Data ONTAP aggregates built from hard disk drive RAID groups. Both solutions are limited to using flash for acceleration and cannot be used to balance volumes across multiple tiers of disk storage. In contrast, HP 3PAR StoreServ systems allow any disks within the system to be part of a tiering optimization strategy.

- **Autonomic Rebalancing**—Data ONTAP has no facilities to dynamically balance data across the configured storage. Within an aggregate, care must be taken when expanding a RAID group, as all future I/O will be directed to the newly added disks until capacity across the RAID group is evenly distributed.

- **Thin Provisioning**—NetApp block volumes are, by default, thick provisioned, and can be created as thin volumes by using the “Guaranteed Space” parameter with a value of “None.” This ensures no space reservation is made for the volume on the containing aggregate. Since data on NetApp volumes is not written in place, but always written to free space. An additional amount of space, known as the Fractional Reserve, is maintained to ensure there is always free space for new updates while invalidated blocks are collected as a background task. Fractional Reserve can be up to 100 percent of the size of a volume and needs to be set by the administrator, based on the write update rate to the volume. In contrast, HP 3PAR StoreServ thin provisioned volumes are extremely efficient, and have no equivalent usage overhead.

**Dell Compellent**

Compellent Inc. was founded in 2002 and acquired by Dell in 2011. Dell continues to retain the Compellent brand name, with the platform forming their main Enterprise storage offering. The Compellent platform uses a unique technology known as Data Progression, which directs writes to the fastest performing disk hardware. From that point and as snapshots are taken, data ages and is moved down the storage performance hierarchy.
Testing Process

Edison has performed a comparison test between HP 3PAR StoreServ and the EMC VNX and NetApp FAS (Data ONTAP 7-mode) systems. The testing uses Edison’s Competitive Management Costs Study methodology and compared the autonomic functions of the HP 3PAR StoreServ platform with the equivalent features and processes of the competitive vendors. The aim of the testing is to demonstrate the benefits of HP 3PAR StoreServ autonomic technology over other vendor solutions. The tests are grouped into the following high-level categories:

- Storage Provisioning
- Data Protection (snapshots/clones/mirrors)
- Maintenance and Change Configuration
- Performance Management, QoS, Monitoring and Reporting

Within each category the individual tasks are different for each platform, depending on the provisioning process and the tools used.

Test Results

The following results were obtained in each category. The table summarizes the totals for the three platforms in terms of the total steps required.

<table>
<thead>
<tr>
<th>Task</th>
<th>HP 3PAR StoreServ Steps</th>
<th>EMC VNX Steps</th>
<th>NetApp FAS Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Provisioning</td>
<td>4</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>Data Protection – Snapshots/Clones/Mirrors</td>
<td>6</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>Maintenance and Change Configuration</td>
<td>6</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>Performance Management</td>
<td>4</td>
<td>8</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 1: Edison HP 3PAR StoreServ Testing Total Step Summary

The performance management testing of the NetApp FAS platform could not be completed, as the management tools do not provide adequate information. NetApp uses a “call home” feature known as AutoSupport, which centralizes data on system configurations, and so is outside of the scope of these tests.
**HP 3PAR StoreServ EMC VNX Comparison**

When compared to the EMC VNX platform, HP 3PAR StoreServ required less effort in every test, taking fewer steps to perform the equivalent tasks. Overall, the HP 3PAR StoreServ platform achieved the following results:

<table>
<thead>
<tr>
<th>Task</th>
<th>HP 3PAR StoreServ Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Provisioning</td>
<td>44% of VNX steps</td>
</tr>
<tr>
<td>Data Protection – Snapshots/Clones/Mirrors</td>
<td>40% of VNX steps</td>
</tr>
<tr>
<td>Maintenance and Change Configuration</td>
<td>54% of VNX steps</td>
</tr>
<tr>
<td>Performance Management</td>
<td>50% of VNX steps</td>
</tr>
</tbody>
</table>

Table 2: HP 3PAR StoreServ VNX Efficiency Comparison

**HP 3PAR StoreServ NetApp FAS Comparison**

When compared to the NetApp FAS platform, HP 3PAR StoreServ was more efficient at three out of the four major tasks. The NetApp FAS platform was not measurable for Performance Management, as already discussed.

<table>
<thead>
<tr>
<th>Task</th>
<th>HP 3PAR StoreServ Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Provisioning</td>
<td>40% of NetApp steps</td>
</tr>
<tr>
<td>Data Protection – Snapshots/Clones/Mirrors</td>
<td>120% of NetApp steps</td>
</tr>
<tr>
<td>Maintenance and Change Configuration</td>
<td>86% of NetApp steps</td>
</tr>
<tr>
<td>Performance Management</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Table 3: HP 3PAR StoreServ NetApp FAS Efficiency Comparison

In the test performed, the HP 3PAR StoreServ platform was less efficient at creating a snapshot of a volume. However, the test performed only included steps to create a new FlexVol and did not include the steps to create a clone LUN from that volume. If this is taken into consideration, the platforms show similar results.
Conclusions and Recommendations

Summary of Benefits

Based on the comparison of HP 3PAR StoreServ autonomic features with the method of operation on competitive platforms, management of HP 3PAR StoreServ arrays requires significantly less effort for storage administrators. The underlying architecture that enables all of the autonomic features is a clear differentiator. HP 3PAR StoreServ reduces the risk involved in “decision points” by either eliminating them or removing the risk of change.

When examining the testing that was performed against autonomic functionality, the HP 3PAR StoreServ platform was more or equally efficient at all tasks against all competitors.

In a world where administration is a significant proportion of the total cost delivering shared storage, HP 3PAR StoreServ is clearly the best technology of its kind available in the market today.
Appendices

Terminology

CPG—Common Provisioning Group—a feature of the HP 3PAR StoreServ system that pools storage using service levels based on RAID configuration. CPGs allow the administrator to provision to a service level requirement without having to physically reference specific hard drives.

Volume or LUN—a unit of storage provided to a host system. Both terms are interchangeable, with the acronym LUN deriving from the SCSI protocol.

RAID—Redundant Array of Independent Disks—a process of storing data across multiple hard disk drives that uses parity information to recreate lost data in the event of a disk device failure.

Testing Platforms

The following hardware platforms were used to generate the test results:

- EMC—VNX5500 using Unisphere management platform
- NetApp—FAS3240 and NetApp Simulator using ONTAP management platform
- HP—3PAR StoreServ 7000 series with 3PAR management platform

The following sections list the tasks that were performed for each of the major categories:

- Storage Provisioning
- Data Protection—Snapshots/Clones/Mirrors
- Maintenance and Change Configuration
- Performance Management, QoS, Monitoring and Reporting

The tasks differ by platform based on the workflow and functionality of each management tool.
### Management Complexity Comparison Summary

<table>
<thead>
<tr>
<th>Task/Category</th>
<th>HP 3PAR StoreServ Steps</th>
<th>EMC VNX Steps</th>
<th>NetApp FAS Steps</th>
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<tbody>
<tr>
<td><strong>Storage Provisioning</strong></td>
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</tr>
<tr>
<td>Test Results for Area</td>
<td>4</td>
<td>9</td>
<td>10</td>
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<tr>
<td>HP Advantage (EMC - HP)</td>
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<tr>
<td>HP Advantage (NetApp - HP)</td>
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<tr>
<td>HP Advantage % (EMC - HP/ABS(EMC))</td>
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<td><strong>Data Protection - Snapshot/Clones/Mirrors</strong></td>
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<td>Task/Category</td>
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<table>
<thead>
<tr>
<th>Task</th>
<th>HP 3PAR StoreServ Steps</th>
<th>EMC VNX Steps</th>
<th>NetApp FAS Steps</th>
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Table 4: Management Complexity Comparison Summary