



**Hewlett Packard
Enterprise**

HPE 3PAR Virtual Domains Software

Secure multi-tenancy with HPE 3PAR

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Executive summary

As organizations become more agile and move to ITaaS, managing different tenants securely becomes a daunting task for IT organizations. HPE 3PAR StoreServ answers the challenge by providing secure administrative segregation of tenants (users and hosts) within the storage array. IT organizations can now deliver a customized storage solution to answer the needs of today's diverse corporate architecture.

HPE 3PAR Virtual Domains Software is an extension of the HPE 3PAR virtualization technologies that deliver secure segregation of virtual private arrays (VPAs) for different user groups, departments, and applications. It also preserves the benefits delivered by the massive parallelism architected into the HPE 3PAR StoreServ platform.

Management of assets is paramount in any organization. Similarly, data center management is the bedrock of a successful IT organization and allows users non-stop access to data. Within the data center, storage management is a quintessential element of data availability and data management.

HPE 3PAR Virtual Domains provides secure administrative segregation of users and hosts within a consolidated, massively parallel HPE 3PAR StoreServ Storage system. What's more, individual user groups and applications can affordably achieve greater storage service levels (performance, availability, and functionality) than previously possible.

HPE 3PAR Virtual Domains is ideal for enterprises or service providers looking to leverage the benefits of consolidation and deploys a purpose-built infrastructure for their private or public cloud.

Overview of Virtual Domains

HPE 3PAR Virtual Domains works by enabling administrators to define multiple autonomous, secure policy-based virtual systems within a single, scalable storage system. Administrators can create domains, which are tailored to a specific need of the organization attached to the storage array. Domains can be created and administered using the HPE 3PAR StoreServ Management Console (SSMC) or the command line interpreter (cli%). Using figure 1, a small company has just purchased a new HPE 3PAR StoreServ array. The organizational layout of the company is displayed here. In this company (Some_Company), there are four different organizations.

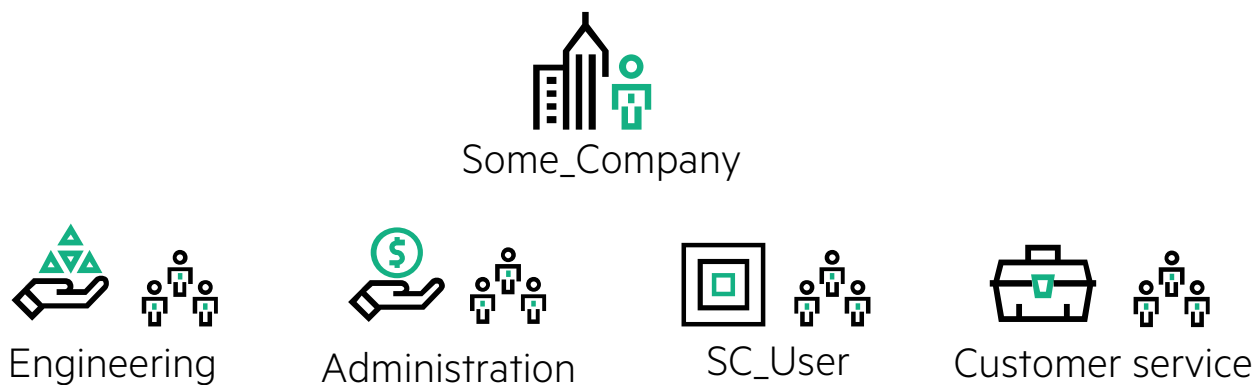


Figure 1. Organizational structure of Some_Company

HPE 3PAR Virtual Domains is used to create logical virtual arrays for physical segmentation of array resources. It uses a policy-based, virtual implementation that preserves the benefits of massively distributing and sharing each application workload across all physical system resources (ports, processors, cache, and drives). Virtual Domains, as the name implies, is completely virtual and represents no physical reservation of resources.

To use HPE 3PAR Virtual Domains, a master administrator first creates a virtual domain and then assigns logically defined entities to it. It includes one or more host definitions based on Worldwide Name (WWN) groupings and one or more CPGs (RAID and disk type). It also includes one or more system administrators (who are also granted role-based privileges by the master administrator) and one or more volumes within the domain.

Roles and usage within the Virtual Domains are administered by a defined resource at the domain level. Domains remain autonomous from the user perspective and the domain appears to be the sole user of the array, from the perspective of a user in a domain. Each of the organizations may have separate departments assigned to the higher organization and they can be subdivided.

Subdivisions within the domain are governed by resources assigned to an application and are done within the domain. Domains are limited to one virtual structure at the domain level. Beyond the organizational divisions may be a corporate division by which all organizations have access to the data, in our example user space acts at that level.

An example of this is shown in figure 2. This figure identifies a structure by which the HPE 3PAR StoreServ array has a top-level domain (SC_User), for this domain there are three different RAID groups (CPGs), which have been defined. Each of the RAID groups may have one or many volumes, which have been created and associated with hosts or users. In the use of this structure, all users have access to the domain but the domain may not be accessed by the outside world further isolating company data from the outside world.

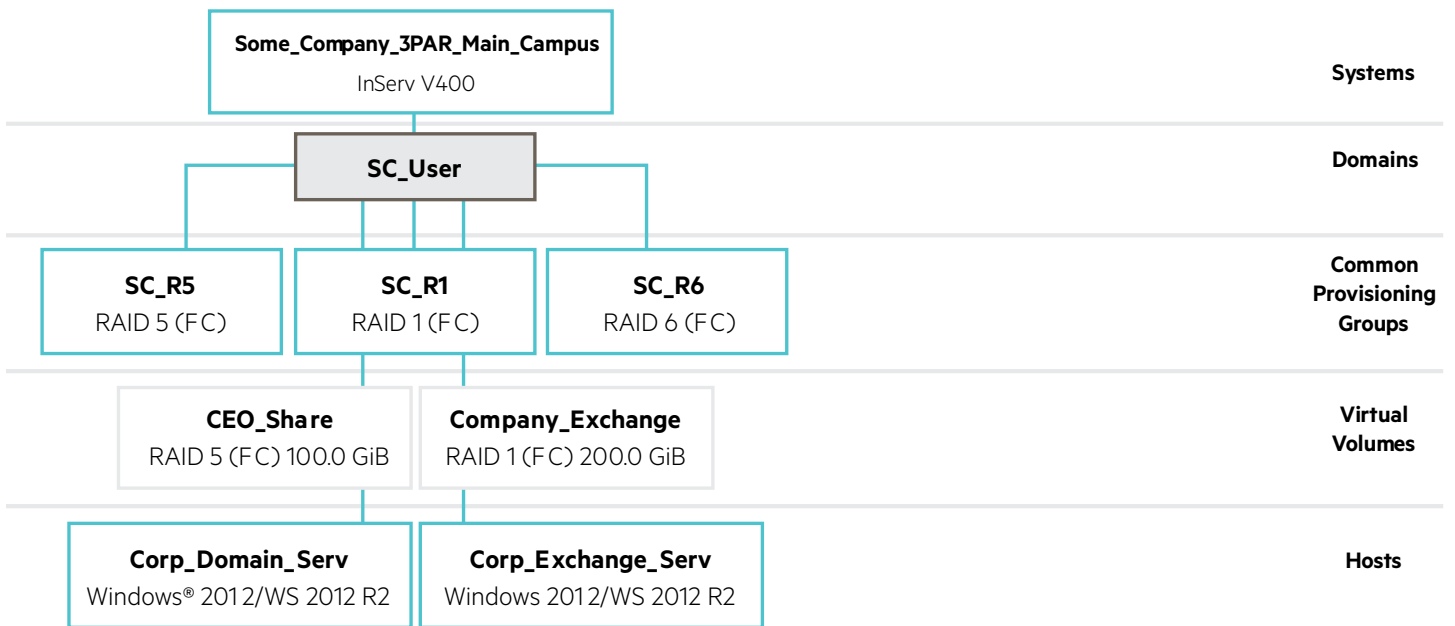


Figure 2. Some_Company top domain

Note

The structure as illustrated in figure 2 is a top-down structure from the view of SC_User and the intersecting lines do not necessarily define the host-to-volume-to-CPG structure. It is a domain SC_User map view and direct links from host to volume to CPG can be viewed within SSMC by hovering over any of the displayed fields.

Domain creation

SSMC

Once a domain has been designed, the creation and administration of the domain can be accomplished using HPE 3PAR cli% or the SSMC. Using the SSMC, a user selects domains (located under the heading of Security) from the drop down menu. A window appears identifying all domains currently created along with information about each of the domains. This is illustrated in figure 3.

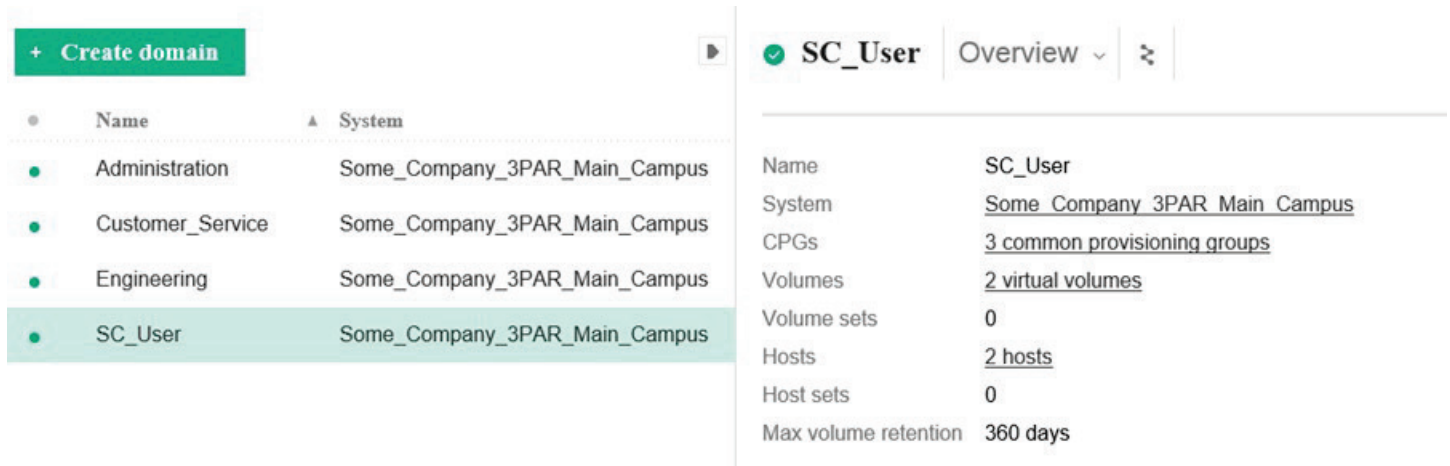


Figure 3. Corporate domain structure

To create a domain, the administrator selects “Create domain” on the SSMC console. A popup appears and the systems administrator enters the appropriate information to create the domain. Information required to create a domain includes the name and system in which the domain will be created on. All other information such as CPGs, volumes, and hosts are subsequently linked to the domain when those objects are created.

Figure 3 illustrates the creation of separate domains to align with the company structure. Items displayed on the left panel are domains, which were created, while the items in the right pane are components contained within the domain structure. The user may click on any of the underlined components, which are links to other sections within SSMC. Besides the informational view illustrated, the administrator can display a map view of the domain, an example of this view is illustrated in figure 2.

cli%

In addition to using the SSMC, the administrator can use cli% commands to create Virtual Domains. The following CLI commands are part of the domain management.

Table 1. CLI commands

CLI COMMAND	DESCRIPTION
createdomain	Creates system domains
createdomainset	Creates a new set of domains and provides an option to add domains into the domainset
showdomain	Displays the list of domains in the system
showdomainset	List the domainsets on the array and members of each set
Removedomain	Removes an existing domain from the system
removedomainset	Removes a domainset or domains from an existing set
movetodomain	Moves objects from one domain to another

To create the domains listed in figure 3 into a domainset the following commands would be entered at the cli%.

```
cli% createdomain Administration
cli% createdomain Customer_Service
cli% createdomain Some_Company_User
cli% createdomain Engineering
cli% createdomainset SomeCompany Administration Customer_Service SC_User Engineering
```

The result of entering these and using the cli% command showdomainset results in the following display in figure 4.

```
Some_Company_3PAR_Main_Campus cli% showdomainset
Id Name Members
 0 .sys_federation_domain_set -
Administration
Engineering
Customer_Service
SC_User
10 SomeCompany Administration
Engineering
Customer_Service
SC_User
-----
 2 total 5
Some_Company_3PAR_Main_Campus cli%
```

Figure 4. CLI command “showdomainset”

The total line on the bottom of the output displays the total number of unique objects found within the domain. For a complete list of commands used with Virtual Domains, refer to the [HPE 3PAR Command Line Interface Reference](#) for the code version used on the HPE 3PAR StoreServ array in which Virtual Domains will be deployed.

Note

In our example, there are two domainsets identified, the domainset for Some_Company in which we just created and a domainset for .sys_federation_domain_set which the system created automatically. The second domainset is created when two or more arrays are part of a federation.

Domain components

Storage components

Each of the domains contains its own separate storage components and follows the HPE 3PAR storage architecture.

- Common Provisioning Group (CPG)—creates a virtual pool of LDs that allows VVs to share the CPG resources and allocates space on demand.
- Virtual Volumes (VVs)—there are two kinds of VVs: “base volumes” and “snapshot volumes.” A base volume can be considered the “original” VV and is either a fully provisioned VV, a thinly provisioned VV, or a thinly provisioned deduplicated VV. A snapshot volume is a point-in-time snapshot of a base volume.
- Hosts—are assigned to the domain to which they belong. A host is dedicated to a domain and is not assigned to other domains on the array. This provides additional security to the Virtual Domain. Users are granted domain access through the hosts.

In addition, each of the domains can contain Host Sets and Virtual Volume Sets. Components are not shared between domains and can be only accessed in the domain assigned.

Security

Secure, virtual implementation means that only authorized users have access to their domains and logical elements. An administrator grants this access. This allows the IT administrator to deliver customized and secure storage by department or application. Each of the components assigned to a domain can only be accessed by the authorized users for the domain(s) they are assigned. Using figure 1 and Some_Company domain structure, figure 5 partially illustrates a domain security architecture.

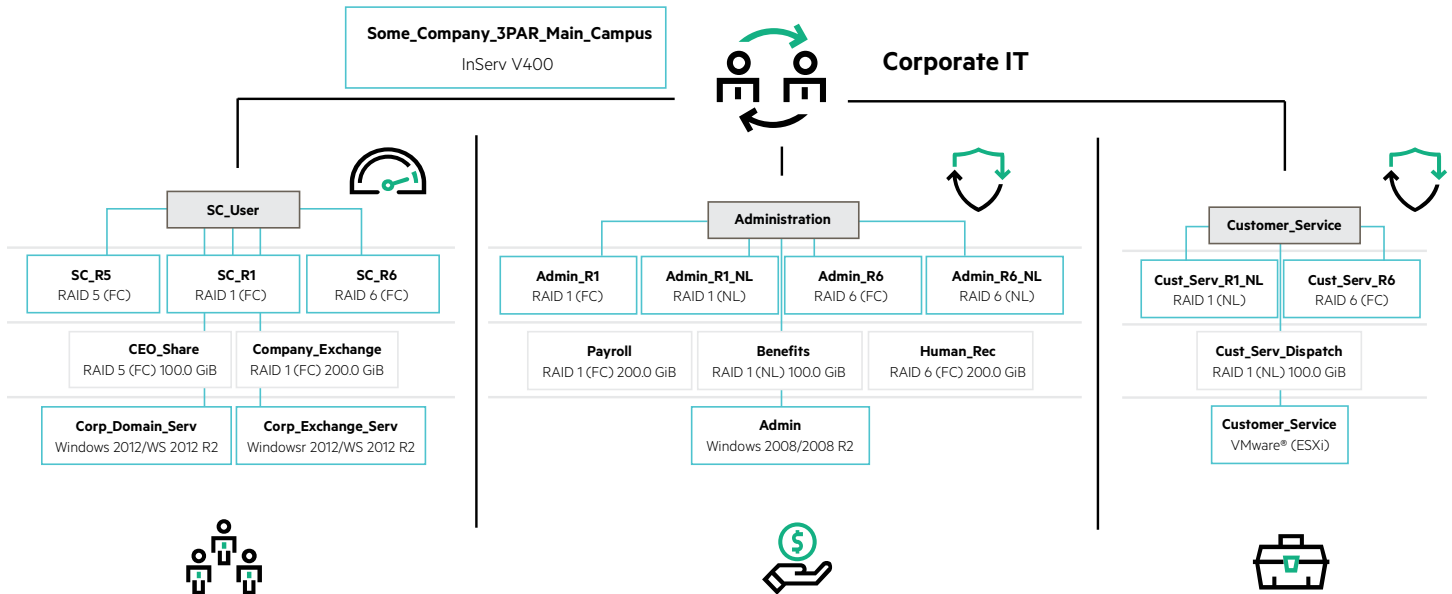


Figure 5. Some_Company domain structure

As illustrated, the SC_User and associated volumes can be accessed by everyone in the company as it contains email and the company SharePoint. Individuals associated with the group assigned to the domain are the ones who can access other domain structures. As an administrator of the array, corporate IT can access all domains and has access to each all the domain structures. Access within the domain is granted at the user level associated with the host.

Note

For user readability, the number of domains illustrated was shortened to three instead of four.

PCI compliance

The Payment Card Industry Data Security Standard (PCI DSS) is a set of requirements designed to ensure all companies, which process, store, or transmit data maintain a secure environment. Using figure 5 as an example, “Some_Company Administration Domain” fulfills these requirements. Access to this domain is strictly enforced by the domain administrator using Active Directory and segments unauthorized users in the domain or array from access. Access to management of the domain is only done through SSH access and the array uses encrypted disk drives along with external key management (EKM) to store data (encryption is done at the physical layer and is not domain specific) securely. The following are attributes of the HPE 3PAR StoreServ array, which contributes to PCI compliance.

- **Data at rest**—complies with the PCI-DSS regulations that the define requirements for protection of card holder data
- **SSH access encryption for management**—encrypted communication between components using registered SSH keys
- **LDAP**—configured Active Directory authentication, which meets all PCI requirements

Using these listed components coupled with CPGs and hosts, which are domain-owned objects, meet all the requirements for PCI compliance.

Domain administrator

Domain administration follows a top-down approach. In a typical organization using Some_Company as an example, corporate IT would assign the domain structure across the array. The administrator of the array can then designate individuals within each of the domains to grant and administer user access and rights. An example of this approach is illustrated in figure 6. SC_User is accessible to all users on the array, which would include the distribution of email. Administration and customer service domains have their own administration for their respective domains. Those administrators would grant rights within the domain depending upon application and the users' access needs.

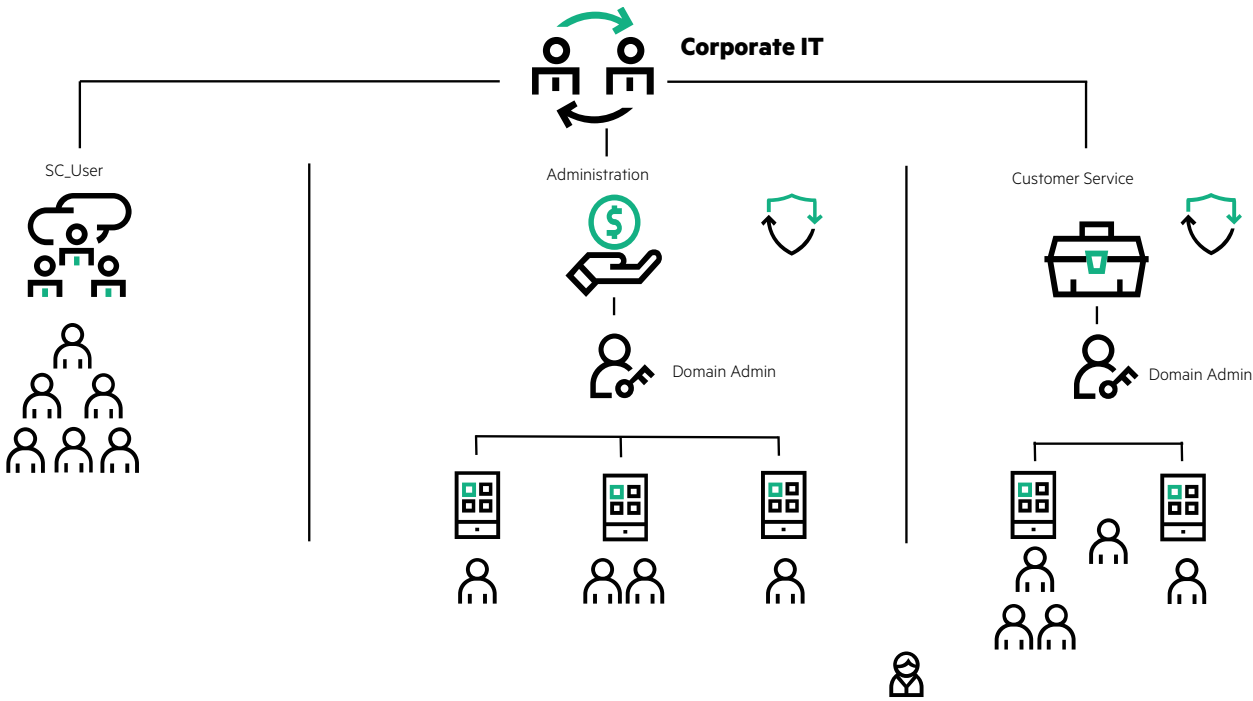


Figure 6. Top-down domain administration

Role-based access control

Role-based access control (RBAC) is a method of regulating access to data, using HPE 3PAR Virtual Domains. It adds the extra security to fulfill those needs. As illustrated in figure 6, users are granted access at the domain level to applications. Administrators within the domain grant access rights based on roles of individual users within the domain. In this context, access is the ability of an individual user to perform a specific task such as view, create, or modify a file. Access can also be administered to domain-sensitive applications.

By assigning a domain administrator, roles can be easily monitored, changed, or removed based on the needs within the domain. A user may also have access to more than one domain. Using figure 6, as an example, a manager has the responsibilities to manage both administration and customer service organizations. Their role requires access to both domains but access may only be granted at the browser level dependent upon the need. The use of RBAC limits the access role to just browse on some files or applications and edit on others. The following is a list of standard roles.

Table 2. Standard roles in RBAC

ROLES	DESCRIPTION
Browse	Rights are limited to read-only access
Edit	Rights are granted to most operations, for example creating, editing, and removing VVs
Super	Rights are granted to all operations
Service	Rights are limited to operations that are required to service the system

Performance

Since the separation of domains is at the HPE 3PAR OS level, there is no performance impact on the array. At the physical layer, all physical disks, array data cache, and buses are part of the array structure and the division of domains occurs at the CPG level and below. The division of domains on the array does not impact performance at the domain level.

The performance of an individual domain is captured at the volume level within the domain. However, capacity usage can be viewed at the domain level. Through System Reporter, the user can create reports on the space usage within each of the domains, an example is provided in the following illustration. In this example (figure 7), a custom chart has been created to plot the space usage per domain CPG. The plotted chart where no bar graph is displayed displays a CPG, which has been created but no volumes have been allocated.

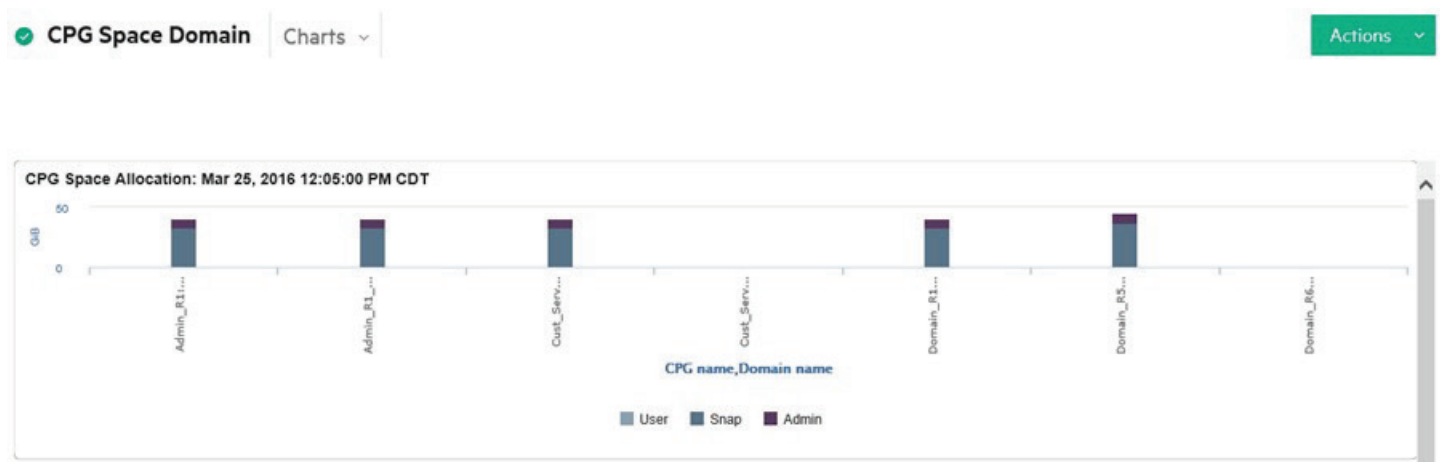


Figure 7. CPG space domain

Other charts, which pertain to the performance within the domain, can be created using the exported volumes assigned to each domain or charting Priority Optimization for domains. Refer to [HPE 3PAR StoreServ Management Console 2.2 Administrator's Guide](#) for instructions on creating custom charts.

Priority Optimization

HPE 3PAR Priority Optimization enables the end user to take full control of performance by specifying maximum limits for IOPS and bandwidth, along with the ability to define “latency goals” for the most important applications. If these goals are not met, the system automatically adjusts the service levels of lower priority (“Min Goal” and “Max Limit”) and workloads to make sure that necessary “Latency Goal” QoS levels for your highest priority applications are maintained.

This paradigm is valid on HPE 3PAR StoreServ systems because all applications on the array share all system resources including the physical drives. Applying HPE 3PAR Priority Optimization to Virtual Domains protects applications from monopolizing resources by a single application or single tenant. These capabilities remove the last barrier to large-scale consolidation by allowing you to deliver assured QoS levels without having to physically partition resources or maintain discrete storage silos.

The use of Priority Optimization allows assignment of QoS parameters to select Virtual Domains as illustrated in figure 8. In this example, corporate top domain is provided a maximum throughput with Priority Optimization. Priority Optimization can be set at the system, domain, or VV level. Refer to [HPE 3PAR Priority Optimization white paper](#) for details on how to use Priority Optimization.

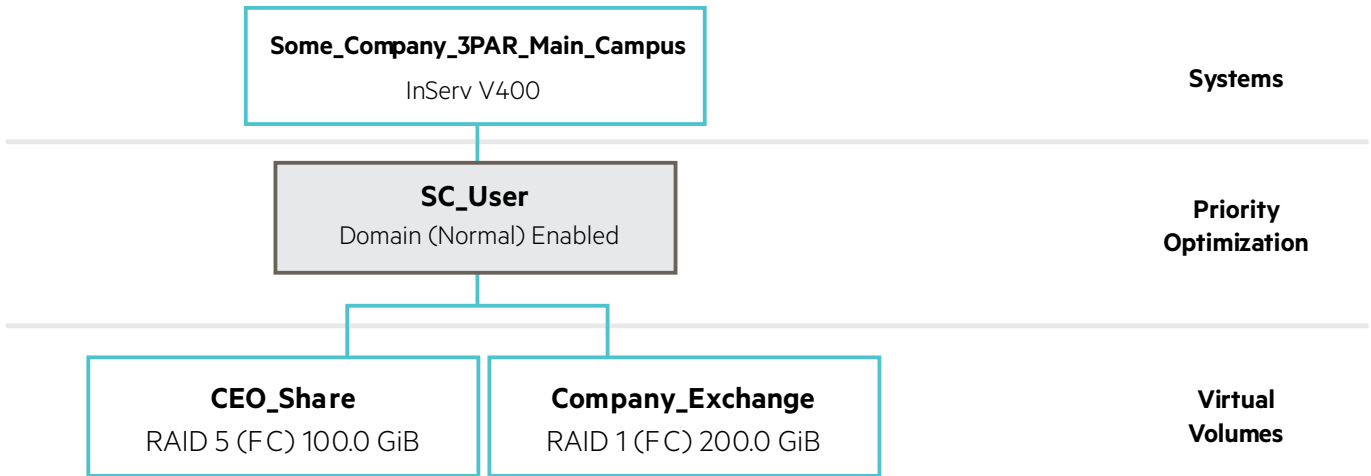


Figure 8. QoS at domain Level

Remote Copy

HPE 3PAR Remote Copy is a replication suite, which provides the basis for disaster tolerant solutions between HPE 3PAR StoreServ arrays. Virtual Domains only apply to software-based objects such as VVs, CPGs, Remote Copy Groups, etc. Hardware or the physical objects of the array are shared across Virtual Domains. These include ports, nodes, drives, and other components. It is the sharing of these objects, which enables the ability to replicate domains. Replication of the domains occurs at the VV level.

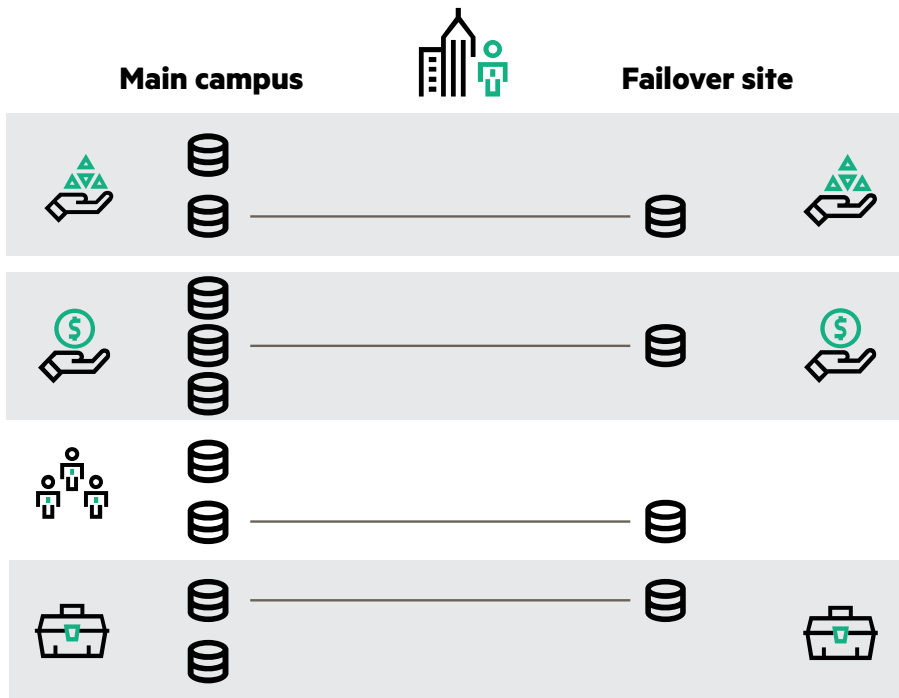


Figure 9. Remote Copy Virtual Domains

Using figure 9 as an example, Some_Company defined a recovery strategy using HPE 3PAR Remote Copy. Their strategy was to replicate the crucial data to an off-campus facility. Remote Copy Groups were defined and volumes were selected for the copy.

Conclusion

HPE 3PAR Virtual Domain Software is virtual machine software, which delivers secure access and robust storage services for different applications and users groups (also known as a virtual private array). It provides a secure architecture for administrative segregation of users and hosts within a consolidated, massively parallel HPE 3PAR StoreServ array. HPE 3PAR Virtual Domain Software allows user groups and applications, the affordability to achieve greater storage service levels without sacrificing speed, reliability, or complexity found in lesser storage arrays.

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