

Enabling Storage Automation in HP CloudSystem Matrix

Technical brief

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Introduction

IT departments are under tremendous pressure to keep pace with business demands. As they witness their business units attempting to fulfill their application requirements by going straight to the public cloud, IT departments are seeking ways to regain control. They want to put in place private cloud solutions that match the perceived speed, flexibility, and affordability of the public cloud yet provide better security and integration into the enterprise. They are also looking at private cloud, and the infrastructure as a service model (IaaS), for its potential to control IT sprawl and better utilize available computing, network, and storage resources.

Private clouds and IaaS make use of virtualized resources; however, they differ from more typical server virtualization environments in ways that are particularly important in dynamic business settings. According to Forrester Research, the main characteristics that differentiate a cloud environment from a virtualization environment are:

- A high degree of standardization—“It’s through standardization that you gain predictability...and begin to lower its operational costs.”
- Full automation—“That’s how...you deliver the fast time-to-market...”
- Self-service—Through “...standardized procedures, fixed deployment options, a service catalog..., and automated approval workflows.”
- Multi-tenancy—“Through a good multitenant [sic] architecture, private clouds keep business units virtually separated but resources highly utilized...”¹

HP offers a path to providing cloud-based services through Converged Infrastructure. HP Converged Infrastructure enables IT staff to consolidate physical and virtual server, storage, and network assets into pools of virtualized resources that can host sets of infrastructure services. HP Converged Infrastructure technologies are at the core of the HP CloudSystem portfolio: a comprehensive, integrated, and open solution that provides IT with a unified way to provision and manage services across private clouds, public cloud providers, and traditional IT. HP CloudSystem equips you to respond to customers or business units faster, more predictably, more efficiently, and with lowered costs. HP CloudSystem offerings provide a range of cloud capabilities as well as an avenue for growth and expansion. HP CloudSystem has three integrated offerings:

- HP CloudSystem Matrix—The ideal private cloud solution for providing IaaS as well as basic application deployment and monitoring
- HP CloudSystem Enterprise—The solution for private and hybrid cloud environments that can provide the full range of “as a service” models (infrastructure, platform, and software) and advanced application-to-infrastructure lifecycle management
- HP CloudSystem Service Provider—The public or hosted private cloud solution designed for service providers to deliver IaaS and software as a service (SaaS), including aggregation and management of those services.

HP CloudSystem Matrix is the base offering of the HP CloudSystem portfolio. The CloudSystem Matrix solution features standardized infrastructure service templates; a self-service portal for accessing an infrastructure service catalog; and automated service provisioning, flexing, and release. The CloudSystem Matrix solution also offers the ability to present separate server, network, and storage resources managed from a common resource pool to different organizations, within the larger private cloud environment that is managed by Matrix. HP CloudSystem Matrix enables you to achieve quickly the self-service, on-demand delivery model needed to establish a private cloud. Moreover, you can attain the flexibility and efficiency of a private cloud infrastructure while permitting centers of IT expertise—such as server, network, storage, and facilities administration—to retain needed controls.

¹ Staten, James, “Q&A: How To Get Private Cloud Right,” Forrester Research, May 25, 2011

This brief gives an overview of the advanced storage provisioning capabilities in HP CloudSystem Matrix. It focuses on the features of Matrix that facilitate and streamline the coordination between the server and storage IT staff for provisioning a private cloud infrastructure. It discusses storage considerations for CloudSystem Matrix and provides a short overview of technologies in HP 3PAR Storage Systems that offer advantages for private clouds. The paper should be useful for IT administrators and architects who are familiar with the CloudSystem Matrix offering and are interested in implementation and automation of storage services to support delivery of IaaS in a private cloud.

Provisioning storage for private cloud environments

In a traditional IT environment, the deployment of a new application requires the involvement of many people and a high degree of coordination among them. An IT architect might draw up a design specifying the servers, virtual machines, storage, and networks needed to support the application. The design would specify the connections between those resources and adhere to established policies and standards. Based on this design, the different IT staff responsible for servers, storage, virtualization, networking, and facilities would assemble and/or activate the needed resources.

To provision storage in this traditional IT scenario, the facilities and server administrators would prepare the physical servers with appropriate connectivity, gather information about the physical host bus adapter (HBA) initiator ports, and provide that information to the storage administrators along with information on required storage (type, size, RAID, and other parameters). The storage administrators would choose an appropriate tier of storage, a specific array, and create appropriate volumes, presenting them to the initiators. That storage team (or a separate SAN team) would then perform appropriate SAN zoning. Finally, the storage team would supply needed details back to the server administrators to complete configuration. The deployment process could take weeks, if not months, and involve repeated communication between the different IT groups.

In a private cloud environment, coordination between IT staff is no less important. However, to achieve the on-demand service delivery model promised by the private cloud requires simpler, more streamlined, and automated IT processes that enable each IT resource group to respond quickly. The Matrix Operating Environment satisfies this requirement by providing an integrated toolkit including powerful role-based infrastructure orchestration software that enables:

- Server, storage, and network administrators to create pools of resources and oversee and control their use.
- IT architects to design the infrastructure to support business applications and publish service templates in a service catalog to drive implementation.
- Users to request IT services by selecting infrastructure templates from the service catalog.

The Matrix infrastructure orchestration software permits completion of these actions quickly and easily and automates coordination between the roles.

HP CloudSystem Matrix has also significantly advanced the automation of IT processes for storage, including enhancements for setting policies for storage resources, specifying storage requirements, and automatically generating and fulfilling storage requests. Matrix extends these enhancements to streamline provisioning through two primary means of handling storage resources:

- On-demand provisioning—Storage administrators can specify storage to be provisioned automatically on demand, only as needed to fulfill service requests
- Pre-provisioned storage—Storage administrators can create storage volumes in advance, ready to be deployed automatically when needed

Within a single IT environment architects and administrators can make use of both on-demand provisioning and pre-provisioned storage, making appropriate decisions based on specific requirements. The following sections provide more details on each of these enhancements for provisioning storage in the HP CloudSystem Matrix environment.

Automating IT processes for storage

Setting policies using storage templates

Using tools provided by CloudSystem Matrix, the storage architect can define storage templates for use in Matrix infrastructure orchestration that contain specifications and policies appropriate to the environment and the intended storage use. The storage architect has flexible control, choosing to define storage templates offering various storage service capabilities. In addition to specifying parameters such as volume size and RAID level and optional tags to indicate performance or availability tiers and/or intended usage, the storage architect can include policies in the templates that control how storage resources are provisioned, such as:

- Enable fulfillment with on-demand provisioned volumes (with appropriate restrictions such as a maximum capacity), pre-provisioned volumes, or both
- Specify use of a particular type of array, a particular array, or a particular storage pool on an array
- Exclude the use of a particular type of array or a particular array
- Indicate whether thin provisioning should (or should not) be used

For example, a storage architect might publish a “Gold Database” template that calls for fulfillment from a set of HP 3PAR arrays with “gold” high performance drives using thin provisioning, and offering a “gold” level of backup services and other support. That template might include minimum and maximum capacity constraints. The storage architect might also define separate templates for “Windows Boot” and “HP-UX Boot” volumes, fulfilling from different arrays using on-demand provisioning with different size specifications. The storage architect specifies these policies once within the template definitions. The storage templates are then used repeatedly as requests are fulfilled, without requiring intervention or monitoring by the architect. Storage templates also contribute to the standardization that is key to enabling a private cloud environment.

Specifying storage requirements for infrastructure services

Through Matrix, the storage templates created by the storage architect are visible to the Matrix architect. When designing service templates for the infrastructure service catalog, the Matrix architect can browse the storage templates and make an appropriate selection for each type of service (as shown in Figure 1). If no appropriate choice is available, or based on architect preference, the Matrix architect can manually specify logical disk information for the service template (including information such as size, RAID level, and optional tags), and a default storage template will be used.

By making storage templates available, Matrix simplifies the task of the Matrix architect in designing services using appropriate storage. Yet Matrix still provides the flexibility to manually specify storage requirements if necessary. Also, as described in the next section, Matrix can automatically create a storage pool entry from the selected (or default) storage template definition if the software cannot locate a suitable entry already created.

Figure 1. Predefined storage templates facilitate service definition and creation

	Template Name	Description	
<input type="radio"/>	3PAR GOLD – Windows Boot	Windows Boot Template	200
<input type="radio"/>	3PAR Silver – Windows Boot	Windows Boot Template	200
<input checked="" type="radio"/>	3PAR Bronze – Windows Boot	Windows Boot Template	120
<input type="radio"/>	3PAR Gold – Data Storage	3PAR Thin Provisioned Data Storage	240

Matching storage assets to storage requests

The storage catalog in Matrix serves as a formal, automated communication mechanism between Matrix administrators and storage administrators. The storage catalog, representing the available storage assets, interfaces with the Matrix storage pool, representing storage requests, to match appropriate candidates with requests. Assets can include existing (pre-provisioned) storage assets and those that can be created on demand. Rather than having to manually communicate storage needs to the storage administrator and later manually enter the storage information, the Matrix administrator (typically a server administrator) can make use of storage pool entries to request candidates from the storage catalog.

The Matrix administrator can directly generate a request by creating the storage pool entry and then select an appropriate candidate from the storage catalog. If there are no matches in the catalog, the storage administrator can see the unfulfilled request and provision appropriate storage. The storage administrator can then fulfill the request with the provisioned storage, and the Matrix storage definition automatically updates to reflect that storage. Using the Matrix storage catalog as a communication device significantly improves the efficiency of the interactions between server and storage staff.

The Matrix administrator has the option to take advantage of the Matrix ability to auto-generate a storage pool entry. Instead of populating the Matrix storage pool manually as just described, the Matrix administrator can allow Matrix to automatically generate a storage pool entry based on the storage needs specified in the service catalog. Then Matrix can also automatically match that request to the best candidate from the storage catalog. With the aid of Matrix automation, the Matrix administrator saves time while ensuring that appropriate storage is available for service requests.

The storage administrator can also take advantage of the more automated methods of provisioning storage in Matrix (for either administrator-initiated or auto-generated storage requests). The storage administrator can populate the storage catalog with pre-provisioned storage volumes (and associated templates) as well as storage templates for volumes yet to be created, designated for on-demand provisioning. By doing so, the storage administrator is freed from the need to respond each time a request for storage is made. When a user initiates a request for provisioning a service from the service catalog, CloudSystem Matrix will await appropriate approval, then provision the appropriate storage (as well as the network and compute resources) as specified in the service template and its associated storage template. The following sections discuss further the two methods of storage provisioning.

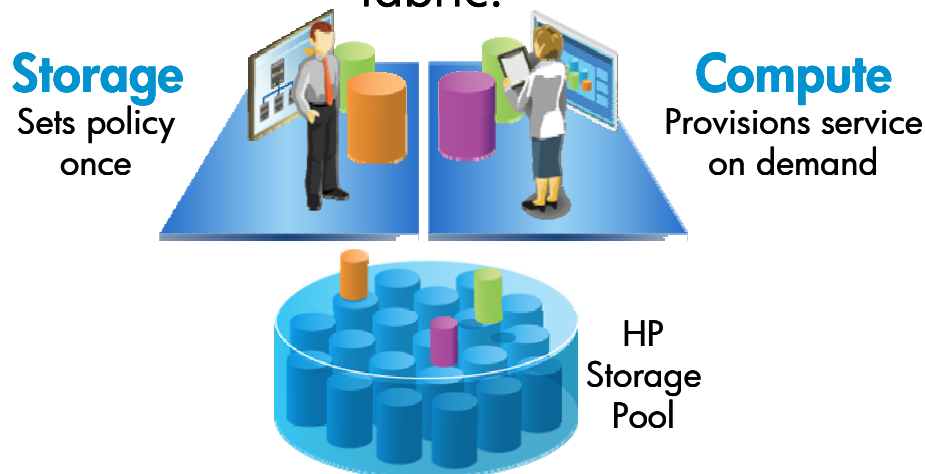
On-demand storage provisioning

When the storage template associated with a service request calls for on-demand provisioning, Matrix automatically provisions the storage resources at the time the service is created. Matrix uses the specifications and policies in the storage template: creating and presenting the volume and performing SAN zoning in Brocade SAN environments.

On-demand provisioning enables rapid deployment of infrastructure services with no requirement to tie up valuable storage resources until they are actually needed. By virtue of the policies specified in the storage template, the storage team exercises control over how the resources are provisioned without needing to intervene at the time of provisioning.

Figure 2. Using policy-based templates, CloudSystem Matrix on-demand storage provisioning saves time for storage and server teams and reduces errors

Provision a service in minutes including storage and SAN fabric.



Pre-provisioned storage

As discussed in [Matching storage assets to storage requests](#), CloudSystem Matrix allows the storage administrator to populate the storage catalog with pre-provisioned storage volumes. Based on requirements communicated through storage and service templates, the storage administrator creates

volumes, presents them, and adjusts SAN zoning if necessary. The storage administrator controls the visibility of the storage volumes and the permissible operations. The storage administrator can also tag specific storage volumes according to the defined tiers based on performance and availability characteristics. Tags can also identify storage volumes according to intended application—such as “production” or “database”—as well as other criteria.

When a user requests an infrastructure service calling for pre-provisioned storage, Matrix automatically matches the storage request to this pre-provisioned storage at the time the compute and network resources are provisioned. Making use of pre-provisioned storage does consume storage resources before they are needed by a workload, but reduces the time to deploy storage at the time it is needed by Matrix. Pre-provisioned storage makes possible much faster service provisioning than traditional methods and complements the on-demand provisioning capabilities of Matrix.

Benefits of storage automation for private cloud environments

HP CloudSystem Matrix solutions are superior to traditional methods of storage provisioning in a number of ways.

- Use of HP Virtual Connect (VC) enables presentation of storage to the VC initiator WWNs rather than the physical HBA WWNs. This alternative enables flexible movement, preserving storage access without changing storage presentation. It also speeds the storage provisioning process, since it makes it possible to create, present, and zone storage prior to identifying and configuring the physical servers.
- There are fewer manual interactions each time storage provisioning takes place. The Matrix solution provides details on the initiator WWNs, as well as the storage needs specified by the Matrix architect, eliminating the need for manual collection and communication of the information. Moreover, the ability to configure storage in advance, and anticipate the needs of infrastructure service catalog users, amortizes the effort of the storage and SAN teams across a number of storage requests.
- Manual intervention is no longer required. Matrix automatically matches storage requests against candidates through the Matrix storage catalog maintained by the storage administrators. At the time of an approved service request Matrix can proceed to fulfill the storage requirement with pre-provisioned storage or through on-demand provisioning.
- The solution enables storage personnel to retain control and facilitates standardized use of storage, without constant monitoring, by employing storage templates encapsulating IT policies.

The powerful storage capabilities of HP CloudSystem Matrix equip IT staff to respond rapidly to their business users’ requests, yet spend less of their time on the process of fulfilling those requests. The flexibility of the solutions and operating methods meets a range of needs for efficiency and control in enterprise customer environments. IT staff can determine the degree of automation most appropriate for a given situation.

Storage considerations for CloudSystem Matrix

Matrix supports a wide range of Fiber Channel (FC) storage, and the storage template and storage catalog aspects described apply to that FC storage (HP or third party storage). When CloudSystem Matrix is paired with the HP 3PAR Storage System, HP Enterprise Virtual Array (EVA) s storage solutions, or HP XP storage solutions, the storage catalog in Matrix can automatically discover existing volumes and enable the storage administrator to import them into the storage catalog and assign authorizations, thus avoiding manual entry. Matrix can also automate certain storage operations on these arrays, such as adjusting OS mode and changing presentations. In addition, the storage administrator can manually load volumes created in other arrays (HP or third-party) into the storage catalog. The on-demand provisioning capabilities described are supported by Matrix out-of-the-box

for the HP 3PAR Storage System and HP EVA storage solutions. The following section provides more details on the benefits of the HP 3PAR Utility Storage solution, particularly when used in conjunction with HP CloudSystem Matrix in cloud environments.

Storage systems designed for the cloud: HP 3PAR Utility Storage

HP 3PAR Utility Storage is designed to provide the efficiency, agility and autonomic control specifically required by private clouds. Built-in HP 3PAR advantages help build a better storage solution in a CloudSystem Matrix environment.² These advantages include thin provisioning, multi-tenancy enablement, and adaptive optimization.

Thin provisioning

HP 3PAR Thin Provisioning Software allows users to safely allocate more storage capacity to host applications than has actually been provisioned. HP 3PAR Utility Storage takes a reservationless, dedicate-on-write approach to thin provisioning that enables the platform's thin software applications to draw and configure capacity in fine-grained increments from a single free space reservoir without prior dedication of any kind. Additional HP 3PAR capabilities extend the benefits of thin provisioning to existing storage volumes by enabling conversions from "fat" to "thin" volumes during a technology refresh (known as Thin Conversion). HP 3PAR software also ensures that thin volumes stay as lean and efficient as possible by reclaiming unused space associated with deleted data within system storage volumes—simply, quickly, and without disruption (known as Thin Persistence). The use of thin provisioning technologies reduces overall capacity requirements and keeps utilization rates high over time, enabling you to save 50% or more on the cost of a storage technology refresh³.

Multi-tenancy

HP 3PAR Utility Storage enables massive consolidation through secure multi-tenancy that enables clients to support multiple external or internal customers (user groups, departments, business units, lines of business, and so on) from a single, consolidated storage array. HP 3PAR multi-tenancy allows massive application consolidation on one storage system, squeezing more economies of scale out of your storage investment. With data striping across disks and 3PAR's mesh active architecture, you can avoid the need to have separate arrays for different types of applications.

The HP 3PAR architecture also features mixed workload support that enables transaction- and throughput-intensive workloads to run without contention on a single storage system without manual segregation of workloads to different physical resources. This capability is a key enabler of multi-tenancy, and eliminates the need to purchase and maintain separate arrays to support individual applications. The resulting alleviation of data center sprawl can reduce storage footprint by 50% or more.

Adaptive Optimization

With Adaptive Optimization, HP 3PAR Storage Systems are able to deliver high performance levels in even the most challenging environments using an extremely lean Solid State Drive (SSD) tier in combination with highly affordable Nearline (Enterprise SATA) drives. At any given time, only the most performance-intensive data is placed onto SSDs, meaning that service level targets can be met with a minimal number of these premium drives. Meanwhile, the ability to stripe writes widely across all system resources, combined with abundantly scalable levels of performance, enables the use of highly cost-efficient Nearline drives to meet broader capacity requirements. This combination of HP

² Both HP CloudSystem Matrix and 3PAR each possess a rich set of unique features; however, some 3PAR features are not yet fully integrated with CloudSystem Matrix environments.

³ Based on deploying HP 3PAR Storage Systems and HP 3PAR Thin Provisioning and Thin Conversion Software. See "Thin Technologies" at <http://h18006.www1.hp.com/storage/solutions/3par/technologies.html>.

3PAR Adaptive Optimization Software⁴, SSDs, and widely striped SATA drives delivers a savings of up to 30% over the cost of using Fibre Channel drives alone.⁵

For general information on the full benefits of HP 3PAR storage, see the HP 3PAR Utility Storage Benefits Summary white paper at <http://h20195.www2.hp.com/V2/GetPDF.aspx/4AA3-4024ENW.pdf>.

Enabling technology

The HP Matrix Operating Environment infrastructure orchestration capability works with HP Storage Provisioning Manager (SPM), a component of Matrix, to provide storage services in the Matrix environment and automate many storage-related operations. The latest release of Matrix technology introduces storage templates, on-demand provisioning, and the automatic creation and fulfillment of storage requests (as discussed in this paper).

This Matrix storage integration capability (also know as SPM) provides a secure service-centric management interface to storage, enabling storage services to be resourced with available storage services from the storage catalog, and securely automating storage management tasks by interfacing directly with storage arrays. SPM is automatically installed as part of the HP Matrix Operating Environment. For details on HP SPM, see the Storage Provisioning Manager User Guide at <http://www.hp.com/go/matrixoe/docs>. For more information on the integration of HP storage provisioning technology with Matrix Operating Environment, see the white paper at <http://h20195.www2.hp.com/V2/GetDocument.aspx?docname=4AA3-1738ENW&cc=us&lc=en>.

Conclusion

With its CloudSystem Matrix solution, HP is enabling IT departments to quickly and confidently establish private cloud environment to meet the ever-growing demands of their business customers. By providing IT with a highly automated environment for time and cost savings, the tools needed to standardize IT offerings and maintain necessary controls, and the mechanisms for self-service, on-demand delivery of IaaS, CloudSystem Matrix is the ideal platform for the private cloud.

⁴ Adaptive Optimization may result in frequent volume migration, which could affect storage services (particularly when using service requirements, such as "RAID Level" or "Use Resource"). Storage Provisioning Manager (SPM) tracks volume migration on a regular basis. It is the responsibility of the storage administrator to make sure that their strategies for Adaptive Optimization and SPM are compatible.

⁵ Savings based on the comparison of an HP 3PAR T400 Storage System configured with 320 x 300-GB 15K Fibre Channel drives and an HP 3PAR T400 Storage System configured with 24 x 50-GB Solid State Drives and 96 x 1-TB Serial ATA drives using HP 3PAR Adaptive Optimization Software.

For more information

For more information on HP CloudSystem Matrix see:

www.hp.com/go/cloudsystem

www.hp.com/go/convergedinfrastructure

www.hp.com/go/matrix

www.hp.com/go/matrixoe/docs

www.hp.com/go/insightsoftware

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